Grades 3-7

Light

Learning Lapbook with Study Guide

A Journey Through Learning

www.ajourneythroughlearning.com

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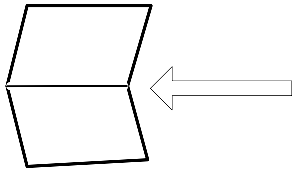
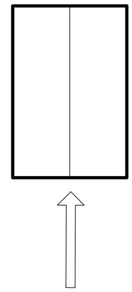
Things to Know

Hamburger Fold-Fold horizontally



Hotdog Fold-Fold vertically



Dotted Lines-These are the cutting lines.

Accordion Fold-This fold is like making a paper fan. Fold on the first line so that title is on top. Turn over and fold on next line so that title is on top again. Turn over again and fold again on the next line so that title is on top. Continue until all folds are done.

Cover Labels-Most of the booklets that are folded look nicer with a label on top instead of just a blank space. They will be referred to as "cover label."

How Long Does it Take to Complete the Lapbook?

Doing a study guide page and mini-booklet a day, a 3-folder lapbook takes about one month to complete. However, you can expand the study portion and make it last as long as you like! That's the beauty of homeschooling! Do it YOUR way!

Lapbook Assembly Choices

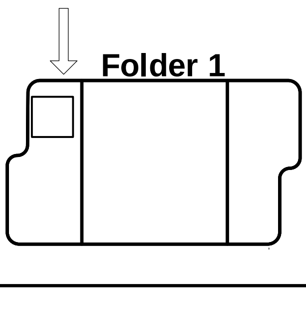
(see photos on how to fold and glue your folders together)

We recommend using Zip Dry Glue or Elmer's Extreme.

Choice #1 -Do not glue your folders together until you have completely finished all three folders. It is easier to work with one folder instead of two or three glued together.

Choice #2 -Glue all of your folders together before beginning. Some children like to see the entire project as they work on it. It helps with keeping up with which folder you are supposed to be working in. The choices are completely up to you and your child!

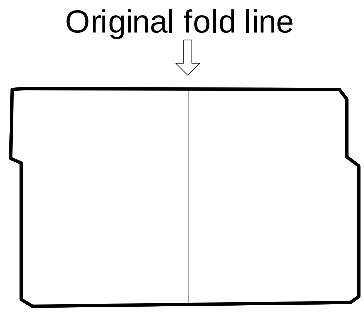
How do I know where to place each template in the folder?



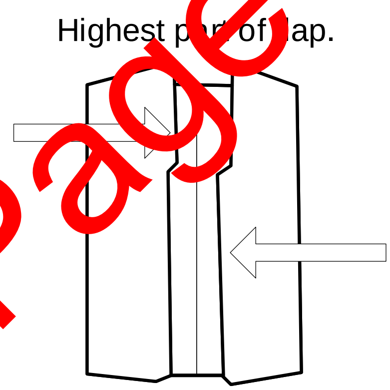
This placement key tells you the template goes in the first folder at the top of the left flap.

Folding a Lapbook Base

Gather the number of folders required for the project. Fold them flat as seen here.



For each folder, fold the left and right sides inward toward the original line to create two flaps. Crease so that the highest part of each flap is touching the original line. It is important not to let the two flaps overlap. *You may want to take a ruler and run it down each crease to make it sharper.*



Glue your folders together by putting glue (or you may staple) on the inside of the flaps. Then press the newly glued flaps together with your hands until they get a good strong hold to each other. Follow this step to add as many folders as you need for your project. Most of our lapbooks have either 2 or 3 folders.

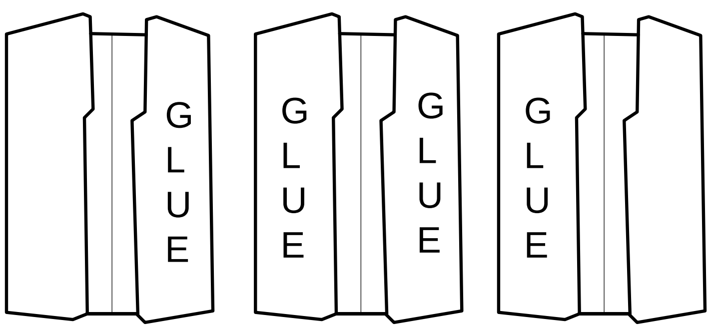
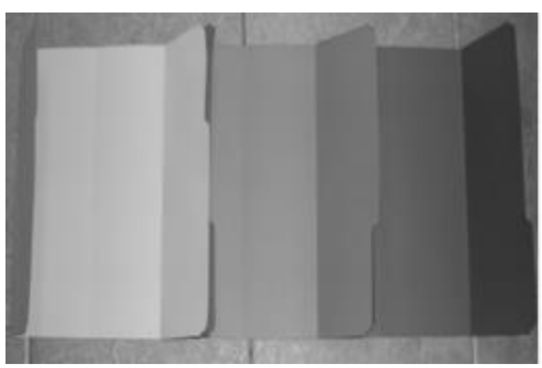


Photo of a completed lapbook base



Supplies and Storage

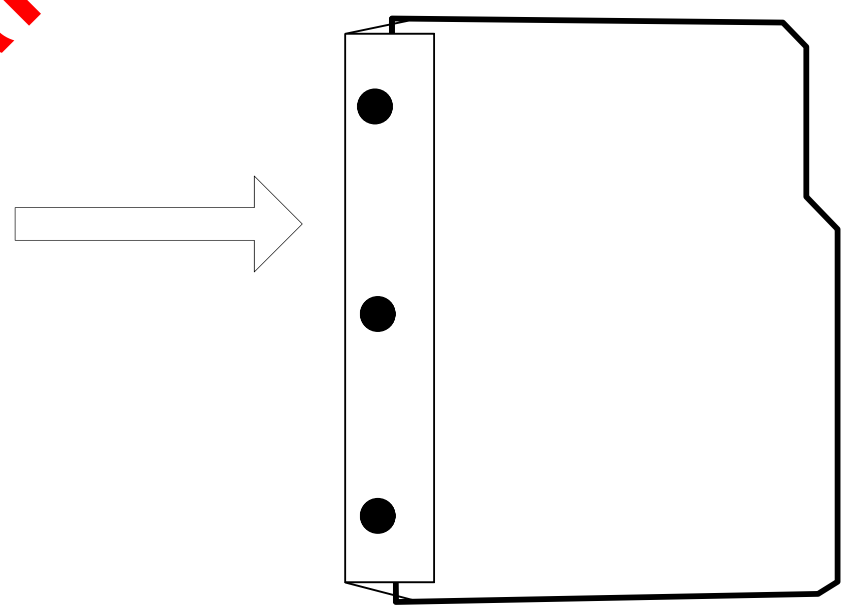
*Lapbook Pages
*3 Colored File Folders
*Scissors
*Glue
*Stapler
*Brads (not needed for every lapbook. If brads are not available, a stapler will do.)
*Hole Puncher (again, not needed for every lapbook.)

To make the storage system (optional)
See details below about the use of a storage system.
*Duct tape (any color)
*One 3-ring binder
*Hole Puncher

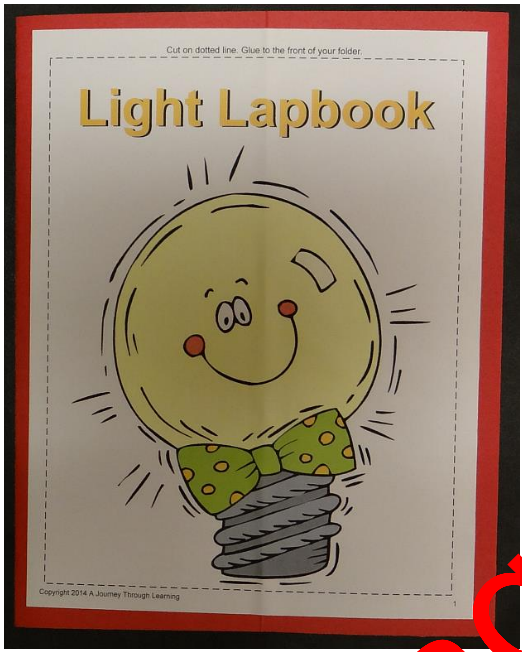
My child has made several lapbooks. Can I store all of the lapbooks together in one place?

Yes! A three-ring binder serves as a great place to keep your lapbooks. This method of storage not only keeps your lapbooks from getting lost but also keeps them neat and readily available to share with dad, grandparents, friends, etc. When you are through sharing your lapbooks, just place the three-ring binder back on your bookshelf. Below are step-by-step directions of how to prepare each lapbook to be placed a in a three-ring binder.

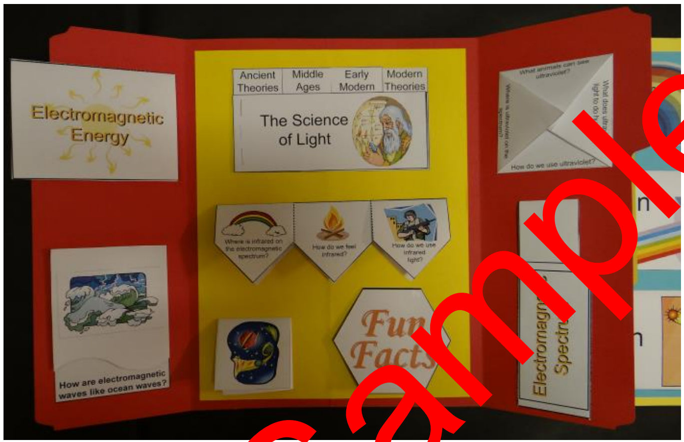
Close the lapbook. Measure a piece of duct tape that is as long as the lapbook. Place the edge of the duct tape on the top edge of the lapbook. Then fold the duct tape over so that it can be placed on the bottom edge. Make sure to leave enough duct tape sticking out from the edges to punch three holes. Be careful when punching the holes that you do not punch the holes in the folder. If you do, that's okay. Then place in three-ring binder. Depending on the size of your three-ring binder, you can store many lapbooks in it.



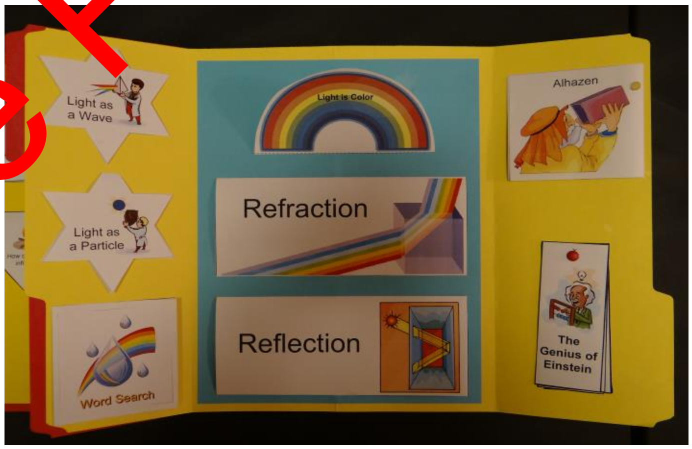
Front Cover



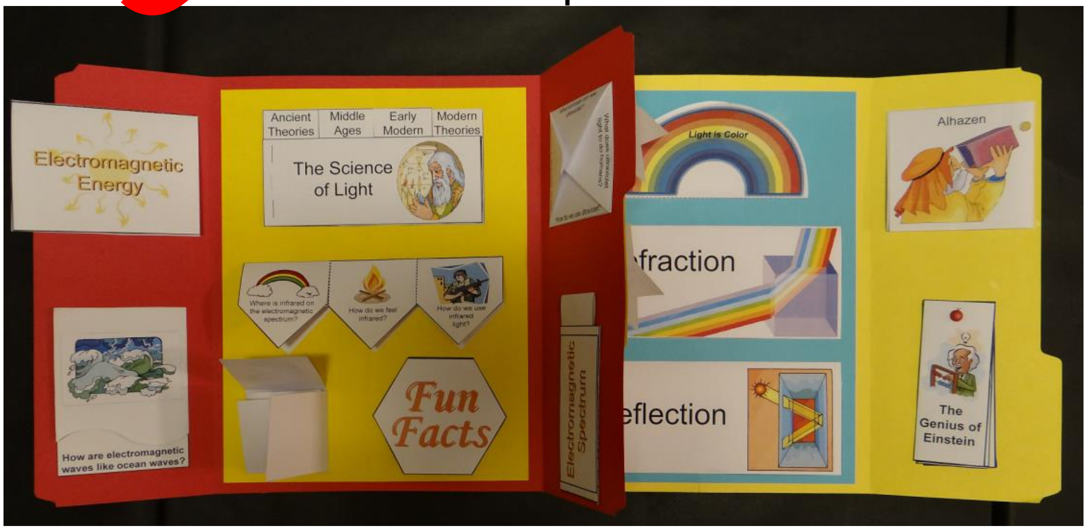
Folder 1



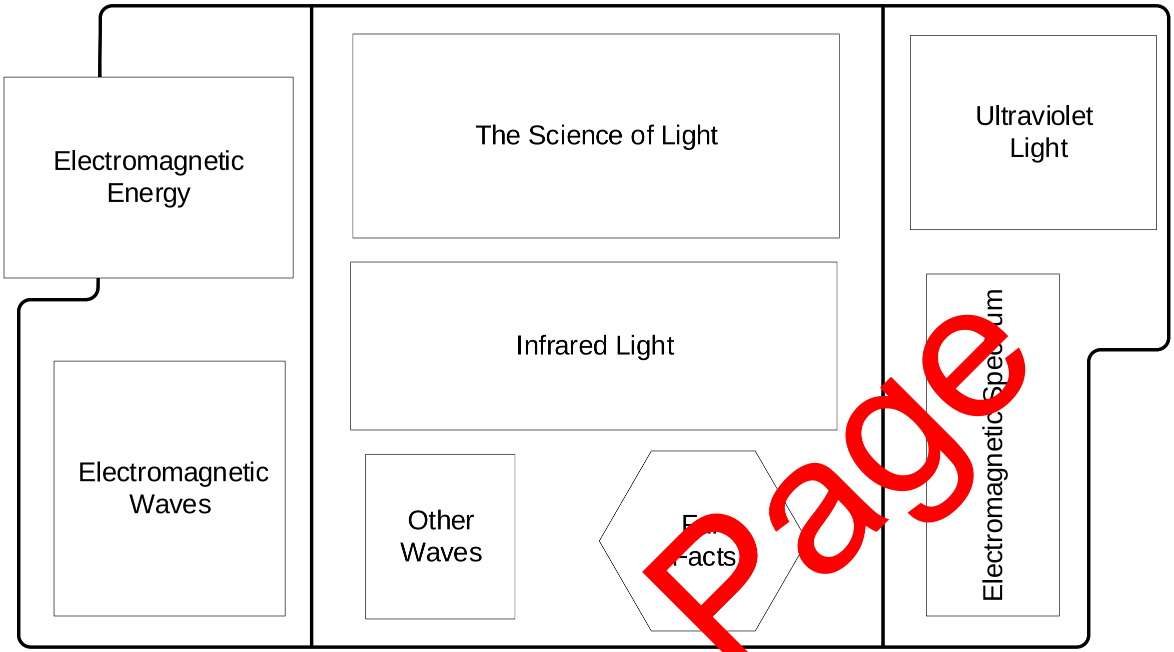
Folder 2



Entire Lapbook



Folder 1



Folder 2

Table of Contents

Light Lapbook

Name ______________________________

Glue this page to front of closed lapbook

The Dual Nature of Light

The earliest scientists described light as rays. They weren't sure exactly where the rays came from or what they were made of, but it was obvious that light acted like a straight line, beaming from one place to another. These ancient scientists studied reflection and refraction to learn about light. They knew how light could be reflected off smooth surfaces, and this can be easily described through the action of a ray. They also knew about refraction, that ability of light rays to bend as they travel through different mediums such as water or glass.

Later, two different theories emerged. In the 17^{th} century, two men, Isaac Newton, and Christian Huygens, both experimented with light. They each came up with explanations for the nature of light, but their ideas were different. Not only different, but so convincing that for 200 years people would argue about which was right.

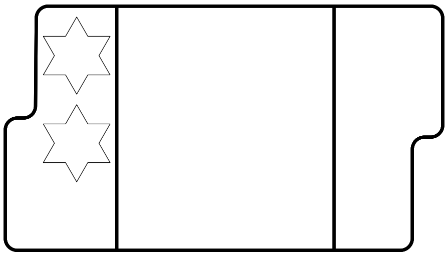
Isaac Newton said that light must be made of small particles, little bullets of light, traveling so fast they cannot be seen. This theory explained several of the unique characteristics of light. Tiny bullets of light would travel in a straight direction, reflect in predictable patterns, and change speed in different materials. Newton thought light sped up as it traveled through different materials, causing the waves to bend. This idea also explained one of the most difficult characteristics of light: the ability to travel through a complete vacuum, a space where nothing at all, not even air, is found.

Christian Huygens argued that light must be a wave, like the waves in water. This is the only way he could find to explain the refraction of light into a rainbow. He said a rainbow must be made when light waves of different sizes get bent as they slow down (not speed up!) traveling through different substances.

Over the next two centuries, first one theory and then another was favored as scientists did more experiments. Some things pointed to the wave theory, while others seemed to prove light must be particles. Newton's theory couldn't explain how light refracted into colors. However, Huygens' theory could not explain how light could travel through a vacuum, or why objects have sharp shadows. Then James Clark Maxwell developed the idea of electromagnetic force, and he noticed that changes in the force happen at the speed of light. The connection between the two was vital. Soon other electromagnetic waves, such as radio waves, were discovered.

Finally, the discovery of quantum theory changed this all. Scientists used the evidence for the particle theory along with the evidence for the wave theory to show the dual nature of light. Light is made of photons- little bundles of energy. Although similar to the particle theory, these photons can also behave just like waves. So light is both a wave, and a particle, depending on how you are looking at it, but it is never both at the same time. This 'dual nature' of light explained all the conflicting aspects of light. Throughout the last century the theory has been proven with every new experiment scientists have thrown at it.

Folder 2

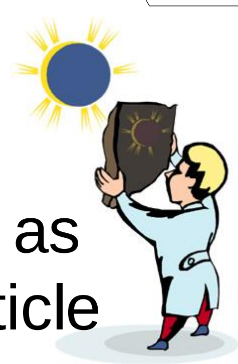


Read The Dual Nature of Light
Hamburger fold in half on middle line and cut out around stars. Do not cut the fold at the top. You will have a star shaped booklet when done. Glue into lapbook.
Directions: Explain how light acts sometimes as a wave and sometimes as a particle.

fold

fold

Light as
a Wave



Light as
a Particle

Light is Color

When light comes from the sun, it's called white light. This light is a perfect mix of all the spectrum of colors in the rainbow. White light is also produced by some light bulbs and other sources, although not perfectly. Most artificial lights produce colored light, and this changes the way things look. A campfire has reddish or yellowish light, which makes you and your family look more red or yellow as you sit around it, roasting marshmallows.

As you know, visible light is the portion of the electromagnetic spectrum that you can see. The slowest end of this spectrum of visible light is the color red. The fastest color is purple, or violet. These wavelengths come from the sun together, and so the colors are all mixed into one, white.

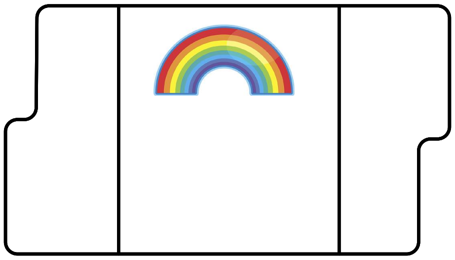
When light waves split into a rainbow after a storm, you can see the nature of light as visible color. The colors arch through the sky, starting with red on the top, because the red waves are slower, thus longer. The colors change to orange, yellow, green, blue, purple, and violet. Violet waves are the fastest (and shortest) of visible light, and thus are in the shortest part of the arch.

When you see colors, it is because some of the light waves are absorbed into the object, and some are bounced back. The color that bounces back is the color you see. If you are looking at a red tulip, the color red bounces to your eyes and the other colors are absorbed. If you are looking at the blue sky, the color blue bounces back to you and the rest of the colors are absorbed.

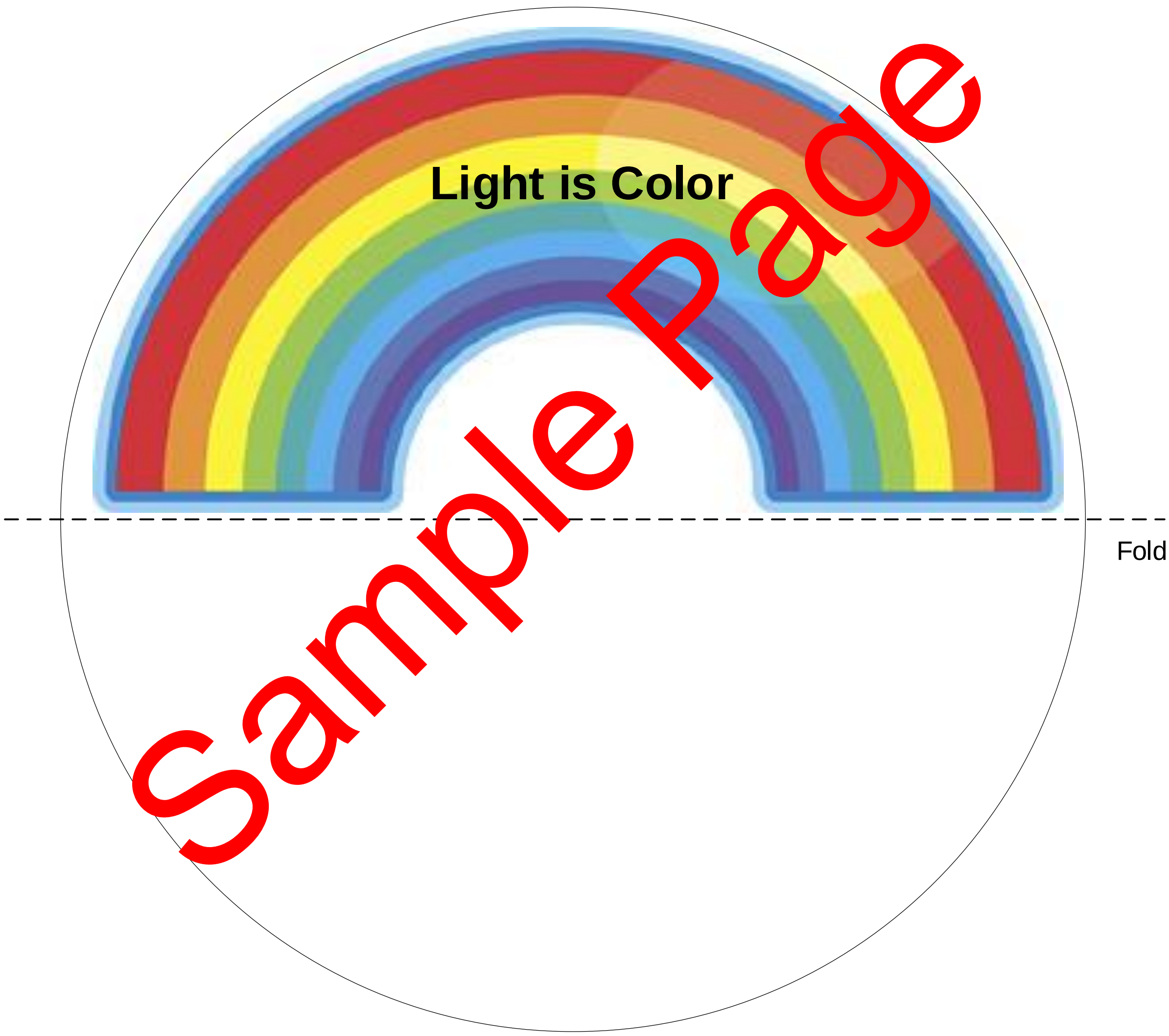
White and black are special colors. Because pure light is white, a white object reflects all of the sun's rays and absorbs none. This is why looking at very white things in the sun, such as snow, can actually blind you after a long time. Things that are black absorb all of the sun's rays, and so you see no color. Things that are black or very dark get hot in the sun, because the energy is absorbed. Light colored things stay cooler.

The reason that light bounces off some colors and is absorbed into others is complicated. The little bundles of energy that make up light act in funny ways when they strike a surface. These photons, or packages, of energy, actually react with the structure of the molecules that it hits. Some of the photons are rubbed off into the molecules and thus absorbed, while others cannot be absorbed and bounce off. In this way light acts as both a wave, bouncing off things, and a bundle of energy, by splitting up and being absorbed.

Folder 2



Read Light is Color.
Cut out the circle and hamburger fold on the dotted line. Glue into lapbook.
Directions: Explain the how visible light is color.



Refraction

Refraction is an interesting characteristic of light. All electromagnetic energy travels at the same speed, what we call the ‘speed of light’. The speed of light is about…. In a vacuum. That doesn’t mean there is light in your vacuum cleaner. Scientists talk about a space that contains nothing- not even air- as a vacuum. Space is a vacuum. When light travels through space, it travels at the ‘speed of light’.

When a light ray travels from one substance to another, some things about it change. The wave length doesn’t change, because then it would turn into a different kind of electromagnetic energy. The wave length stays the same, but the speed that it’s traveling at changes. Light travels the fastest through a vacuum, and through other substances it slows down.

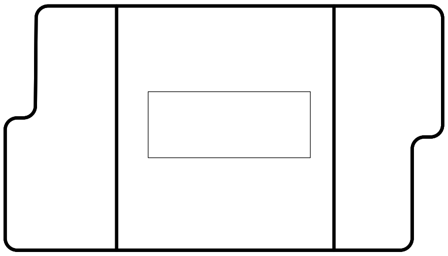
As light from our sun enters our atmosphere it slows down. Other substances and objects slow down light, too. When traveling light rays slow down or speed up, they bend. Bending light is what causes refraction. Water and glass are the common things we can use to show refraction. If you look through a glass full of water, objects on the other side look distorted. They may be shaped funny, or a different size. The edges might not line up. This is because the light is bent.

When light is refracted, it changes in different ways. It bends in different directions depending on whether it is slowing down or speeding up. Refraction also bends the light more when the rate of change is higher. The more it speeds up or slows down, the more it bends. A diamond refracts light more than most other substances, and this is what makes it look sparkly and have different colors in it.

Rainbows are caused by refraction. Light from the sun is white, a perfect combination of all visible light waves. We can’t see color in pure white light. When those rays are refracted in the right way, all the different wavelengths are split apart and we can see colors. This happens naturally after a storm when the sun shines on water droplets that are still falling. The water in the air splits the light into a rainbow. This can also be done with a glass prism or a glass of water.

Refraction is one of the easiest ways to experiment with light. You can use lots of different things around the house to see how light bends. If something looks bent because of refraction, remember it isn’t really the object bending, but the light reflecting off of it. One of the easiest ways to see refraction is to look through a pair of eye glasses. Glasses are made of curved lenses, which bend the light. The lenses are made to bend the light just the right way to correct vision. Lenses are also used in telescopes and binoculars, to make things look bigger and smaller. You can also place clear glasses, jars, and bowls full of water in front of a sunny window to make different rainbows on the floor.

Folder 2



Read Refraction.
Cut out large square. Hamburger fold on middle line. Glue into lapbook.
Directions: Write about refraction of light inside the booklet.

GLUE

Hamburger fold here

Refraction