Light Meets Matter



BRIGHT ART CHALLENGE



<u>MSPS4-2</u>

Vocabulary

- Understand what happens when light meets matter
- Understand how we see color
- Learn about reflection, absorption, transmission, scattering
- Discover how transparent, translucent and opaque objects are determined using light

- white light
- light wave
- transmission
- absorption
- reflection
- scattering
- refraction
- transparent

- translucent
- opaque





What do you think happens when a light wave hits an object?

Think about how light hitting different matter (solid, liquid or gas) might change the way it reacts.





Properties of Light

Before we learn what happens when light waves hit an object, lets learn a few more properties of light.

- 1) Light travels in straight lines until it interacts with something. When light goes between one material and the next it will sometimes bend at the interface.
- 2) Light does not need a medium to travel through. This is the reason why we can see stars when we look up into the night sky. Visible light can travel through empty space without air!





Image Credit: NASA





White Light

How light waves interact with matter affects how our eyes see and perceive our world, and it all starts with white light.

White light is the term we use for ALL of the wavelengths of light in the visible spectrum that is created by a light source.

Visible sunlight, for example, is white light. The sun generates all of the wavelengths in the visible spectrum.

But how that white light interacts with different materials is where it gets interesting!





Transmitted, Reflected, or Absorbed

What we see in our world is dependent on whether the wavelengths in that white light get transmitted, reflected or absorbed when they hit an object.





Transmission

The easiest thing a light wave can do when it hits an object is to pass right through it.

Light shining through a window is a simple example of transmission.





Transmission

When light hits a pane of glass, all wavelengths of light are transmitted, which is why we perceive the window as clear or **transparent**.

Window





Absorption

Light waves can be absorbed by an object. For example, black objects absorb almost all light.

During absorption, light hits an object and causes its atoms to vibrate resulting in the release of heat. If you wear a black shirt or get into a dark-colored car on a hot day, you will feel the effects of absorption.

This is also why the blacktop on your playground feels extra hot on a sunny day.





All Light Absorbed

When a surface absorbs almost all light, we perceive that object as black, or without color.

No light into our eye = black.





Black Book



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Reflection: Color of Light

Reflection of light waves is all around us! Reflection is when a light wave hits an object and bounces off of it.

When an object absorbs some wavelengths and reflects others, that is when we see color.

For example, blueberries reflect blue wavelengths while strawberries reflect red wavelengths.





Absorbed and Reflected

When white light hits a material that absorbs every wavelength except red, the red wavelength of light reflects and we see that object as red.



Red Book



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Absorbed and Reflected

When white light hits a material that absorbs every wavelength except blue, the blue wavelength of light reflects and we see that object as blue.



Blue Book



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Only Reflected

When light hits a material that reflects everything, what we see depends on the properties of the surface. Is it a polished mirror-like surface or a dull surface?



Polished/Shiny or Not polished/Shiny?



Specular Reflection: Mirrors

When light hits a material with a polished mirror surface, it reflects an orderly, aligned reflection of the light. This is why we see our own reflection in our bathroom mirror. The fancy word for a mirrored reflection is called "specular reflection". But most surfaces in our world are not that perfect.



POLISHED MIRROR SURFACE



What about things that aren't traditional mirrors, but I can see a mirror reflection in them?

Its all about surface properties. When you polish a pair of shoes you are taking off all the dirt and roughness and sometimes applying wax to even the surface. Or a pond of water could be so calm it is perfectly flat. Or a car door could be so smooth that it bounces light back very orderly.





Diffuse Reflection (Scattered Light)

Light that is reflected on non-mirror surfaces reflects in many different directions. This is called a diffuse reflection. Light waves are reflected, but not in perfect alignment. If you don't see a mirror-like reflection in an object, that means it is a diffuse reflection. Most objects in our world diffuse or scatter light.





Diffuse Transmission (Scattered Light)

Light transmitted through a material that scatters in many different directions is a diffuse transmission. Like shining light through paper, or through a thin piece of fabric such as silk, or through a frosted shower glass door.



Matter & Light

Matter can be defined by how light interacts with an object. Do you know the difference between transparent, translucent and opaque? How do each of these materials absorb, reflect, or transmit light?







Opaque





Transparent

Objects that transmit all light are **transparent** objects, such as glass.

What other objects transmit light?





Opaque

When light cannot pass through an object it is called opaque. The light is either reflected or absorbed.

Opaque is the opposite of transparent.

Can you think of examples of opaque objects?





Translucent

When light partially transmits through an object it is translucent. Examples include frosted glass and wax paper.

Can you think of any other examples?







Refraction

When light waves travel from one medium to another it changes direction and speed. This is called **Refraction**.

For example: Have you ever entered a swimming pool and noticed your legs look smaller? That, is refraction! As the light passes through the water it bends, making your legs appear smaller. You can also demonstrate refraction by putting a pencil in a glass of water.

Another example is when lights moves from air into a glass prism. The different wavelengths of light refract at different angles, splitting white light into a spectrum or a rainbow. When light refracts into a rainbow it's called dispersion.





What types of light interactions do you see in this image?





What types of light interactions do you see in this image?





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Optional Learning Activity: Brainstorming Materials

Selecting the right material for your art piece is vital to satisfying the design guidelines. Visit the following stations and experiment with a variety of potential materials to discover how they interact with light from a flashlight.

- Transmission
- Absorption
- Reflection: Color
- Reflection: Mirrors
- Diffusion/Scattering
- Refraction



Sketch a Design... and build it!

Sketch a design of your art piece and build it. Your artwork must have at least two light interactions. For materials, you may use any of the following:

- Recycled Materials
- Trash
- Borrowed/Found objects (valued at no more than \$10 each)
- Items Found in Nature

Review the Design Guidelines for more details.

