



BRIGHT ART CHALLENGE



BRAINSTORM & DESIGN LESSON

LIGHT MEETS MATTER

It's brainstorm time! Investigate how different materials interact with light. Students will experiment with reflection, absorption, transmission, scattering and diffraction and use an LED light to learn how transparent, translucent and opaque objects are determined.

FOR THE CLASSROOM

POSSIBLE APPROACH
FOR THE CLASSROOM



LESSON LENGTH
2, 30-50 MINUTES



OBJECTIVE
LEARN HOW DIFFERENT MATERIALS
INTERACT WITH LIGHT



MATERIALS
SEE BELOW

VOCABULARY:

- Transmission
- Absorption
- Reflection
- Specular Reflection
- Color
- Scattering
- Refraction
- Transparent
- Translucent
- Opaque



MATERIALS

Try to include materials students will have access to for their art project. Feel free to include materials with more than one light interaction.

ACTIVITY ONE: LIGHT MEETS MATTER

- Brainstorm & Design Worksheet (1 per student)
- Flashlight (Minimum of 1 per station)
- Ruler (1 per group)
- Recycled or Borrowed Materials (1 set per station needed)
- STATION A: 3+ opaque objects that absorb and or reflect light to create color, black, or white surfaces
Examples: Non-white objects, Colored Cardstock, Egg carton, Fabric, Cardboard Boxes/Pieces
- STATION B: 3+ objects that transmit light (transparent or translucent objects)
Examples: Clear Plastic (bottle, container, bag, plastic wrap), Clear Glass (cup, glass laboratory wear), Thin Paper, Lamp Shade, Sheer Fabric and Clear Tubing
- STATION C: 3+ objects that reflect light with mirror-like surfaces
Examples: Old CDs, Mirror, Foil, Metal Can, Shiny Coins, Metal Paper Clip, Rocks that shine/shimmer (obsidian, granite)
- STATION D: 3+ objects that scatter (diffuse) light
Examples: Clear glass of water with 1-2 teaspoons of milk mixed in, cloudy/sheer objects such as:
<https://www.instructables.com/id/13-Ideas-for-Diffusing-LEDs/>



CONTACT: support@futureengineers.org / web: www.futureengineers.org



LESSON PLAN CONTINUED

LIGHT MEETS MATTER

MATERIALS CONTINUED

- STATION E: 3+ objects that refract light

Examples: Glass container with water and objects $\frac{1}{2}$ immersed (pencil in water), Coin at the bottom of a glass beaker filled with water, Prism, Magnifying Glass, Glass slab on top of printed material

PROCEDURE

1) DOWNLOAD AND TEACH THE [LIGHT MEETS MATTER SLIDE DECK](#)

2) ACTIVITY ONE: LIGHT MEETS MATTER

Pre-Preparation

Find materials for each of your stations. Depending on how many students you have, you may need duplicate stations.

Set up stations (A-E) in the classroom with a flashlight and materials.

- Students will work in groups of up to 4 students and spend 5 minutes at each station investigating how light reacts with the various materials. Teacher can use a timer if needed.
- Students will use their worksheets as a guide to complete the activity. Worksheets ask the following questions at each station.
 - Is the material/object transparent, translucent or opaque?
 - Does the material/object absorb, transmit, reflect (is it specular), scatter, refract or diffract light?
 - Do you see a trend with the objects in the station? Describe the trend.
- Students will use the flashlight at each station and experiment with each material provided and test the following
 - How light reacts to the static (non-moving) material at 1" distance
 - How light reacts to the static material at 5" distance.
 - How light reacts to the kinetic (moving) material at 1" distance
 - How light reacts to the kinetic material at 5" distance
- When the investigation is complete, discuss results. Ask the students what materials they will consider for their art piece and why.

3) ACTIVITY TWO: DESIGN, SKETCH AND BUILD IT!

Use the worksheet provided to sketch your art piece design... and then build it!





LESSON PLAN CONTINUED

LIGHT MEETS MATTER

BACKGROUND INFORMATION

Light and Matter

When light interacts with matter it can be transmitted, absorbed, reflected, refracted or scattered. The way light reacts depends on the material and frequency (color) of the light. It is important to note that light waves travel in straight lines until they interact with something.

- **Transmission:** Occurs when light passes through the object without interacting. Light shining through a window is a simple example of transmission.
- **Absorption:** Is when light hits an object, is absorbed, and causes its atoms to vibrate. This vibration converts the energy into heat. If you wear a black shirt or get into a dark-colored car on a hot day, you will see/feel the effects of absorption.
- **Reflection:** Reflection is when light bounces off an object.
- **Color of Light:** The color we see is a result of which wavelengths of light are reflected back to our eyes and which wavelengths are absorbed when light hits an object.
- **Specular Reflection:** When incoming light hits a smooth, mirror-like surface and bounces off at the same angle it arrived.
- **Diffuse Reflection (Scattering):** When incoming light bounces off an object in many different directions. Scattering is also called diffusion.
- **Refraction:** When incoming light travels through another medium, like from air to glass for example, it slows down and changes direction. The direction change is dependent on the light's wavelength.
- **Transparent:** Transparent objects allow light to travel through them. Materials like air, water, and clear glass are called transparent.
- **Translucent:** Translucent objects allow some light to travel through them. Materials like frosted glass and some plastics are called translucent. When light passes through these objects it changes direction many times and is scattered as it passes through. Therefore, we cannot see clearly through them and objects on the other side of a translucent object appear fuzzy and unclear.
- **Opaque:** Opaque objects block light from traveling through them. Most of the light is either reflected by the object or absorbed and converted to thermal energy. Materials such as wood, stone, and metals are opaque to visible light.

ADDITIONAL LIGHT ENERGY TEACHING RESOURCES:

- Colors of Light: <https://www.sciencelearn.org.nz/resources/47-colours-of-light>
- Reflection of Light: <https://www.sciencelearn.org.nz/resources/48-reflection-of-light>
- Light Absorption, Reflection, and Refraction: <https://www.physicsclassroom.com/class/light/Lesson-2/Light-Absorption,-Reflection,-and-Transmission>
- Light, Absorb, Reflect & Refract: <https://www.youtube.com/watch?v=k0eGjaEWpPU>
- Light Absorption, Reflection & Transmission: <https://www.youtube.com/watch?v=DOsro2kGjCc>
- Understanding Refraction: <https://www.youtube.com/watch?v=95V-QJYZ2Dw>





BRIGHT ART CHALLENGE



LESSON PLAN CONTINUED LIGHT MEETS MATTER

NEXT GENERATION SCIENCE STANDARDS

[MS-PS4-2](#) Waves and their Applications in Technology for Information Transfer: Develop and use a model to describe that waves are reflected, absorbed or transmitted through various materials.

- **PS4.B Electromagnetic Radiation:** When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the objects material and frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bend. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.
- **Crosscutting Concepts:** Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used





BRAINSTORM & DESIGN WORKSHEET

LIGHT MEETS MATTER

When light hits something it can either be absorbed, transmitted (go through it) or be reflected. However, in most cases, the interaction is a combination of these three ways. Review the vocabulary below, then answer the questions that follow at your stations.

VOCABULARY

Transmission: Light passes through an object.

Absorption: Light gets taken in by an object.

Reflection: Light bounces off an object.

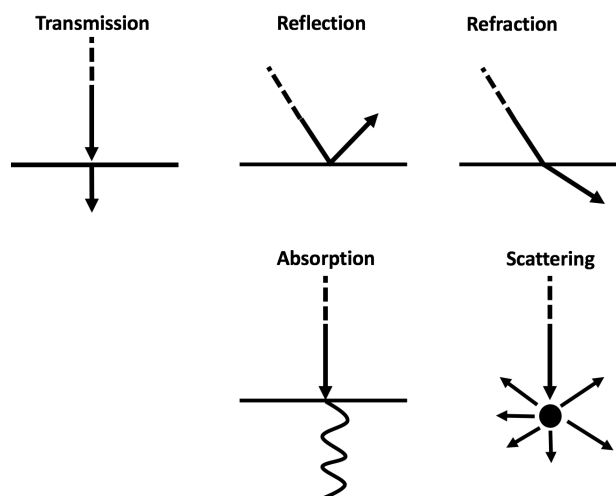
Specular Reflection: Light bounces off a smooth polished mirror-like surface at the same angle it arrived.

Scattering: Light bounces (reflects) off an object in many different directions because the object is not smooth.

Refraction: Light bends as it passes (transmits) through an object.

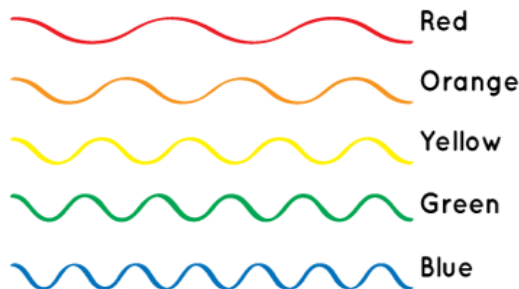
Transparent: A clear object light can pass (transmit) through.

Translucent: A semi-clear object that some light can pass (transmit) through.



Color: Visible light is made up of wavelengths, and each wavelength is a particular color. The color of an object is based on what frequency of light is reflected from that object to our eyes. Visible light waves with lower frequencies fall into the red and yellow range. Visible light waves with medium frequencies are green and blue and high frequency visible light waves are blue and violet.

Visible Light





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STATION A - OPAQUE and COLOR: Non-white objects, Colored Cardstock, Egg carton, Fabric, Cardboard Boxes/ Pieces, etc.

Select a material from the station and describe it in the space provided.

Is the object transparent, translucent or opaque?

How does the object interact with light ? Does it absorb, transmit, reflect, scatter, refract or diffract light?

Use a flashlight to shine a light on your material from the distances listed in the table answer the following questions. If the table says Kinetic have your partner gently shake the object.

Distance from Flashlight Beam	Static (Still Object)/ Kinetic (Shake the Object)	Describe what happens to the light.
1 inch	Kinetic	
5 inches	Static	
5 inches	Kinetic	

Describe the light interaction/s in the diagrams below





BRIGHT ART CHALLENGE

STATION B - TRANSPARENT AND TRANSLUCENT: Clear Plastic (bottle, container, bag, plastic wrap), Clear Glass (cup, glass laboratory wear), Thin Paper, Lamp Shade, Sheer Fabric, Clear Tubing, etc.

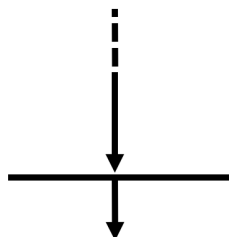
Is the object transparent, translucent or opaque?

How does the object interact with light ? Does it absorb, transmit, reflect, scatter, refract or diffract light?

Use a flashlight to shine a light on your material from the distances listed in the table answer the following questions. If the table says Kinetic have your partner gently shake the object.

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1 inch	Kinetic	
5 inches	Static	
5 inches	Kinetic	

Describe the light interaction/s in the diagram below







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STATION C - SPECULAR REFLECTION: Mirror, Foil, Metal Can, Coins, Paper Clip, Items that shine/shimmer, etc.

Select a material from the station and describe it in the space provided.

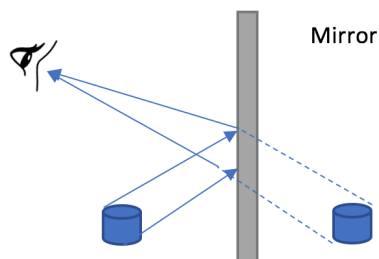
Is the object transparent, translucent or opaque?

How does the object interact with light ? Does it absorb, transmit, reflect, scatter, refract or diffract light?

Use a flashlight to shine a light on your material from the distances listed in the table answer the following questions. If the table says Kinetic have your partner gently shake the object.

Distance from Flashlight Beam	Static (Still Object)/ Kinetic (Shake the Object)	Describe what happens to the light.
1 inch	Kinetic	
5 inches	Static	
5 inches	Kinetic	

Describe the light interaction/s in the diagram below







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STATION D - DIFFUSION/SCATTER: Glass with Water & Milk, Ping Pong Balls, Cotton balls, Fabric, Thin Paper, etc.

Select a material from the station and describe it in the space provided.

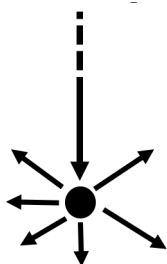
Is the object transparent, translucent or opaque?

How does the object interact with light ? Does it absorb, transmit, reflect, scatter, refract or diffract light?

Use a flashlight to shine a light on your material from the distances listed in the table answer the following questions. If the table says Kinetic have your partner gently shake the object.

Distance from Flashlight Beam	Static (Still Object)/ Kinetic (Shake the Object)	Describe what happens to the light.
1 inch	Kinetic	
5 inches	Static	
5 inches	Kinetic	

Describe the light interaction/s in the diagram below







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STATION E - REFRACTION: Glass container with water and objects 1/2 immersed (pencil in water), coin at the bottom of a glass beaker filled with water, prism, magnifying glass, glass slab on top of printed material

Select a material from the station and describe it in the space provided.

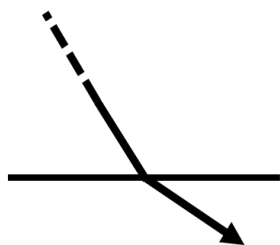
Is the object transparent, translucent or opaque?

How does the object interact with light ? Does it absorb, transmit, reflect, scatter, refract or diffract light?

Use a flashlight to shine a light on your material from the distances listed in the table answer the following questions. If the table says Kinetic have your partner gently shake the object.

Distance from Flashlight Beam	Static (Still Object)/ Kinetic (Shake the Object)	Describe what happens to the light.
1 inch	Kinetic	
5 inches	Static	
5 inches	Kinetic	

Describe the light interaction/s in the diagram below

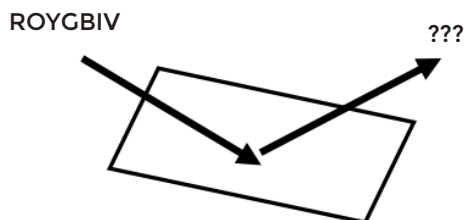




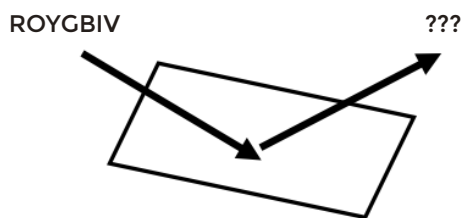


BRAINSTORM LESSON WORKSHEET COLOR ABSORPTION & REFLECTION

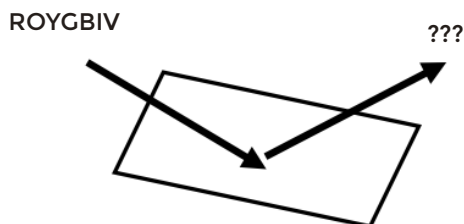
White light is made up of the colors of the rainbow ROYGBIV (Red, Orange, Yellow, Green Blue, Indigo and Violet). Objects will absorb and reflect ROYGBIV. The reflected colors are what we see. For example, a red shirt is absorbing OYGBIV reflecting R (red). With this in mind, try to determine what color the blocks are below..



Illuminated by ROYGBIV.
Object capable of absorbing **ROYGBI**.
What color is this block?



Illuminated by ROYGBIV.
Block capable of absorbing **ROYBIV**.
What color the block?



Illuminated by ROYGBIV.
Block capable of absorbing **RYGBIV**.
What color is the block?

