Name:	Date:	Block:

Practice Sheet for the "Can I Believe My Eyes?" Unit Test

The test on learning sets 1-3 will be on 12/ _____. Complete this practice sheet to prepare for the test.

Helpful study tip: Complete what you know first. Then use your resources to complete the questions you don't know. This will help tell you what to focus on when you study.

Vocabulary

light shadow opaque transparent scattering reflection absorption transmission

1. _____ → Formed when an object **blocks light** from reaching something
2. _____ → When light bounces off a surface at the **same** angle the light source hits it, but in the opposite direction
3. _____ → When light bounces off a surface at **different** angles than the light leaving the source
4. _____ → When light travels **through** an object, such as glass
5. _____ → When light hits an object, and the object **changes** or **uses** the light in some way
6. _____ → Any source of **illumination** such as the sun, a light bulb, television
7. _____ → **Not** able to be seen through
8. _____ → **Allowing** light to pass through so that objects behind can be distinctly seen

9. How does light interact with matter? Fill in the following chart. ***(Use your learning set 2 study guide and quiz as a resource)***

Interaction	***Describe the Interactions***	***How do we know this? What is the EVIDENCE?!?!***	***Draw a diagram: Include surface, light source, direct path of light, and eye***
Reflection	***Type/Color of surface:*** ***What happens to the light when it hits the surface:***	***Evidence from 6.2 investigation:***	
Scattering	***Type/Color of surface:*** ***What happens to the light when it hits the surface:***	***Evidence from 6.2 investigation:***	
Transmission	***Type/Color of surface:*** ***What happens to the light when it hits the surface:***	***Evidence from 7.2 investigation:***	
	Type/Color of surface:	***Evidence from 8.3 investigation:***	
Absorption	***What happens to the light when it hits the surface:***		

10. Use the chart to help you answer question A below:

Object	Total light energy	Light Scattered	Light Transmitted	Light Absorbed
Brick	1000 lux	157lux	0lux	

Remember: total energy = light scattered + light transmitted + light absorbed

a. How do we know light has been absorbed? Explain using evidence above to support your answer.

_____

_____

_____

_____

b. What other evidence could we use to tell if an object absorbs light? (beaker investigation)

_____

Seeing Color

11. What are the three primary colors of light? *Use the color packet as a resource.*
    a.
    b.
    c.

12. What color results when red and blue are combined? _____

13. What color results when red and green are combined? _____

14. What color results when green and blue are combined? _____

15. How is mixing light **different** then mixing pigment (paint)?

a. what happens when you combine all 3 primary colors of light?_____

b. What happens when you combine all 3 subtractive colors of light?

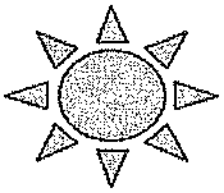
_____

c. What happens to the colors when you add more light?

_____

Why We See Objects of Color

16. Why does a banana appear yellow? Draw a picture to demonstrate what happens using the primary colors of light..



Explain why we see yellow using the terms absorption and reflection:

_____

_____

_____

_____

17. What color would a banana appear under blue light? Explain. (hint: think about which primary colors are present)

_____

_____

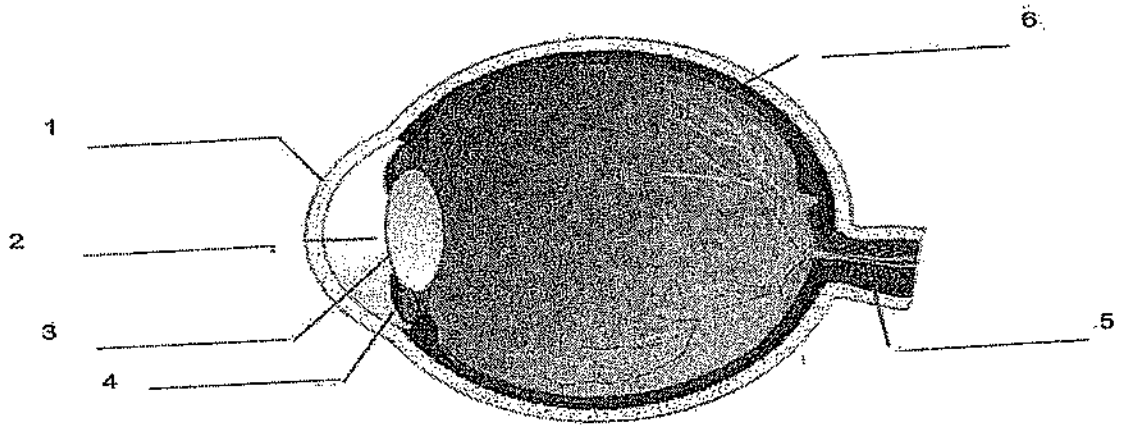
_____

Consensus Model

18. How can we see an object?Draw the consensus model. Make sure to include all **four conditions**.

19. Label the model of the eye with the following terms: retina, iris, lens, cornea, pupil, optic nerve. *(See reading 4.1)*

The Parts of the Eye



Complete the table to describe how the eye uses the parts labeled above to see an image. Use the word bank to help you. **Each word will only be used once.**

Words to use:

Brain	back	pupil	signals	image	amount
retina	focuses	adjusts	senses	optic nerve	

1. Light is reflected off an object and reaches our eye.
2. Light reaches the _____, which lets light in.
3. The **iris** _____ the size of the pupil and determines the _____ of light that enters your eye.
4. The **lens** _____ light through to the back of the eye.
5. The _____ is located in the _____ of the eye and _____ light entering the eye.
6. The _____ sends _____ from the retina to the _____ allowing you to process the _____.

20. How can you model the phases of the moon? *Review the reading 6.4.*

B. Why can we see the moon from Earth?

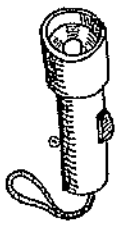
21. What are fiber optics? *Review reading 7.3 on fiber optics. Review your answers to the "Reading Follow-Up" (rally coach).*

B. What are two uses of fiber optics?

1.
2.

22. How does light travel? Draw light rays to demonstrate:

Ceiling



b. How did the flashlight demonstration provide evidence that supports your answer?

When Mrs. Ruppel shined the flashlight on the ceiling

c. Why does light get weaker as you move away from the source?

Review reading 3.1 on models.

23. What do models help scientists do? Give two examples
    a.

    b.

24. What is one example of a model?
    a.

Can I Believe My Eyes? Lesson 2

1. Key Vocabulary:

- **Pixels**: a collection of tiny dots that join to make a big picture on your television screen, in computer and newspaper images, and in paintings

- **Light source**: any source of illumination such as the sun, a lightbulb, television

2. Key Concepts from class activities

- How light travels: in straight lines
- How does light get to eye: light travels from light source in all directions, bounces off object, and travels to eye
- Conditions needed to see an object include: light, direct path for light, eyes, and an object
- Light travels in straight line (flashlight demo on ceiling)

3. Key Concepts from Reading 2.2

- Look at the images below:

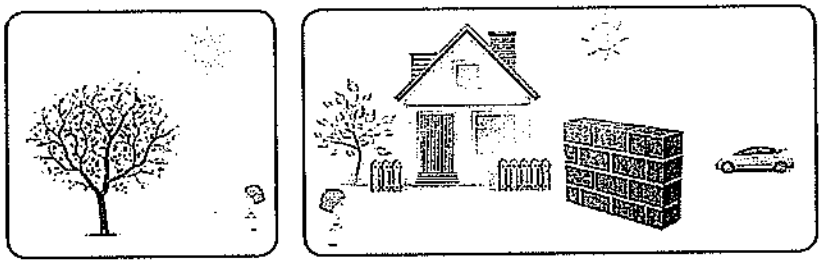


Image 1 Image 2

  - the girl can see the tree in image one because light travels from the sun, bounces off the tree, and enters her eye.

  - In image two, light travels towards the girl but is blocked by the wall, so the light bouncing off the car doesn't enter her eye. Therefore, she does not see the car

- What is the difference between seeing an object seeing an image on television?

Seeing an object	Seeing an Image on TV
• An object must have a light source bouncing off of it for us to see it • You need an object • A direct path of light • eyes	• The image is both the object AND light source • When you see an image, you are really seeing **pixels** creating an image

Can I Believe My Eyes Lesson 3.1

1. Key Vocabulary:

- **Scientific model**: used to represent an idea, process, or system in order to explain or predict something that occurs in the real world

2. Key Concepts from class activities

- **A model of light demonstrates:**
  - How light travels *travels in a straight **continuous** line *but in all directions*
  - Line of vision
  - Where the object is
  - Light bouncing off the object
  - Light entering eye from image

3. Key Concepts from Reading 3.1

- **What do scientists use models for?**
  - Explain things that are hard to understand
  - To communicate
  - Think about answers to phenomena

- **When do scientists revise, or change, their models?**
  - When observations suggest a new explanation
  - When it doesn't work well for explaining a phenomenon

- **Examples of real world models:**
  - Model of how an eye sees light
  - A globe model can explain the position of the sun and seasons
  - Maps to show how to get from one place to another

The four things needed to see an object:

Light Source	
Eyes	
Object	
Light Path	

Can I Believe My Eyes? Lesson 3.2

1. Key Vocabulary:

- **Galileo:** scientist who tried to measure how fast light moves

2. Key Concepts from class activities

- How does light help you see: reflects off objects and enters your eye
- Line of vision: you cannot see someone in a different room because they are not directly in your path and light does not travel through the wall.

3. Key Concepts from Reading 3.2

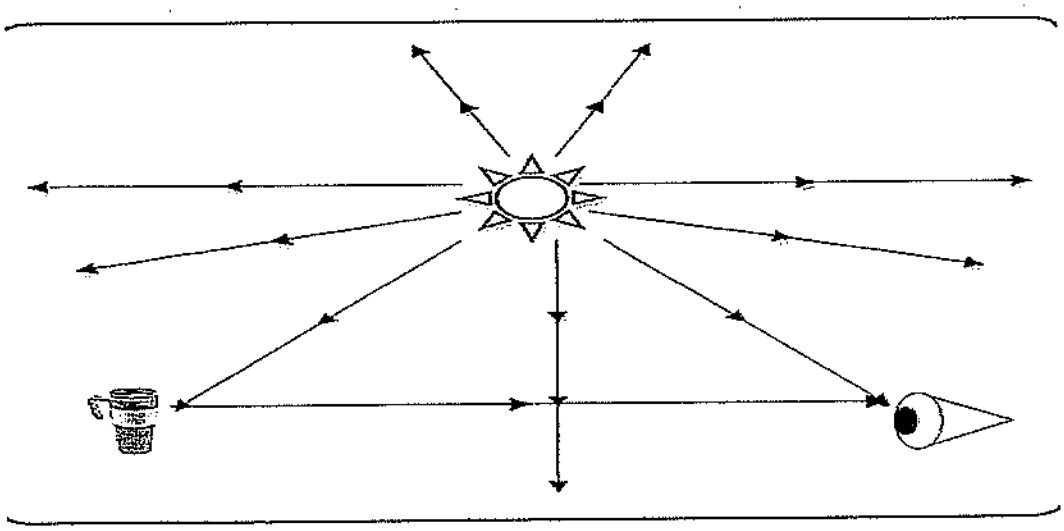
- How did Galileo try to measure how fast light moves?
  - He measured how long it took light to travel from one hilltop to another thinking standing on the hill would give him and his assistant a clear line of vision to each other
  - It did not work

- What do we know about the speed of light today?
  - Light can travel around Earth 10 times in just one second
  - Nothing else can travel as fast as light

- How can speed of light help people move faster?
  - Solar sails are pushed by light meaning they could travel faster than a space shuttle being pushed by burning rocket fuel

Model of how we see an object:

Consensus Model



Can I Believe My Eyes? Lesson 4.1

1. Key Vocabulary:

- **Iris:** the colored part of the eye that determines how much light goes through your eye by adjusting the size of the pupil
- **Pupil:** the black opening in the center of the eye
- **Cornea:** protective covering over the eye that keeps the eye from getting scratched
- **Lens:** focuses the light entering the eye into the back of the eyeball
- **Retina:** the back of the eyeball where sensors detect light
- **Optic Nerve:** nerve in the back of the eye that send signals from the retina to the brain

2. Key Concepts from class activities

- Light sensors only detect light that comes from an object or light source that is directly in front of it
- What areas of the room have more light?
- What areas of the room have less light?
- How do our eyes act like light sensors?

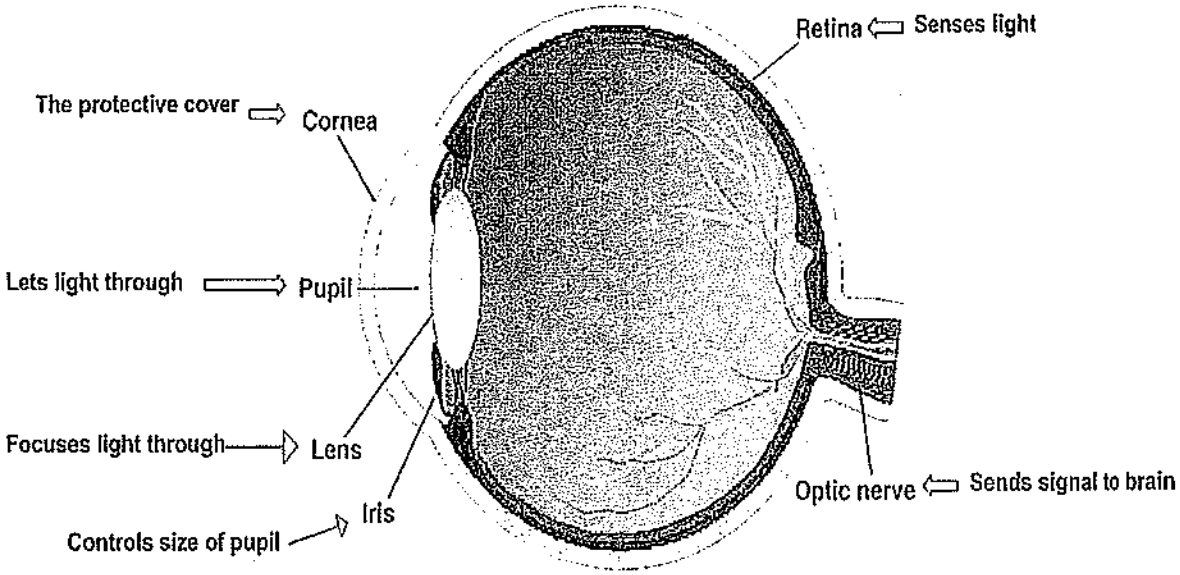
3. Key Concepts from Reading 4.1

- How do my eyes sense light?
  - Light enters your eye and reaches your retina
  - Your retina sends a signal to the brain
  - Your brain knows if the signal is a direct light source such as a bulb, or if the light is bouncing off an object, allowing you to see the object instead.

- How animals see

Polar Bears	Cats	Giant Squid
• Eyes allow them to see very bright light to see in snow • Protective, clear covering over eye to protect from bright sunlight • Also protects them when swimming underwater	• See as well as humans during the day • Strong nighttime vision • Cannot see in total darkness • Sensitive retinas • Slit like pupils to let less light in during the day • Wider pupils at night to let more light in to see in darker places • Protective covering to allow them to see in bright lights during the day (causes glowing eyes at night)	• Huge eyes with huge pupils to let more light in • Allows them to see in the darkness of deep water • Cannot see in total darkness

The Parts of the Eye



Name: Key	Date:	Block:

Study Guide

The quiz on the first 5 lessons in the IQWST unit "Can I Believe my Eyes?" will be Tuesday 10/24 for A day students and Wednesday 10/25 for B day students. In preparation for the quiz, complete both sides of this handout.

1. What is a phenomenon?
Something that occurs in nature that we can observe and ask question about.

2. Give an example of a phenomenon we discussed in class.
Optical illusions, eyes dialating, shadows, light, etc.

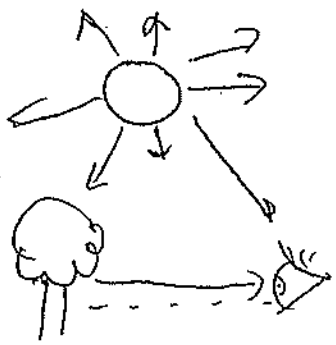
3. Give two examples where pixels are used to produce an image. *(See reading 2.2)*
1. Comic Strips 2. TV, Pointilism

4. What is a model? Use the word phenomenon in your answer. *(See reading 3.1)*
A representation of a phenomenon

5. List 2 characteristics of a model. *(See reading 3.1)*
Can change
Have advantages + disadvantages

6. List the four conditions needed to see an object. *(See the principles tab in IQWST)*
1. Eye 2. object
3. light source 4. direct path

7. Draw the consensus model that answers the question "How can we see an object?" *(See the driving question board)*



8. Use the consensus model and the four conditions to explain why you can see an object in the room. Make sure to elaborate. This answer should be several sentences.

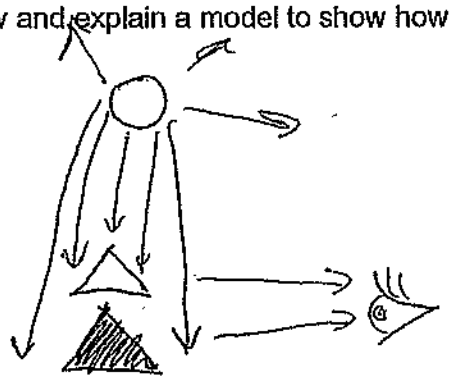
When light shines on an object, the object reflects light in all directions. If there is a direct path between your eye and the object, you are able to see the light reflecting off the object.

9. List the four conditions needed to see a shadow. *(See the principles tab in IQWST)*

1. Surface 2. eye

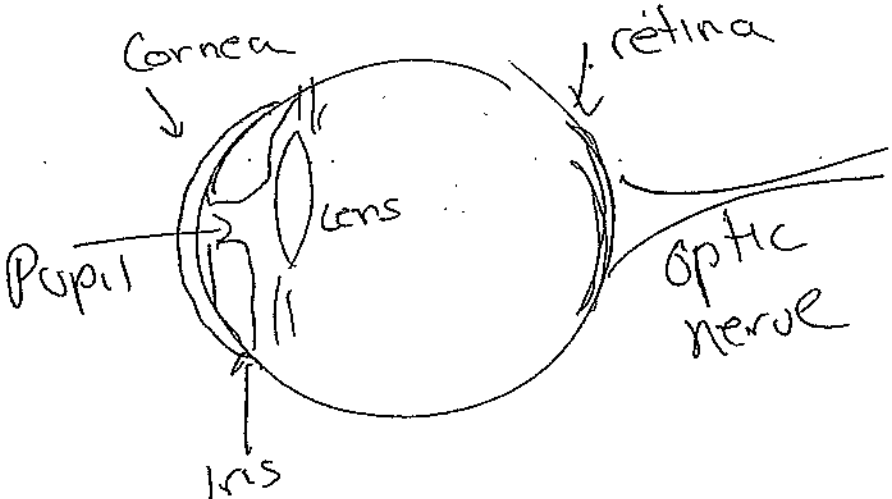
3. Object 4. light

10. Draw and explain a model to show how a shadow is formed. *(See lesson 5)*



Light that reaches the object is blocked. Light surrounding the object reaches the surface, producing a shadow. This is the light that reaches your eye, allowing you to see a shadow.

11. Draw a model of the eye and label the following: retina, iris, lens, cornea, pupil, optic nerve. *(See reading 4.1 and the cartoon under "links and resources" on my website.)*



12. Write a short paragraph to describe how the eye uses the parts labeled above to see an image. Make sure to describe the function of each part.

Light passes through the cornea (protective layer) through the pupil (opening that controls the amount of light entering eye). The iris has muscles that can grow and shrink the pupil. The lens focuses the light which then is projected onto the retina. Signals are then sent through the optic nerve to your brain so that you can see an image.

Can I Believe My Eyes? Lesson 5.2 How Are Shadows Created?

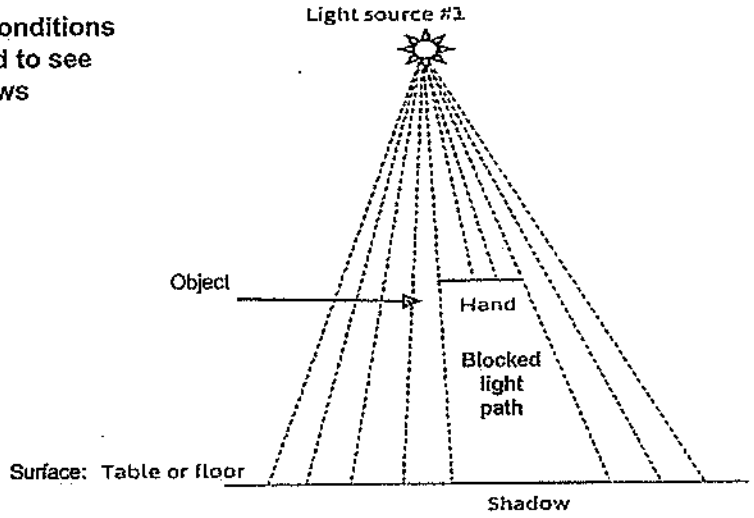
1. **Key Vocabulary:**

   - **Shadow**: formed when an object blocks light from reaching something. (You are seeing the light surrounding an absence of light)

2. **Key Concepts from Class Activities**

   - **What do you need in order to see shadows:**
     - **Light**
     - **Object *blocking* light path**
     - **Surface for shadow to be projected onto**
     - **eyes**

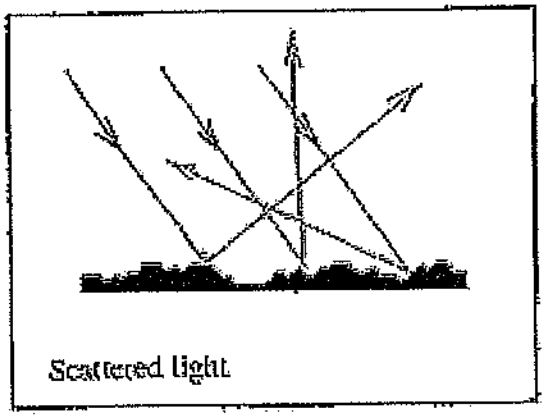
Four conditions needed to see shadows



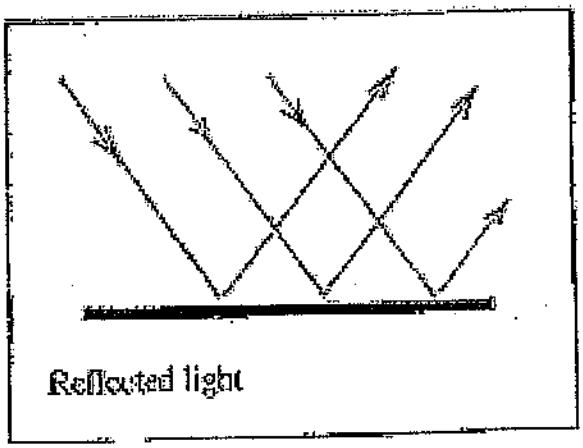
   - How do shapes and locations of shadow **change**?
     - When light source is turned off: shadow disappears
     - When object is removed: the shadow disappears creating a clear path
     - **To make shadow larger**
       - move the object closer to the light source
       - Move the surface farther away
       - Move the light source closer
     - **To make shadow smaller:**
       - move the object away from the light source
       - Move the surface closer
       - Move the light source farther away

Principles for **scattering** and **reflection:**

1. **Scattering** occurs when light bounces off an object in **all directions**



2. **Reflection** occurs when light bounces of an object only in a **certain direction**. This occurs when the surface of the object is **smooth and polished** (like a mirror)



3a. If the 2nd object **reflects** light, we **can** see the reflection of the 1st object in the 2nd object.

3b. If light **scatters** when it hits the 2nd object, we **cannot** see the reflection of the 1st object in the 2nd object.

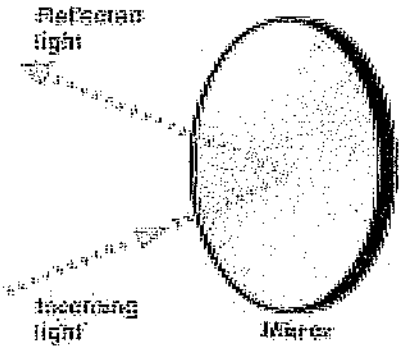
Can I Believe My Eyes? Lesson 6.1 Scattering and Reflection of Light

Key Vocabulary:

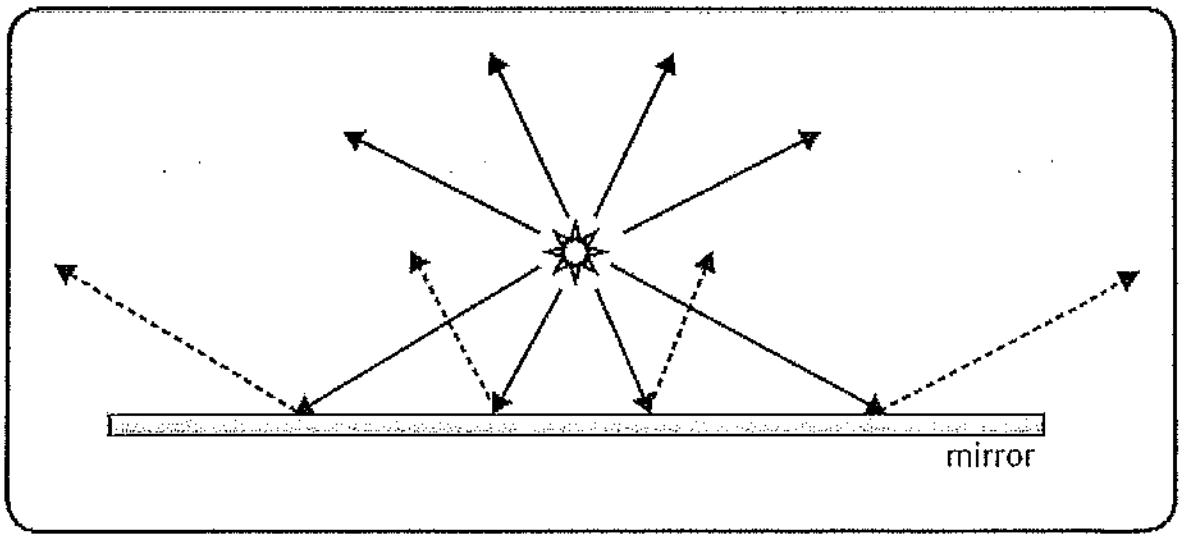
1. **Reflection:** when light bounces off of a surface at the same angle the light source hits it, but in the opposite direction

Key Concepts from Class Activity:

1. When light bounces off a mirror, it shines (reflects) that light on another surface at the same angle that the flashlight is pointing at the mirror



2. Light reflecting at different angles: notice how each angle of reflection is the same as the angle the light hits the mirror at



Can I Believe My Eyes? Lesson 6.3 Polishing Objects

1. **Key Vocabulary:**

   - Polishing- smoothing bumps and ridges on a surface to make it shiny

2. **Key Concepts from Class Activities**

What determines if an object will reflect light?	What determines if an object will scatter light?
• Shininess • smoothness	• Rough surface • Dull color

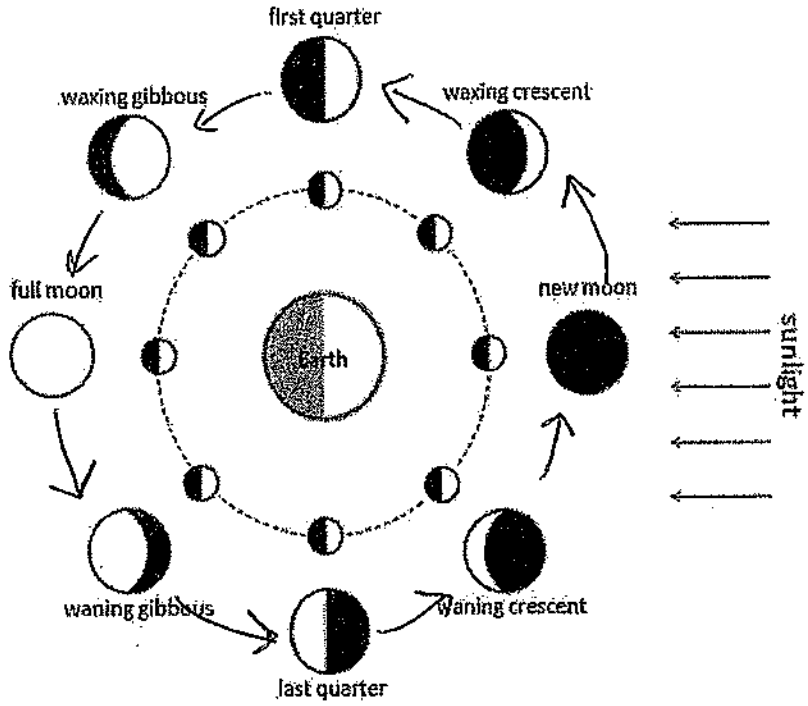
3. **Key Concepts from Reading 6.3**
   - **Reflection** is what happens when light bounces off a *smooth surface* like a mirror
   - **Scattering** is what happens when light bounces off a *bumpy, or rough surface*, like wood or paper.
   - **HOW DOES A MIRROR WORK**: all of the light rays are reflected from the mirror so that they bounce back towards your eye
   - Telescopes use curved, large, smooth mirrors that reflect a lot of light in order to see stars far away
   - Polishing occurs on surfaces for many reasons, but in science helps make sure instruments like telescopes work properly
   - Surfaces that are polished
     - Hale telescope: one of the largest telescopes in the world that uses a polished mirror that took 11 years to create.
     - Rocks (rock tumblers smooth out bumps in rocks to make them more shiny because the smooth surface reflects more light)
     - Diamonds (
     - Hard wood floors (wax creates a shine because it fills in most of the bumps on the surface)
   - No surface can have pure reflection: even the smoothest surfaces have some bumps, even if they are microscopic. Some scattering will still occur!

Lesson 6.4 Moon Phases: Can I Believe My Eyes

Key Vocabulary

- Scattering (see 6.2)
- Reflection (see 6.3)

Key Concepts from Class:



- Moon phases are caused by sunlight scattering from the moon's bumpy surface
- The moon phase also depends on our position on Earth and the moon's position
- One half of the moon is always lit, and one half is always in shadow because light doesn't reach it
- How We See It
  - sun=light source
  - moon= object
  - Our position= eyes
  - Clear path from Earth to Moon

Key Concepts from Reading:

1. What makes day and night happen:
   a. As the Earth rotates around the sun, it spins on axis. During the day, your position on Earth ***faces*** the sun.
   b. At night, your position on Earth is facing ***away*** from the sun

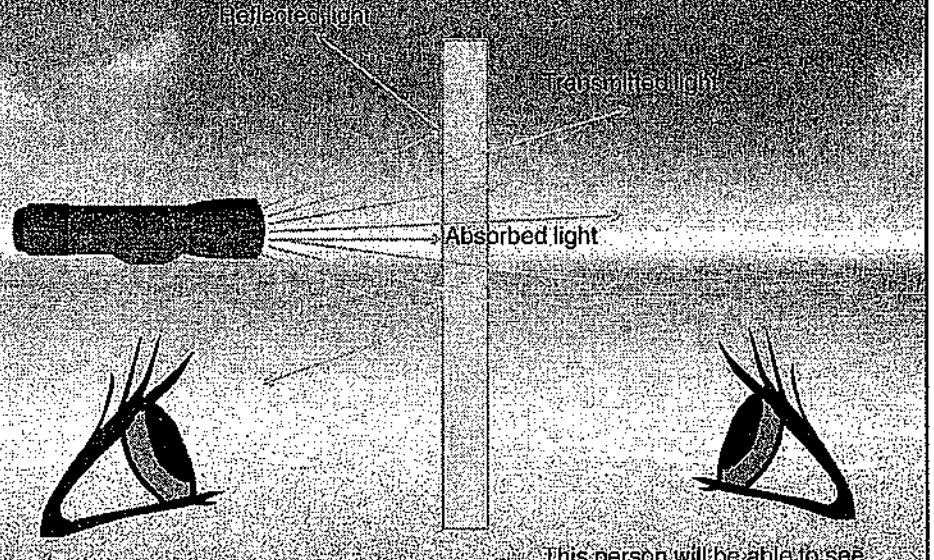
2. How do people see the moon?
   a. The moon is an object that is lit up by the sun (a light source)
   b. Half the moon is always lit by the sun, while the other half is always dark because light never hits it. No light can scatter to your eyes from the back of the moon

3. Moon Phases (see diagram for full explanation)
    a. Phase of the moon is the part of the moon that is BOTH lit by the sun and seen from a position on Earth.
    b. Caused by scattering of light being reflected off the moon. Some light rays travel to Earth giving us a specific view of the moon.
    c. Waning moon= shrinking
    d. Waxing moon = growing
    e. **New moon**: occurs when the ***moon is between the Earth and the sun***. The lit side of the moon is facing directly away from Earth, so you cannot see it.
    f. **Full moon**: occurs when the earth is ***directly between*** the Sun and Moon. One whole side is lit up, giving us a full circle view of the moon.

Scientific Principles

- When light reaches an object it is scattered or reflected, transmitted, absorbed or some combination of these.
- Light can make things happen when it is absorbed.

The Consensus Model



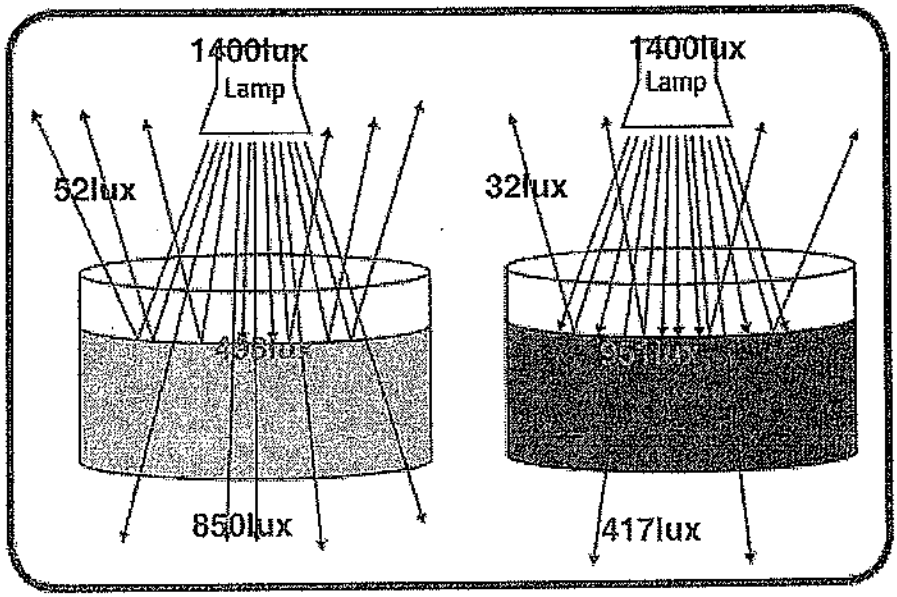
	Incident Light lux	Reflected Light lux	Transmitted Light lux	Starting Temperature °C	Ending Temperature °C
Plain Water	1400	52	850	20	21
Colored Water	1400	32	417	20	24

Plain water

52 lux reflected + 850 lux transmitted + 498 lux absorbed = 1400 lux

Colored water

32 lux reflected + 417 lux transmitted + 951 lux absorbed = 1400 lux

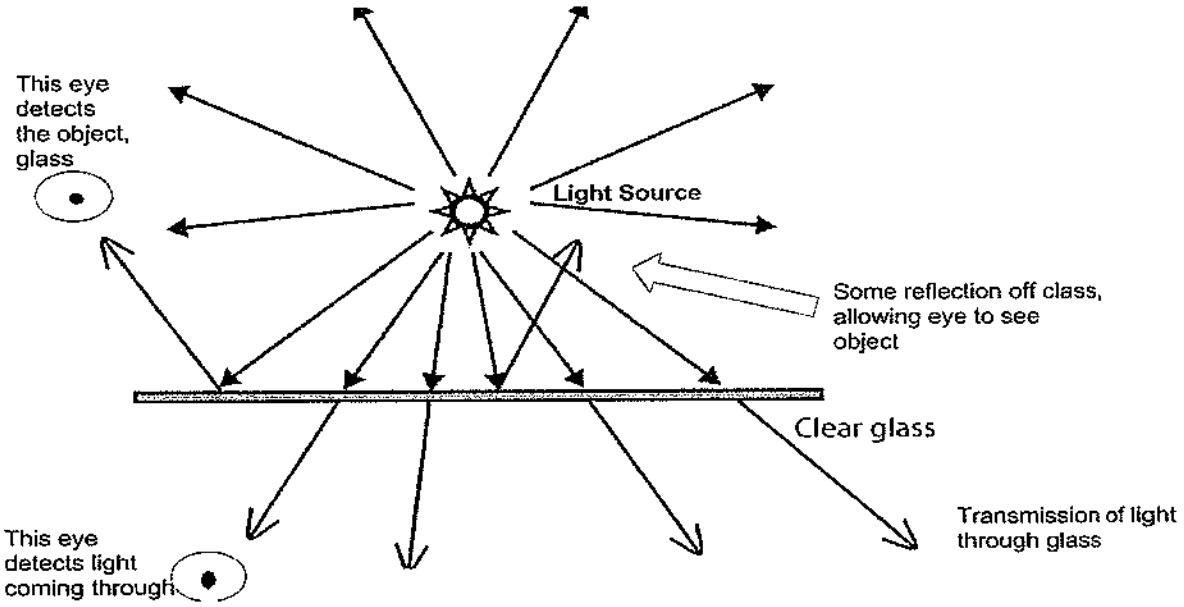


Activity 7.3 Can I Believe My Eyes

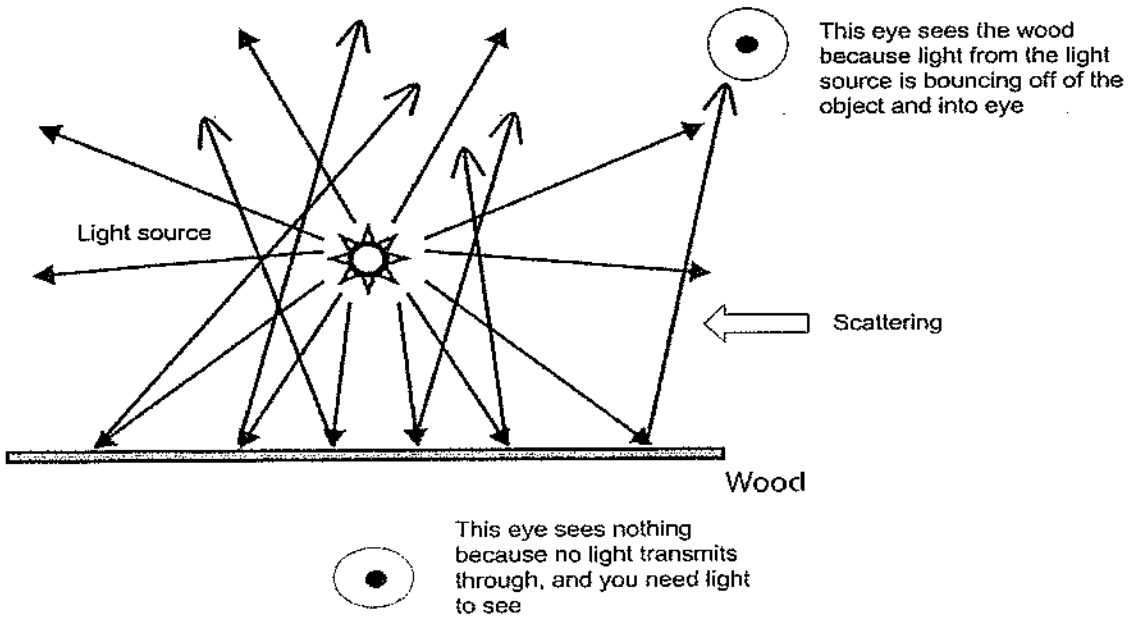
Key Concepts from Class:

1. **Different surfaces react to light differently**

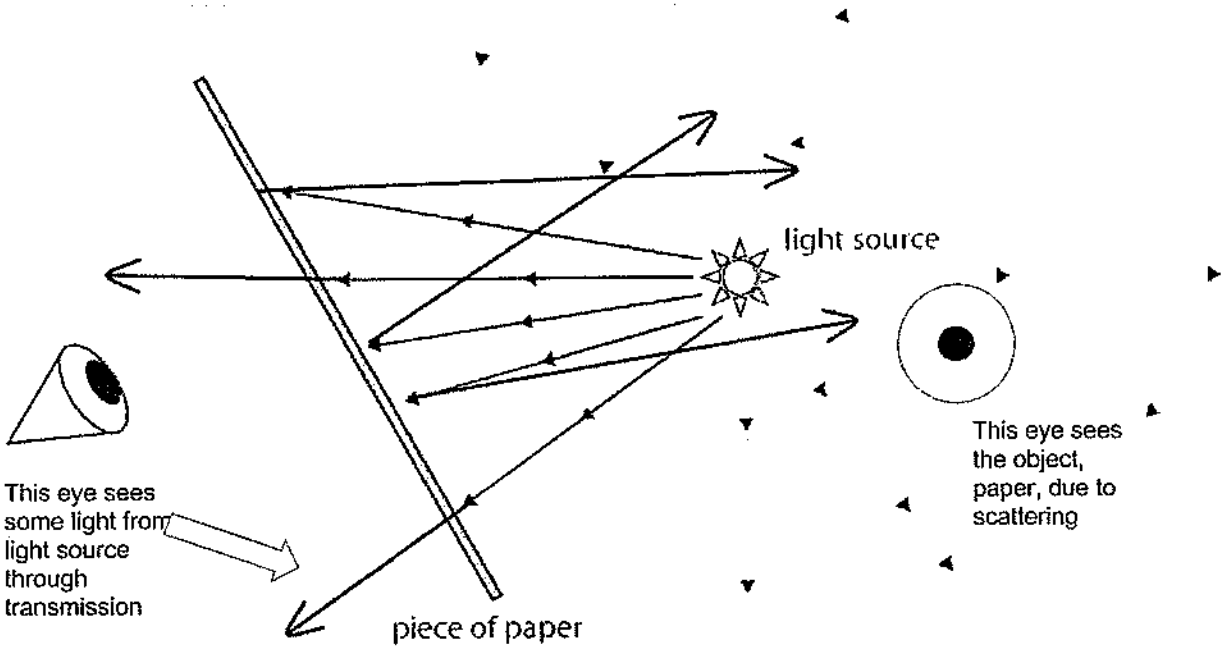
- Light **transmits**, or travels through, clear objects like glass:



- Light **scatters, or bounces off of wood** in different directions *without any transmission*



- Light **<u>scatters</u>** off of paper, but *some light transmits through*.



- **ENERGY CANNOT BE CREATED OR DESTROYED**

Math Model for Light:(math expression)

Amount of Reflection + Amount of Light Transmitted + Amount of Light Absorbed= Total Light Ener

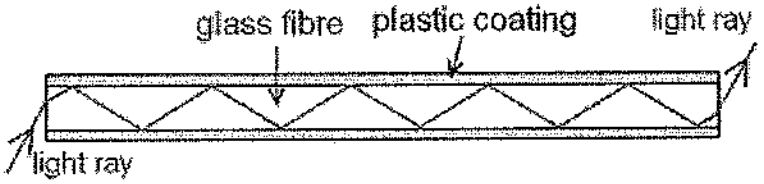
Reading 7.3: Using Light in Optical Fibers

Key vocabulary:

- **Fiber optics:** Clear glass that allows light to be reflected and transmitted by materials in the fiber

What does Plastic Have to Do with Optical Fibers

1. Optical fibers work because light is reflected and transmitted by materials in the fiber
    a. The center of the optical fibers is glass which allows light to transmit easily through the strand
    b. When the light hits the side of the glass, it is reflected allowing it to travel around bends in the strands



2. How Does Our Light Model Apply to What Happens in Optical Fibers
    a. Our consensus model shows that light travels in a straight direction until it has an interaction with a surface and then travels in a new direction (light hitting mirror)
    b. Light travels in a straight light in fiber optics, but changes direction frequently
    c. This allows it to appear like the light is bending

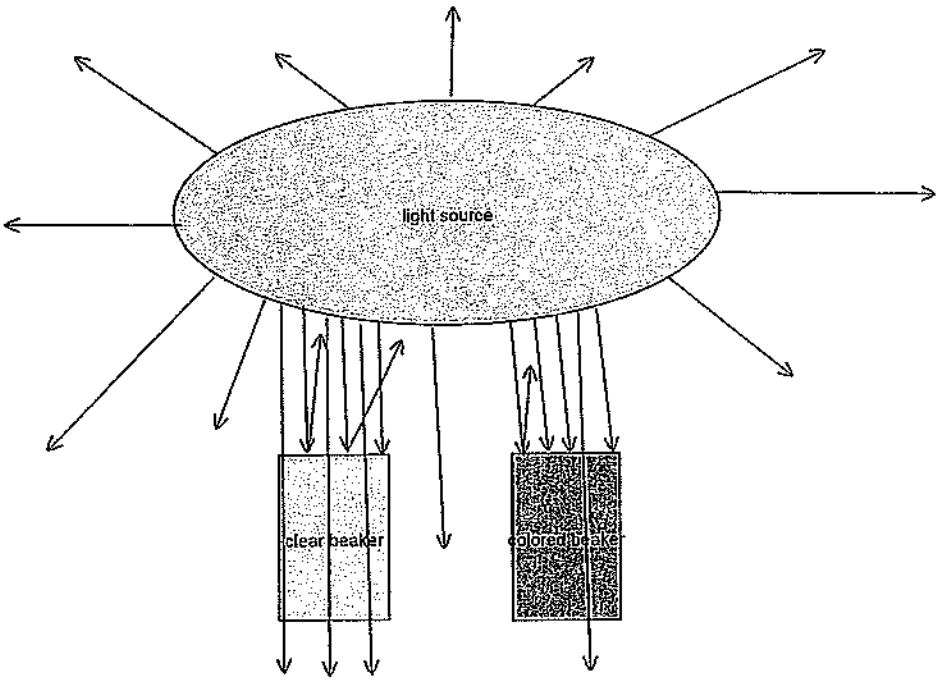
3. How are fiber optics useful?
    a. Computers use fiber optics to send signals:
        i. a single fiber can do the same work as multiple electric wires
        ii. A single fiber can carry more signals at once
    b. Surgery
        i. Doctors can make small cuts on the body
        ii. Place a single fiber in and shine light into the body
        iii. The light reflects off organs and enters another fiber that sends an image to a camera to allow the doctor to see what is wrong
    c. Lighting
        i. Rooms without windows can be lit up by placing one end of a fiber outside a window. Light will travel into room through other end of fiber

Lesson 8.3 and 8.4 Keeping Track of Light: Can I Believe My Eyes

Key Concepts from Class:

- ***Darker colors*** absorb more light than <u>lighter colors</u> because less light can transmit through or reflect off of darker colors.

- This makes the darker colors **warmer** than lighter colors.



- **For example:**
  - If the sun were shining on a black top and a sidewalk for an hour, the **black top would be much hotter because more light is being absorbed** by the black top, while *the sidewalk reflects more light because it is white.*
- **Transmission, reflection, and absorption are all related because the amount of one occurring determines how much the others will occur.**
  - If a small amount of light is transmitted or reflected, then a larger amount is absorbed.
  - If only a small amount of light is being absorbed or reflected, then a larger amount of the light is being transmitted.

Light reflected + light transmitted + light absorbed = total light energy

Key Concepts from Reading 8.4:

- Light can interact with objects in three ways
    - Reflection
    - Scattering
    - Absorption
        - one , two, or three of these things can happen at the same time
- Example: **when light hits a window**
    - some of the light is *reflected off the window, allowing us to see it*
    - Some light is absorbed by the glass, so the *glass would feel warm* when we touch it
    - Some light is transmitted through, and it continues to travel until it hits other objects
    - These objects then reflect absorb, and transmit light, allowing different objects to be seen, and warmed by the light source
- Solar Water Heaters
    - Have three parts: a hot water storage tank, a solar collector that absorbs light from the sun, and a backup gas or electric heater when it is cloudy
    - It is designed to absorb as much water as possible to heat water, so it reflects very little light
- How does solar energy make electronics work
    - Solar cells produce electricity by using light energy from the sun
    - Cars have solar cells that allow them to move without using gas
    - Solar panel powers calculator use smaller solar cells to work
    - A small solar cell is used for smaller objects like toy cars, where larger objects would need a larger solar cell to run

Name: Key	Date:	Block:

Can I Believe My Eyes?

Study Guide for Learning Set 2 Quiz

The quiz on lessons 6-8 will be 11/21 & 11/22.

Complete the following table.

Interaction	Describe the Interactions	How do we know this? What is the **EVIDENCE**?!?!	**Describe** 1 Example
Reflection & Scattering	Light bounces off of an object When the object is smooth, it reflects light in an organized way. When an object is rough, it scatters light at different angles.	When light was shined on a mirror, the light sensor had the highest reading at the same angle/position, showing all light reflected back at the same angle. When light was shined on the paper, every position/angle had a similarly, low reading, indicating that the light that bounced back spread out everywhere.	A mirror reflects light. A leather shoe scatters light.
Transmission	Light can pass through an object.	When a flashlight was shined through different materials, the more transparent materials allowed more light to pass through. We know this because the light sensor read higher readings for the clearer materials.	A glass transmits more light than paper.
Absorption	Light that does not reflect or transmit, can be absorbed or taken in by an object.	When a large amount of light was shone on two different beakers, the light sensor was able to detect that only some of that light was transmitted or reflected. This means the rest must have been absorbed.	The colored water absorbed more light than the clear water.

Describe the data collected in activity 8.2.

If in total 1000 lux was shone on both beakers...
and the colored water reflected and transmitted only 151 lux,
and the plain water reflected and transmitted only 313 lux,
what remains of the 1000 lux must have been absorbed by each beaker of water.

This means the colored water absorbed more light because it reflected and transmitted less than the plain water.

Colored Water: 16 reflected + 125 transmitted + **849** absorbed = 1000 lux

Plain Water: 13 reflected + 300 transmitted + ***687*** absorbed = 1000 lux

How did this data provide evidence for all of the interactions we have studied?

When the light sensor was pointed at the surface of the water, the light sensor gave a reading indicating that some of the light shining on the water was **reflected.**

When the light sensor was placed under the beaker and pointed up towards the light, the light sensor gave a reading indicating that some of the light was **transmitted** through the water into the sensor.

Since the amount of light transmitted + the amount of light reflected did not equal the amount of light shone on each beaker, some of the light must have been **absorbed.** The absorbed light increased the temperature of the beaker.

On the back of this paper, draw a consensus model that includes **all interactions** in the table. Make sure to include **all four conditions** in your model.

A complete consensus model can be found under "links and resources" page on my website.

Color Addition and Subtraction Notes

Be able to identify the following

1. What are the primary colors of addition? Red, blue, and green

2. What are the primary colors of subtraction? Yellow, cyan, and magenta

3. What is a complementary color pair?

One primary color of addition and one primary color of subtraction that create white light when combined. Examples: yellow and blue, magenta and green, cyan and red

4. What is color subtraction? each color of subtraction (yellow, cyan, and magenta) is made up of two primary addition colors, ***the third missing primary addition color is the color that is subtracted or absorbed***.

a. Yellow subtracts which color? ___blue_

b. Magenta subtracts which color? __green_____

c. Cyan subtracts which color?____red_____

Be able to determine what color is created when different colors are combined. Use the color wheels on the back to help visualize!

Color Additions

1. Red and green make what color? ___yellow____

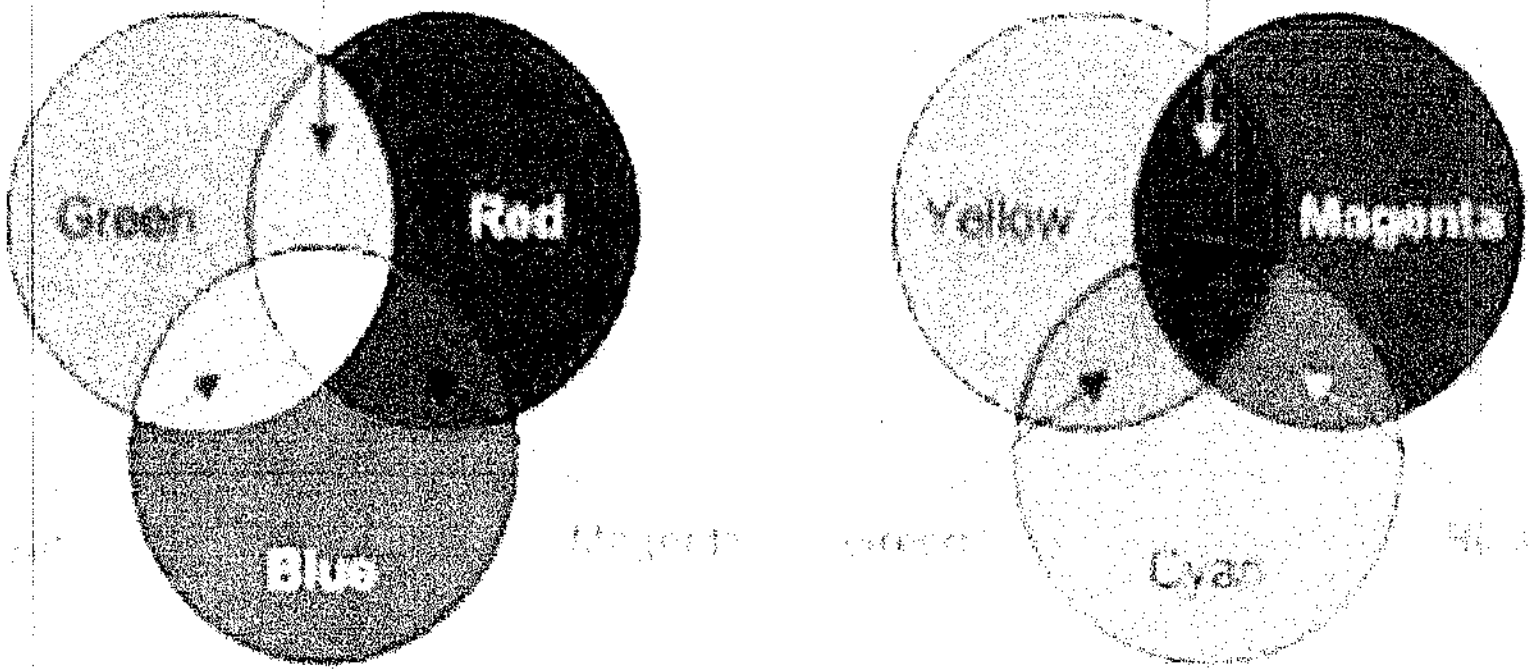
2. Blue and red make what color? ____magenta____

3. Green and blue make what color? __cyan_____

4. Green, blue, and red make what color? ___white___

Color Subtractions

1. What color is left when you combine yellow and cyan? green because subtracts blue and cyan subtracts red
2. What color is left when you combine magenta and yellow? red because magenta subtracts green and yellow subtracts blue
3. What color is left when you combine cyan and magenta? blue because cyan subtracts red and magenta subtracts green
4. Yellow, cyan, and magenta make what color? black because all primary colors are subtracted allowing no light to reflect



Additive and subtractive color combinations

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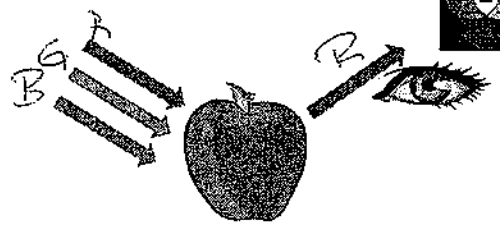
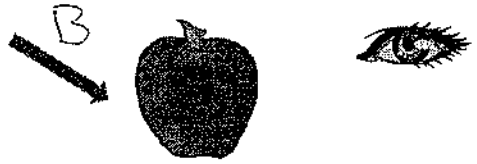
14.a.



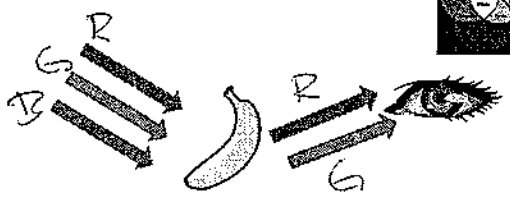
White light is made up of red, green and blue. A red apple absorbs green and blue and reflects red.

14.b.



Blue light is made up of only blue light. A red apple will absorb blue and reflect nothing.

14.c.



White light is made up of blue, green and red. A yellow banana absorbs blue and reflects green and red.

14.e.

Cyan is made up of blue and green. A yellow banana absorbs blue and reflects green.

Closing Questions

A yellow light shines on a magenta flower. What color will the flower appear?

Yellow light is made of Red & Green

A magenta flower absorbs Green and reflects Red & Blue

Since no blue light is shining. It will only reflect red.