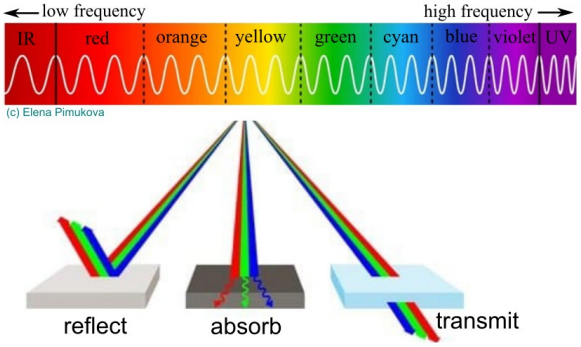
Light and Color

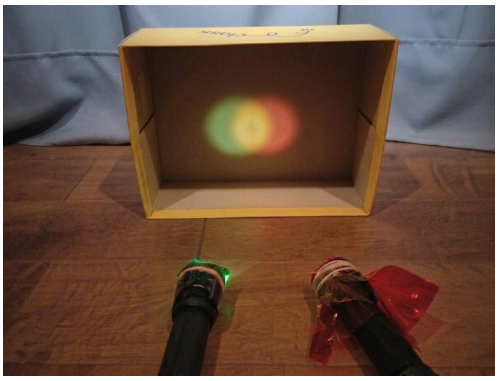
- Light is a wave that travels through empty space
- When light interacts with objects it can be: **reflected**, **absorbed**, or **transmitted**
- A **shadow** is formed when an object blocks light, leaving a dark spot behind it.
- Colors are different **frequencies** of light waves. White light has many frequencies mixed together.
- Our eyes have special cells that respond to the **primary colors of light:** red, green, blue.



Part 1: Adding Colors

1. Fold a red filter into quarters and use a rubber band to secure it on a flashlight. Repeat with the blue and green filters to make 3 different color flashlights.

2. Set the shoebox with the open side facing you. Shine in the flashlights, using the inside of the box as a screen.



What color do you get when overlapping red + green spots? _____

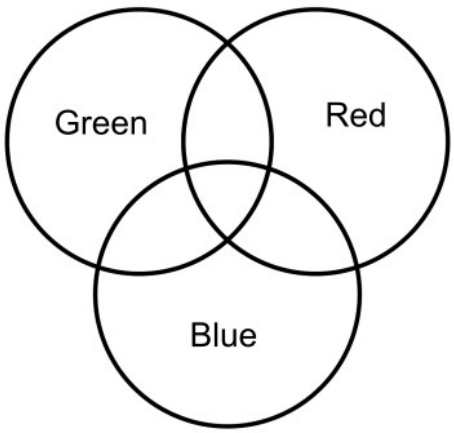
Overlapping red + blue spots? _____

Overlapping green + blue spots? _____

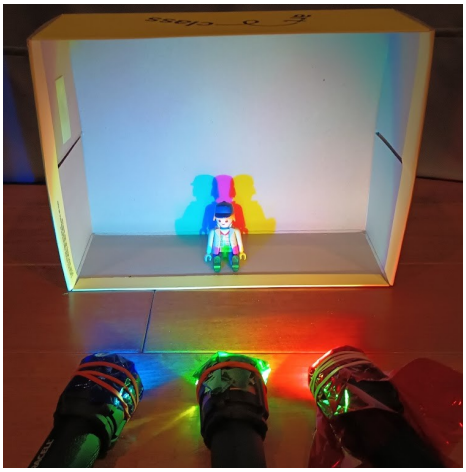
Overlapping red + blue + green spots? _____

Fill in the Venn diagram with what you see.

Additive color model:



Word bank:
Yellow, Magenta, Cyan, White



3. Stand a toy figure about 1in from the back of the box.
Shine a green light on the figure.
What color is the shadow behind it? _____

4. Leaving the green light on, also shine a red light on the figure.
How many shadows do you see? _____
What colors are they? _____
Discuss: why are there multiple shadows?

5. Now add the blue light on the figure.
How many shadows do you see? _____
What colors are they? _____

Each shadow forms because the figure blocks one of the colors of light. The remaining colors combine to make the shadow!

6. Try putting your hand in front of each flashlight. Can you predict which shadow disappears?

The yellow shadow is formed because the figure blocks the _____ light.
The magenta shadow is formed because the figure blocks the _____ light.
The cyan shadow is formed because the figure blocks the _____ light.

Part 2: Subtracting Colors

When light passes through one color filter then another, different colors of light are subtracted away (absorbed) rather than added together.

1. Explore what happens when you shine a red laser pointer through different color gummy bears.
Circle what you see: (more than 1 might be correct)

The red bear	absorbs	/	transmits	/	reflects	red light.
The green bear	absorbs	/	transmits	/	reflects	red light.

2. Repeat the experiment with a green laser pointer.
Circle what you see:

The red bear	absorbs	/	transmits	/	reflects	green light.
The green bear	absorbs	/	transmits	/	reflects	green light.

3. Make a prediction. If you stack the bears length-wise in the order red, green, red and shine a red laser pointer at the end, how far will will the light be transmitted?

On the picture above, mark how far the light penetrated.

4. What if you stack the bears in the order red, red, green? How far does the light go?

5. What does the yellow bear do:

To red light? Absorb / transmit / reflect

To green light? Absorb / transmit / reflect

6. Now use white light (remove a filter from a flashlight). When you shine it through a red bear, what color do you see on the other side?

_____

What if you shine light through a red bear <u>followed by</u> a green bear?

7. When you shine the white light through a yellow bear, what color do you see on the other side? _____

Make a prediction: what will happen if you shine white light through a red bear and then a yellow bear?

_____ Test your prediction!

8. Fill in the blanks:

White light contains _____, _____, and _____ primary colors of light mixed together. The red bear transmits _____ light and absorbs _____ and _____ light. The yellow bear transmits _____ and _____ light and absorbs _____ light.

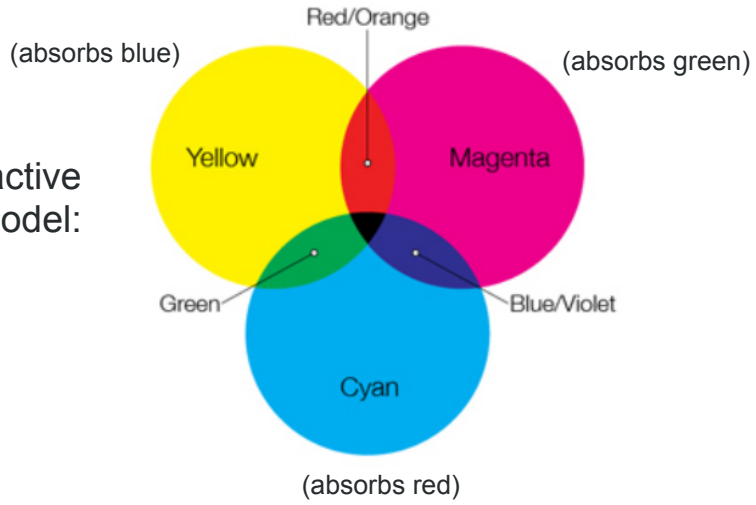
Yellow is one of the basic colors in the **<u>subtractive light model</u>** because it absorbs just one primary color of light. From your Venn diagram in Part 1, can you figure out what other colors belong in the subtractive light model (absorb only one primary color)?

Suppose you could make gummy bears in any color.

What color gummy bear would absorb red but transmit blue and green? _____

What color gummy bear would absorb green but transmit blue and red? _____

Subtractive Color model:



Mixing paint follows the subtractive light model. So a mixture of yellow + cyan paint will absorb blue and red light, and will appear green.

9. Make some predictions! Then use the flashlights to test if you were right.

If you shine a single white light through a yellow filter followed by a magenta filter:

- What color will you see? _____
- Are you combining colors in a **subtractive** or an **additive** way? _____

If you shine one white flashlight through a yellow filter and another white flashlight through a magenta filter, then overlap the spots of light:

- What color will you see? _____
- Are you combining colors in a **subtractive** or **additive** way? _____