Color Subtraction Challenge Lesson Plan

Amount of time Demo takes: 3 minutes
Try this at home!

Materials

● Red glasses (we use laser safety glasses)
● Small box of multi-colored craft poofs
● Optional: sheets of paper, different colors

Set up instructions

1. Set out the box of colored poofs, and open 3 to 4 pairs of glasses. Set these aside.

SAFETY! -- Safe demo

Lesson’s big idea

● Passing light through a red filter eliminates all color wavelengths except for red - this is called color subtraction. The ‘redder’ a color is (think red, pink, purple), the lighter it appears through a red filter. The ‘less red’ a color is, the darker it appears (think green, blue).
● When you wear the red glasses, they take away all the colors except for red. That’s why everything looks different through the filter!

Background information

● The white light all around us is made up of all the different wavelengths: each color that we know has a different wavelength. Many students have passed light through a prism, or seen a rainbow, and know that there are all different colors in the light around us.
● A green poof looks green because, when all the light around us hits it, the poof absorbs all wavelengths except green. The green gets reflected back at us, and that’s why we see it in that color.
● If, instead of a prism, you use a filter, it removes some wavelengths of light. A red filter will absorb all of the color wavelengths except for red -
in our case, that means only red wavelengths can get through the glasses. All the other colors are stripped away/absorbed by the glasses.

- This is called color by subtraction.
- So, when you wear the red glasses and look at an object (like the poofs), the red glasses absorb all the color wavelengths of that object except for red. So, the less ‘related’ to red a color is (think blues, greens), the darker it looks (because more of its wavelengths are being absorbed/subtracted). Reds, yellows, magentas, and oranges look brighter (see below).

Figure 4: Subtractive colour mixtures of cyan, magenta and yellow to produce blue, green and red.

2/3
Instructional Procedure
1. Have two to four students gather around the box of colored poofs.
2. Instruct everyone to look up at the ceiling while you mix up the poofs. Tell them that when you say go, they should pick out as many orange poofs as they can.
   
   Note: you can choose whatever color you want, but orange, pink, and red work best. Stick with the same color throughout the demo.

3. Say go! Count down from 10: at the end, see who got the most poofs. Recap with the students whether this was difficult or not.
4. Now, tell the students that they’re going to try again - this time with the red glasses. Have them put on their glasses and look up at the ceiling while you mix all the orange poofs back in.
5. Same as before, tell them that when you give the word, they should pick out all the orange poofs.
6. Say go and count down from 10! It should be much more difficult now, and students will probably pick out some of the wrong colors!
7. Recap what the students saw, and if this changed the difficulty of the challenge. Discuss color by subtraction.

Assessment/sample questions you can ask
● Why does everything look strange when you put on the glasses?
● What colors look really dark through the glasses? What ones look really light?
● What is a filter? How is it different from a prism?

Clean Up
● Put all poofs back in their bin.
● Wipe off the glasses and put them into their cases.

References
● https://www.le.ac.uk/se/centres/sci/selfstudy/lht5.htm

Next Generation Science Standards
● 1-PS4.B, 4-PS4.B
● MS-PS4.B
● HS-PS4.B