Digital - Impossible Colors

- What are the fundamental principles that you want the students to learn about this?
  - Rods & Cones
  - Color comes from stimulating cones
  - RGB Cones
  - Impossible colors are colors that we think should exist but cannot be seen because of the way our cones in our eyes work
  - It is possible to trick your brain into seeing these colors with “Afterimages”
  - Afterimages are caused by fatiguing certain cones
  - Types of impossible colors
    - Hyperbolic
      - Hyper saturated colors
    - Stygian
      - Impossibly Dark Colors
    - Self-Luminous
      - Impossibly Bright Colors
    - Impossible Combination Colors
      - Colors which consist of colors from opposite sides of the spectrum
- What are physical, hands-on ways to demonstrate these principles?
  - Show students visible light spectrum
  - Show students simple model of eye with RGB cones
  - Demonstrate different cones and combinations of cones activating in relation to color
- What type of experiment could students conduct to test this principle?
  - Have students try to create an impossible color by first having them work out on paper which cones in their eyes they may have to tire out to combine a color on the opposite ends of the spectrum and provide them with a tool to test their hypothesis.
- What types of technologies could help with these demonstrations and experiments?
  - Colored Light Source - NeoPixels, RGB led
  - Laser Cutting - Acrylic to diffuse light source

Analog - Color Models

- What are the fundamental principles that you want the students to learn about this
    - Rods & Cones
    - Color comes from stimulating cones
    - RGB Cones
    - The additive model of colors (The RGB Light system)
    - The subtractive model of colors (CMYK color pigments)
    - The process of how we observe color (And how it differs with each model)
- What are physical, hands-on ways to demonstrate these principles?

Going through the process of creating the same color but through the different color models, so they can better understand the additive and subtractive natures of the systems. For example, showing them that even though yellow is a primary pigment color, its a combination of red and green lights.

To best represent the RGB additive model, having a red, green, and blue LED partially covered by a diffuser would allow them to see the effects of combining colors while still being able to see each individual color separate.

For the CMYK subtractive model, the same PCB from the RGB model would have a bright white LED that would allow the diffuser to act like a solid white backing that they could then overlap Cyan, Magenta, and Yellow colored squares of acrylic. This would let them experience the Subtractive color model in an engaging and physical way.

- What type of experiment could students conduct to test this principle?

    After being taught how to achieve various colors through both models, we would give them various colors to combine with each system, and have them hypothesize what the resulting color would be. Each student would have a small PCB with leds, and a white diffuser, and three small squares of colored acrylic for them to conduct the experiments with. We could also have them have certain colors to target, and they would have to predict what colors they would combine instead of the other way around.

- What types of technologies could help with these demonstrations and experiments?
    - ATTiny
    - Red, Green, Blue, and White LEDs
    - Colored acrylic

X-Rays

- What are the fundamental principles that you want the students to learn about this?
    - X-rays are one of the highest energy wavelengths in the EM spectrum
    - The high energy they contain makes them potentially dangerous if not treated carefully
    - Due to their high energy, it has the power to penetrate objects and materials below a certain density. This makes them very useful in a medical setting, as it lets doctors take scans of your body structure that would otherwise be hidden.
- What are physical, hands-on ways to demonstrate these principles?
    - To help the students visualize an x-ray working, we could show them what happens when a bright light is held up to our hands and it illuminates the skin and flesh, but not the bones or cartilage. Using this example, we can help give them a more approachable concept of how it operates. Working off of that, we could then have them play with visible light in place of actual x-rays to conduct testing on what types of objects do and don't let x rays pass.
- What type of experiment could students conduct to test this principle?
    - The students could be given a small clear acrylic box that they could put different things into. Along with this, they would have a bright light and a sheet of glow in the dark paper (Or some other light sensitive material) for them to shine the light onto. We would have various materials representing materials found in the body for them to place into their boxes and shine light through. By doing this, they can visualize the energy absorbed and passed through when an x ray hits the body.
- What types of technologies could help with these demonstrations and experiments?
    - Bright LEDs
    - Laser Cut Acrylic
    - Light sensitive material (Glow in the dark paper, Blue Phosphor paper, Ect.)