Pixels, Pictures and Phones

Investigate how colored images are formed from small red, green and blue lights.

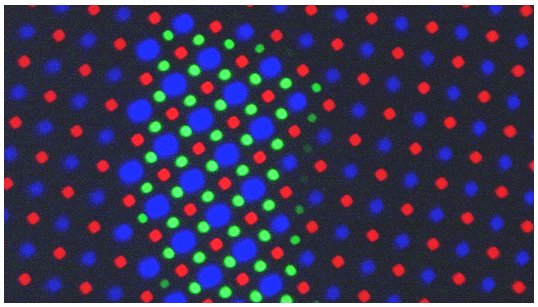
Tools and Materials:

- A mobile device (Smart cell phone or tablet; any brand will work)
- An app that allows a colored image or screen to be displayed (a browser, photo gallery, movie player…)
- A microscope or hand lens with at least 10x optical power.

To do and notice:

1. Set your phone to display something white.
   Note: To ensure your phone doesn't "go to sleep" during this activity, you may have to regularly tap your screen or adjust your setting.
2. Place your mobile device on the microscope stage.
3. Focus and carefully increase the power of your microscope until you see discreetly lit red, green and blue dots or lights - What? Where's the white!
4. If your screen has other colors displayed, move your phone to view these colors or change the image and view. See if the colors you see on the screen with your naked eye correlate to what you see in the microscope.
5. Finally, try watching a movie at the pixel scale. See how the pixels change as the scenes in the movie change.

What's going on?:



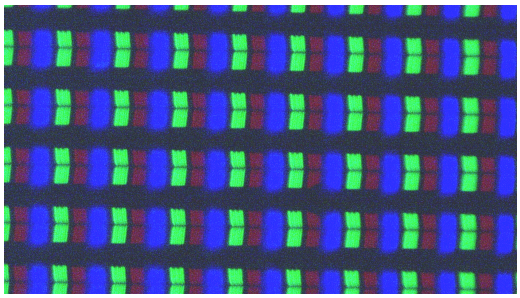
Mobile device manufacturers take advantage of three visual processing tricks or optical illusions to display images:

1. We only have visual receptors for 3 different colors on our retina: red, green and blue. Using only those three colors and adjusting their intensity on the screen, all the colors we see can be created.
2. We humans have limited visual resolution, which means we can only make out details to a certain degree. Pixels are the smallest visible color unit on a display screen. These colored pixels are created by their associated sub-pixels, red, green and blue. On modern mobile device display screens, pixels and sub-pixels are really small and really tightly packed together. Because of your inability to differentiate individual pixels and sub-pixels, the light broadcast from these spots make an image on your retina that you blend into an illusion of a clear picture.
3. If you watch a movie, manufacturers take advantage of an illusion commonly referred to as "persistence of vision." If multiple discrete and sequential

images are rapidly displayed, your eye/brain system merges them into what you perceive as motion.

By looking through the microscope, you can see all three illusions in action. You can see the three colored sub-pixels make all the colors, images and movies on your display screen.

Going Further:



- Look at a variety of brands and models of smart/mobile devices.
- See if you notice a difference between the technologies of various models.
- Notice the shape, sizes and spacing of pixels and sub-pixels.
- How does a device with a very sharp image compare with one that not as clear?
- Can you figure out which is an older technology device vs. newer one?