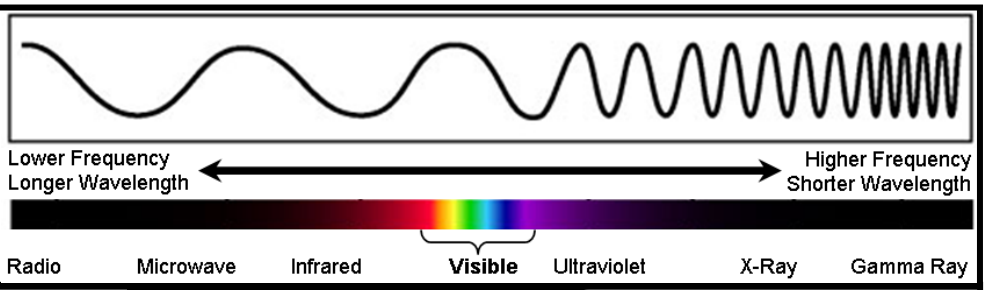
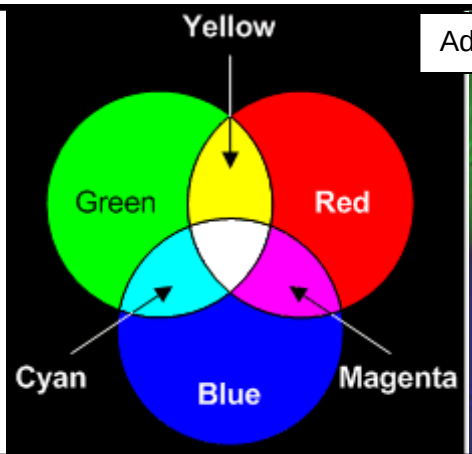
1. Exploring Color Mixing

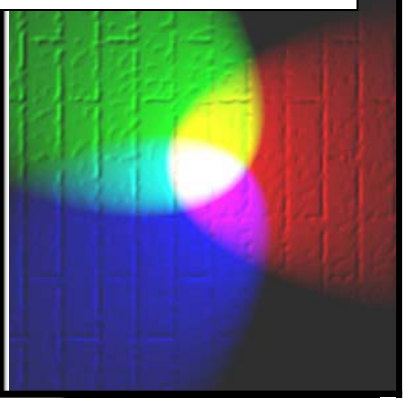
Electromagnetic waves are all around us. Humans can see one piece of the electromagnetic spectrum, so we call that portion "visible." Light is really only visible when these waves bounce off something and then go into our eyes.



Different wavelengths are different colors. Actually, our eyes only see Red, Green, and Blue light. Our brains understand all other colors as a combination of these three.
For example, if light with a wavelength of 570nm (nanometers) bounces into your eye, your brain says: "Yellow!" And if you see equal amounts of 650nm (Red) and 510nm (Green) light together your brain also says, "Yellow!"
White light is all colors mixed together. To our eyes, the combination of Red, Green, and Blue also looks white.

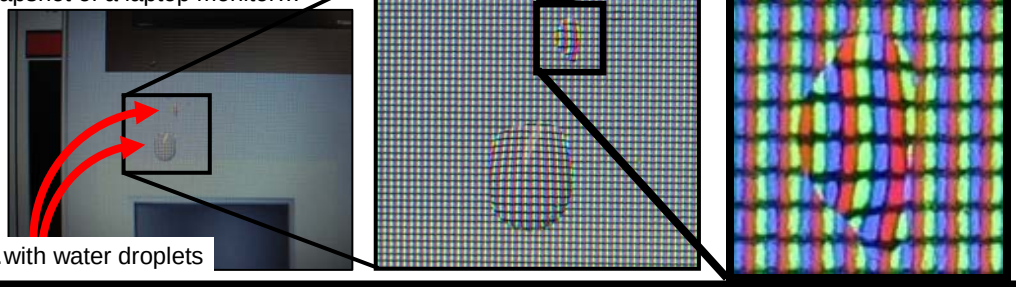


Additive Color Mixing (light)



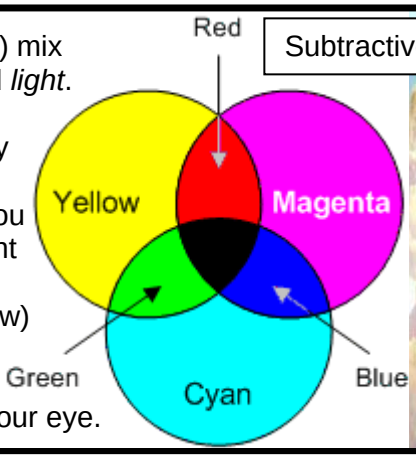
Computer monitors are designed to show us combinations of red, green, and blue (RGB) light. If you look closely, you can see the tiny "pixels" on a computer monitor when they are magnified by a droplet of water.

Snapshot of a laptop monitor…

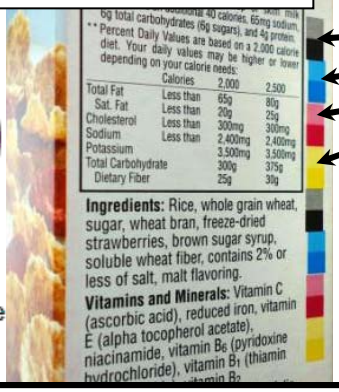


…with water droplets

Colored *paints* (or inks) mix differently than colored *light*. When white light (all colors) bounces off any object, you see only what is reflected. So you can think of yellow paint absorbing all the other colors (except for yellow) from the light and letting only yellow light reflect back into your eye.



Subtractive Color Mixing (paint)



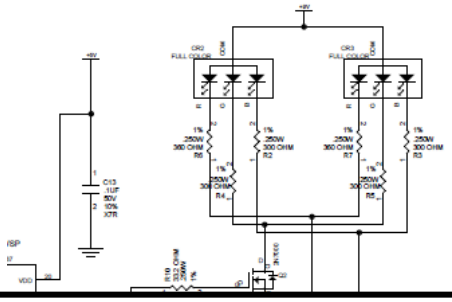
Most color printing (like on this cereal box) uses:

- black
- cyan
- magenta
- yellow

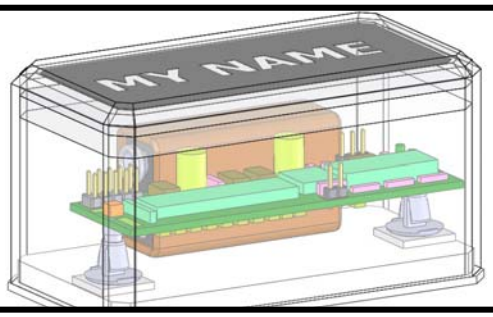
Some boxes use fewer print colors if they do not need realistic photos. Check boxes in your home—look for the test print squares to see what colors were used.

2. How Printed Circuit Boards (PCBs) are made.

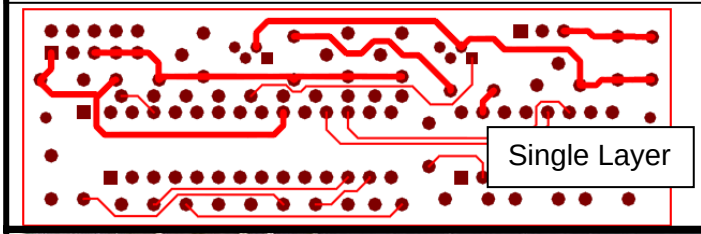
A schematic (pronounced "skee-mat'-ick") diagram is used to show how the circuit components will be connected.

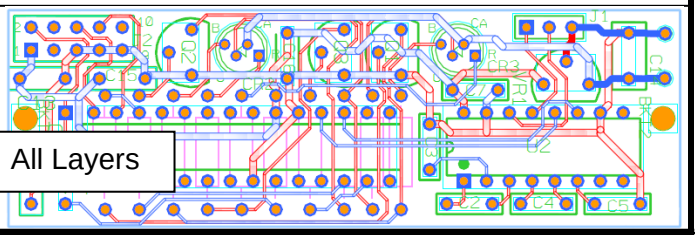


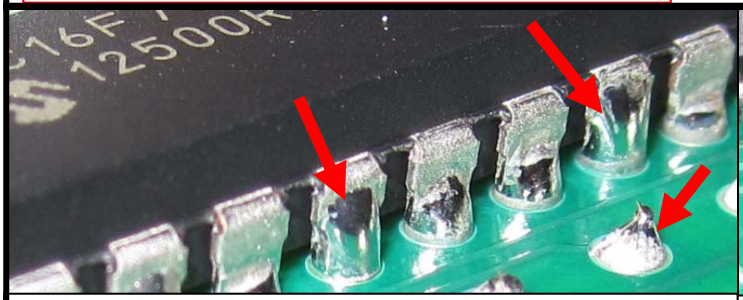
Mechanical models help check that everything can fit together, before the PCB is made.



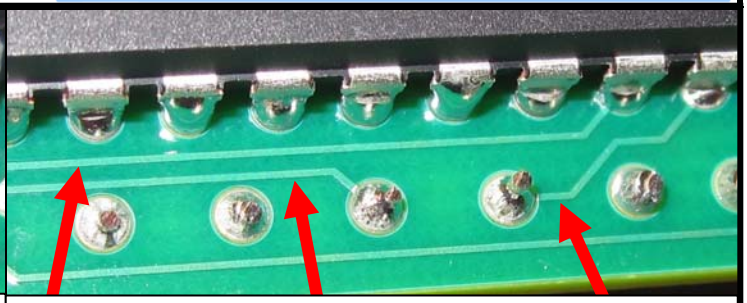
The electrical connections, called “traces” are laid out using a computer program before the PCB is made. The PCB has several layers, each with different traces. The layers are connected by holes drilled through all layers.







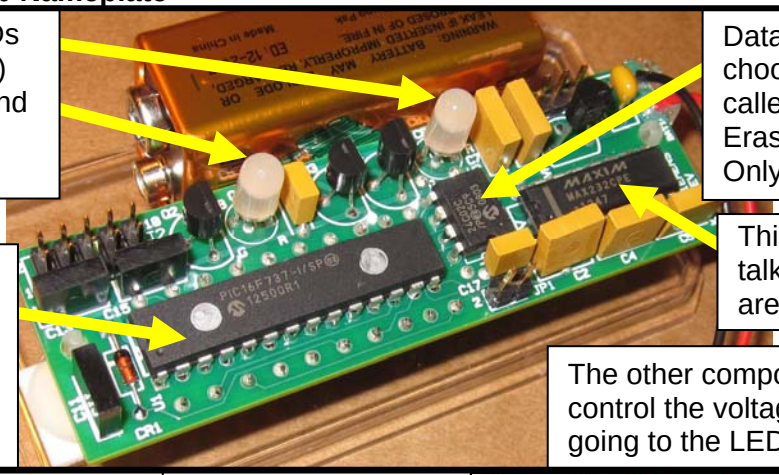
Solder (pronounced “sah-der”) is metal that can be melted to “weld” components to a PCB.



Thin copper traces make electrical connections. Green paint called “solder mask” protects them from damage.

3. Program a Light-Up Nameplate

These three-color LEDs (Light Emitting Diodes) can emit red, green, and blue light, and any combination of those.



Data for what colors you choose gets stored on a “chip” called an EEPROM (Electrically Erasable Programmable Read-Only Memory).

This other chip helps the PCB talk to the computer while you are setting the colors.

“Firmware” – kind of like software – is stored on a microcontroller “chip” which is like a very simple computer.

The other components on the PCB help control the voltage and electrical current going to the LEDs and the chips.

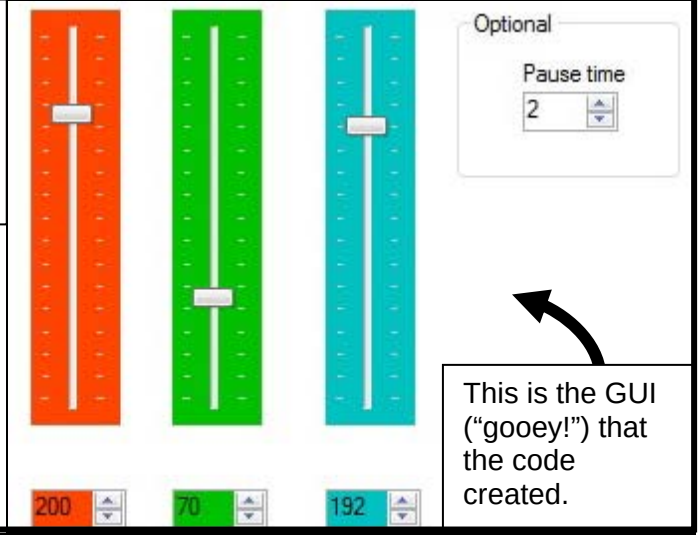
```
private void trackBarBlue_Scroll(object s
{
    numericUpDownBlue.Value = trackBarBlu
    bufToPIC[(int)LEDConf.Phase1B] = (byt
}

private void numericUpDownBlue_ValueChang
{
    trackBarBlue.Value = (int)numericUpDo
    bufToPIC[(int)LEDConf.Phase1B] = (byte)trackBarBlue.Value;
}

// Phase 2
private void trackBarRed2_Scroll(object sender, EventArgs e)
{
    numericUpDownRed2.Value = trackBarRed2.Value;
    bufToPIC[(int)LEDConf.Phase2R] = (byte)trackBarRed2.Value;
}

private void numericUpDownRed2_ValueChanged(object sender, Even
{
    trackBarRed2.Value = (int)numericUpDownRed2.Value;
    bufToPIC[(int)LEDConf.Phase2R] = (byte)trackBarRed2.Value;
}
```

Software code creates the “Graphical User Interface” (GUI) that is used to set the colors for the LEDs.



This is the GUI (“gooey!”) that the code created.