VERY RARE COLOR PHOTO OF ABRAHAM LINCOLN
Color models
There are two models of color.

One is **additive**. This is the way that monitors, stage lights, projectors, and light emitting objects work. All the colors add up to white.

The other is **subtractive**. This is the way that printing inks and paint work. They absorb specific wavelengths of light. When all colors are added, they produce black (ideally).
Subtractive color (CMYK)

Additive Color (RGB)
What influences color in an image?
Many things

The color of the original material
The color and lighting of the surroundings
The level of lighting
The atmosphere (fog, absorption)
Additive or subtractive media (print, monitor)
The accuracy of the inks or monitor setup
The observer’s vision
Color gamut
The range of colors that can be shown by a medium

It’s assumed that the widest range of colors is that which can be perceived by human vision.

Printing ink (CMYK) is smallest, but can be extended with careful choice of spot colors.

Standard RGB (sRGB) is better, but is digital. The widest range of colors can be shown by traditional chemical film as projection.
Color Gamuts
For the Graphic Designer
Attainable colors by medium

- Film
- sRGB
- CMYK
- Human Vision
Radiosity
This is the quality of objects that are subtractive as well as additive.

For example, a wall painted red will absorb all wavelengths of light except red. That reflected red light will then tint any object near it with a red hue in addition to its natural color and the lighting in the space.
Red Apple

Light Rays

Light Rays Absorbed

Red Light Reflected

Eye
<table>
<thead>
<tr>
<th>bit</th>
<th>tones per channel per pixel</th>
<th>total possible tones</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 bit</td>
<td>256</td>
<td>16.78 million</td>
</tr>
<tr>
<td>10 bit</td>
<td>1,024</td>
<td>1.07 billion</td>
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<tr>
<td>12 bit</td>
<td>4,095</td>
<td>68.68 billion</td>
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<tr>
<td>14 bit</td>
<td>16,383</td>
<td>4.39 trillion</td>
</tr>
<tr>
<td>16 bit</td>
<td>65,532</td>
<td>281 trillion</td>
</tr>
</tbody>
</table>
Color Depth:

- Color depth refers to the number of distinct colors an image can contain.
  - 1-bit (black and white)
  - 8-bit (indexed color) – 256 colors
  - 24-bit (full-color) – 16.7 million colors
Gamma

People’s perception of brightness is more sensitive to lower levels of illumination.

Since monitors have the same linear response to differing levels of illumination, they give too much bandwidth to light levels that humans cannot easily differentiate. Gamma adjustment adjusts the brightness response of an additive device to (more or less) match human perception.
Gamma characteristics of monitors

Color information adjusted to match gamma characteristics

Color handling approaching the “y = x” idealcs