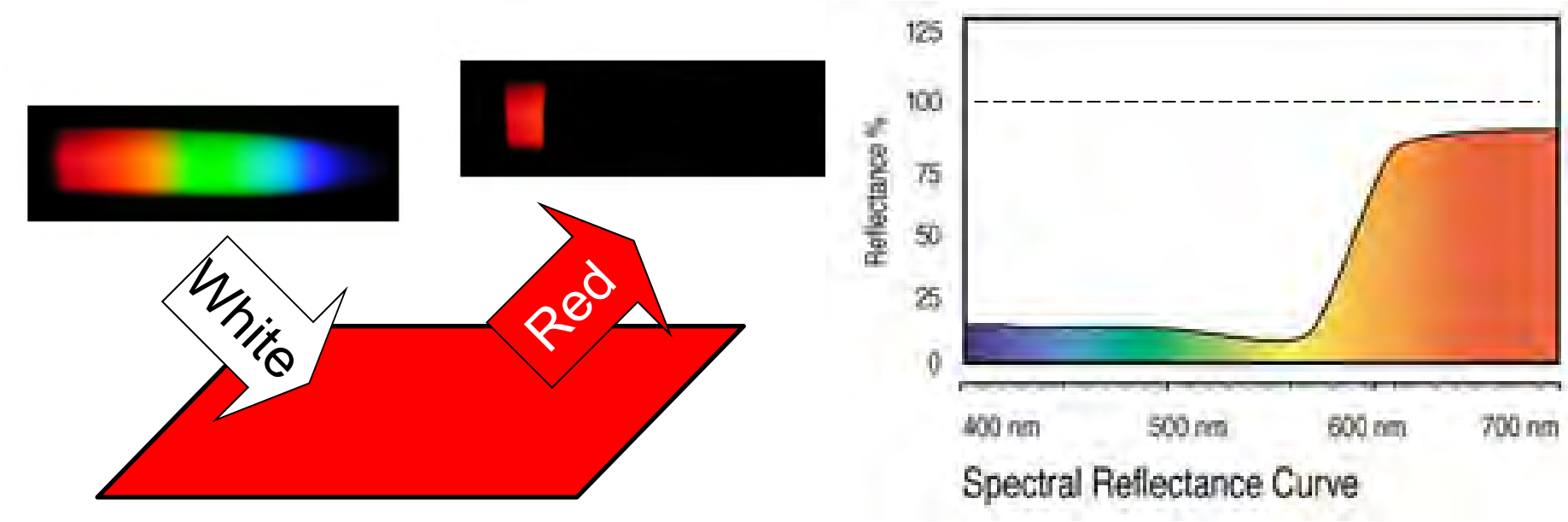
Subtractive Color

Spectral Reflectance Curves

When light shines on a colored object, some photons are reflected, others are absorbed by the surface.



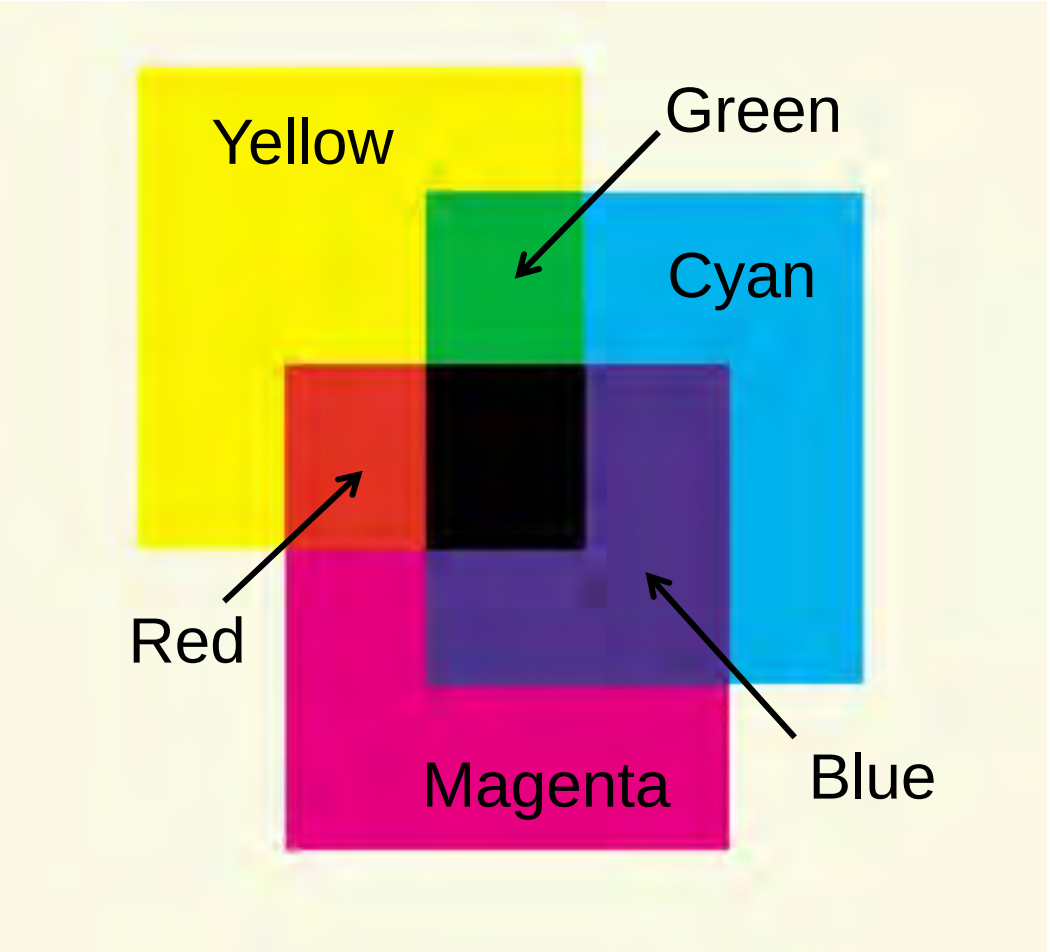
Reflection coefficient varies with wavelength.

CYMK Printing

CYMK printing uses three bright pigments:

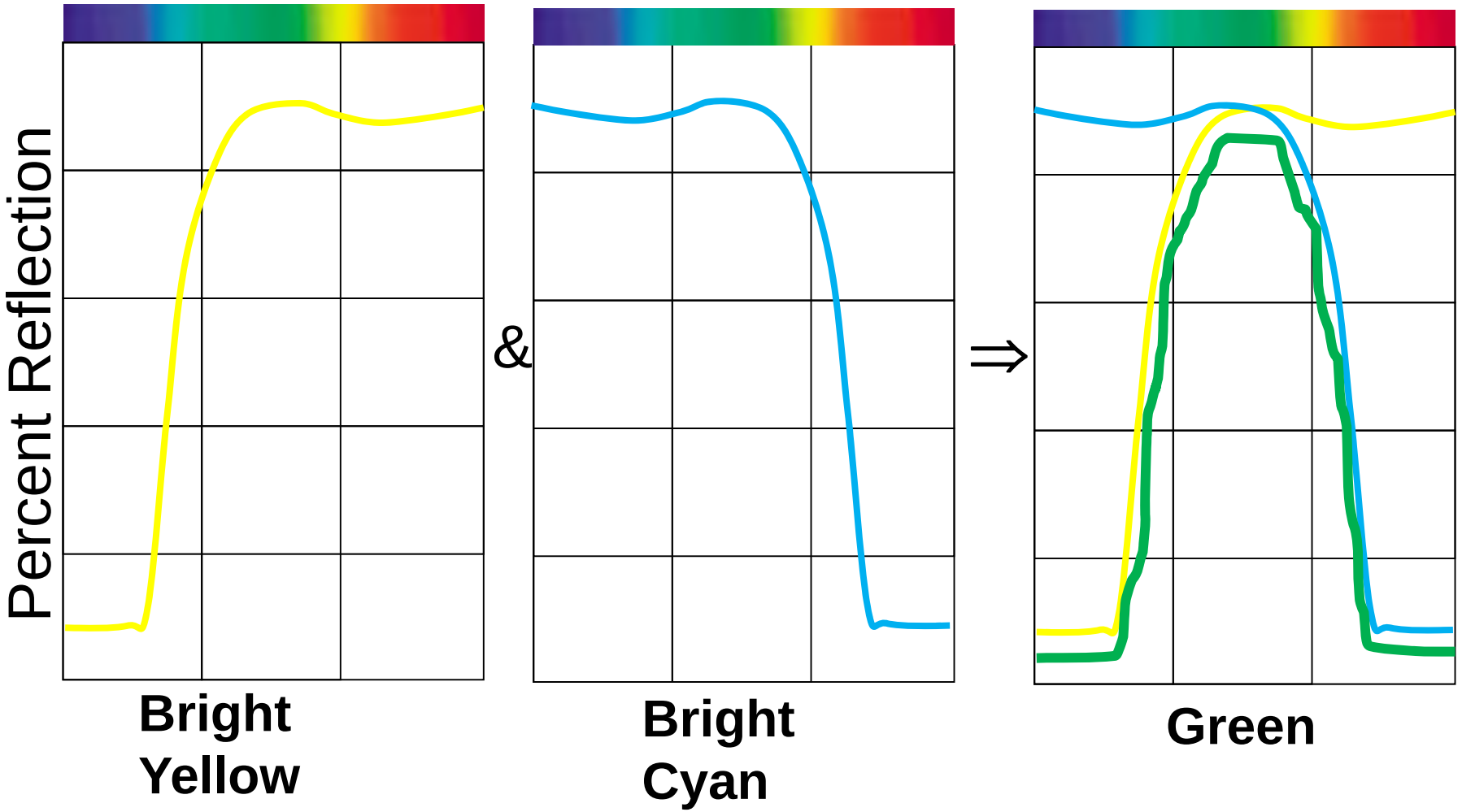
- Cyan (C)
- Yellow (Y)
- Magenta (M)

And use black (K) ink, which is cheaper than mixing for black.



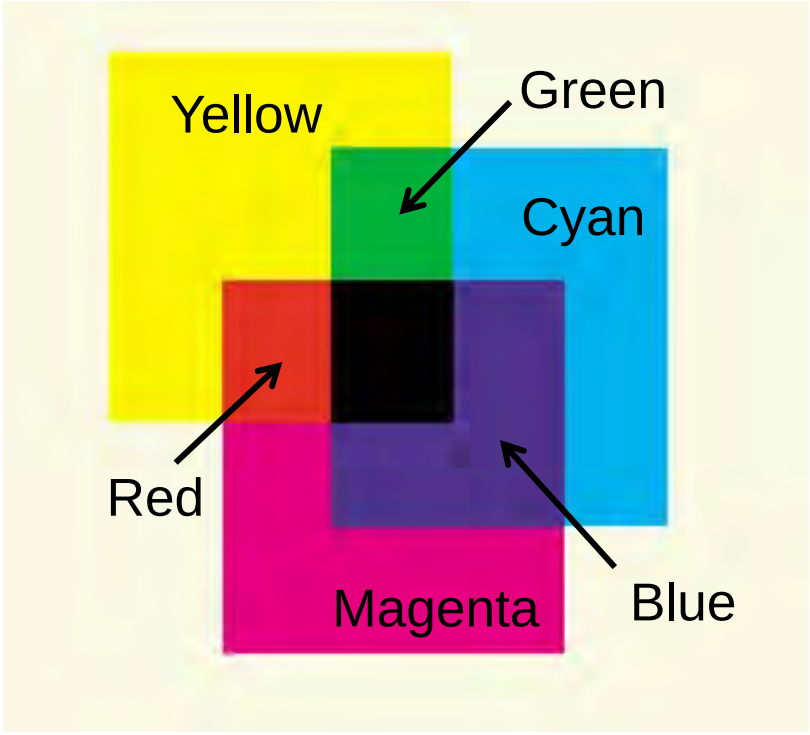
Mixing Yellow & Cyan Inks

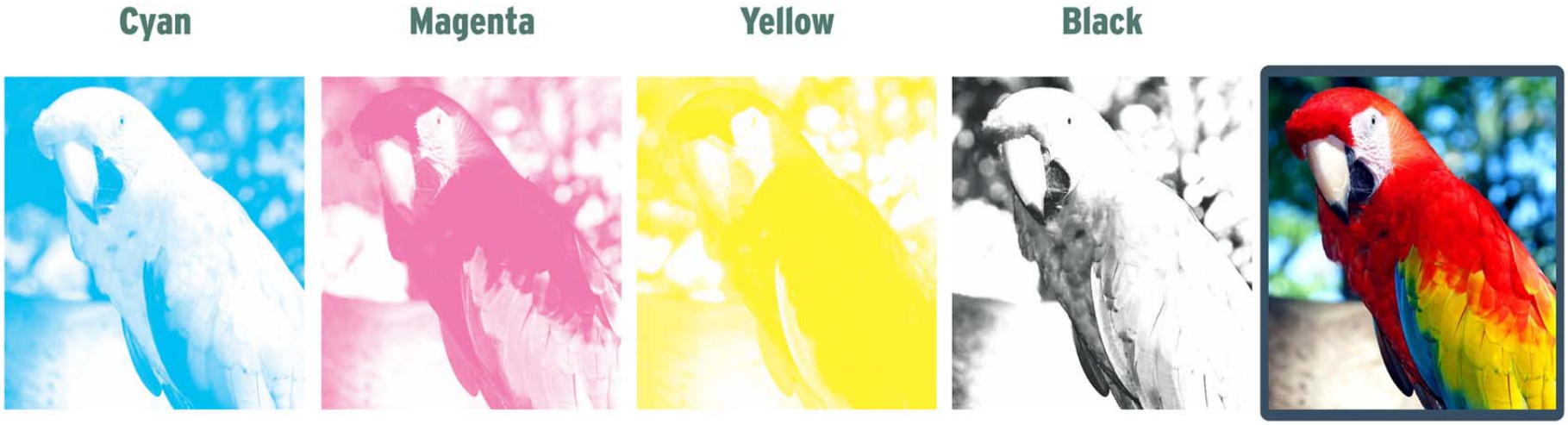
Spectral reflectance curves for simple inks



Four Color Printing

The bird's saturated red is printed with a mix of magenta and yellow ink.



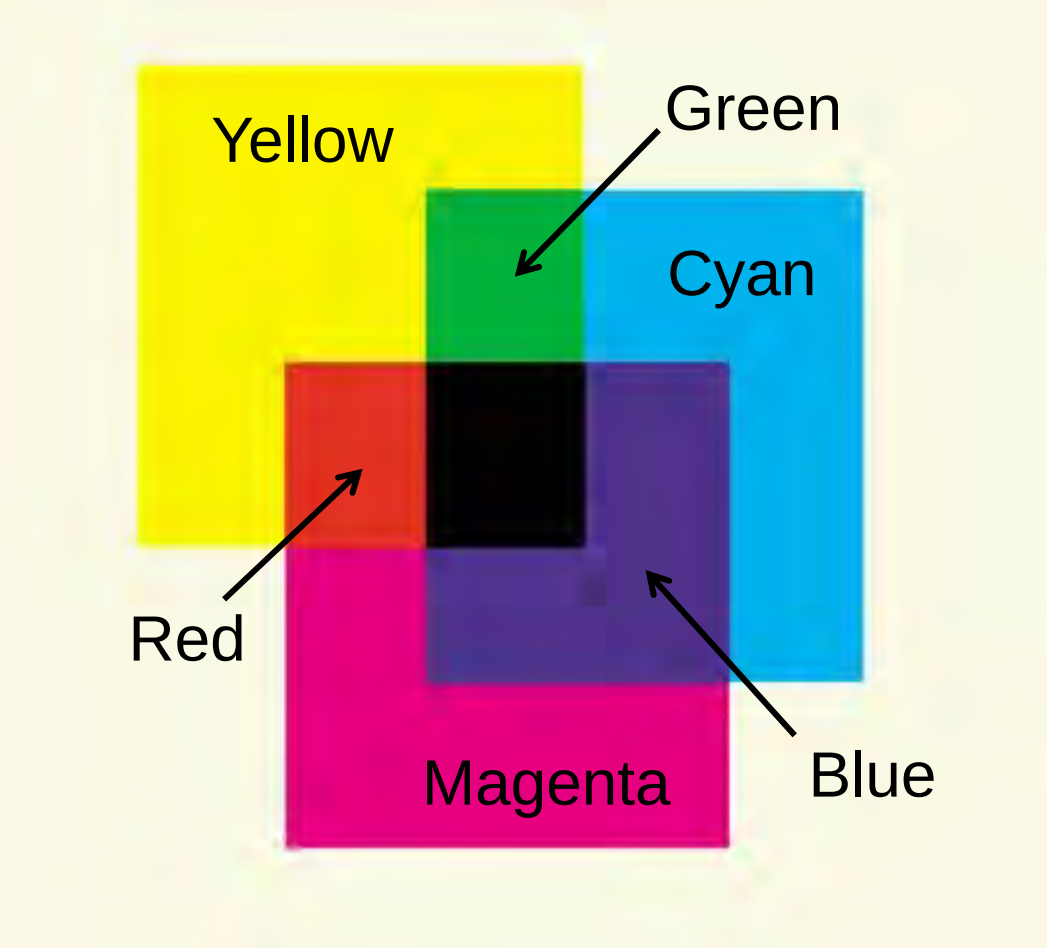


Subtractive Color

Find mixture color by simple color “arithmetic.”

Yellow = Red+Green
Cyan = Blue+Green
Magenta = Blue+Red

So mixing:
Yellow & Cyan = Green



Paint Pigments

Paints are suspensions of pigment.

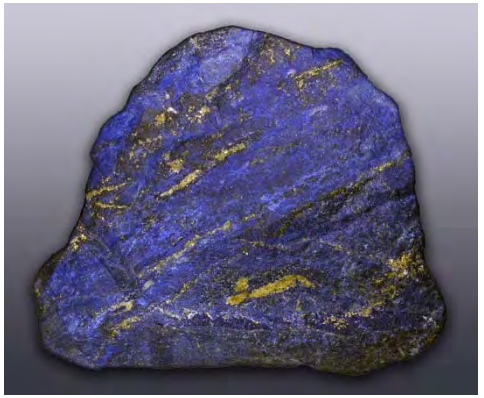
Different types of paint (watercolor, acrylic, oil, gouache, etc.) are just different binding solutions for holding pigment.

Vermeer's *Girl with a Pearl Earring*

Natural ultramarine pigment in powdered form

Synthetic ultramarine in watercolor binding

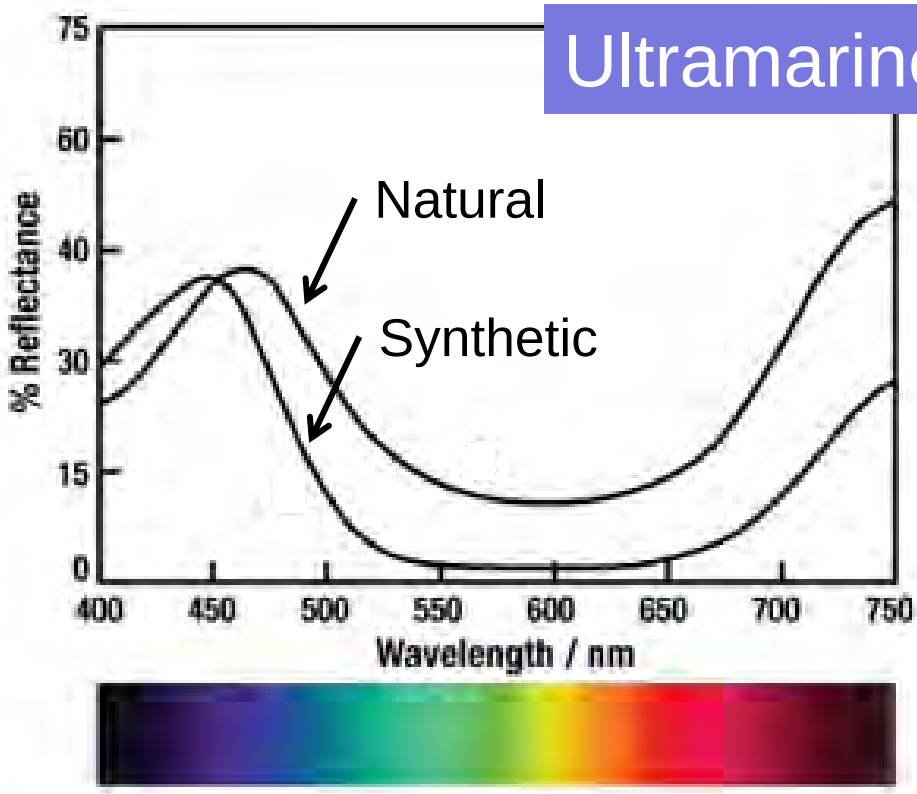
Spectral Reflectance



Lapis lazuli

Pigments used in paints typically have complex spectra reflectance curves.

The colors are more interesting than simple ink colors but also more difficult to mix successfully.



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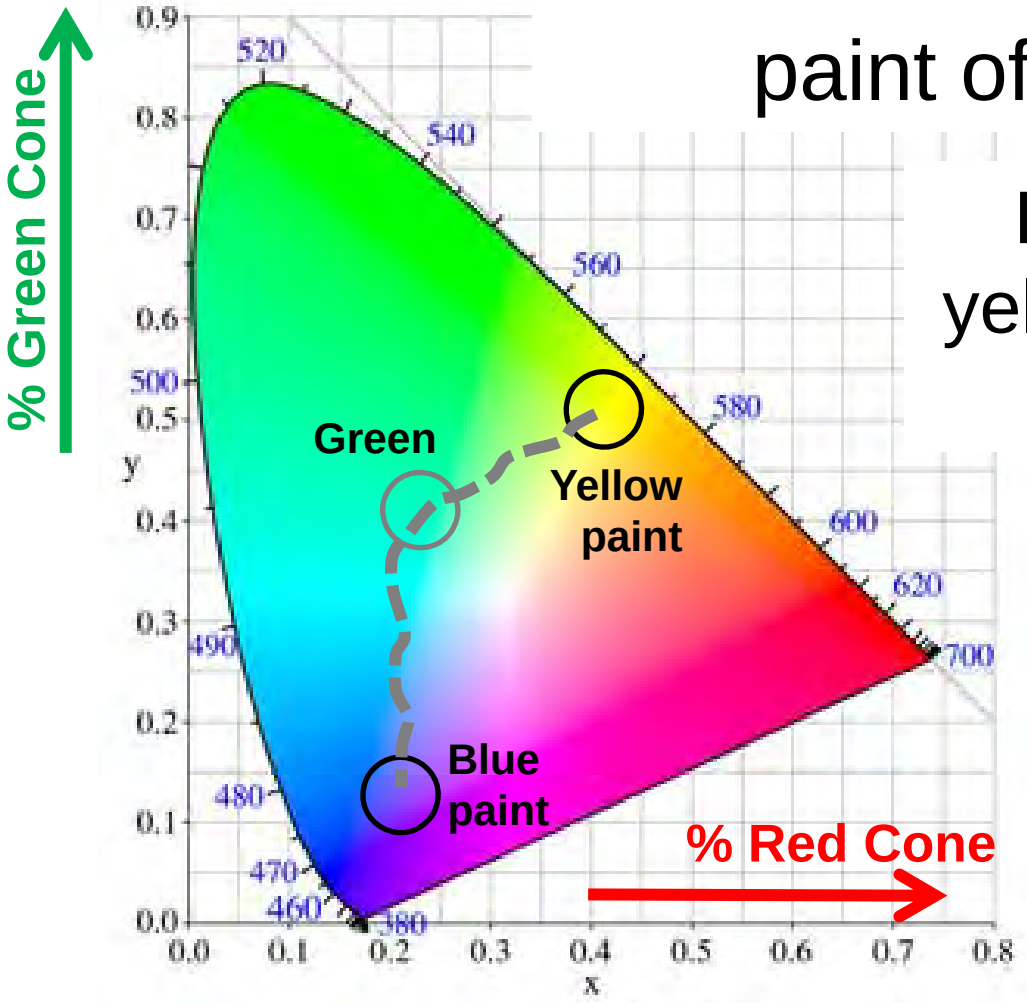
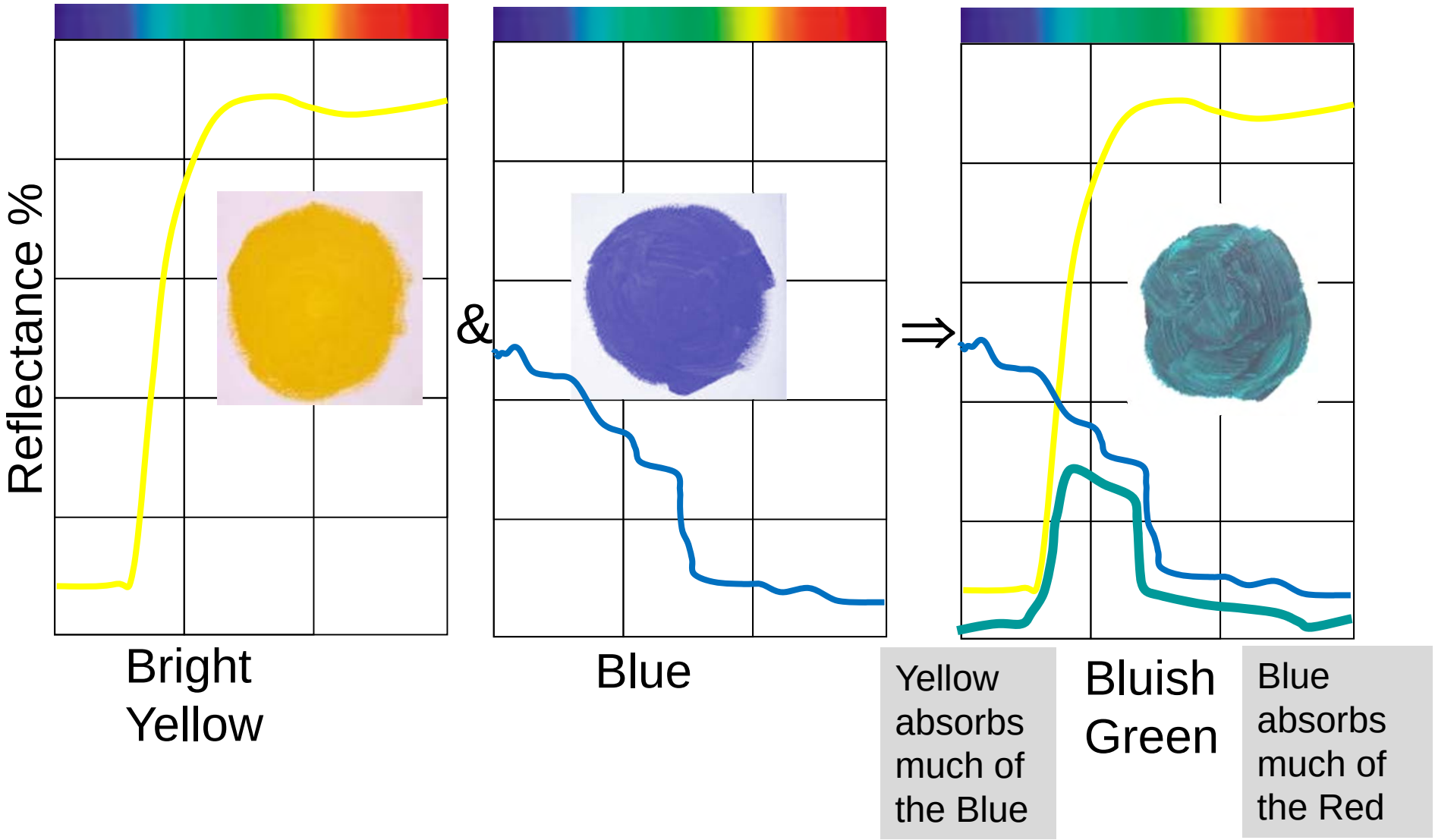
Mixing Yellow & Blue Paint



Mixtures of yellow and blue paint often mix to green

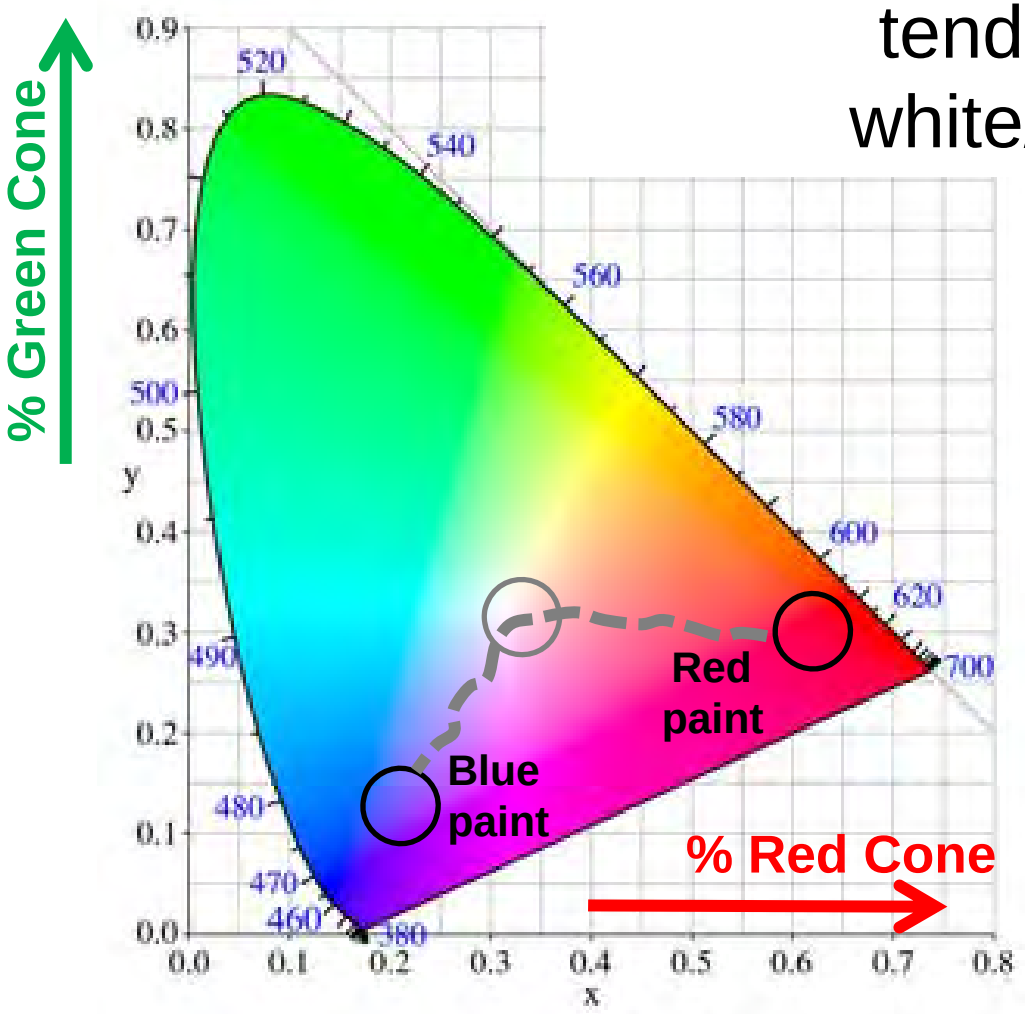
By contrast, adding yellow and blue lights gives white light

Mixing Yellow & Blue



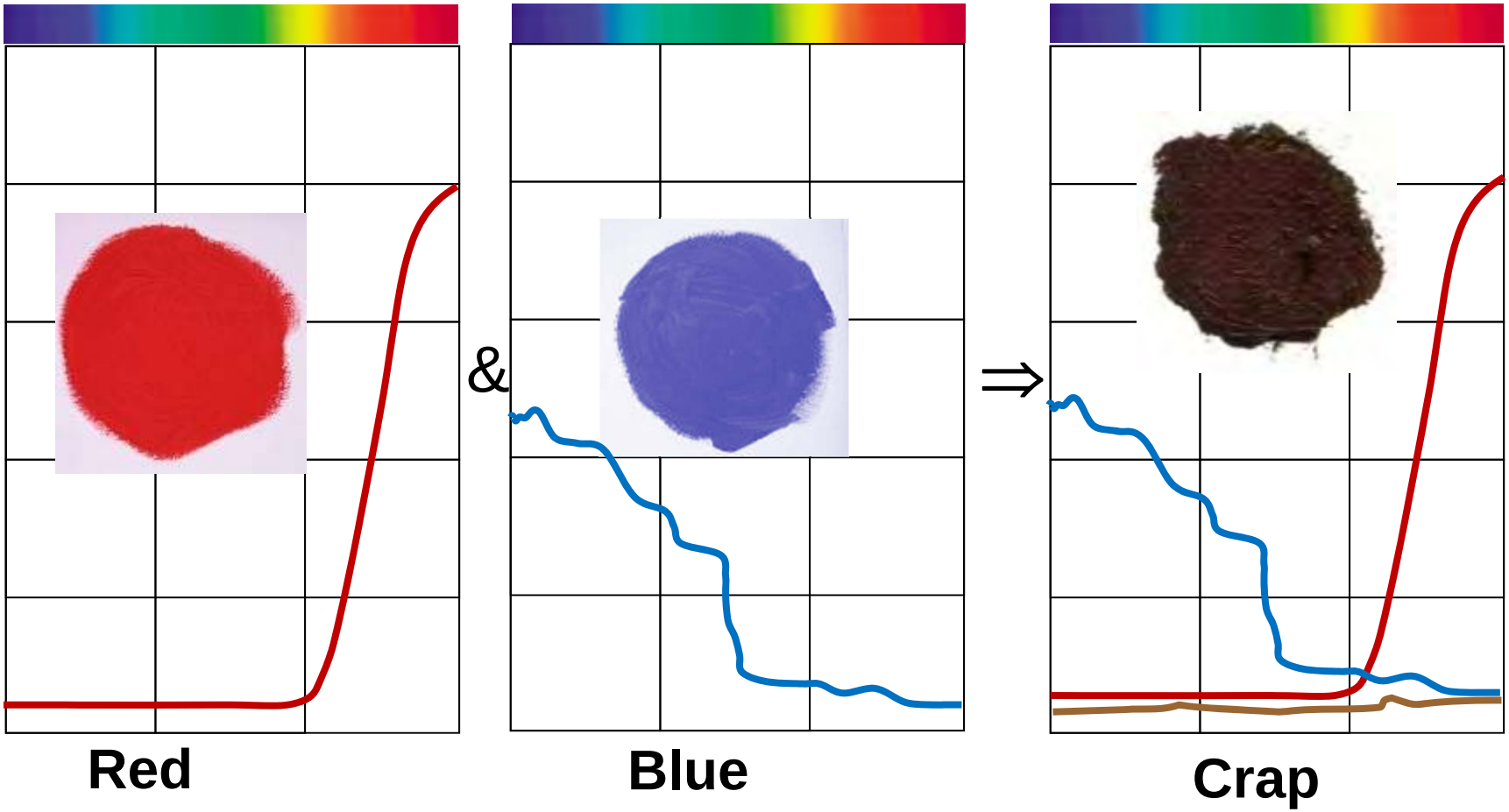
Mixing Blue & Red Paint

Mixtures of red and blue paint tend to fall towards the white/black center point



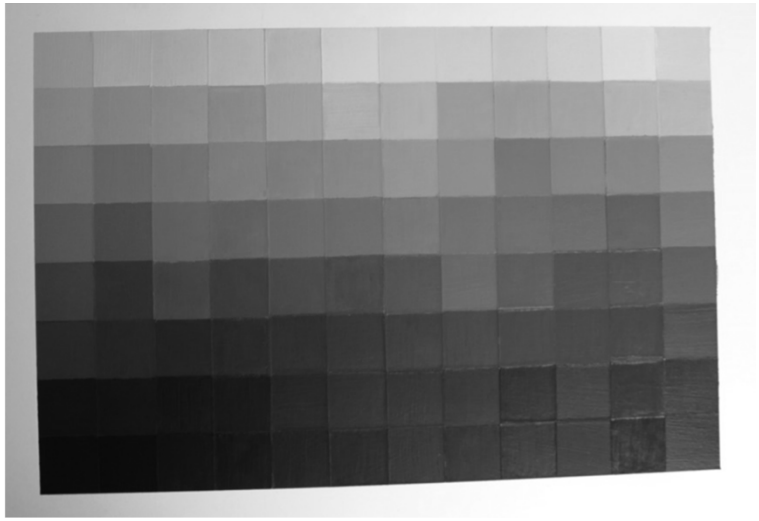
By contrast, adding yellow and blue lights gives magenta light

Mixing Red & Blue



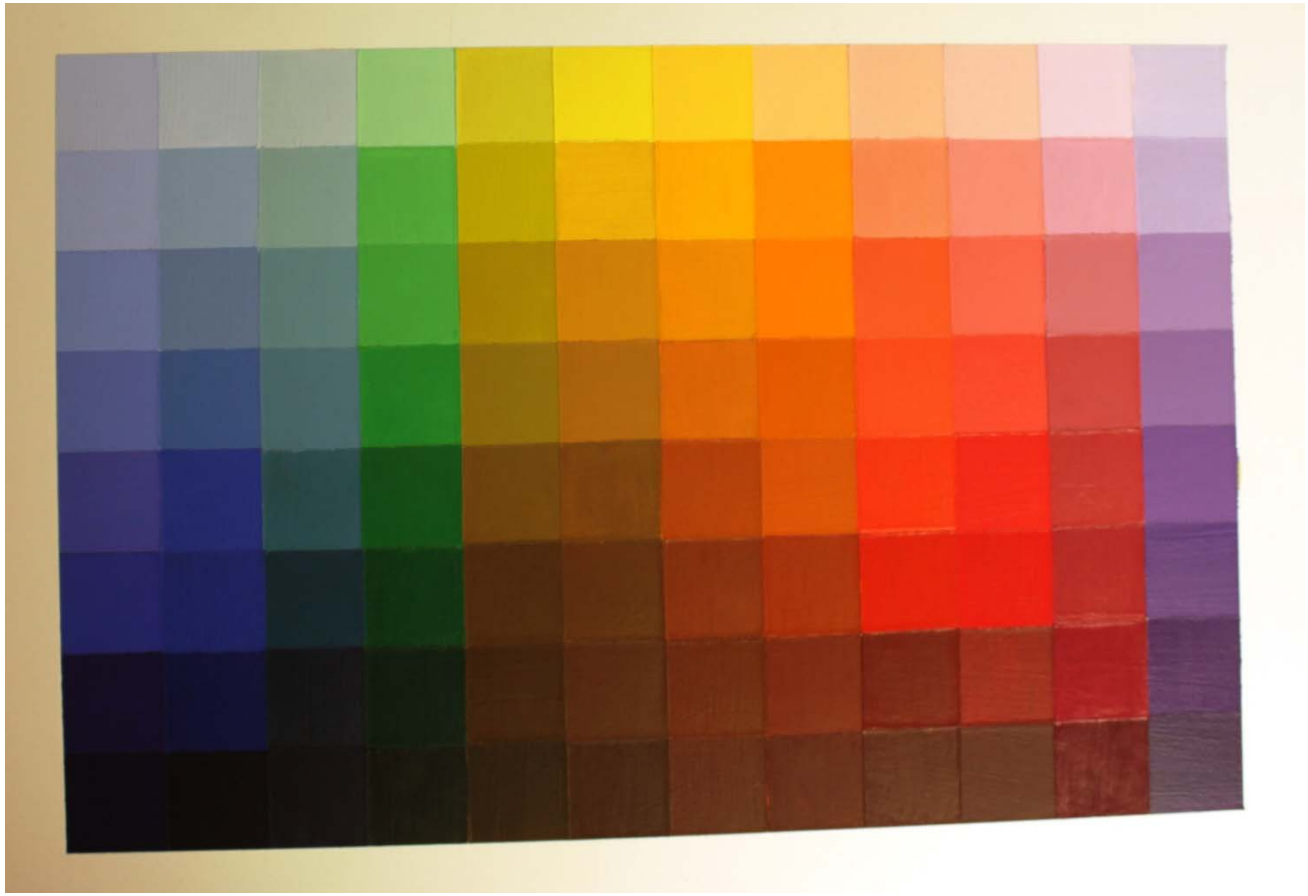
Reflectance curves for pigments and their mixture

Paint Color Grid

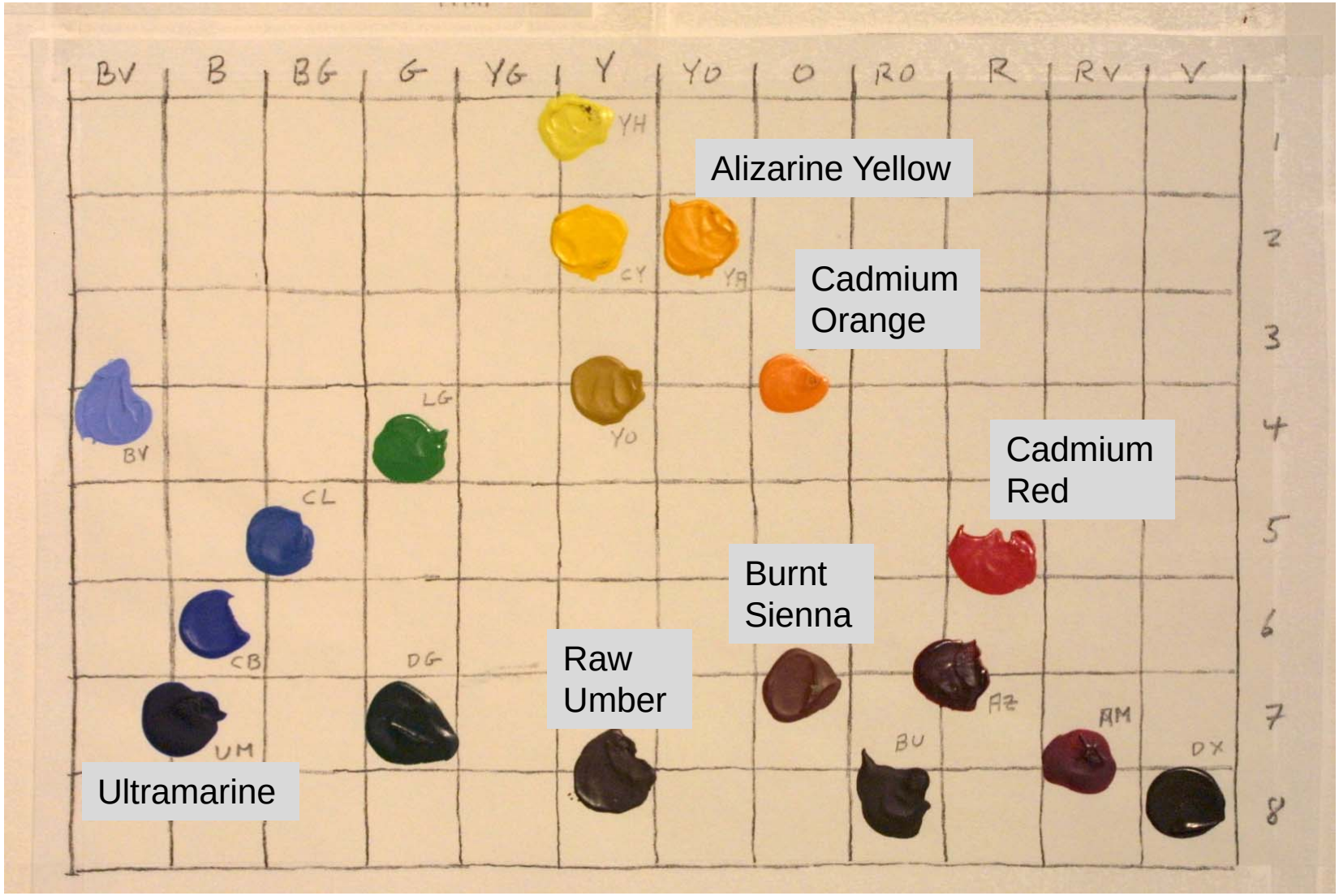


Painting a color grid is an exercise for learning to mix pigments.

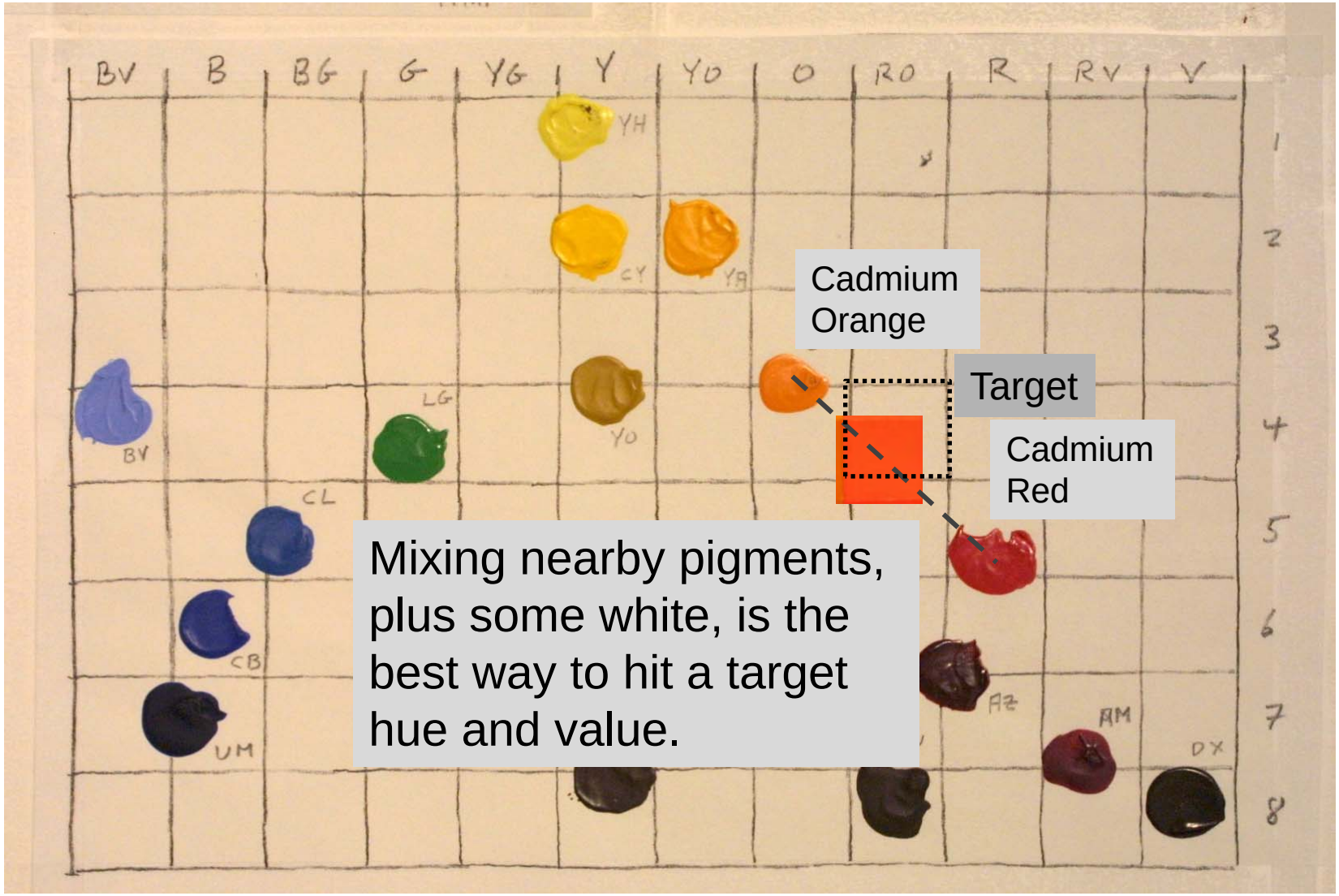
Attempt to paint the squares with the same hue in each column and the same value in each grid row.



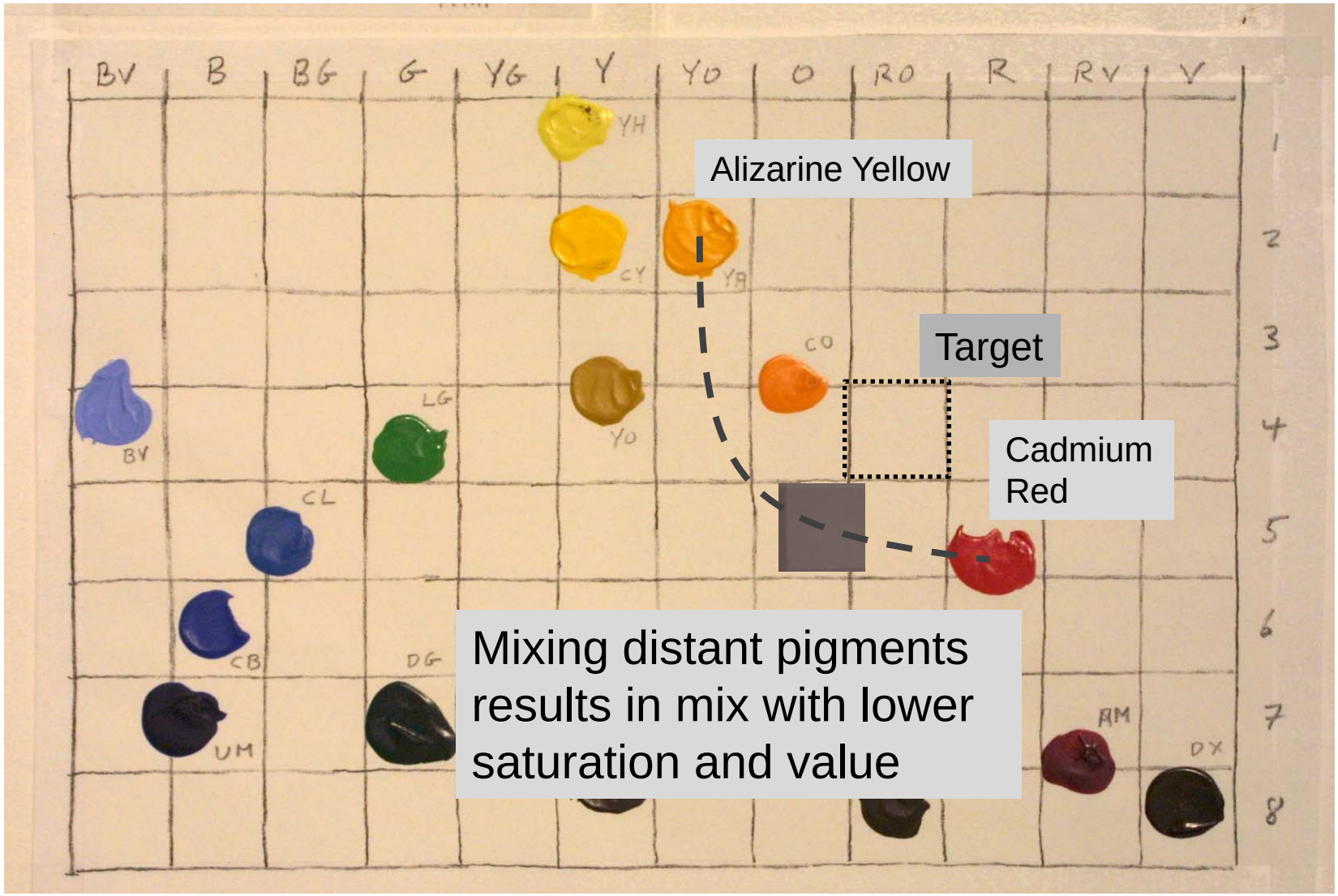
Pigments on the Grid



Pigments on the Grid



Pigments on the Grid



Summary

- A surface's color depends on its reflection coefficient at different wavelengths (spectral reflectance curve).
- Mixing colored pigments gives very different results from mixing colored lights.
- Subtractive color rules determine the result of mixing ink or paint pigments, with the details depending on the spectral reflectance curves.
- In mixing paint pigments, nearby colors results in the highest saturation and value.