

Saturation & Value

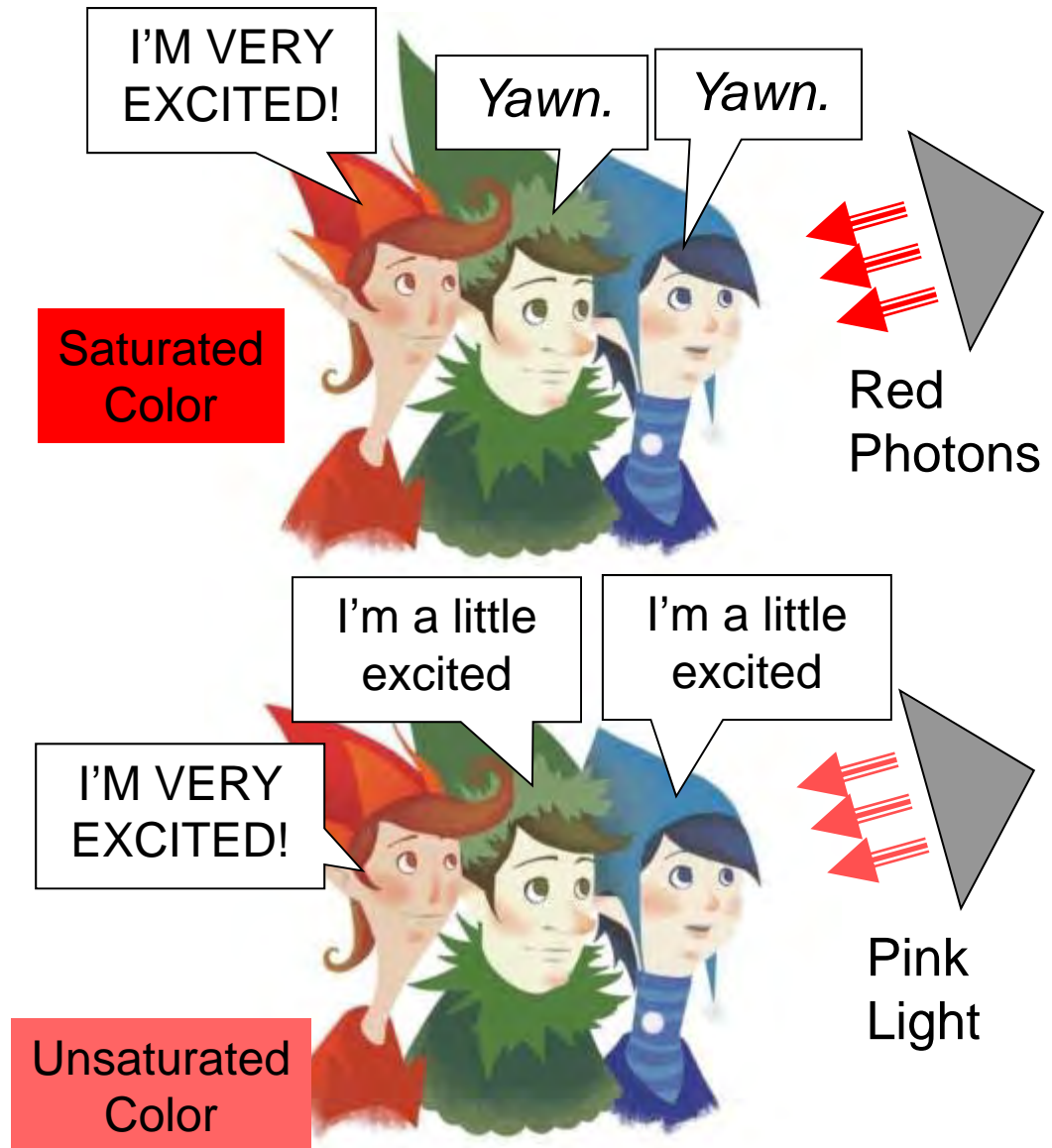


National Science Foundation
WHERE DISCOVERIES BEGIN

Saturation

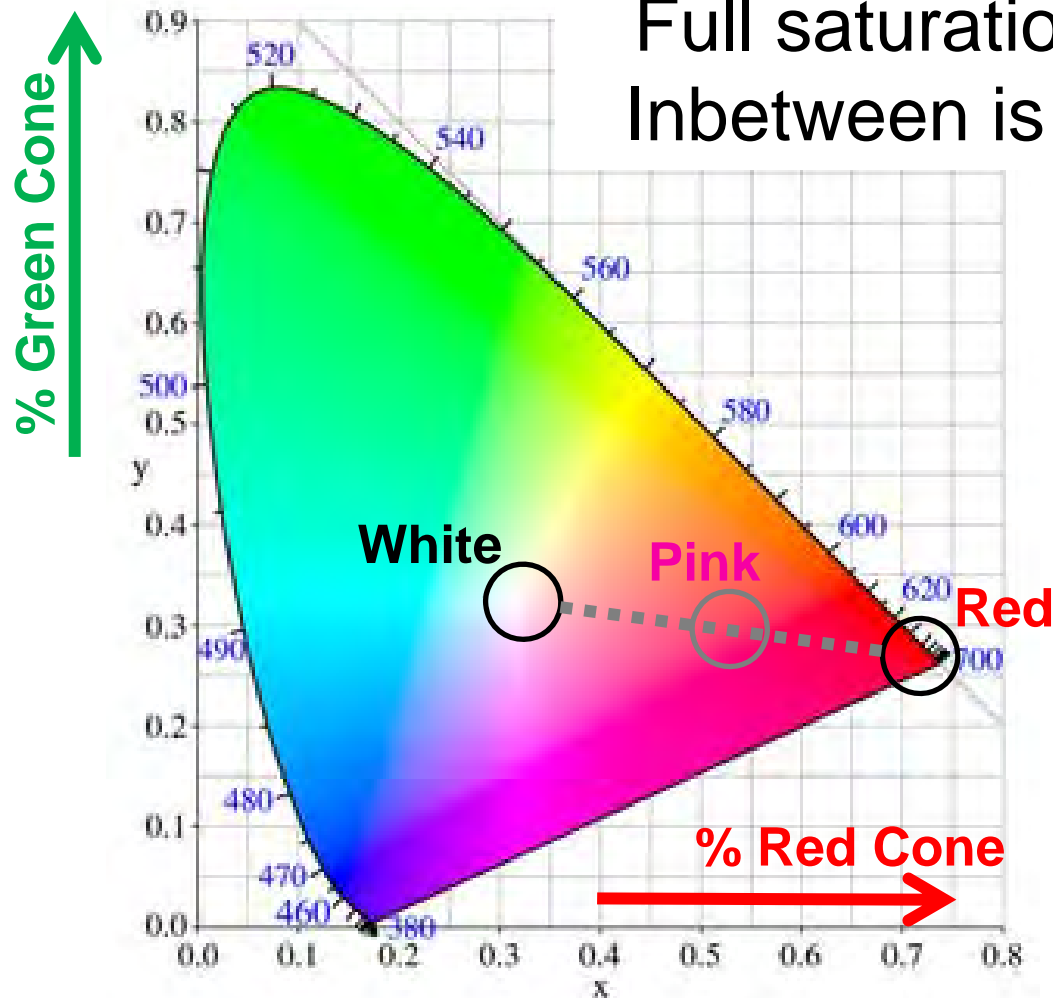
When white light is mixed in with a pure color the eye sees the sum as being less saturated.

Saturation is also called chroma.

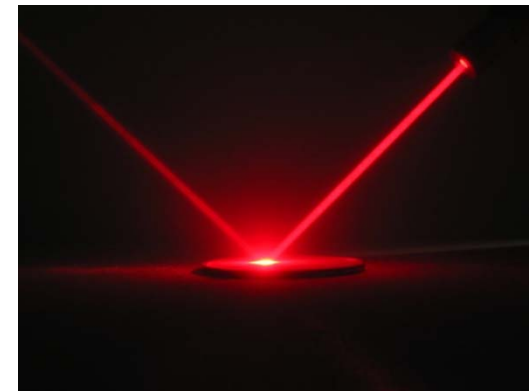


Saturation

Zero saturation is white center.
Full saturation is the outer rim.
Inbetween is partial saturation.

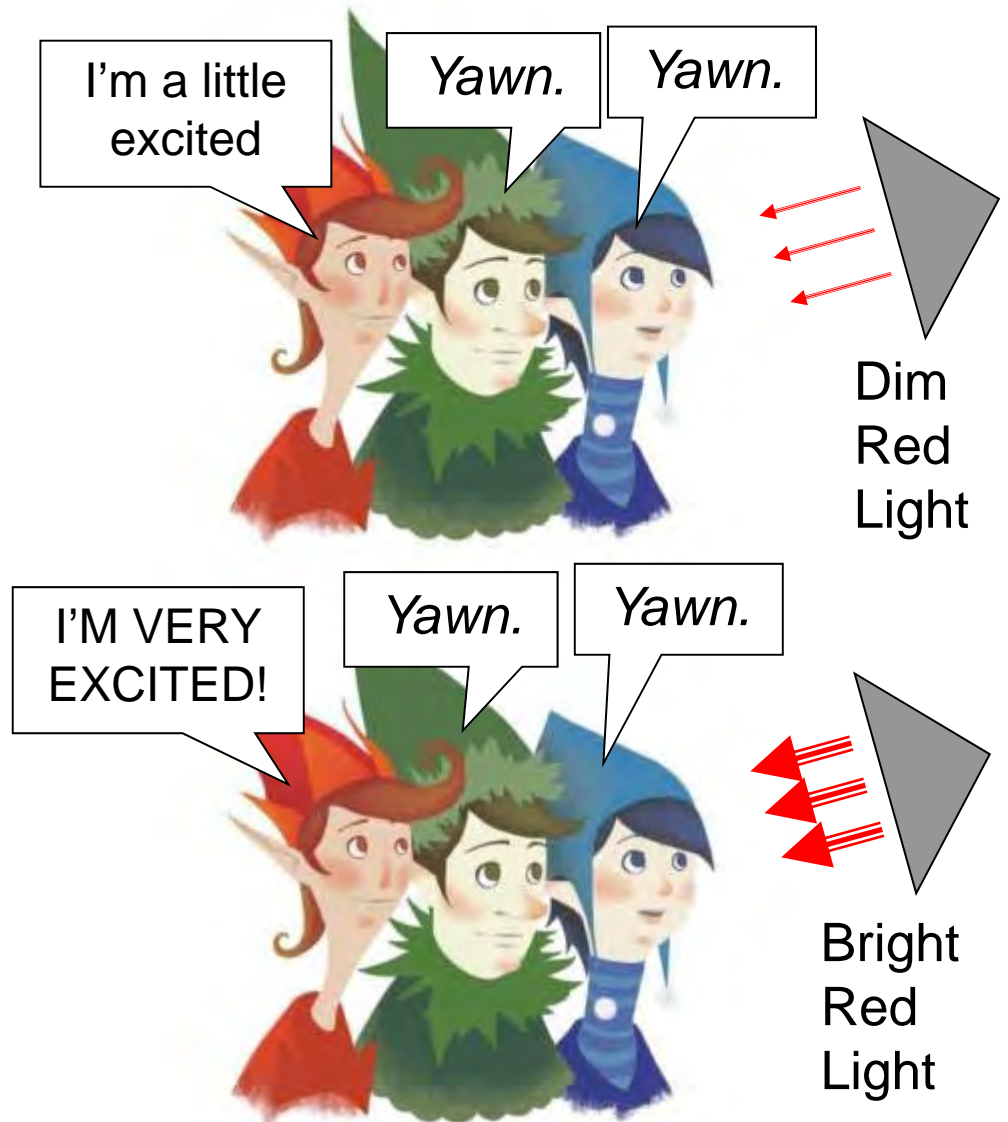


Laser light is full saturation (single wavelength)



Value (Brightness)

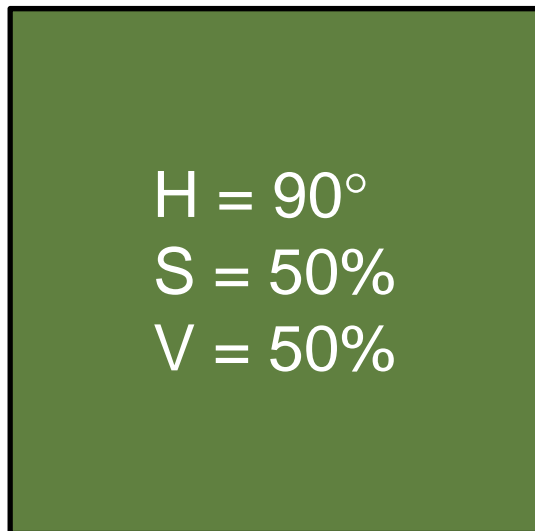
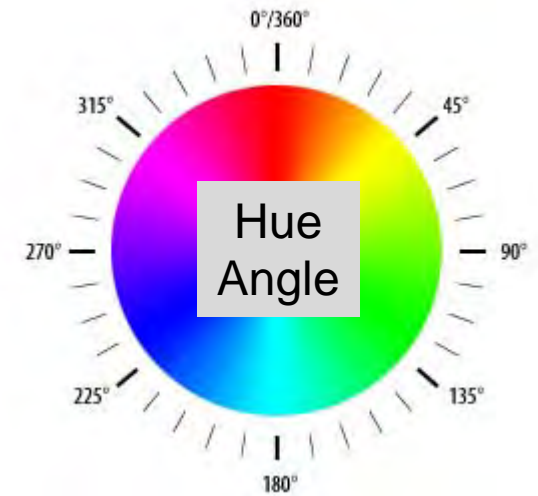
The level of excitement indicates the **value** of a color, which is sometimes called the brightness.



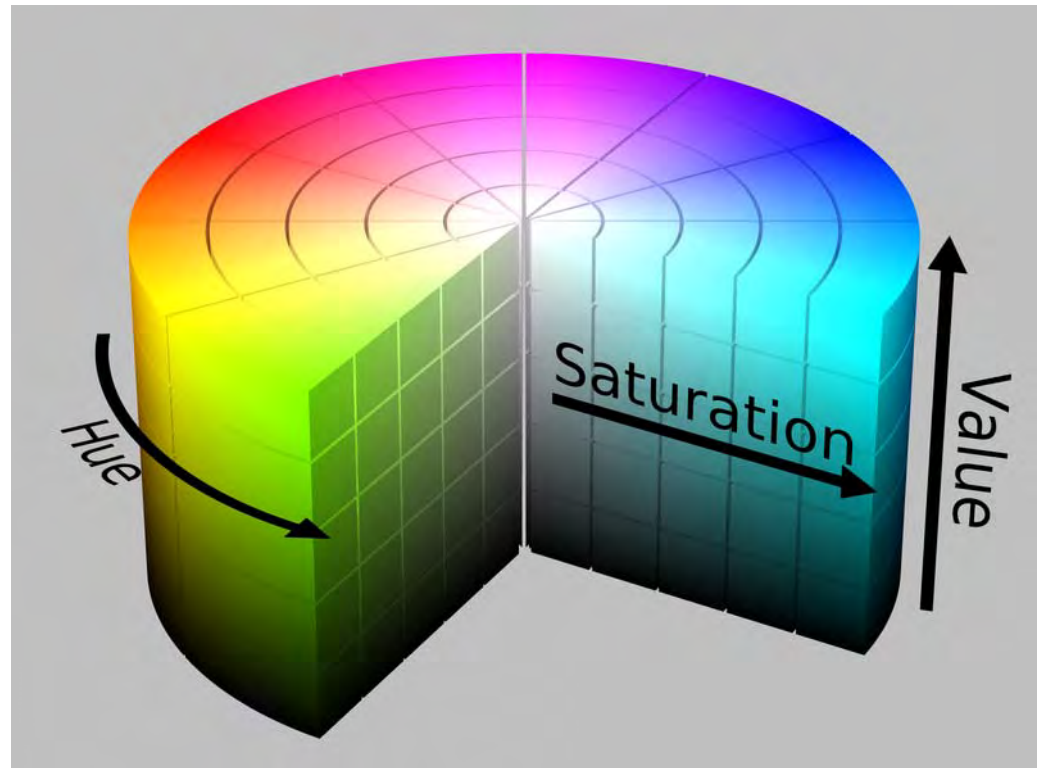
HSV Color Space

One way to map color is by:

- Hue (0° to 360°)
- Saturation (0 to 100%)
- Value (0 to 100%)

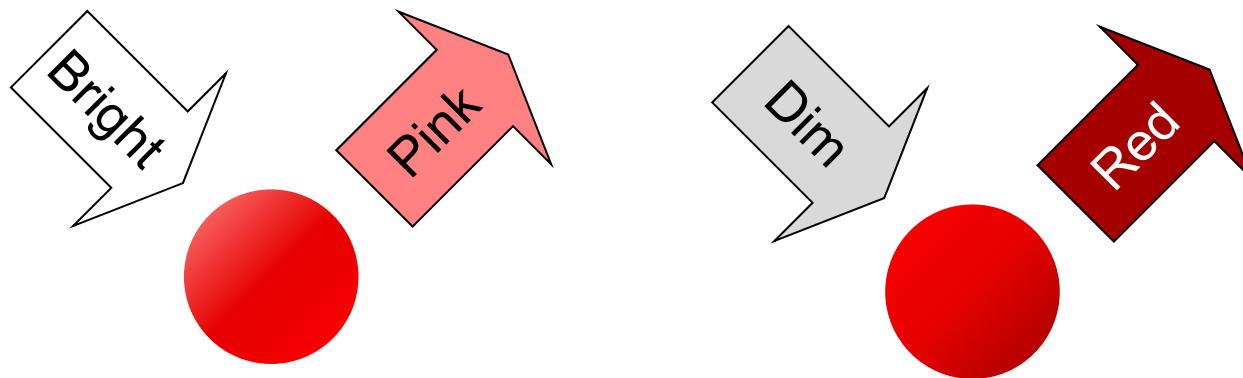


Cannot do color addition



Light Source, Value, Saturation

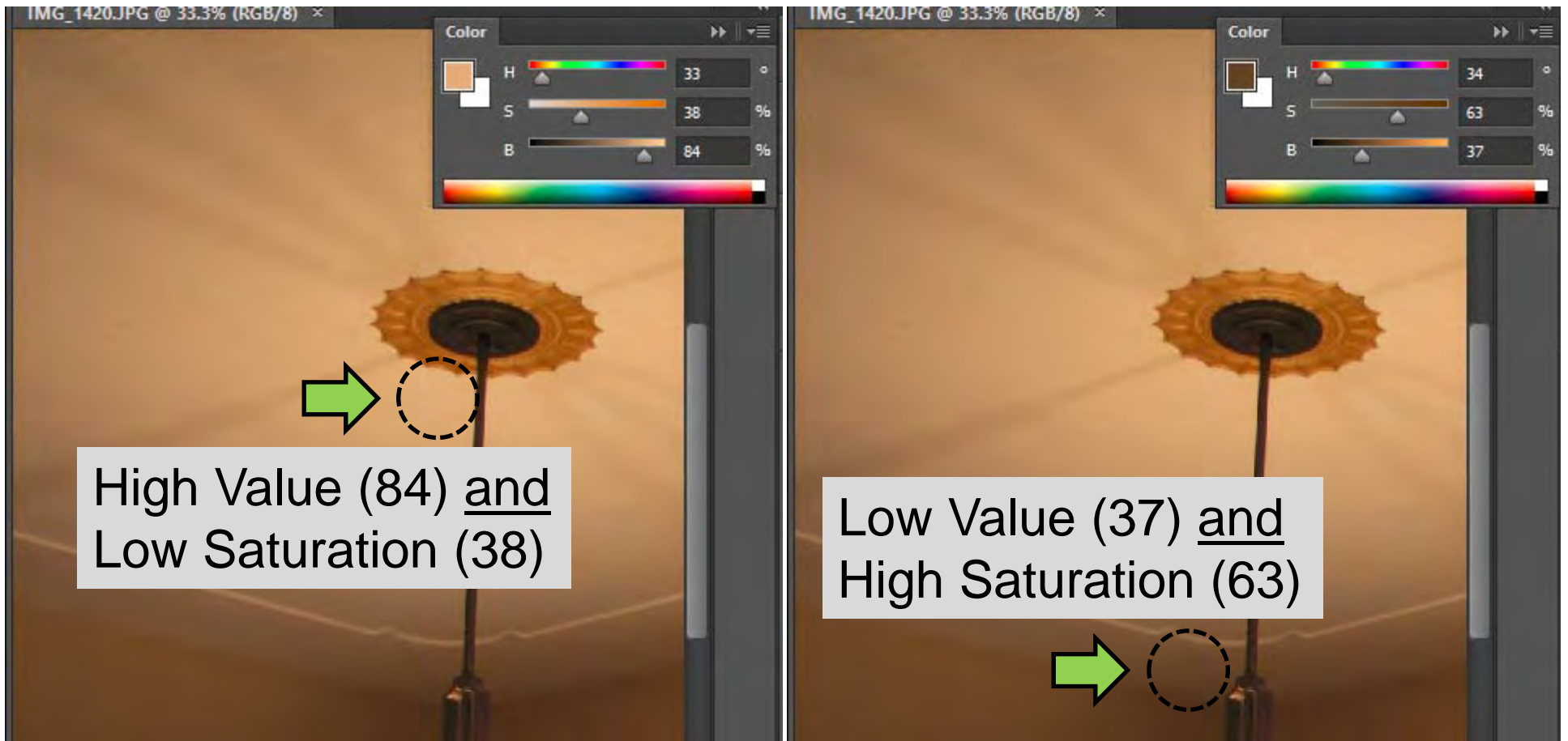
The value and saturation of an object's color also depend on the light source shining on the object.



Same “red” object in different lights

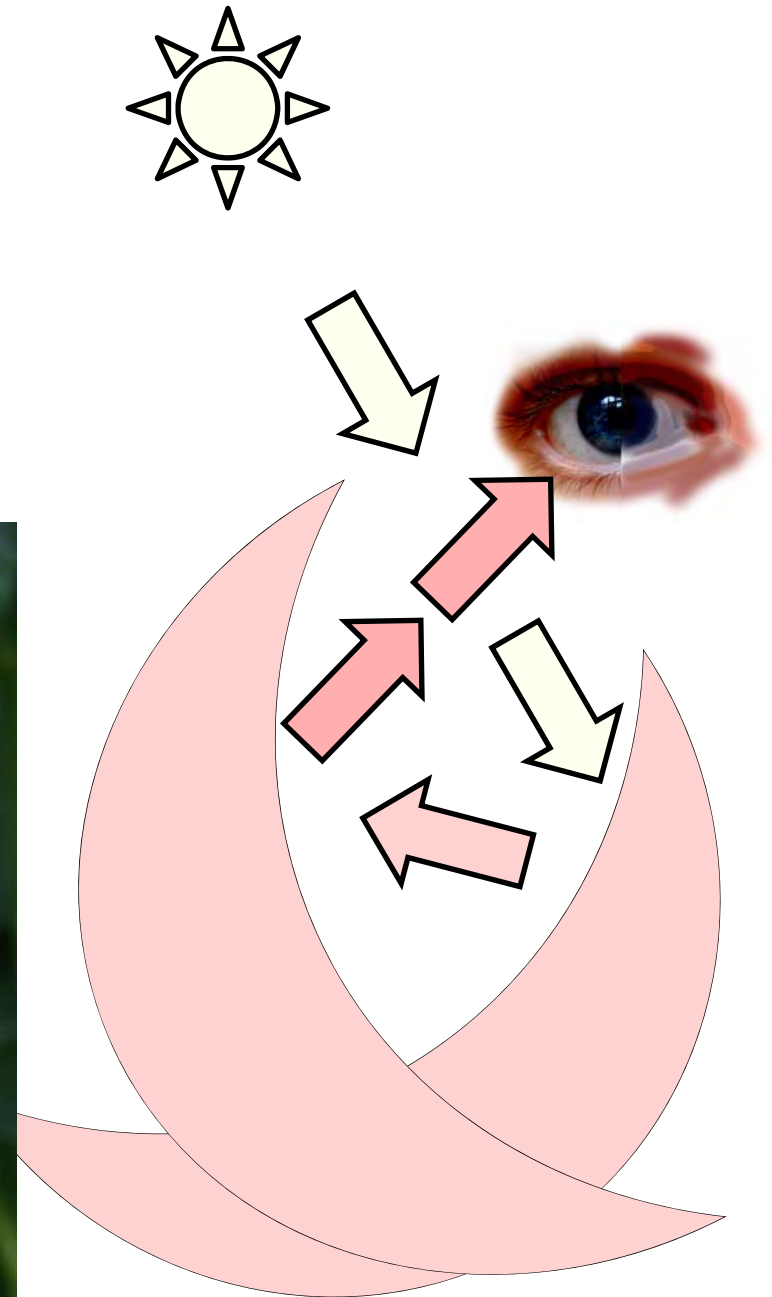
Saturation & Value

As lighting conditions change, value and saturation usually vary together.



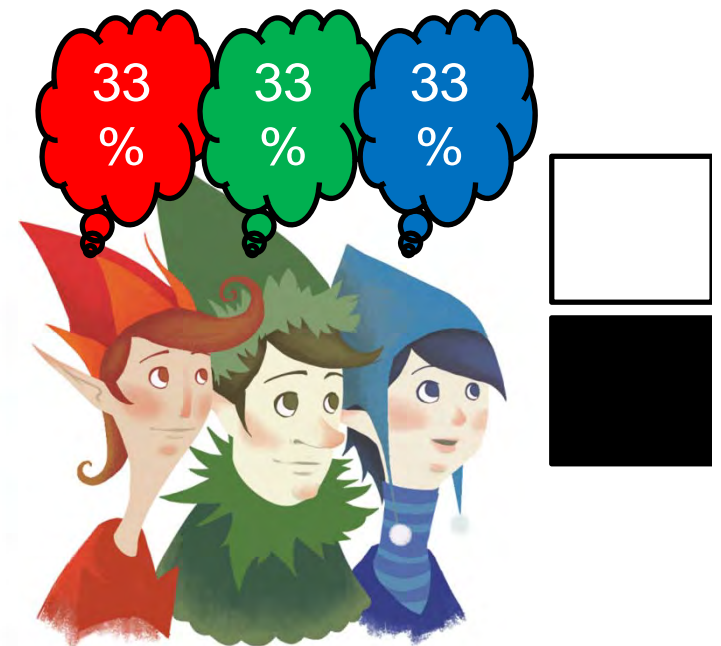
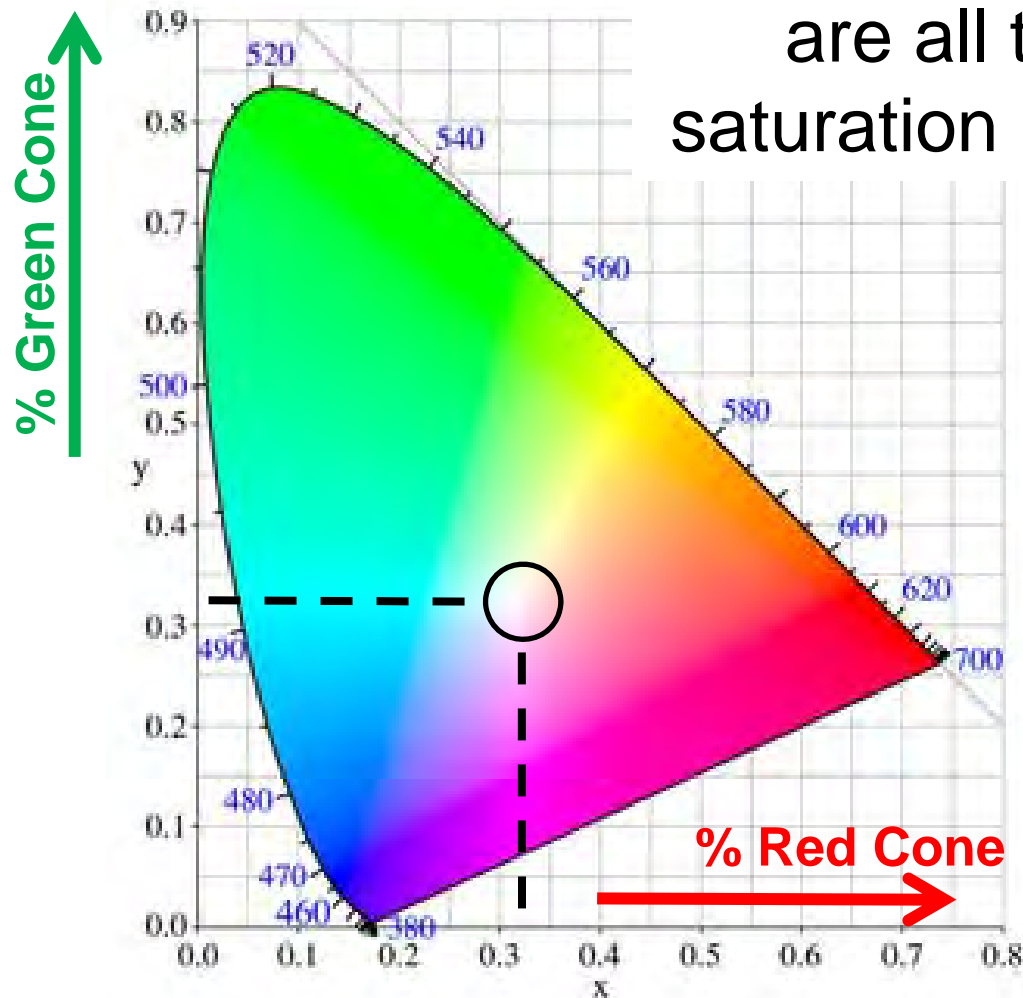
Saturation & Reflected Light

Saturation is also affected by reflected light, as in these folds.



Black, White, and Gray

Black, white, and gray are all the same hue and saturation but differ in value.



Black or White?

Photographed black felt and white flannel tablecloths



Black or White?



Black Table Cloth

Black or White?



White Table Cloth

Black or White?



White Table Cloth

Black Paint

Black paint actually reflects more light (has higher value) than you may imagine.

Compare the value of the matte black paint with that of the holes.



Black Paint



True Black

The closest you can get to true black is a hole that lets light in but not back out.

Surprisingly, even the lunch box painted white inside doesn't reflect much light out the hole.



White in the shadow is darker than black in the light.

Checker Shadow Illusion

Our perception of value is strongly influenced by local contrast, as seen in this optical illusion.

The square labeled A appears to be a darker than the one labeled B but they are actually *exactly the same*.

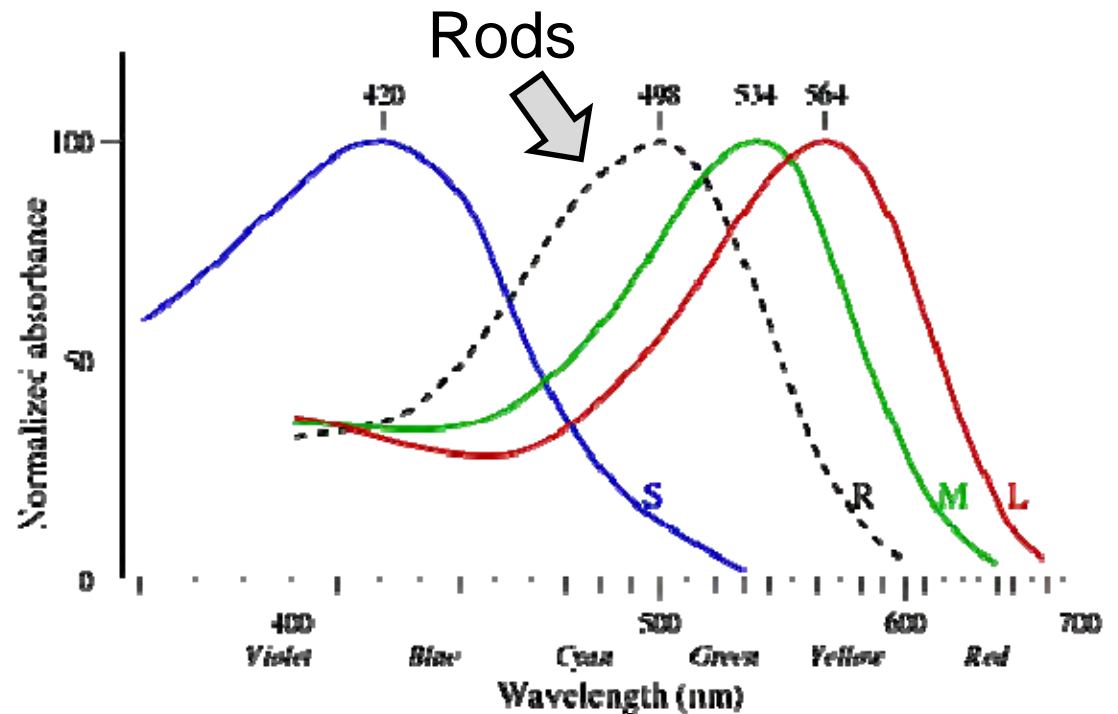
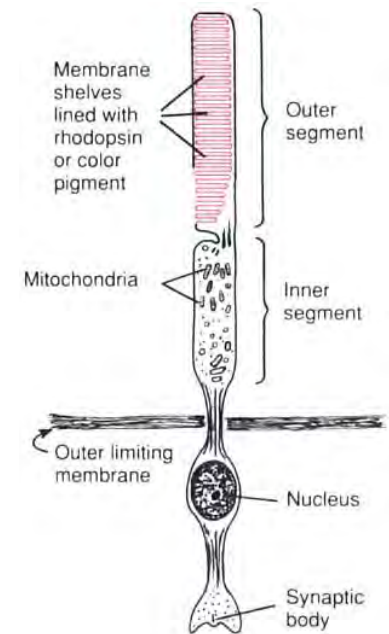


Scotopic (Night) Vision

In dim light we see with rod cells instead of cones.

Rods send no hue or saturation information to the brain, only value.

Peak sensitivity for rods is in the cyan range.



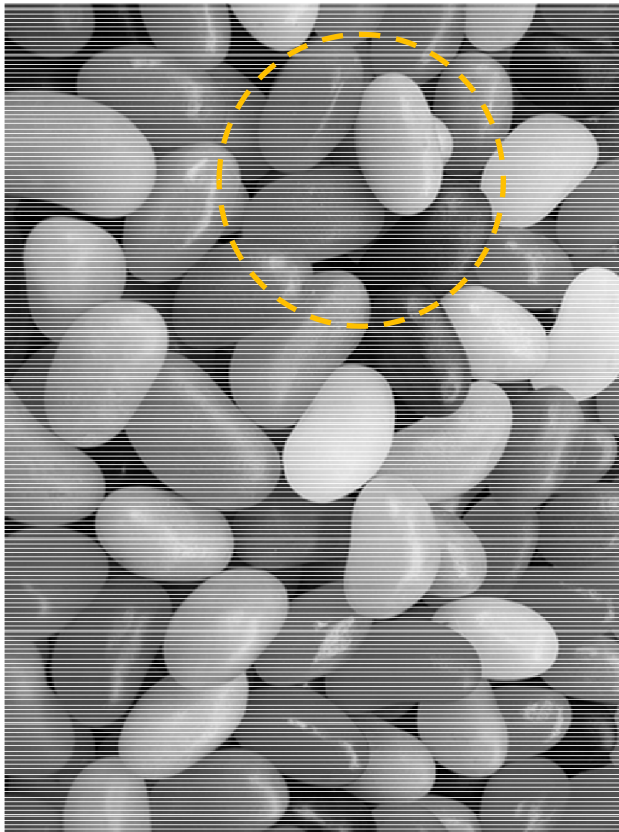
Purkinje Shift

Rods see blue as brighter
and red as darker

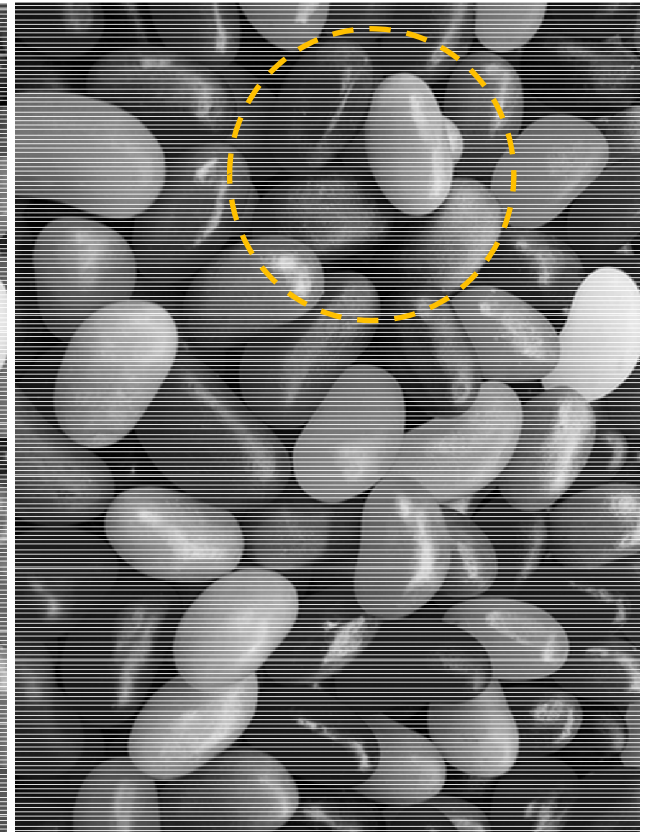
Color



Grayscale



Night vision



The Purkinje shift is approximated in the night vision image

“Day for Night” in Film

Tricks for “Day for Night” effect in cinematography:

- Use blue filter and de-saturate the image
- Underexpose the image (shorten the shutter time)
- Avoid showing the sky or replace it in post
- Minimize shadows except near light sources



Summary

- Saturation measures the amount of white light in a color's spectrum (pink is de-saturated red).
- Value indicates the total amount of light, with white as the highest value & black the lowest.
- Saturation and value vary with lighting.
- Black, white, and gray are all the same hue and saturation (zero) but have different value.
- In dim light we see with rod cells, which do not distinguish hue or saturation, only value.
- Rods have a greater sensitivity to the blue side of the spectrum than cones (Purkinje shift).