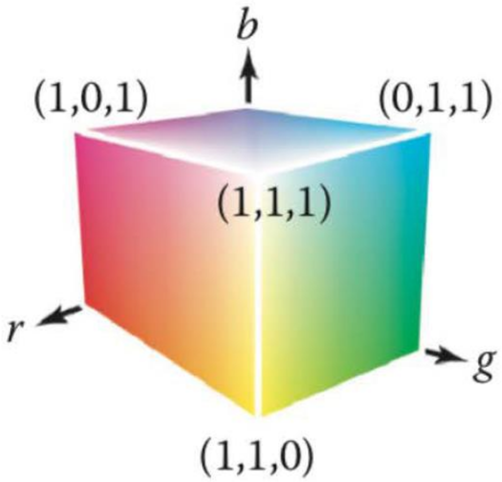
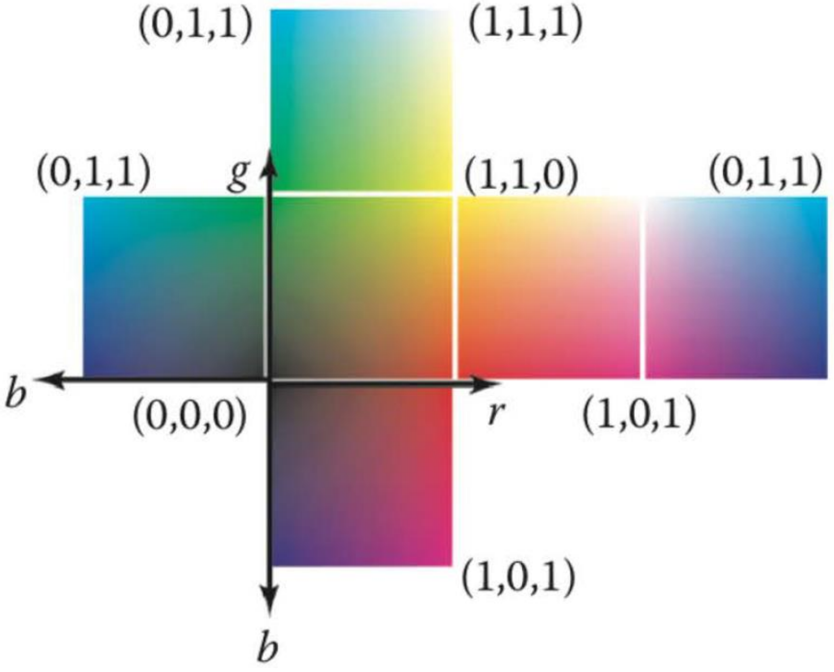
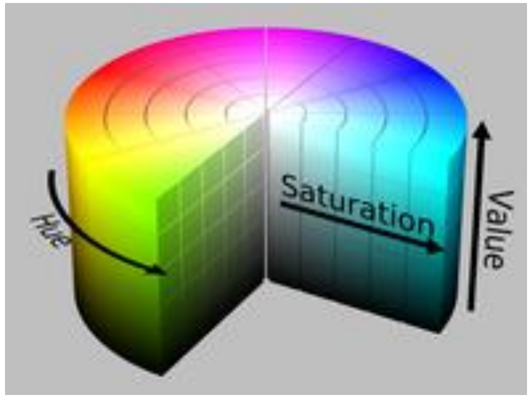
RGB Images

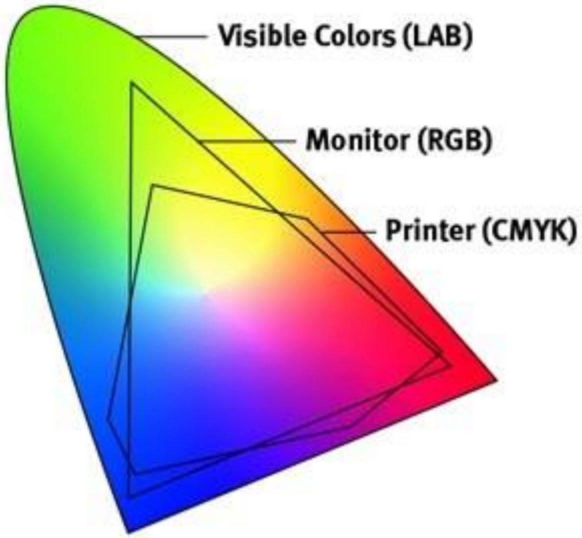




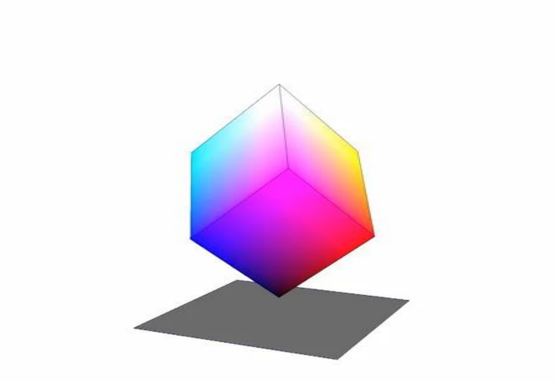
$$
\begin{aligned}
\text{black} &= (0,0,0),\\
\text{red} &= (1,0,0),\\
\text{green} &= (0,1,0),\\
\text{blue} &= (0,0,1),\\
\text{yellow} &= (1,1,0),\\
\text{magenta} &= (1,0,1),
\end{aligned}
$$

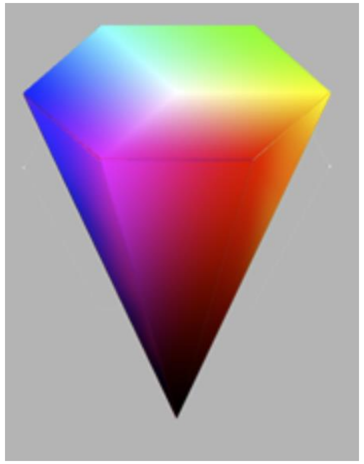


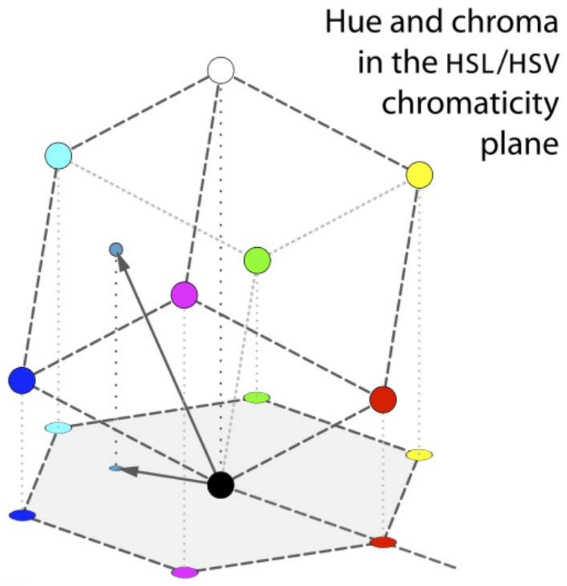
HSV

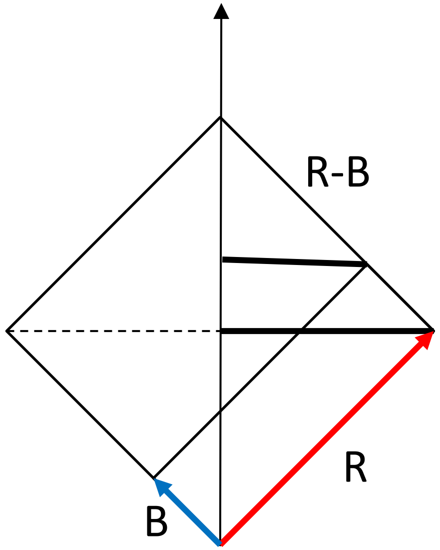


HSV <=> RGB









V=R

S=(R-B)/R

chroma

$$M = \max(R, G, B)$$
$$m = \min(R, G, B)$$
$$C = \operatorname{range}(R, G, B) = M - m$$

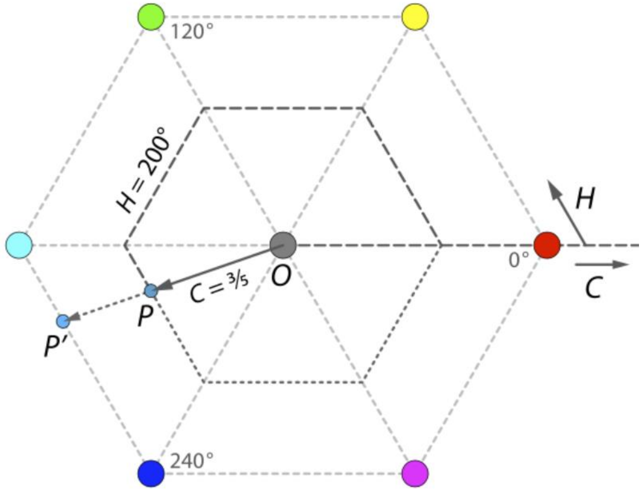
$$\boxed{V = \max(R, G, B) = M}$$

$$\boxed{S_V = \begin{cases} 0, & \text{if } V = 0 \\ \frac{C}{V}, & \text{otherwise} \end{cases}}$$

$$H' = \begin{cases} \text{undefined}, & \text{if } C = 0 \\ \frac{G-B}{C} \bmod 6, & \text{if } M = R \\ \frac{B-R}{C} + 2, & \text{if } M = G \\ \frac{R-G}{C} + 4, & \text{if } M = B \end{cases}$$
$$H = 60^\circ \times H'$$

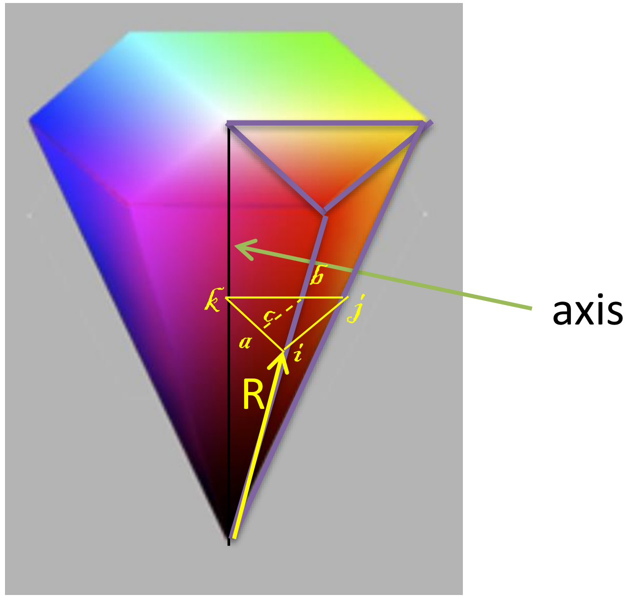
$R = 1/5$
$G = 3/5$
$B = 4/5$

$$C = \frac{OP}{OP'} = B - R = 4/5 - 1/5 = 3/5 = .6$$
$$H = 60^\circ \times \left(4 + \frac{R-G}{C}\right) = 60^\circ \times (4 - 2/3) = 200^\circ$$



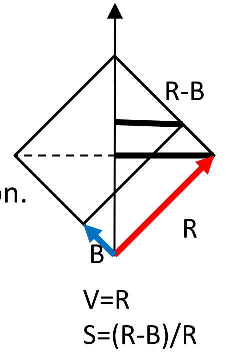
RGB to HSV

maxcomp=max (R,G,B)
mincomp=min(R,G,B)



In the HSV hex-cone:
V is the height of the color along the cone axis.
NOTE: The cone axis has all shades of grey i.e. R=G=B,
black V=0; white V=1;
all primary colors red, green, blue, cyan, magenta, yellow V=1,
And in general V=maxcomp

Let R is maxcomp and B is mincomp (without loss of generality).
Then the color RGB is somewhere in the purple wedge shown in general,
And more specifically somewhere in the equilateral yellow triangle (i,j,k).
The colors at the yellow triangle vertices are i=(R,0,0), j=(R,R,0) and k=(R,R,R).
More generally the color c=(R,G,B) must lie on the yellow dashed line (a,b) parallel to (i,j),
with the length of (a,k)=R-B.
Saturation S ranges from 0 along the axis to 1 on the boundary of the cone, i.e.
S=|a,k|/ |i,k| = (R-B)/R.
Looking at the R,B axis ortho view at right can also provide some intuition, why increasing B reduces saturation.



Hue is the angle around the hexagon. H is undefined if S=0. otherwise = |c,a|/|a,b|=(G-B)/(R-B) *60^o.
Remember G is a value between B and R (a=(R,B,B) and b=(R,R,B)).
The mod / +2 /+4 places the triangle in the right pie slice (out of 6) so the angle is 0..360^o instead of 0..60^o.