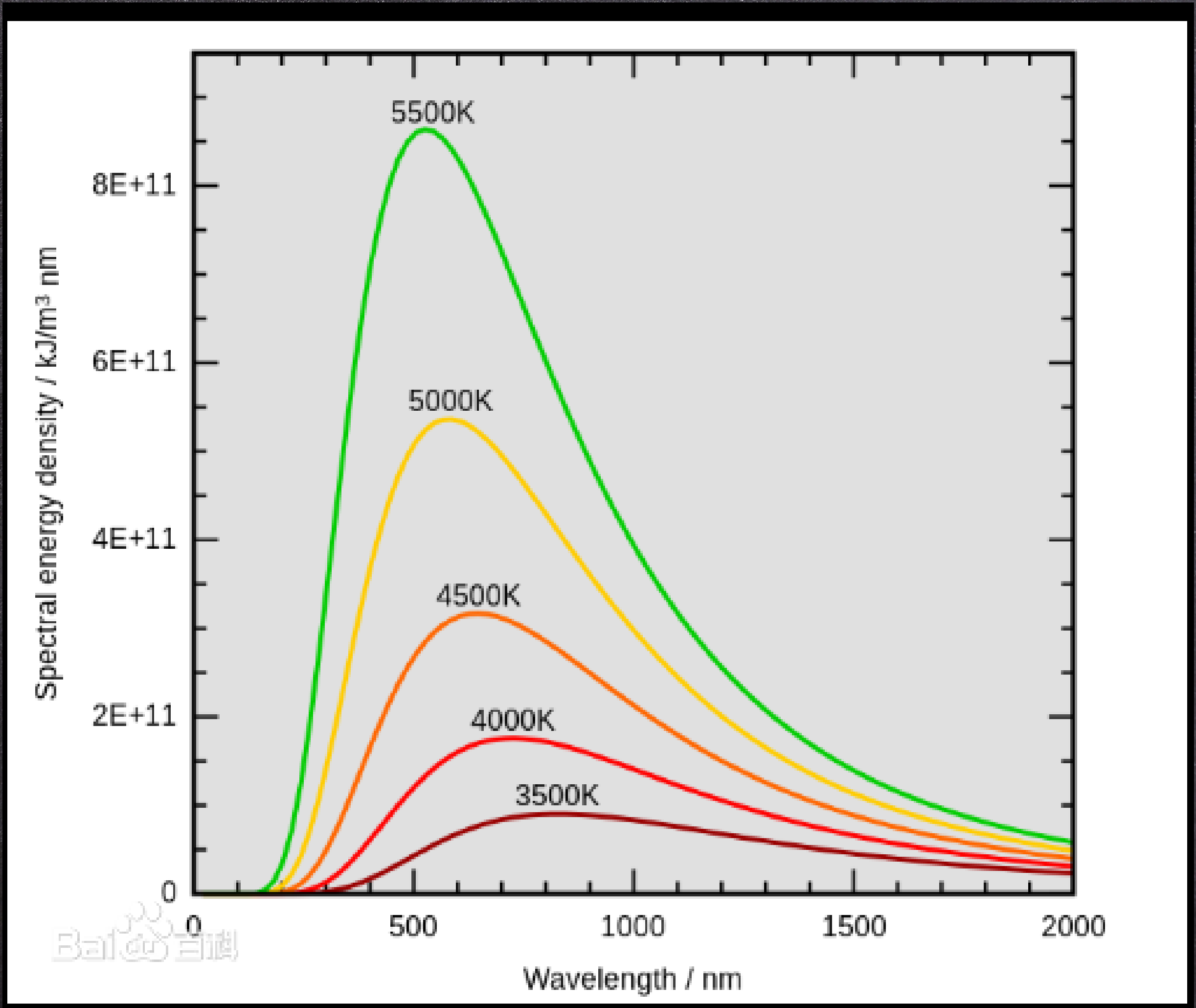
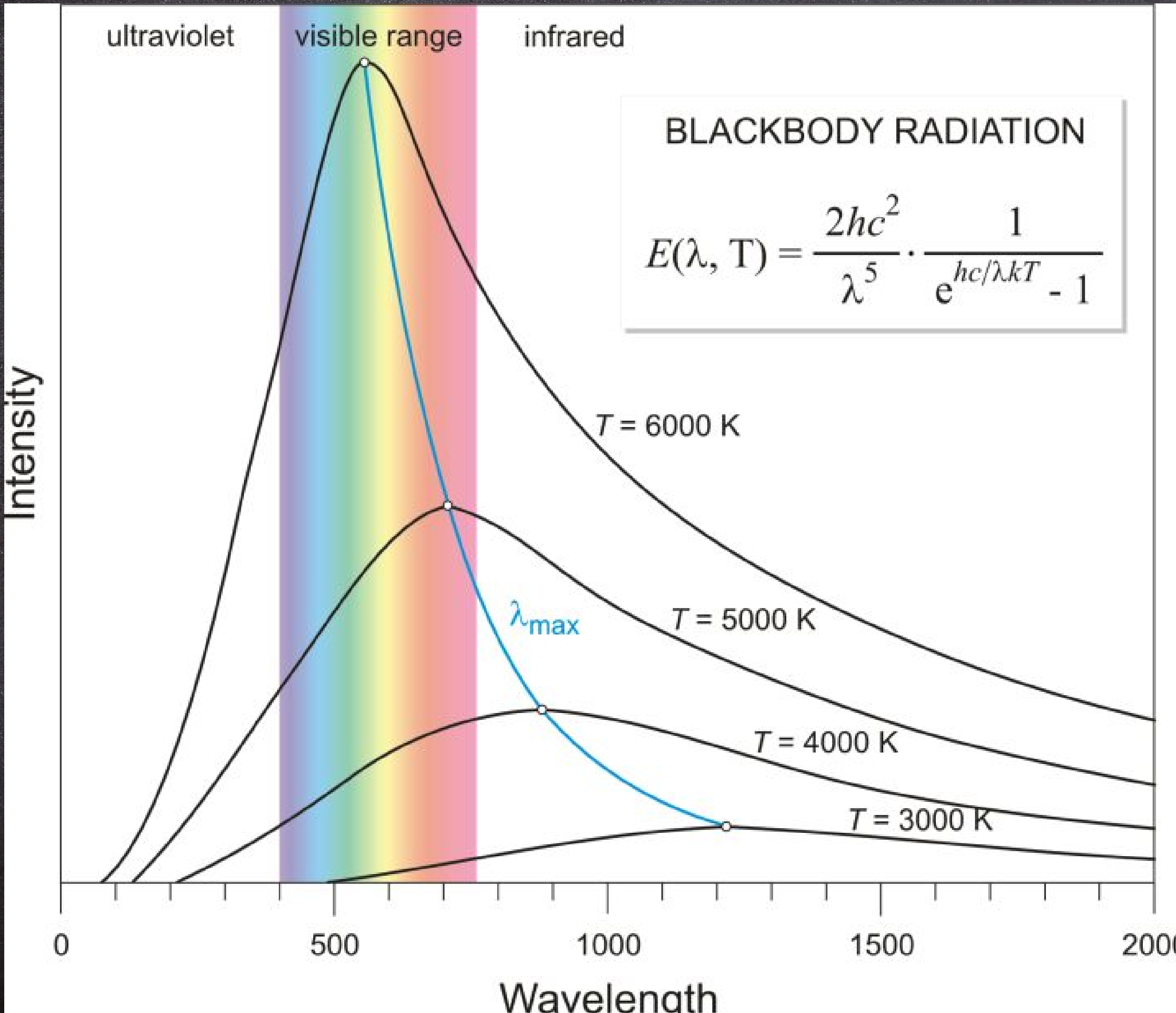
计算视觉与模式识别

黑体辐射


5500K
5000K
4500K
4000K
3500K
8E+11
6E+11
4E+11
2E+11
0
0
500
1000
1500
2000
Spectral energy density / kJ/m³ nm
Wavelength / nm



ultraviolet
visible range
infrared
BLACKBODY RADIATION
$$E(\lambda, T) = \frac{2hc^2}{\lambda^5} \cdot \frac{1}{e^{hc/\lambda kT} - 1}$$
Intensity
T = 6000 K
T = 5000 K
T = 4000 K
T = 3000 K
λ_{max}
0
500
1000
1500
2000
Wavelength

太阳与天空

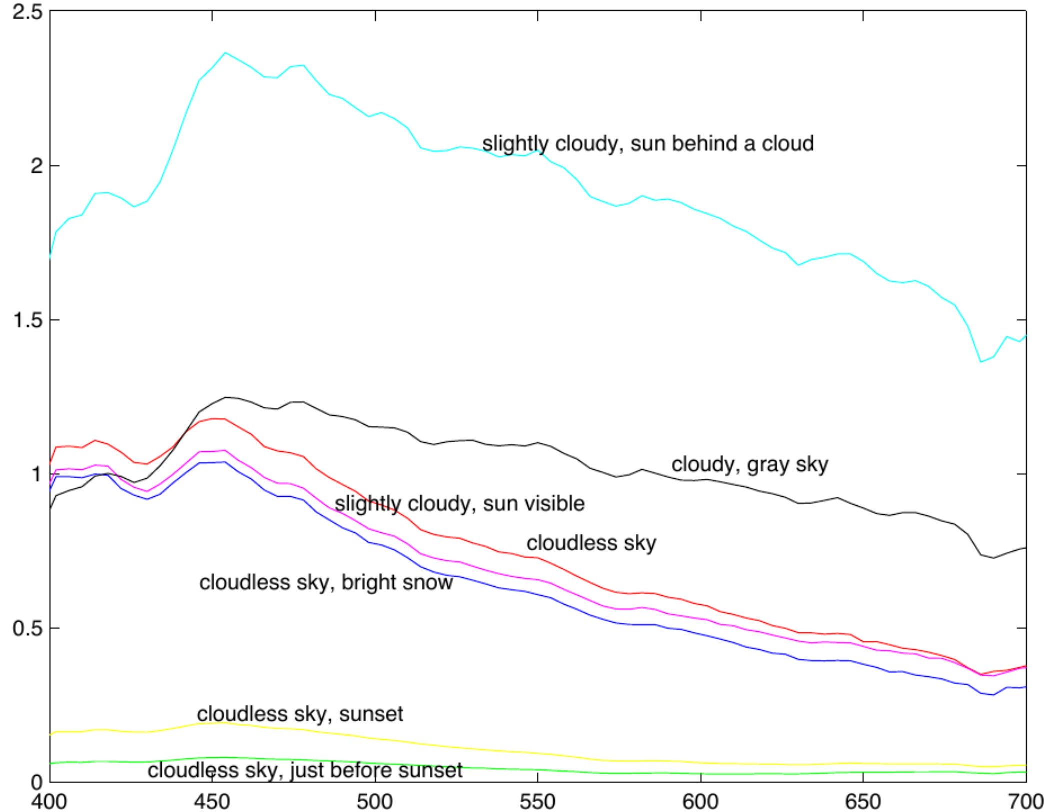


Figure 4.3. There are significant variations in the relative spectral power of daylight measured at different times of day and under different conditions. The figure shows a series of seven different daylight measurements, made by Jussi Parkkinen and Pertti Silfsten, of daylight illuminating a sample of barium sulphate (which gives a very high reflectance white surface). Plot from data obtainable at `http://www.it.lut.fi/research/color/lutcs_database.html`.

灯光

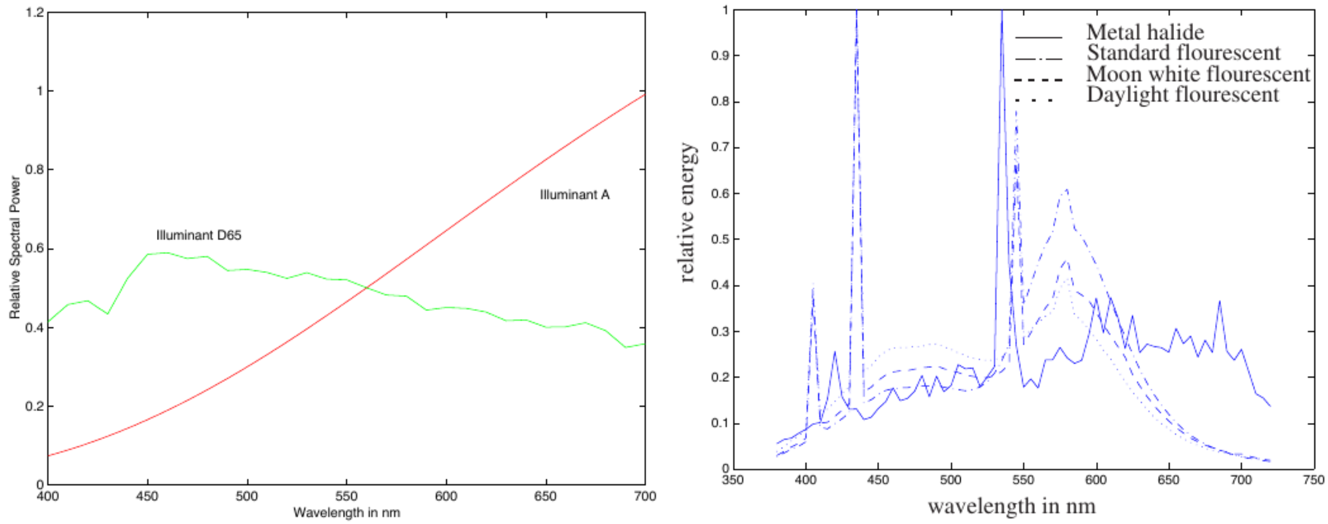


Figure 4.4. There is a variety of illuminant models; the graph shows the relative spectral power distribution of two standard CIE models, illuminant A — which models the light from a 100W Tungsten filament light bulb, with colour temperature 2800K — and illuminant D-65 — which models daylight. *Figure plotted from data available at* `http://www-cvrl.ucsd.edu/index.htm`.The relative spectral power distribution of four different lamps from the Mitsubishi Electric corp, measured by ****, data from *****. Note the bright, narrow bands that come from the flourescing phosphors in the fluorescent lamp.

表面的颜色

朗伯加镜面反射模型：

$$E(\lambda) = \rho_{\mathrm{dh}}(\lambda)S(\lambda) \times \text{geometric terms} + \text{specular terms}$$

光谱反射率——花与叶

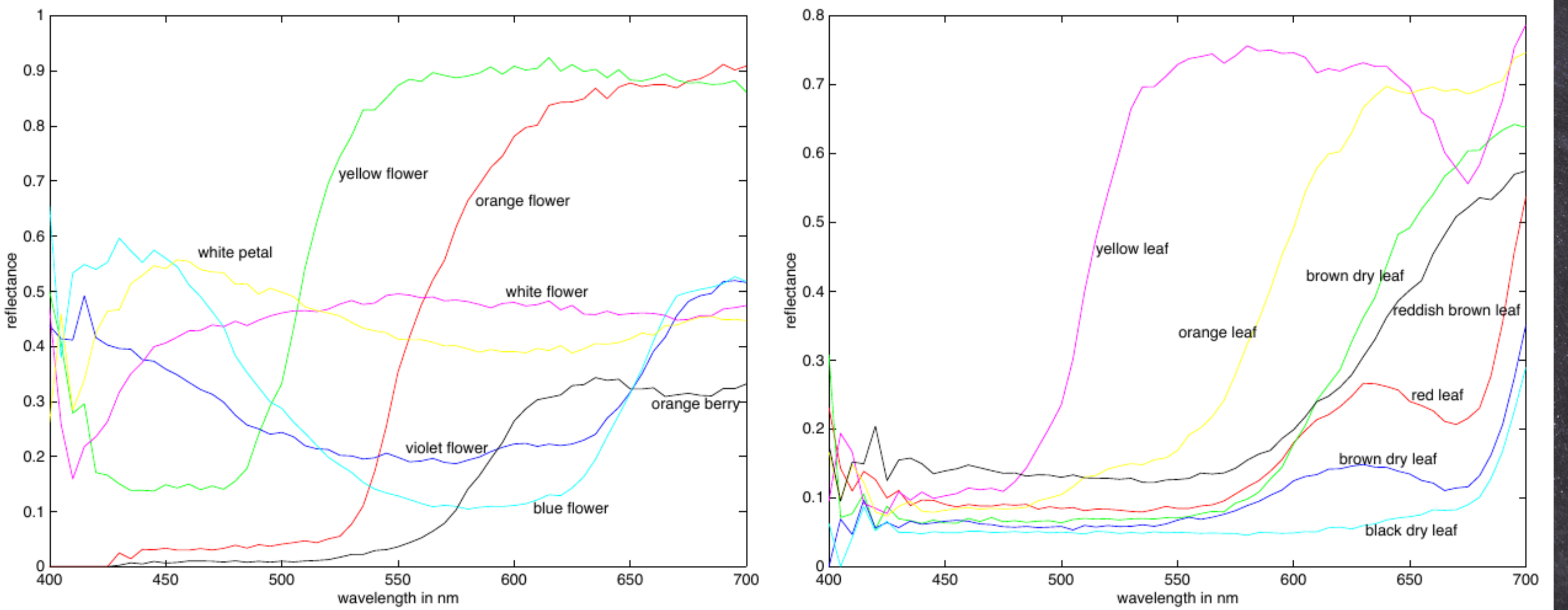


Figure 4.1. Spectral albedoes for a variety of natural surfaces, measured by Esa Koivisto, Department of Physics, University of Kuopio, Finland. On the left, albedoes for a series of different natural surfaces — a colour name is given for each. On the right, albedoes for different colours of leaf; again, a colour name is given for each. These figures were plotted from data available at `http://www.it.lut.fi/research/color/lutcs_database.html`.

光谱反射率——红花与绿叶

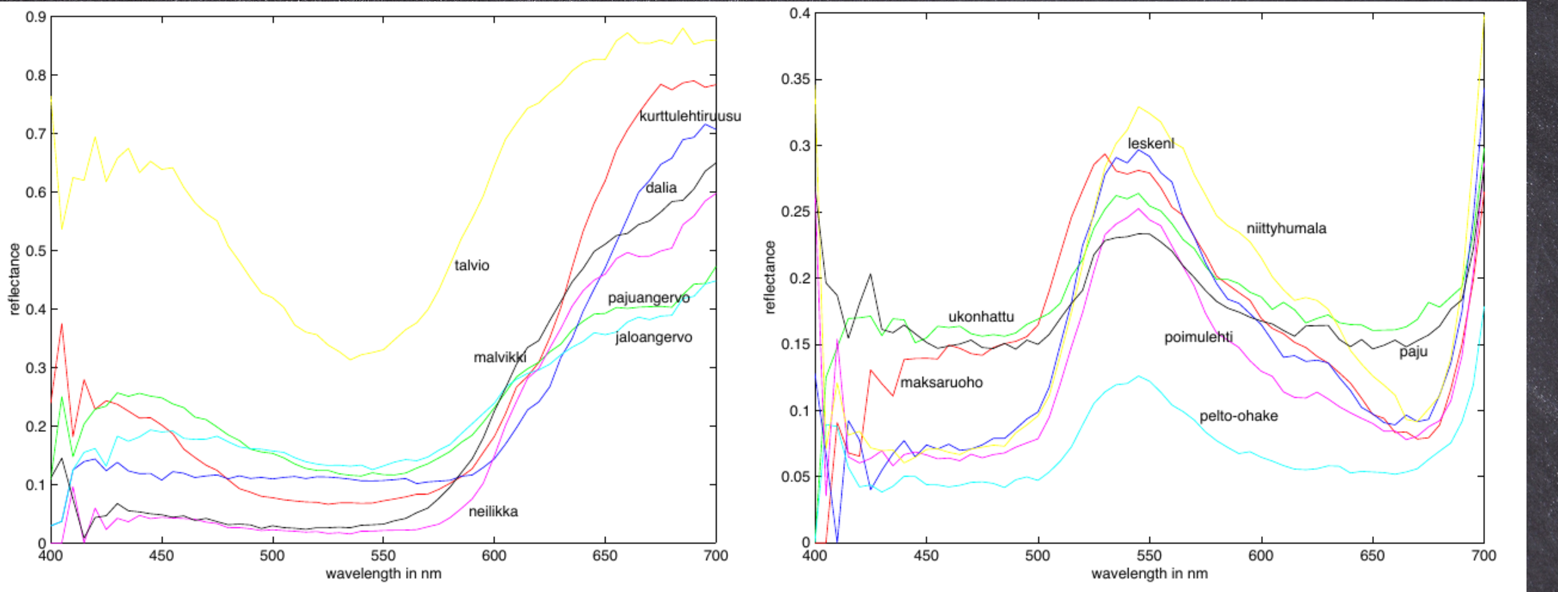


Figure 4.2. More spectral albedoes for a variety of natural surfaces, measured by Esa Koivisto, Department of Physics, University of Kuopio, Finland. On the left, albedoes for a series of different red flowers. Each is given its Finnish name. On the right, albedoes for green leaves; again, each is given its Finnish name. You should notice that these albedoes don't vary all that much. This is because there are relatively few mechanisms that give rise to colour in plants. These figures were plotted from data available at `http://www.it.lut.fi/research/color/lutcs_database.html`.

颜色匹配

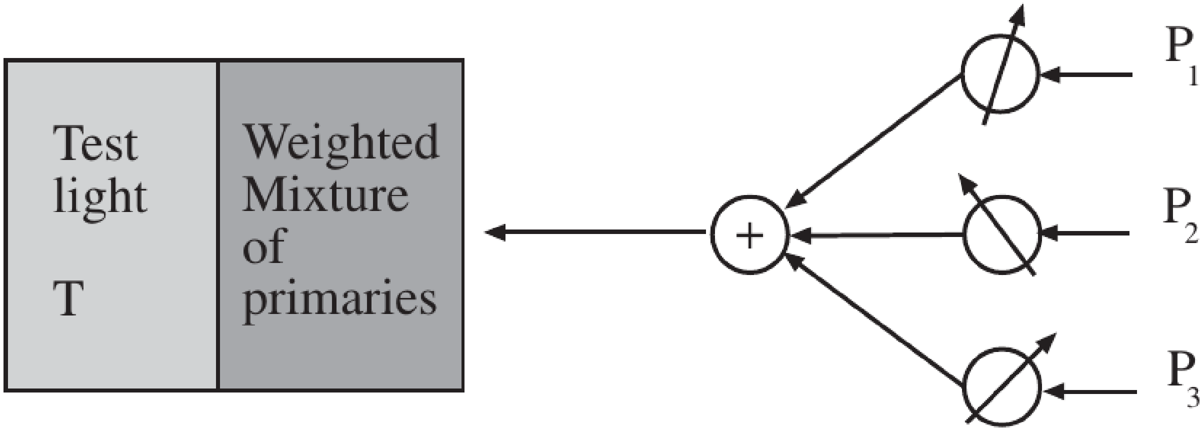


Figure 4.5. Human perception of colour can be studied by asking observers to mix coloured lights to match a test light, shown in a split field. The drawing shows the outline of such an experiment. The observer sees a test light T, and can adjust the amount of each of three primaries in a mixture that is displayed next to the test light. The observer is asked to adjust the amounts so that the mixture looks the same as the test light. The mixture of primaries can be written as $w_1P_1 + w_2P_2 + w_3P_3$; if the mixture matches the test light, then we write $T = w_1P_1 + w_2P_2 + w_3P_3$. It is a remarkable fact that for most people three primaries are sufficient to achieve a match for many colours, and for all colours if we allow subtractive matching (i.e. some amount of some of the primaries is mixed with the test light to achieve a match). Some people will require fewer primaries. Furthermore, most people will choose the same mixture weights to match a given test light.

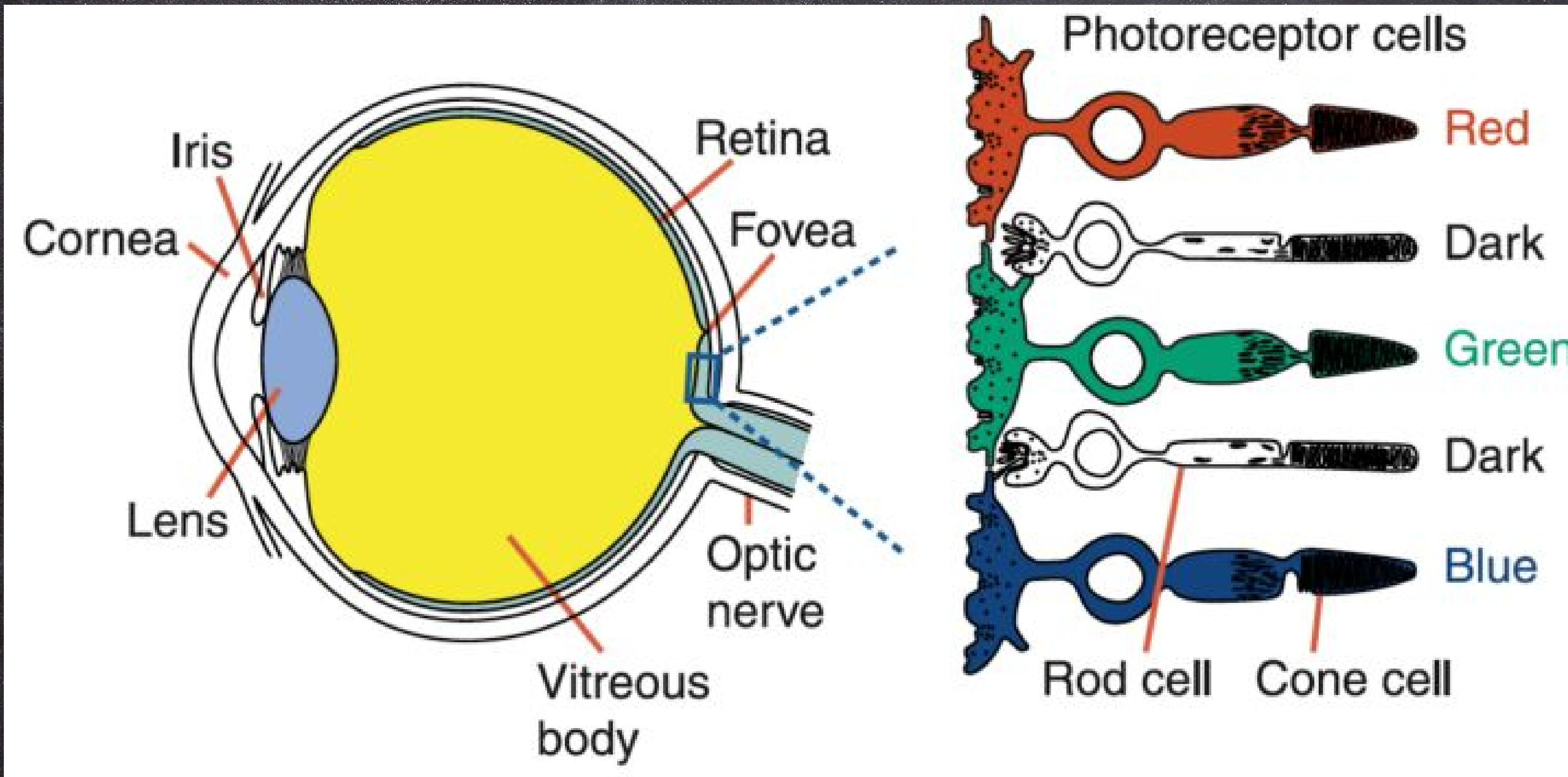
Grassman 定律

$$
\begin{aligned}
T(\boldsymbol{w}) &= \sum_i w_i P_i \\
T(\boldsymbol{v}) &= \sum_i v_i P_i \\
T(k\boldsymbol{w}) + T(k\boldsymbol{v}) &= kT(\boldsymbol{w} + \boldsymbol{v})
\end{aligned}
$$

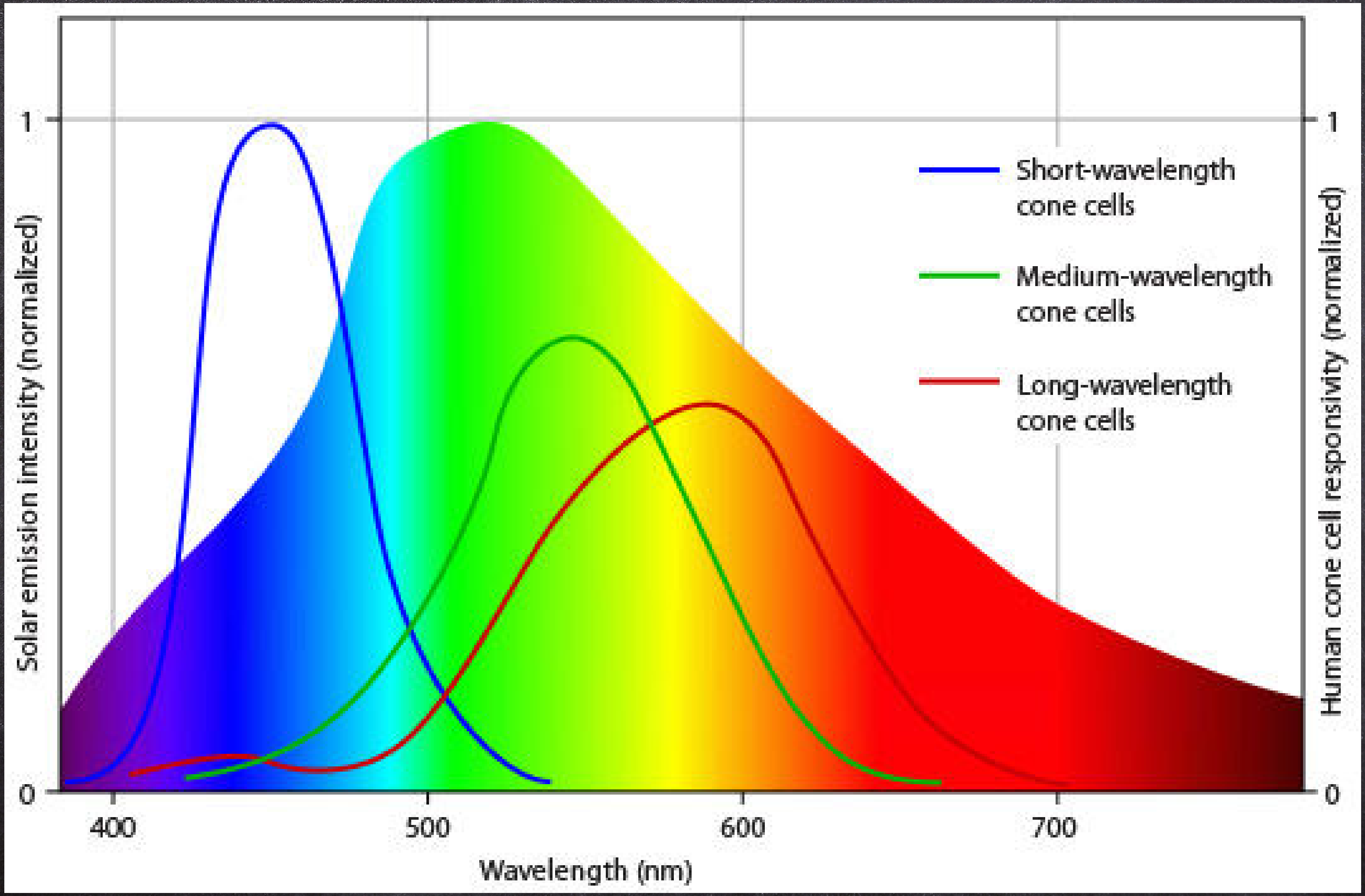
颜色感受体

$$p_k = \int_\Lambda \sigma_k(\lambda) E(\lambda) \mathrm{d}\lambda$$

彩色视觉


Iris
Cornea
Lens
Retina
Fovea
Optic nerve
Vitreous body
Photoreceptor cells
Red
Dark
Green
Dark
Blue
Rod cell
Cone cell

视锥细胞响应曲线



Short-wavelength cone cells
Medium-wavelength cone cells
Long-wavelength cone cells
Solar emission intensity (normalized)
Human cone cell responsivity (normalized)
Wavelength (nm)
400
500
600
700
0
1
0
1