What is Light?
- electromagnetic radiation, 400-700nm

The Retina
- rods and cones

Cones
- concentrated in fovea
- three types of cones in human eye

Tristimulus Colour Theory
- match any given wavelength with a mix of some specific wavelengths:
  \[ R = \int P(\lambda) R_\lambda \, d\lambda \]
  \[ G = \int P(\lambda) G_\lambda \, d\lambda \]
  \[ B = \int P(\lambda) B_\lambda \, d\lambda \]

Spectra
- rods and cones
- concentrated in fovea
- three types of cones in human eye
**XYZ Colour Matching**

- CIE: Commission Internationale d’Eclairage
- Goal is to develop a colour standard that uses only positive mixing coefficients

\[
\begin{align*}
X &= k \int P(\lambda) x(\lambda) d\lambda \\
Y &= k \int P(\lambda) y(\lambda) d\lambda \\
Z &= k \int P(\lambda) z(\lambda) d\lambda
\end{align*}
\]

**XYZ and RGB Colour Spaces**

- XYZ and RGB colour spaces
- Colour transformation matrix:

\[
\begin{bmatrix}
X \\
Y \\
Z
\end{bmatrix} = \begin{bmatrix}
2.30460 & -0.1515 & 0.00520 \\
-0.89653 & 1.40240 & -0.00441 \\
-0.64807 & 0.08675 & 1.00921
\end{bmatrix}
\begin{bmatrix}
R \\
G \\
B
\end{bmatrix}
\]
- Each monitor has its own RGB-to-XYZ transformation matrix
- Suppose we have a colour \( R, G, B \) on monitor A and wish to view the same colour on monitor B:

\[
C_B = M_B^{-1} M_A C_A
\]

**CIE Chromaticity Diagram**

- Produce a 2D colour space by projecting onto the plane given by \( X + Y + Z = 1 \)

**RGB vs XYZ revisited**

- Another view of why the R curve goes negative

**CIE Chromaticity Diagram**

- C: white point
- Complementary colours
- Dominant wavelength
- Non-spectral colors