Electronics basics

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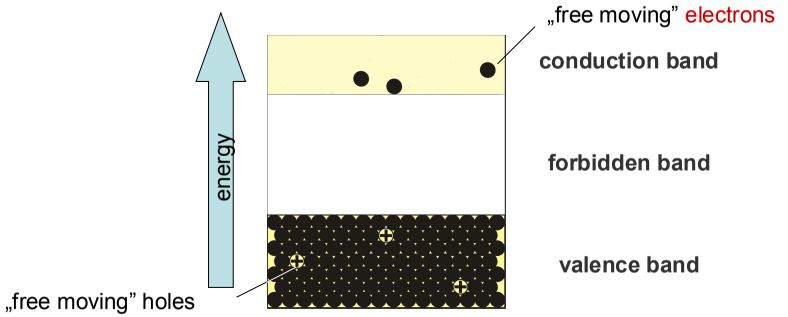
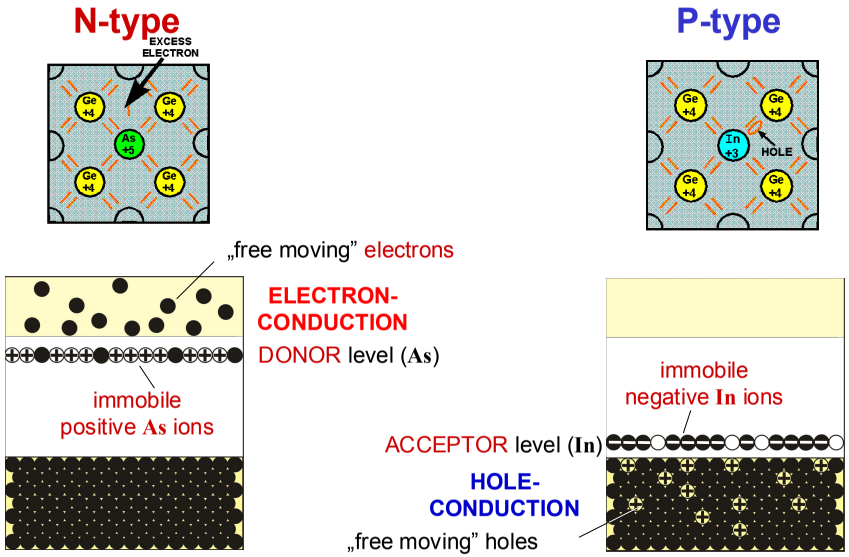
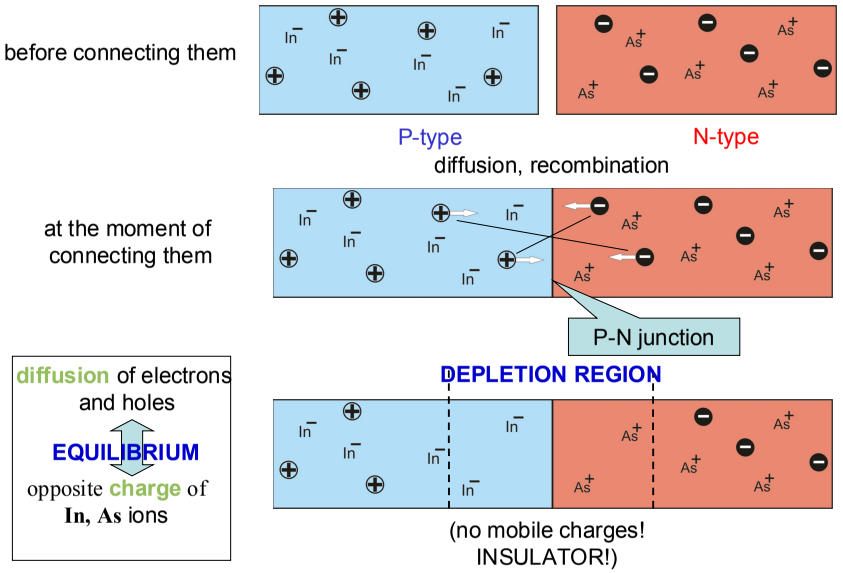
Energy structure of semiconductors



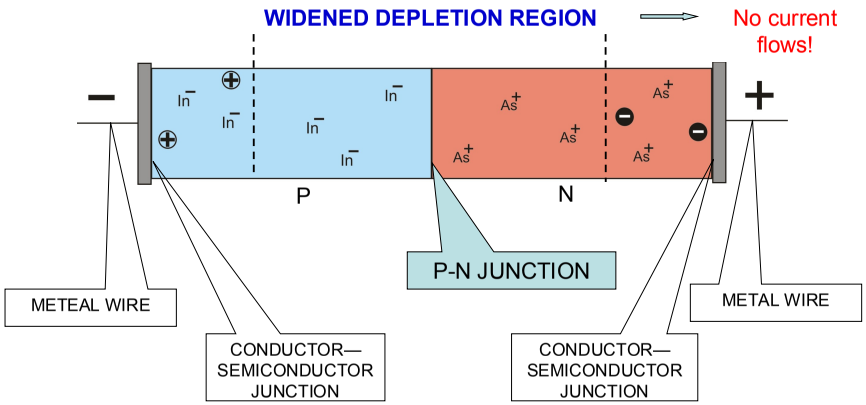
Doped semiconductors



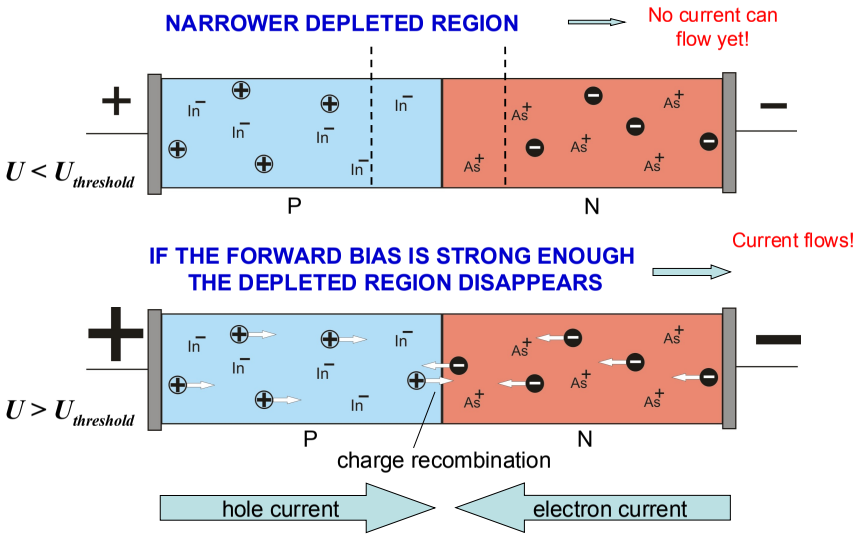
P-N junction (without outer electric field)



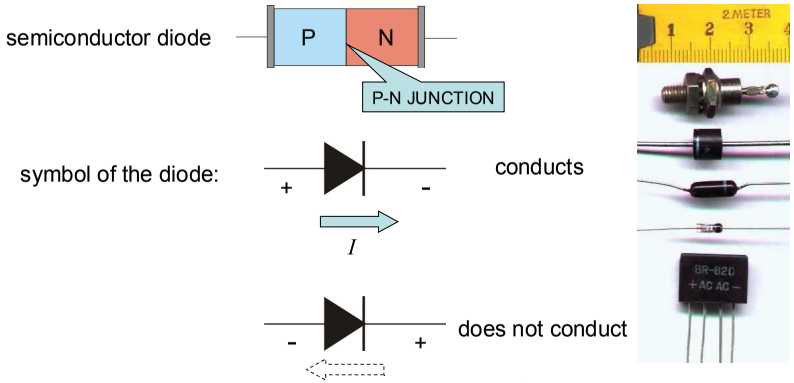
P-N junction
(reverse bias)



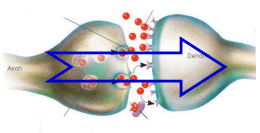
P-N junction
(forward bias)



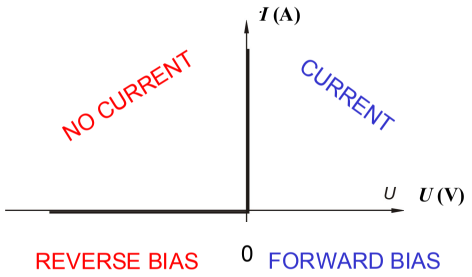
P-N junction rectifying diodes



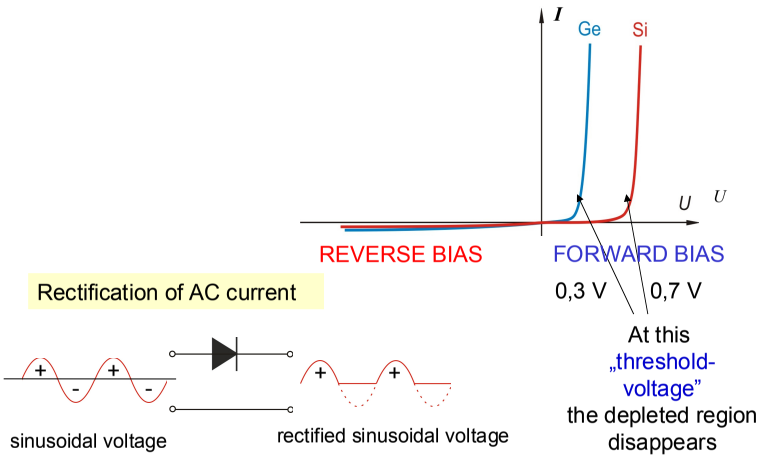
Biological analogy: SYNAPSIS



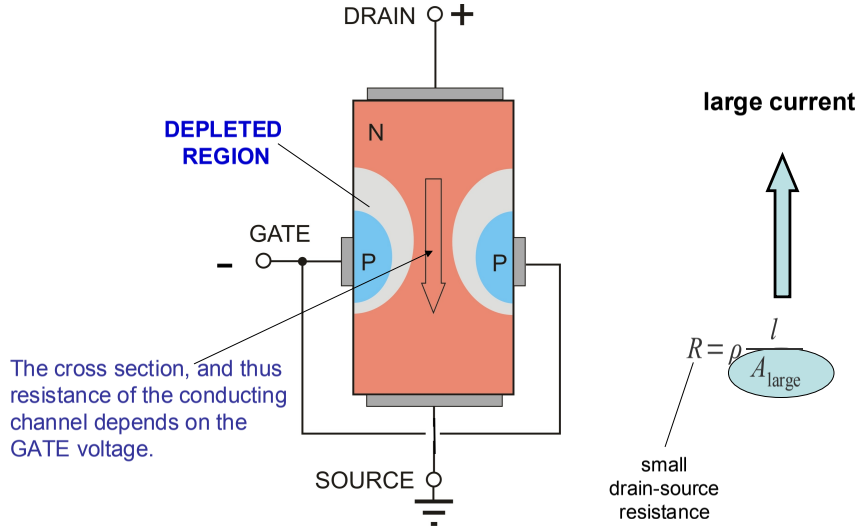
Diode characteristics
(IDEAL DIODE)



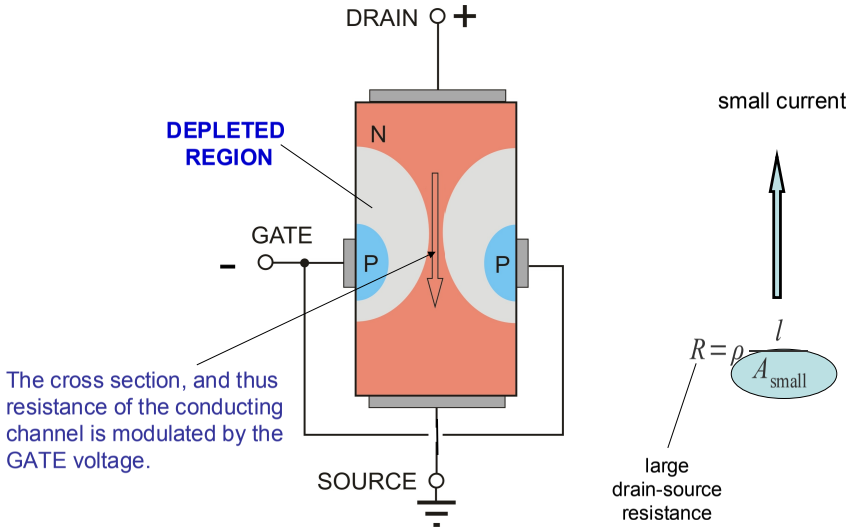
Diode characteristics
(REAL DIODE)



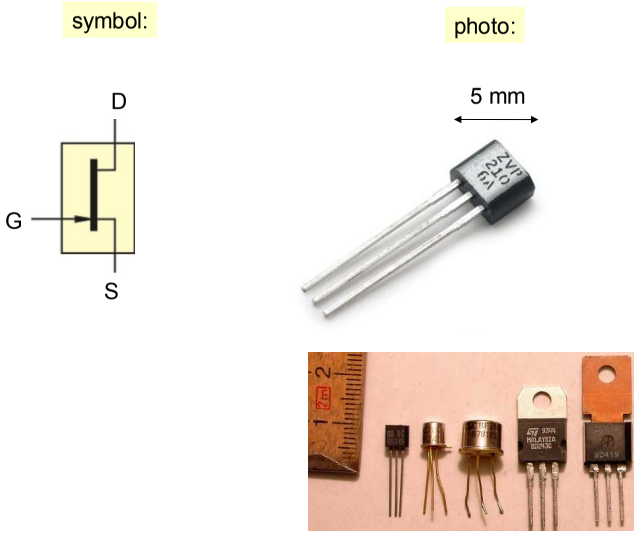
Field effect transistor I.
(FET)



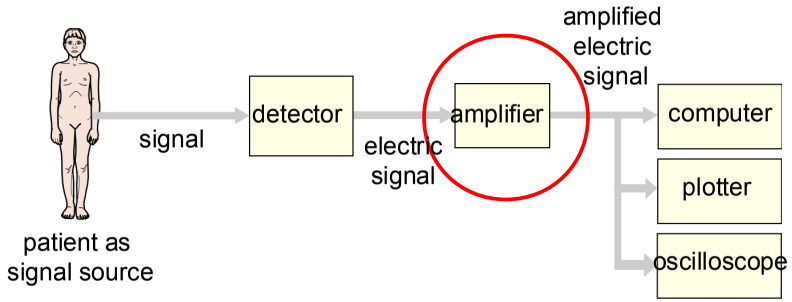
Filed effect transistor II.
(FET)



Field effect transistor III.
(FET)

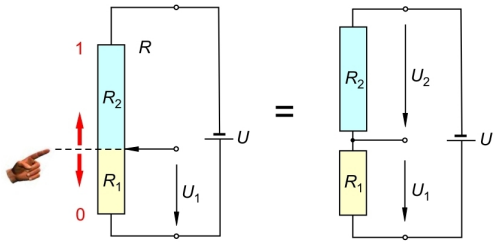


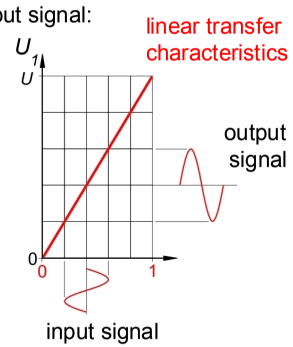
Analog devices (Amplifier)



Voltage divider potentiometer as amplifier?

$$U_1 = U\frac{R_1}{R_1+R_2}$$

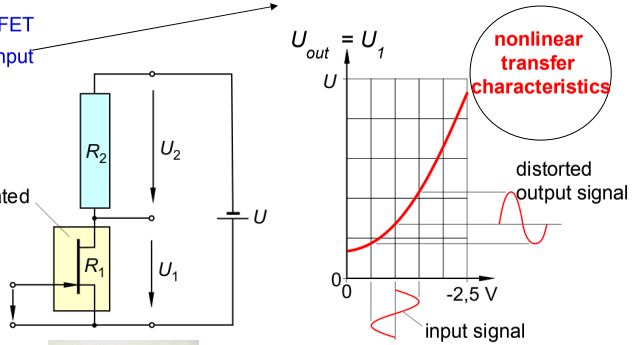




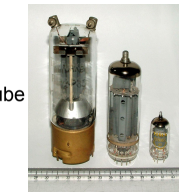
Amplifying with transistor

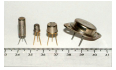
As part of a voltage divider the resistance (R_1) of the FET can be modulated by the input voltage (U_{in}).

the output voltage (U_{out}=U_1) also changes

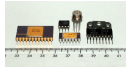


other amplifiers: electron tube





transistor

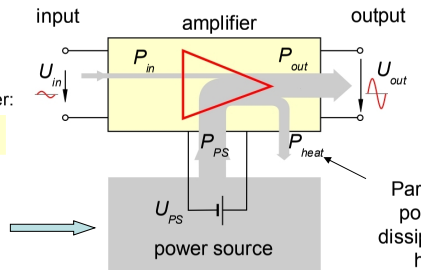


integrated circuit (IC)

Parameters of amplifiers

for an amplifier: $P_{out} > P_{in}$

The $P_{out} - P_{in}$ power increase comes from a power source.



Part of the power is dissipated as heat.

Power gain: $A_P = \frac{P_{ki}}{P_{be}}$

Voltage gain: $A_U = \frac{U_{ki}}{U_{be}}$

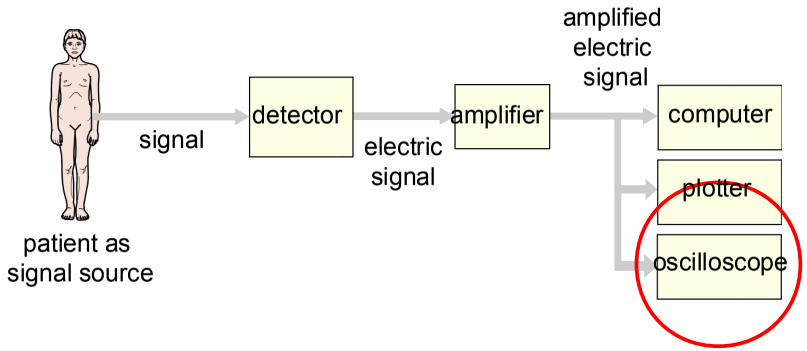
Power gain level: (decibel, dB)

$$n(\text{dB}) = 10 \lg \frac{P_{out}}{P_{in}}$$

$$n(\text{dB}) = 20 \lg \frac{U_{out}}{U_{in}}$$

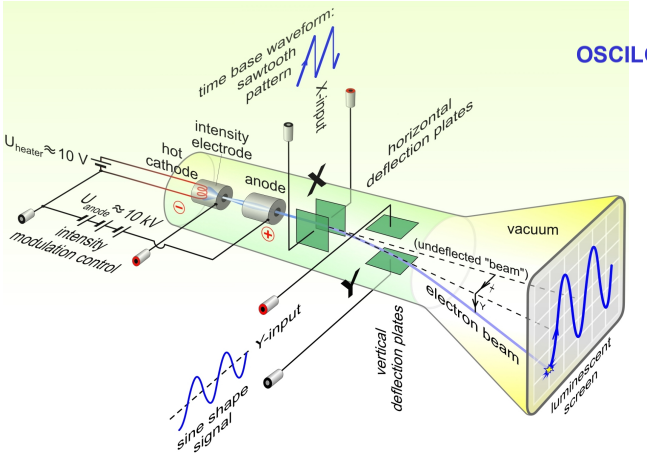
(if $R_{out} = R_{in}$)

Analog devices (Oscilloscope)



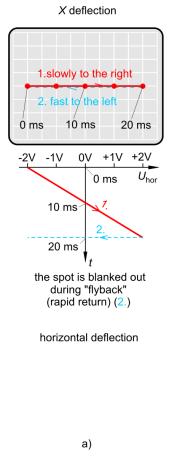
Cathode ray tube (CRT)

OSCILOSCOPE



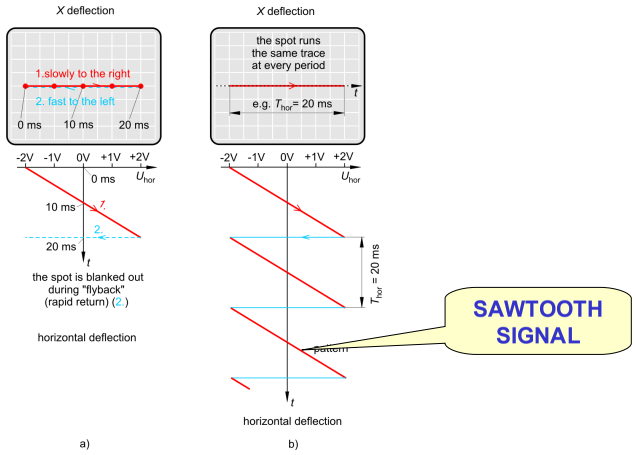
Controlling the cathode ray tube I.

***X* displacement = generating TIME scale with uniformily increasing votage**



Controlling the cathode ray tube II.

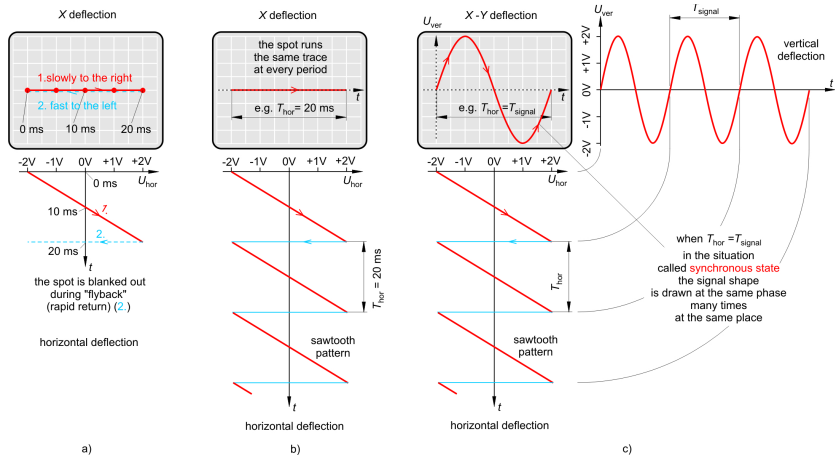
repeated *X* displacement = generating TIME scale with sawtooth voltage



Controlling the cathode ray tube III.

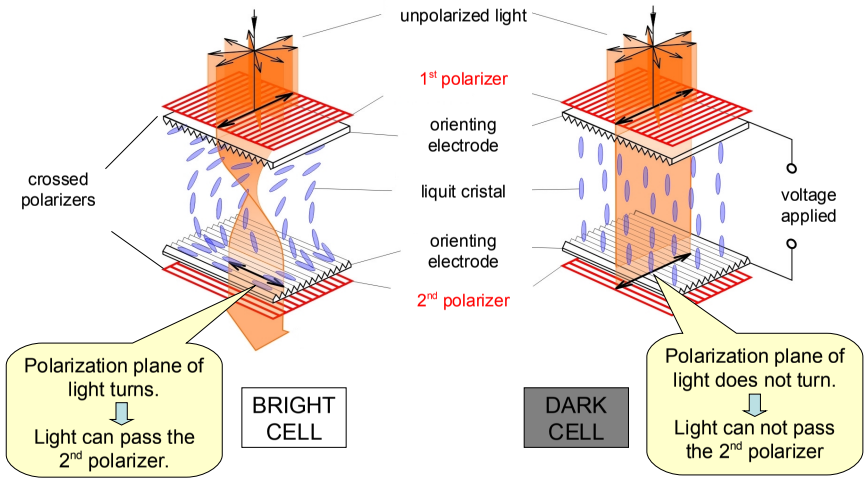
X displacement = TIME scale generated by sawtooth signal

Y displacement = SIGNAL VOLTAGE



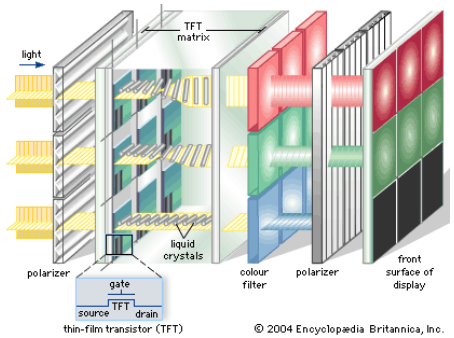
LCD (Liquid Crystal Display)

PIXEL



Color LCD

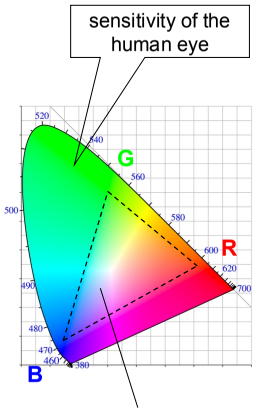
color pixel (RGB)



Red

Green

Blue



With the weighted addition of the RGB colors new colors may be generated.

Pixels of a color LCD