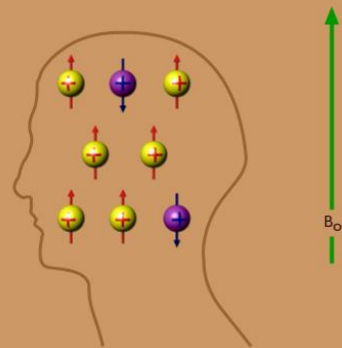
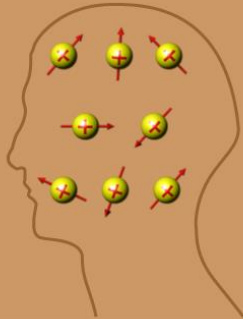
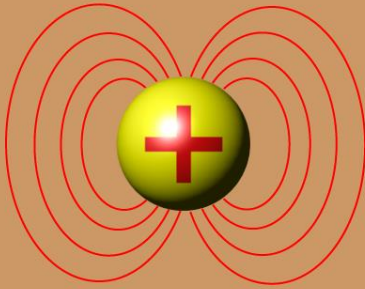
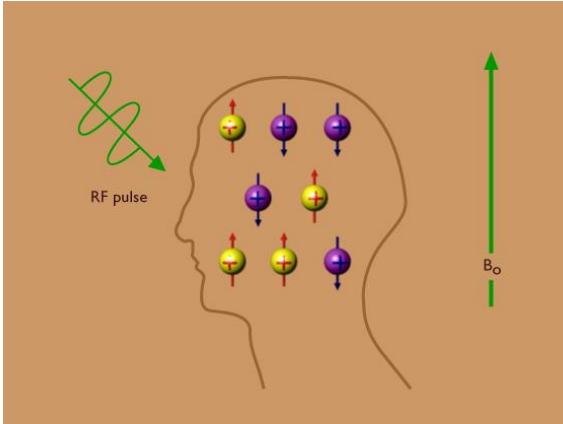


MR FİZİĞİ

Prof.Dr.Nail BULAKBAŞI

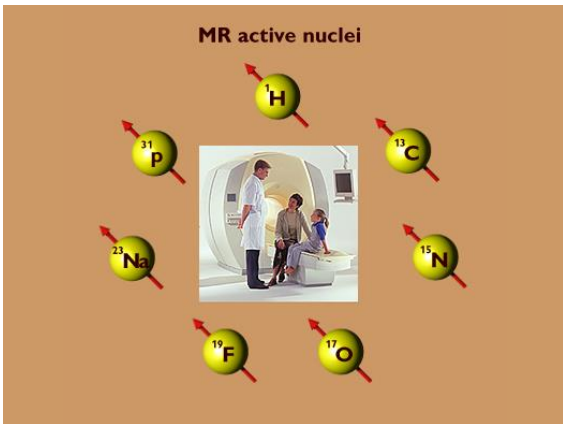
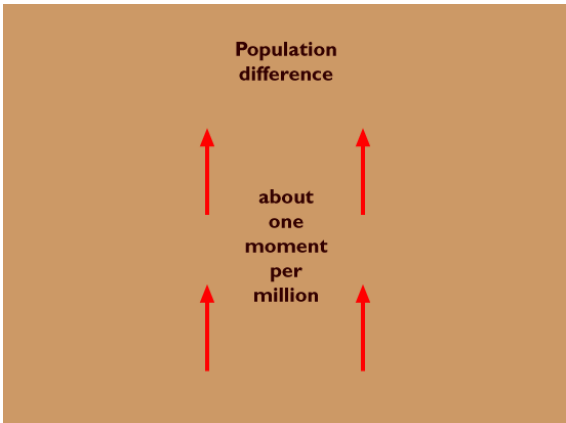
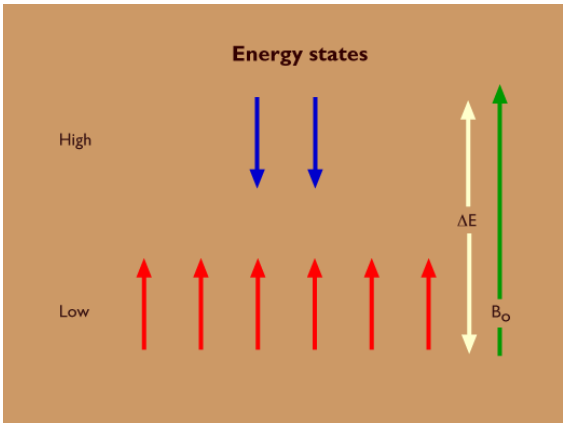




The Boltzmann equation

$$N_l / N_u = e^{(\Delta E/kT)}$$

N_l = number of nuclei in lower energy state
 N_u = number of nuclei in higher energy state
 ΔE = energy difference between states
 k = Boltzmann constant
 T = absolute temperature



The Larmor equation

$$\omega = \gamma \cdot B$$

ω = the Larmor frequency in MHz
 γ = the gyromagnetic ratio in MHz/Tesla
 B_0 = the magnetic field strength in Tesla

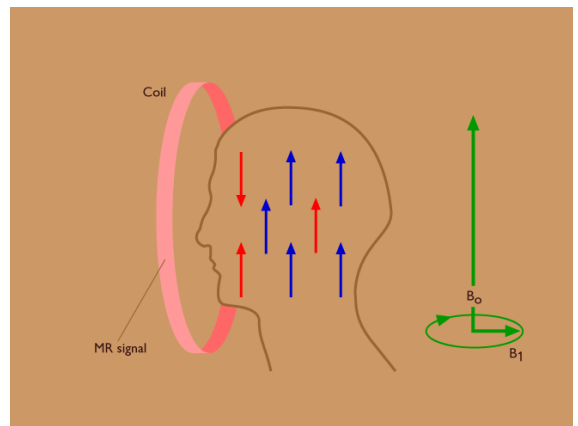
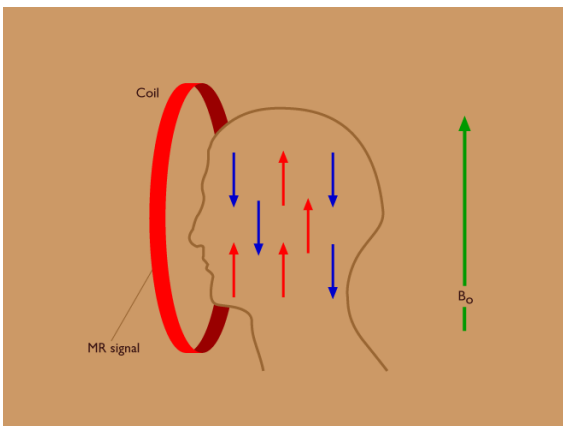
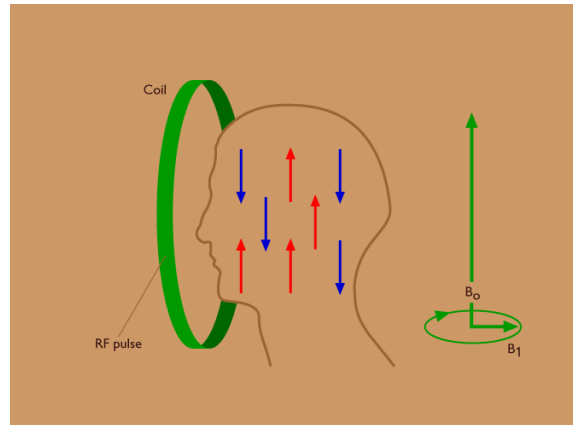
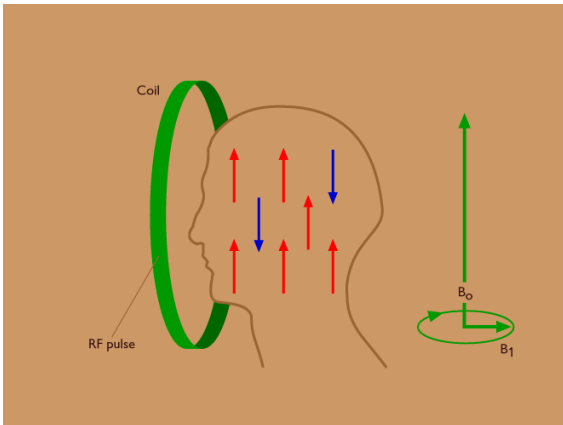
The Larmor frequency

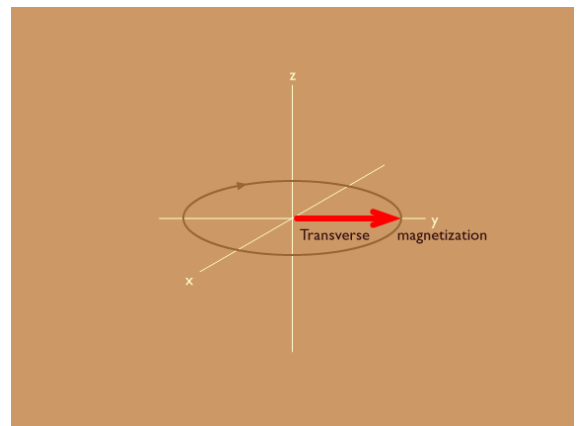
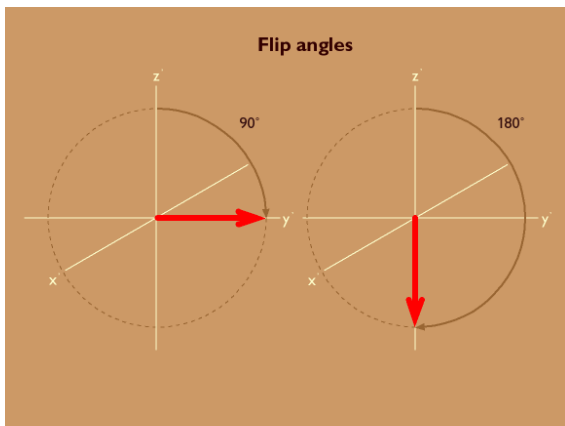
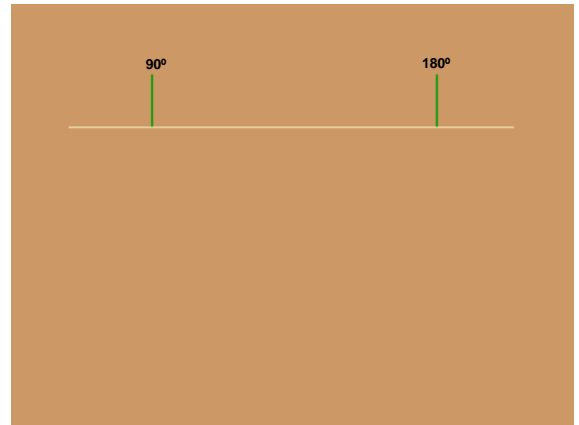
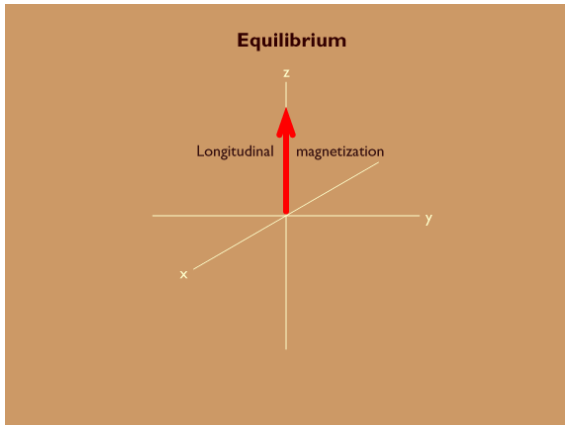
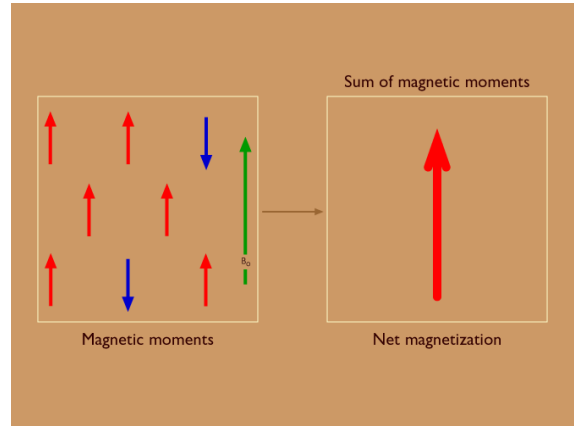
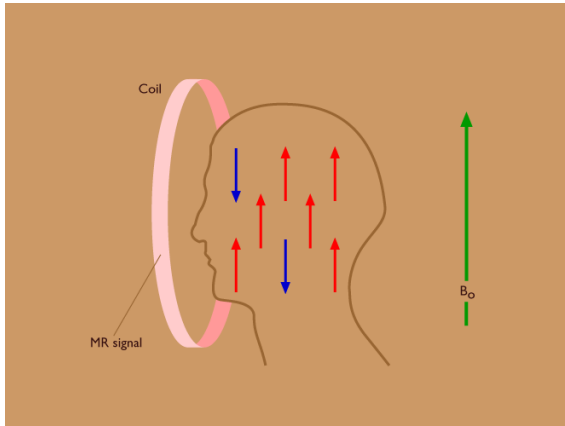
Field strength	Frequency
0.5 T	21.3 MHz
1.0 T	42.6 MHz
1.5 T	63.9 MHz

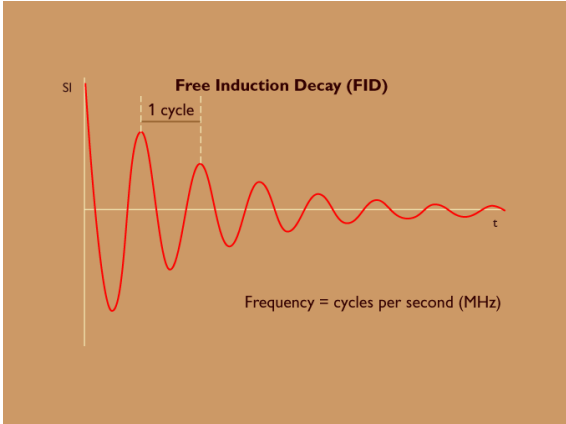
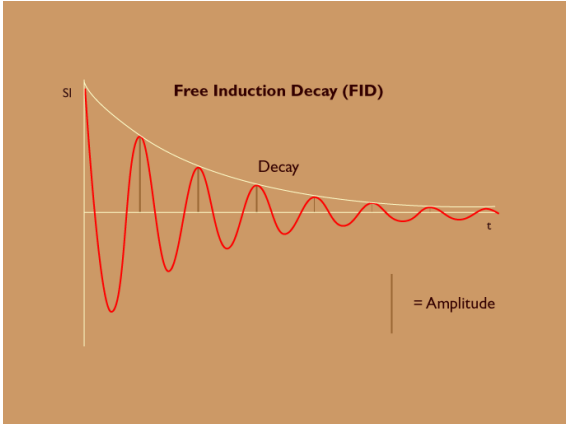
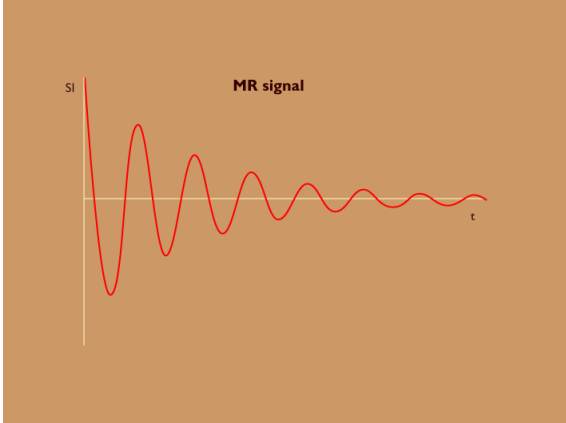
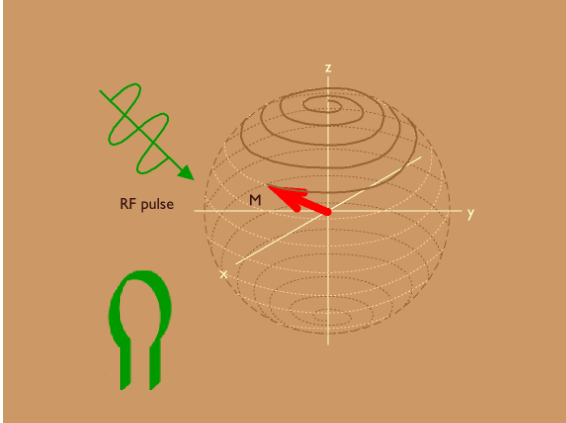
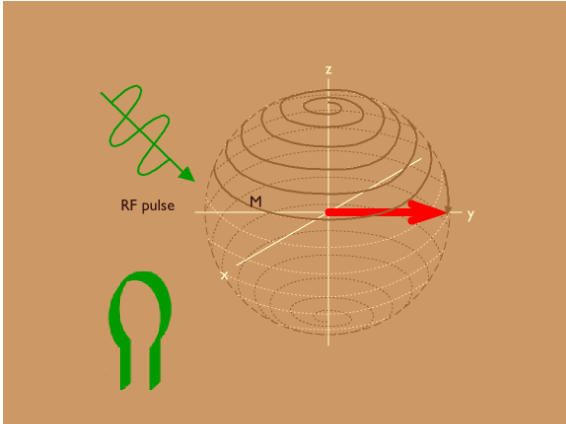
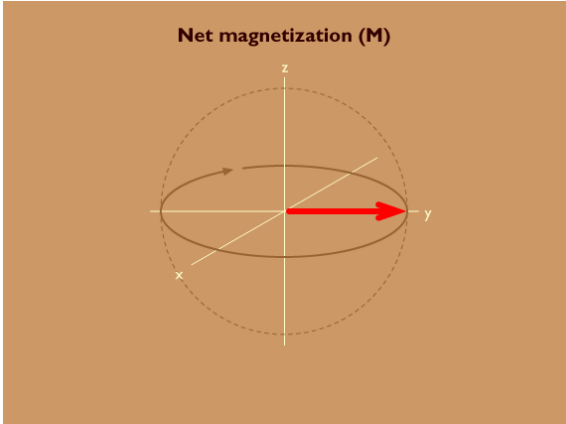


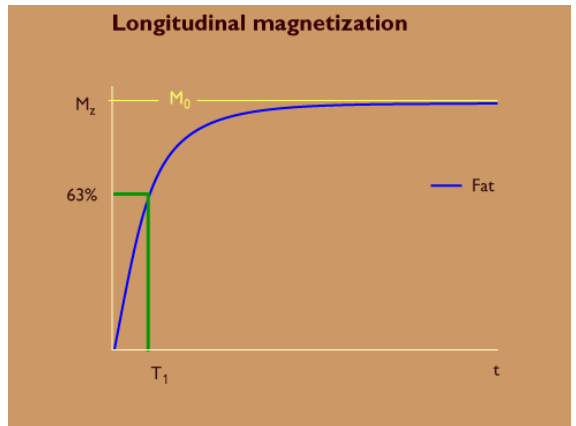
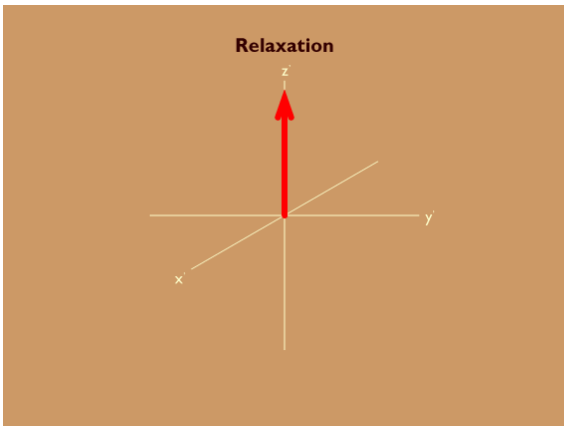
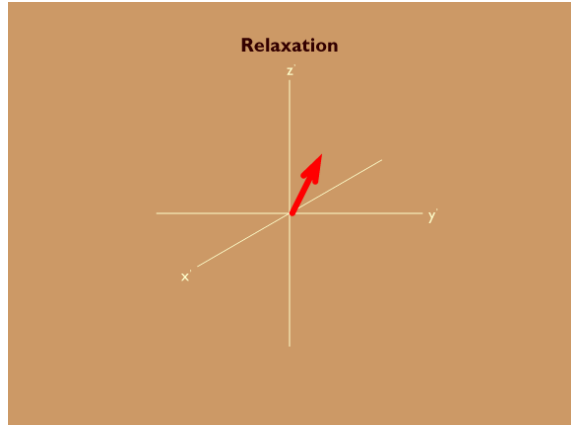
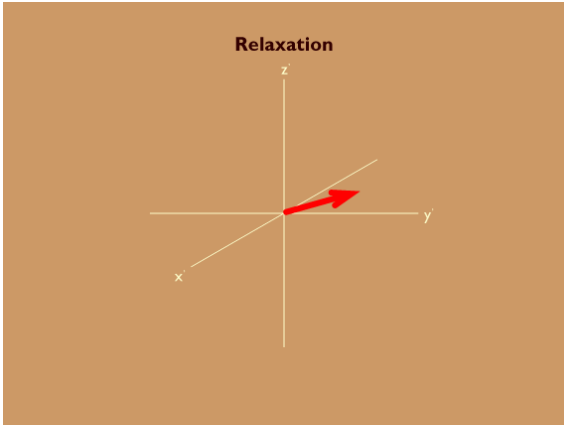
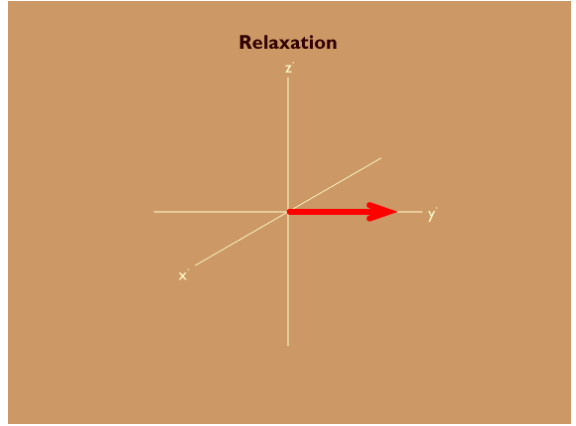
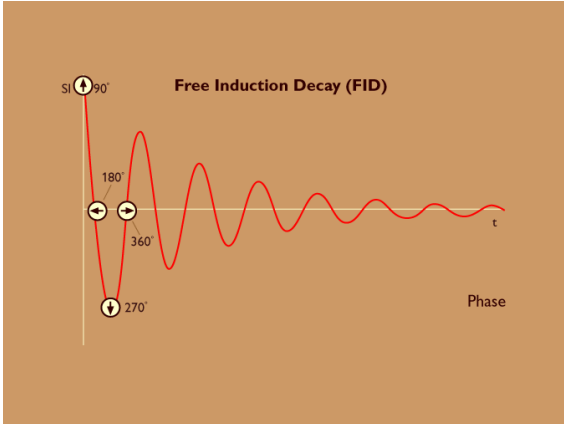
Characteristics of MR active nuclei

Nucleus	Gyromagnetic ratio (MHz/T)	Molar concentration (Mol/l)
¹ H	42.58	99.00
¹³ C	10.71	0.1
¹⁹ F	40.05	0.0066
²³ Na	11.26	0.078
³¹ P	17.12	0.35
³⁹ K	1.99	0.045

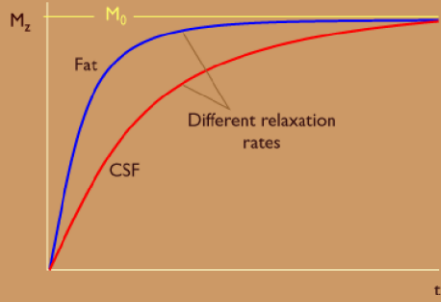




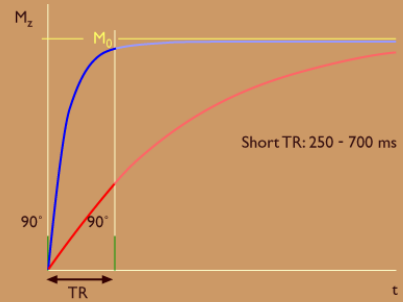




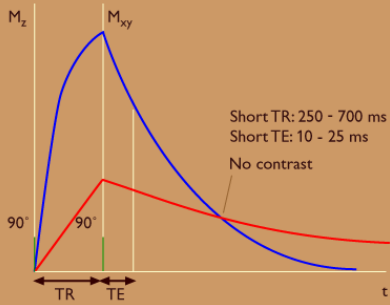
Longitudinal magnetization



T_1 weighting



T_1 weighting



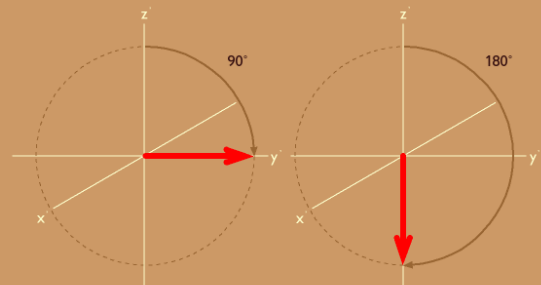
T_1 weighted image

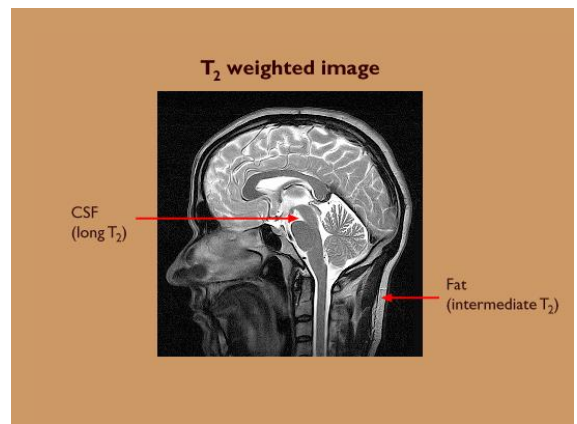
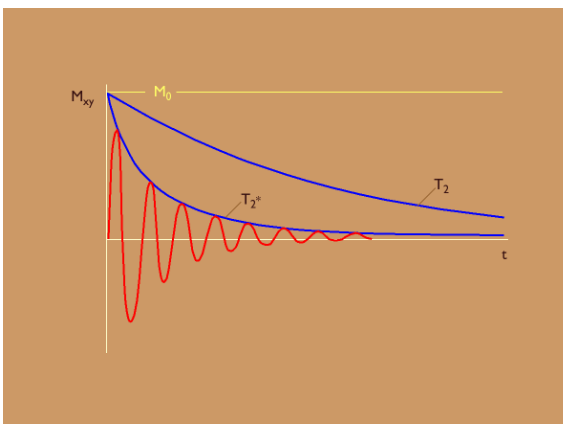
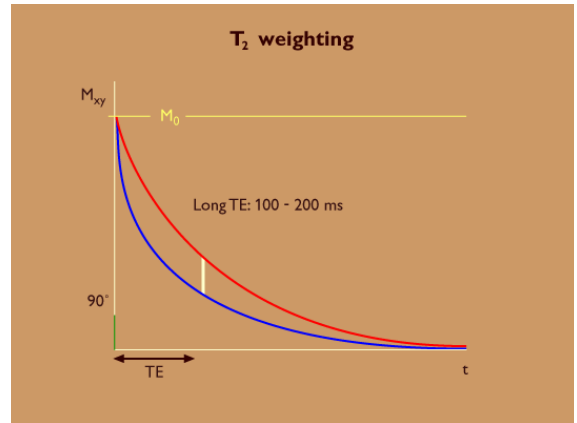
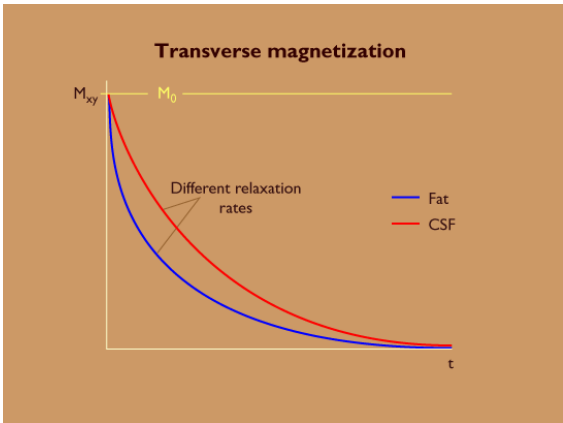
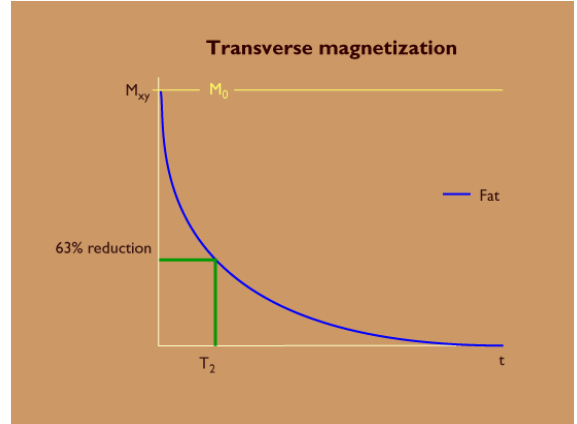
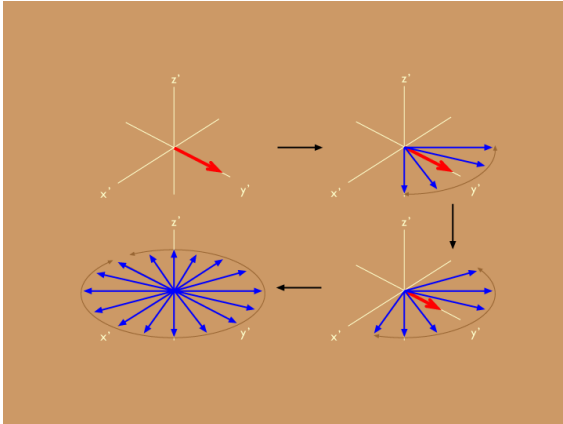


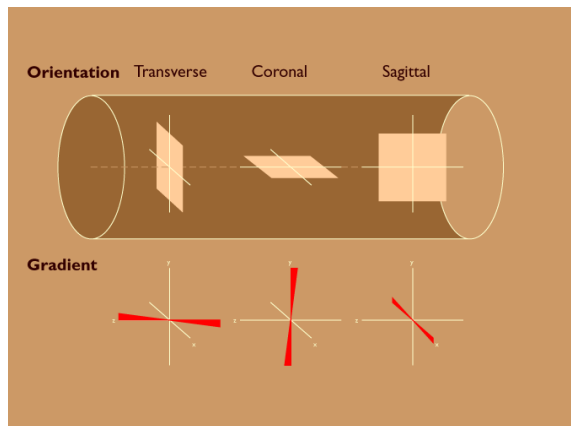
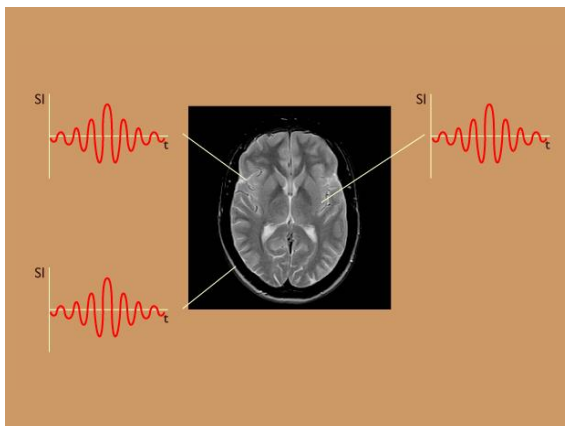
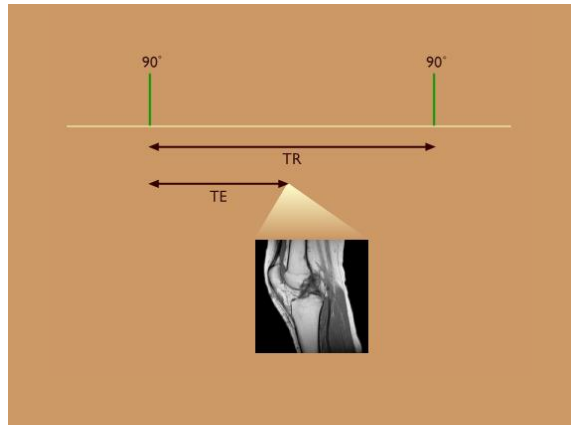
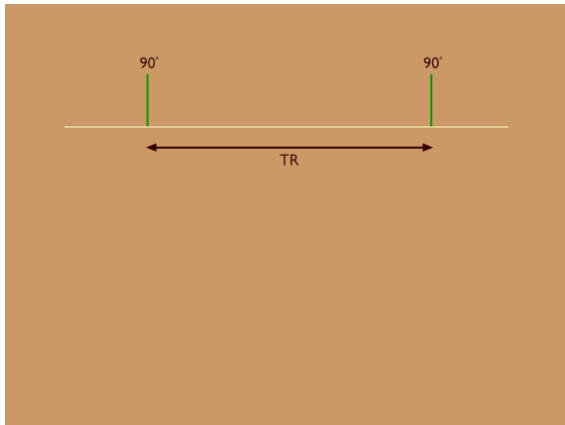
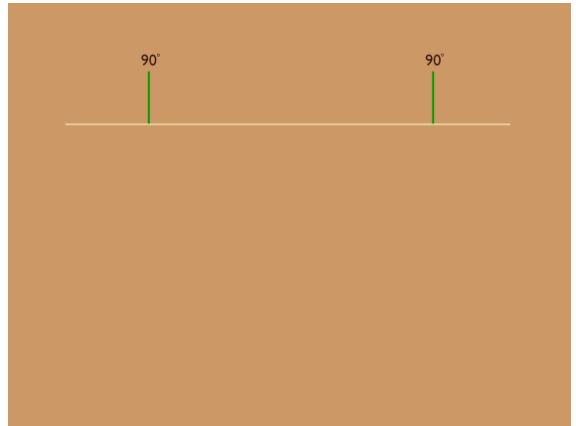
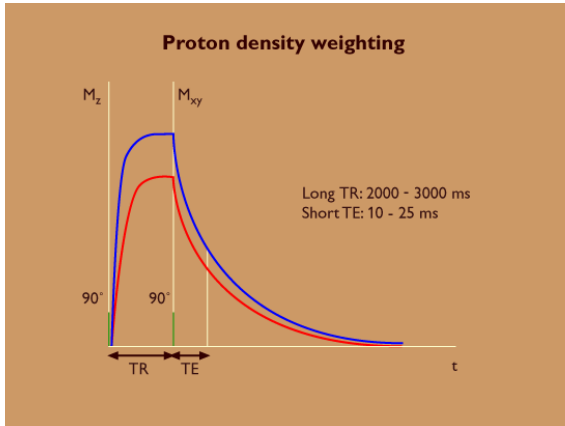
90°

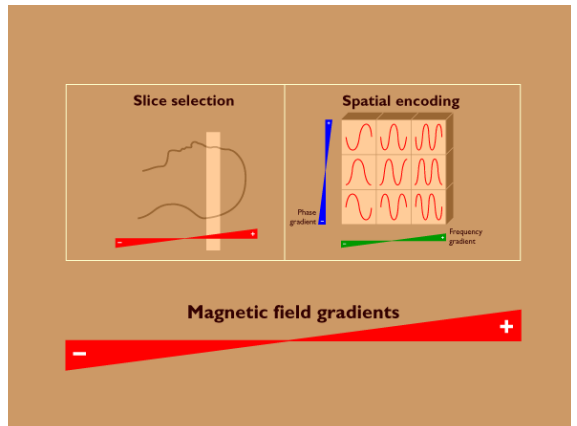
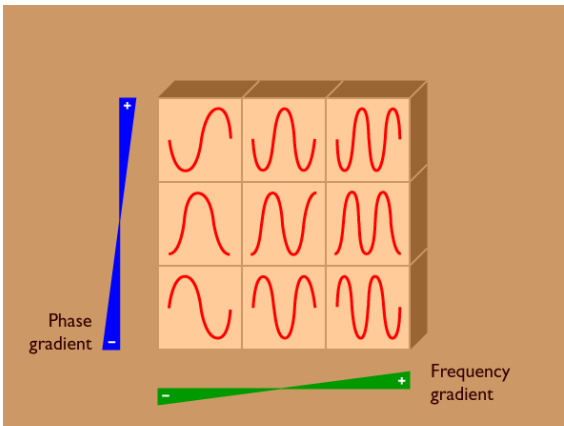
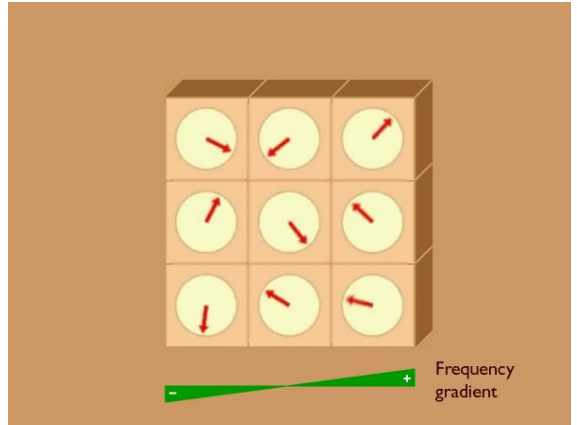
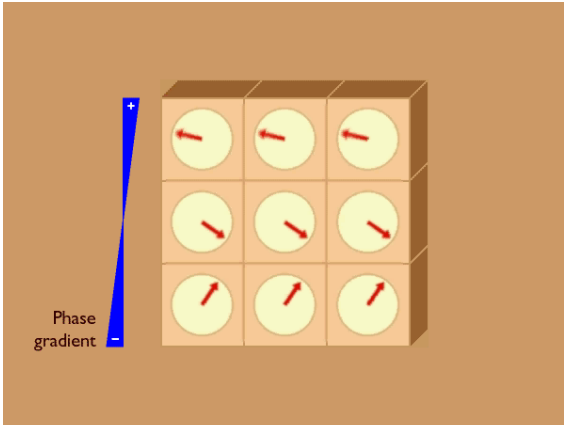
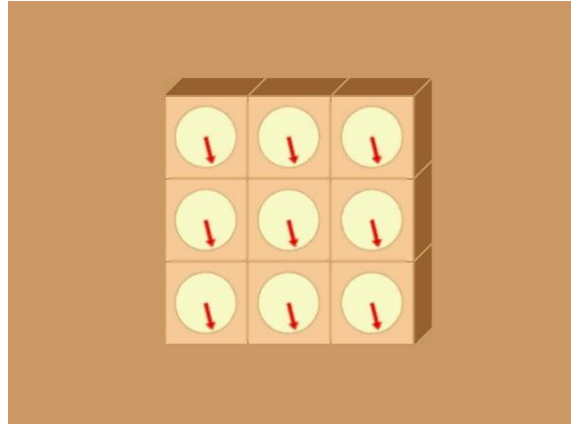
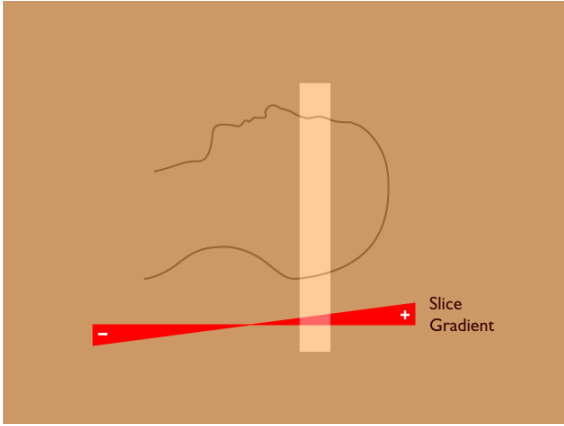
180°

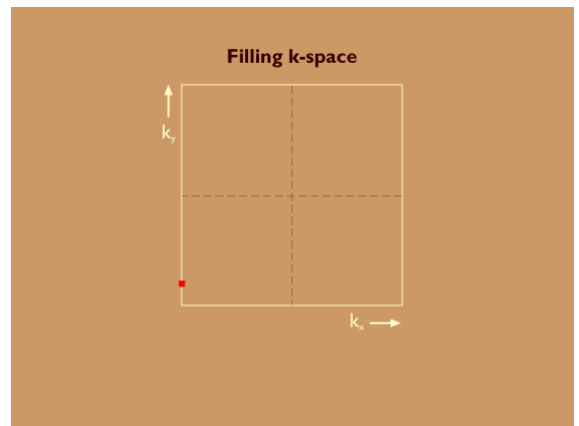
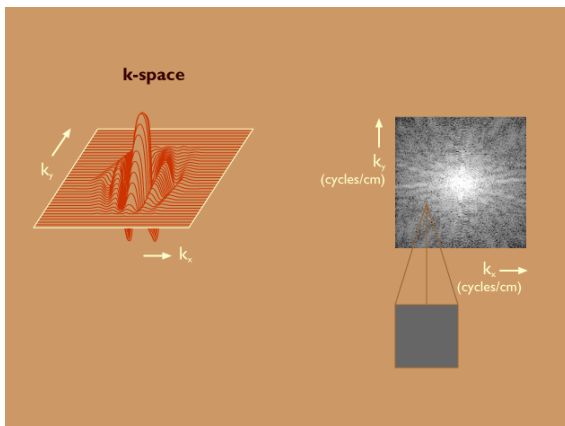
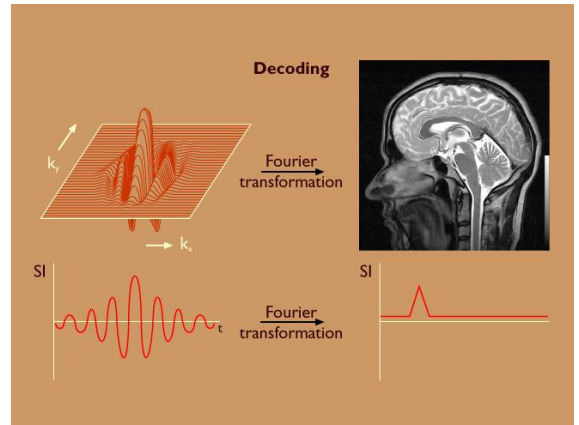
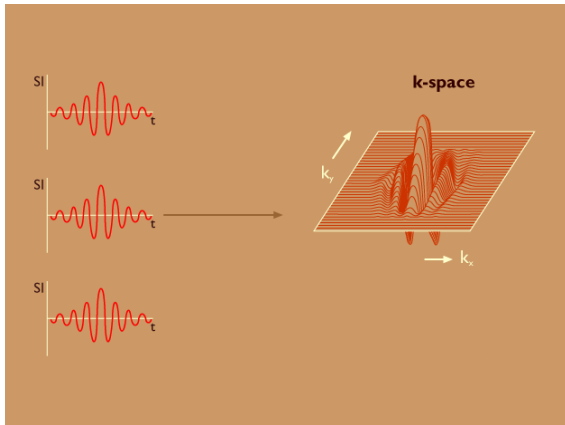
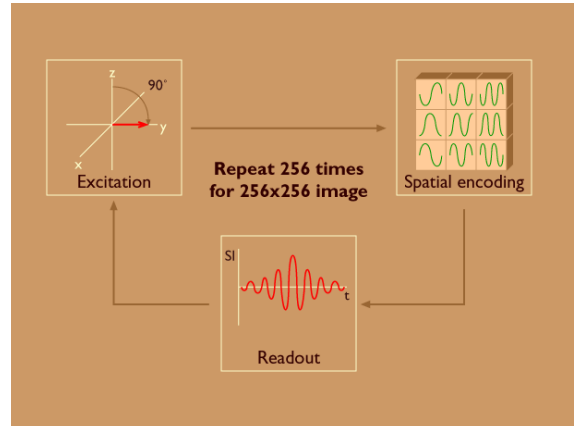
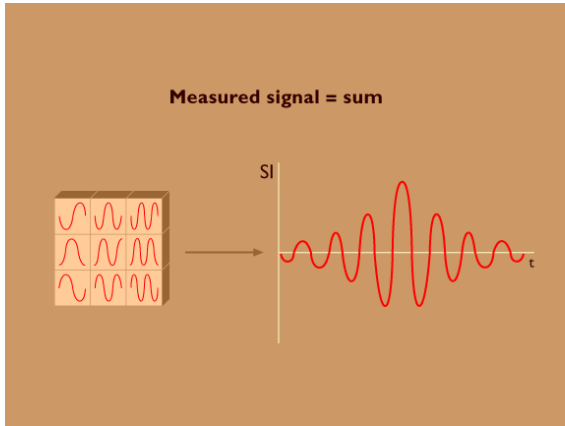
Flip angles

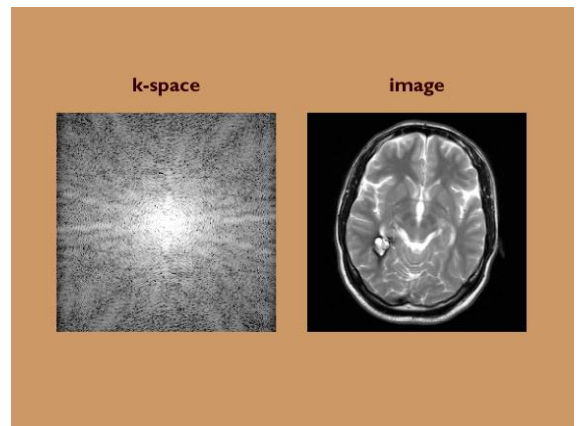
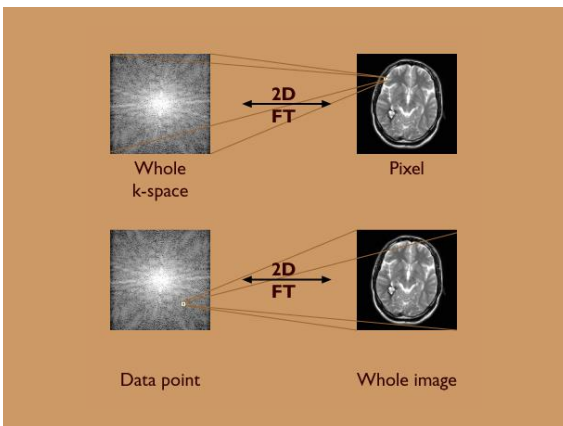
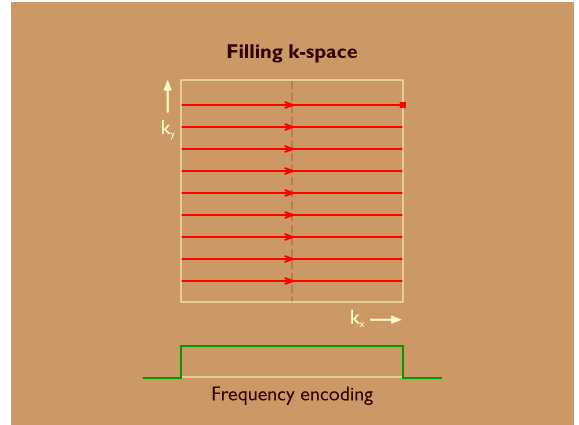
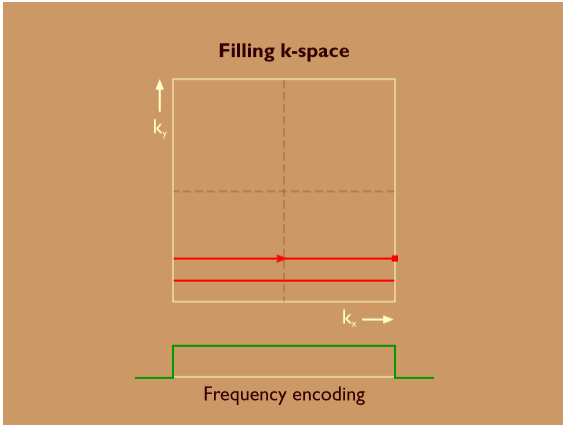
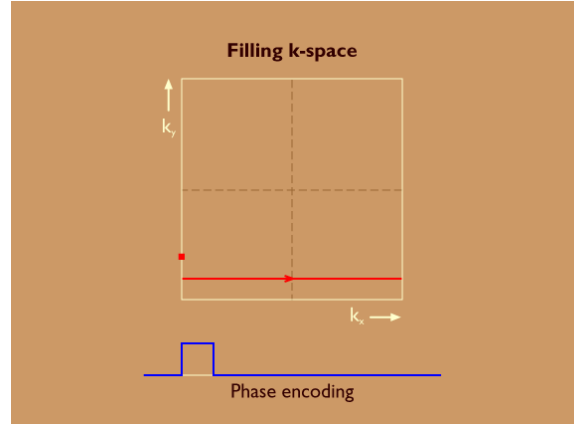
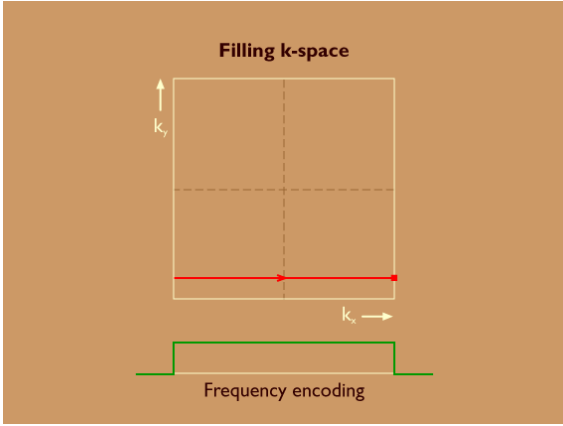


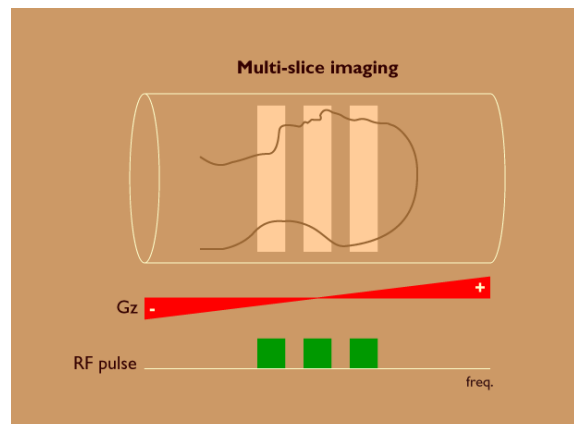
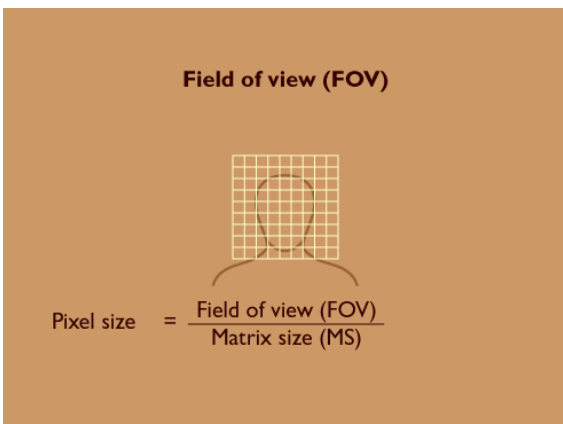
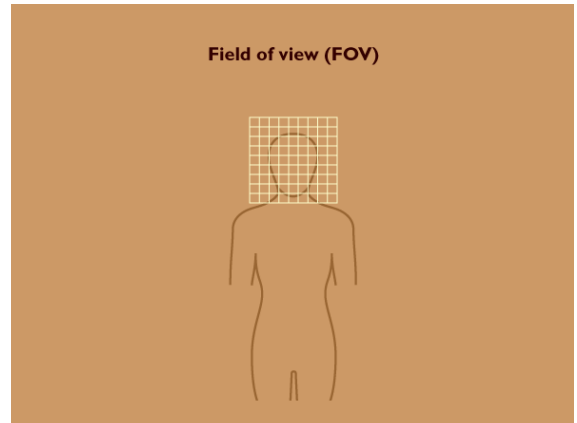
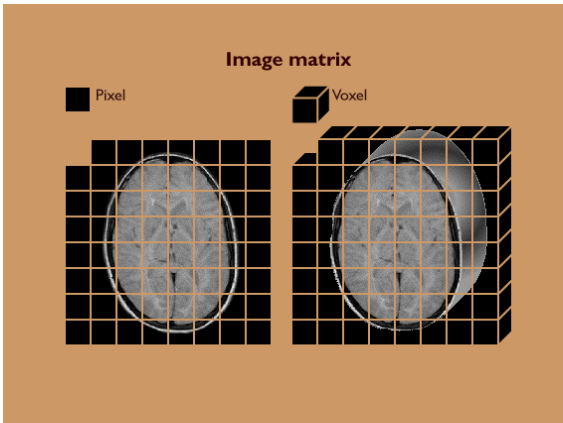
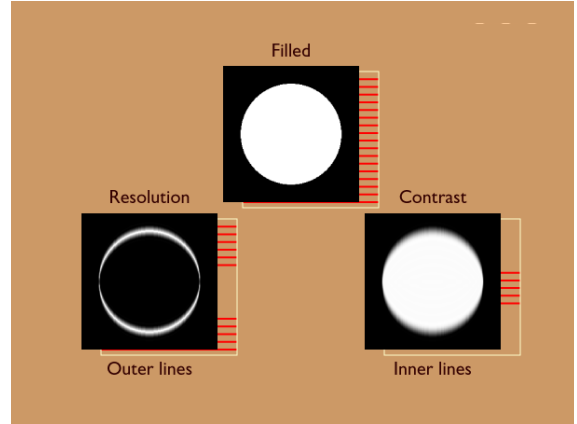
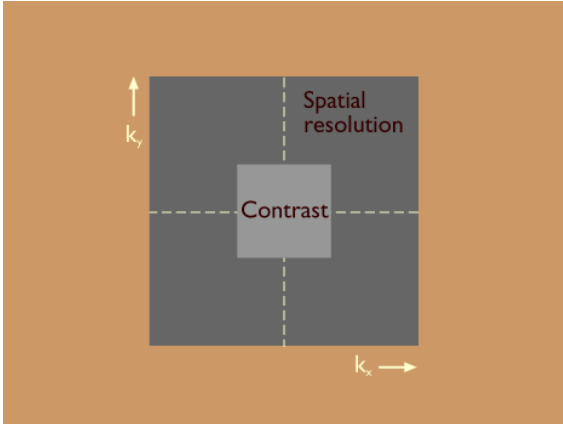


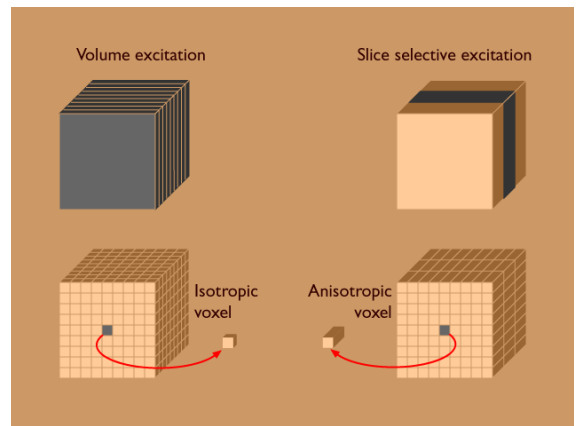
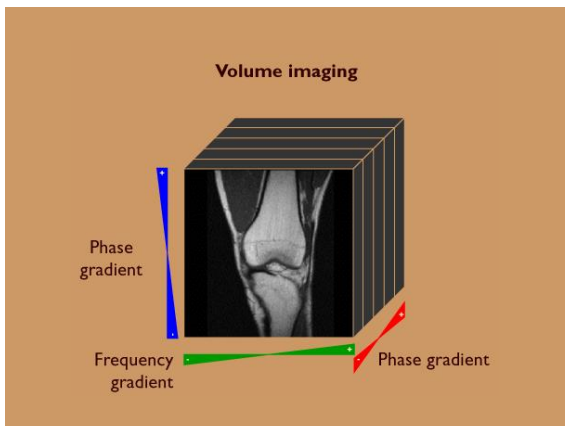
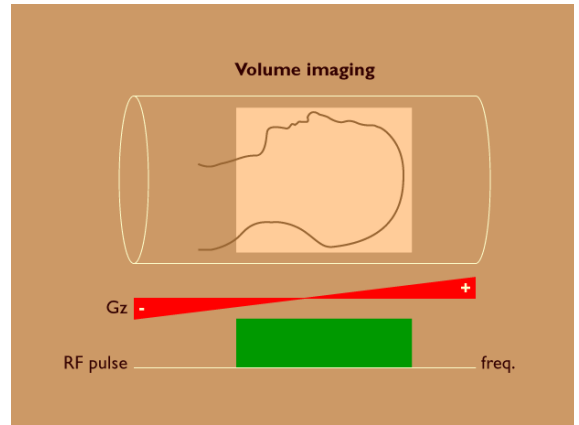
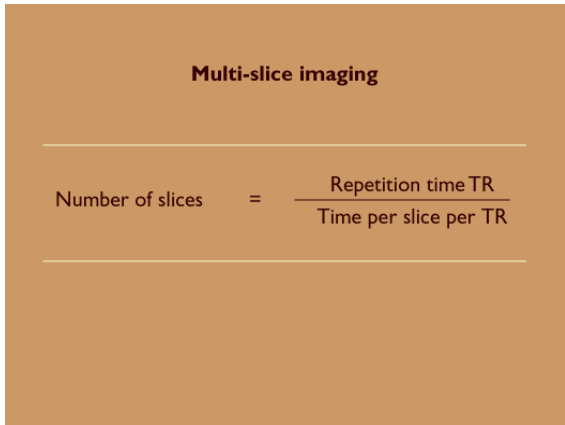
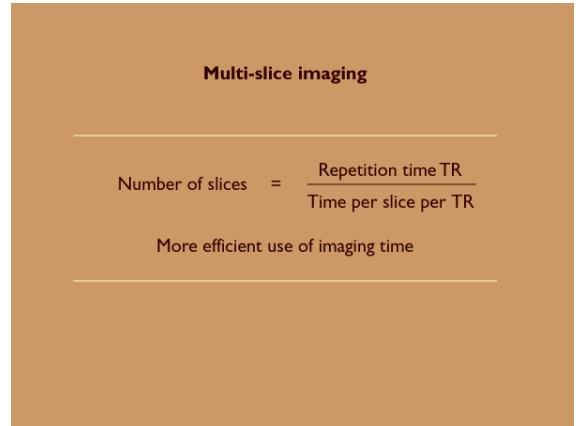
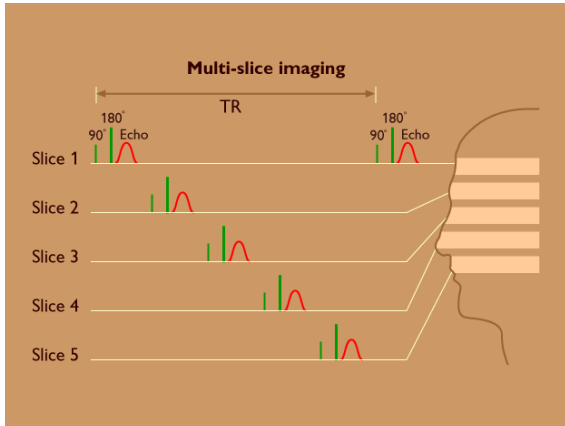












3D scanning

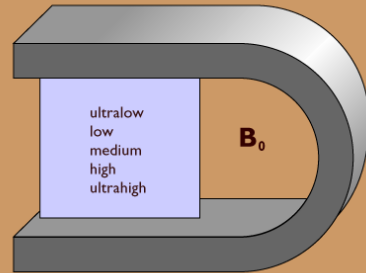
Benefits

- Isotropic voxels
- Rectangular slice profile
- Multiplanar reformatting
- Thinner slices

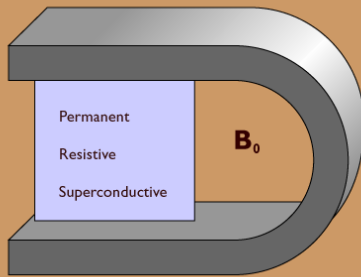
Drawbacks

- Longer scan times
- Increased data processing requirements

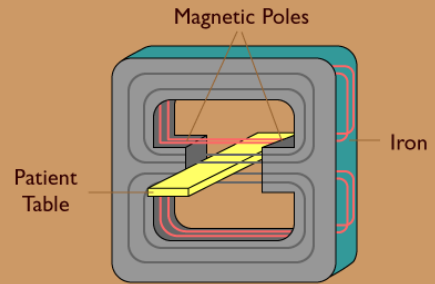
Field strength



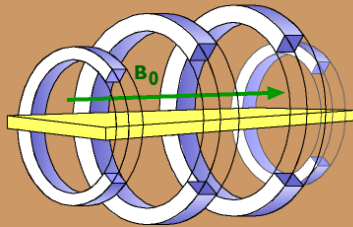
Magnet types



Permanent magnet

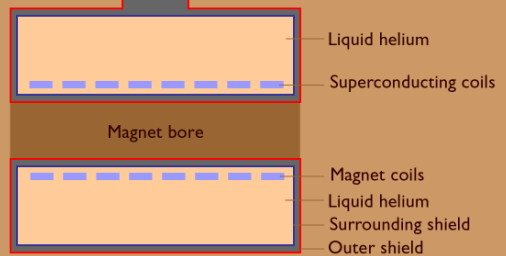


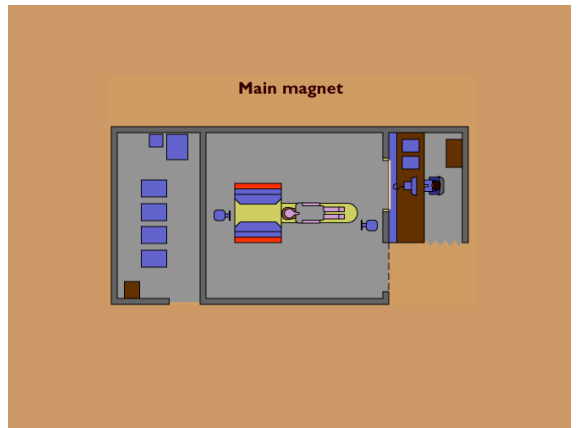
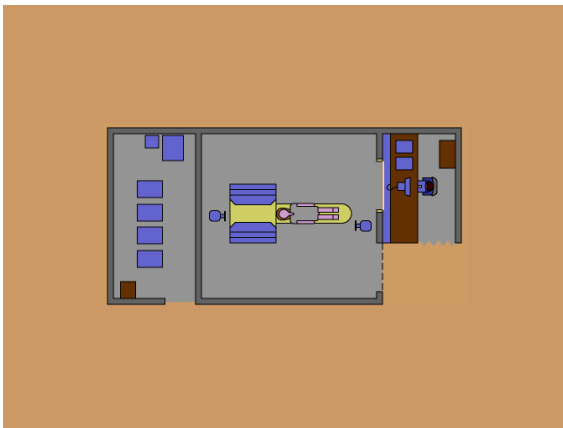
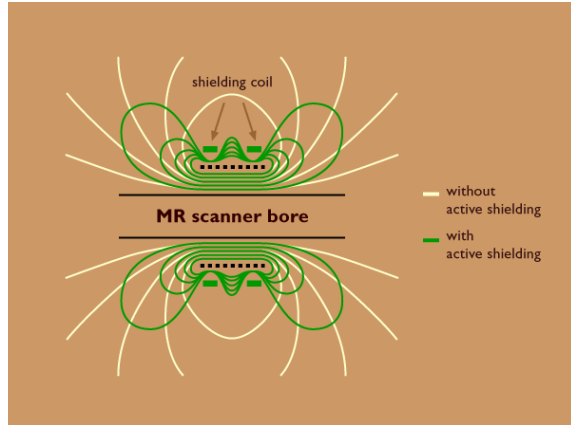
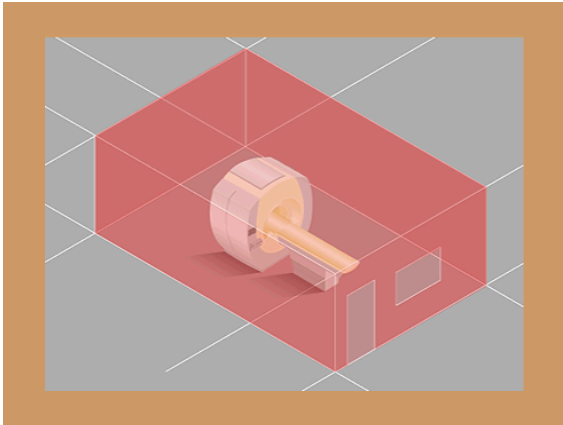
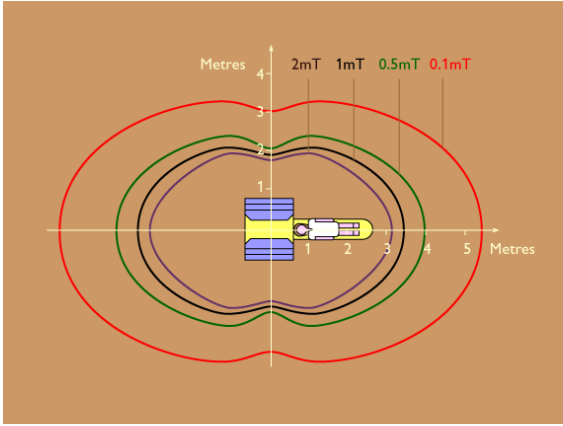
Resistive magnet

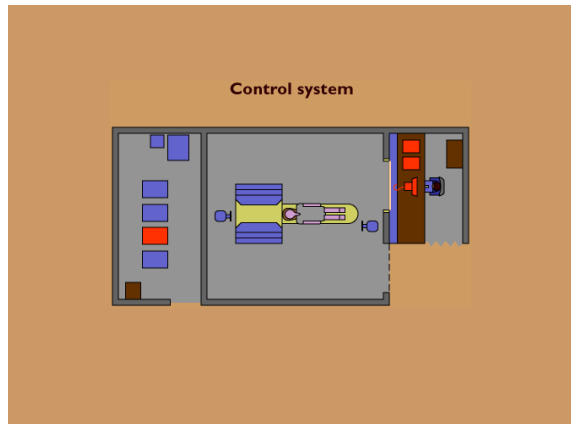
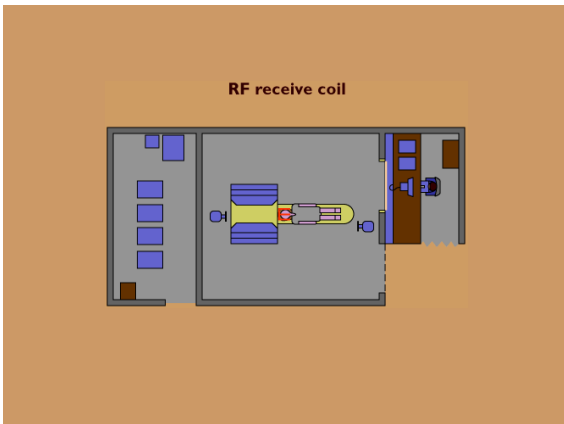
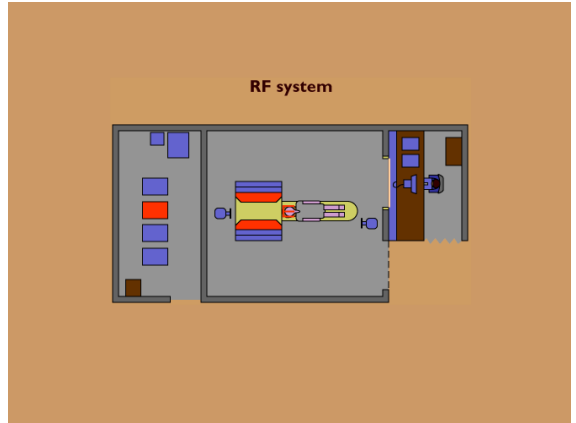
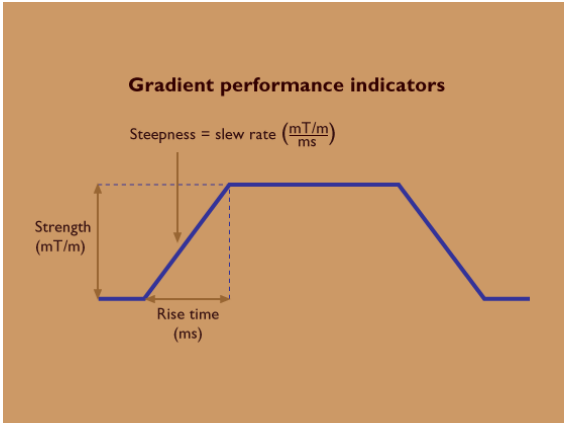
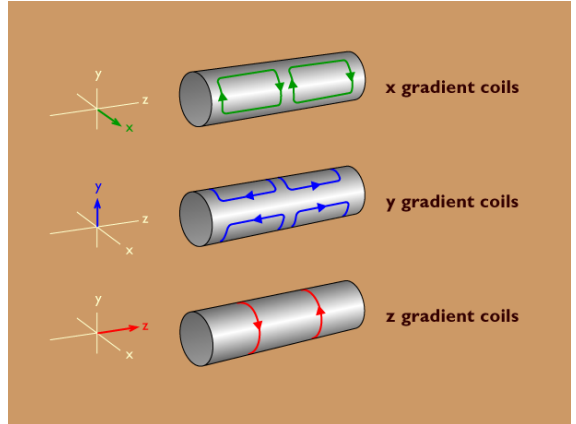
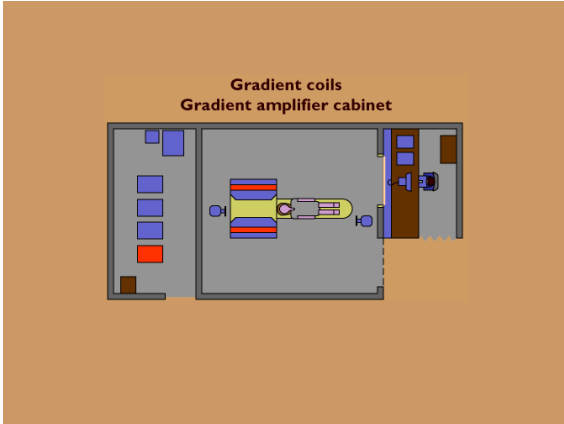


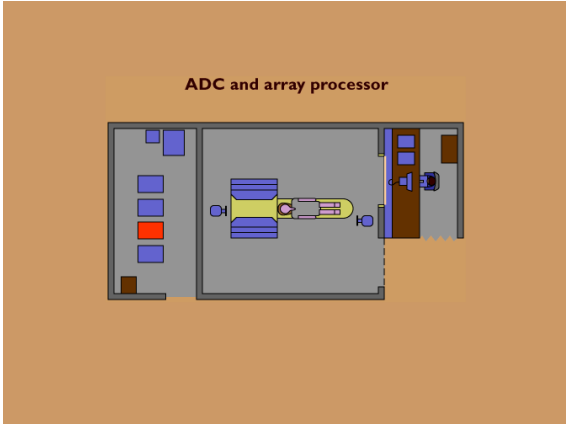
Continuous power supply

Superconducting magnet









Surface coil **Volume coil**

Types: Linear
 Quadrature
 Synergy = phased array

Body coil
 (fixed inside magnet)

Head coil

Circular Rectangular

Extremity Body wrap around

