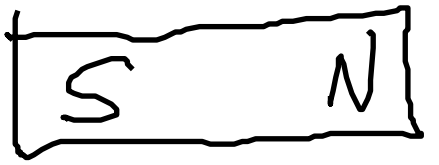
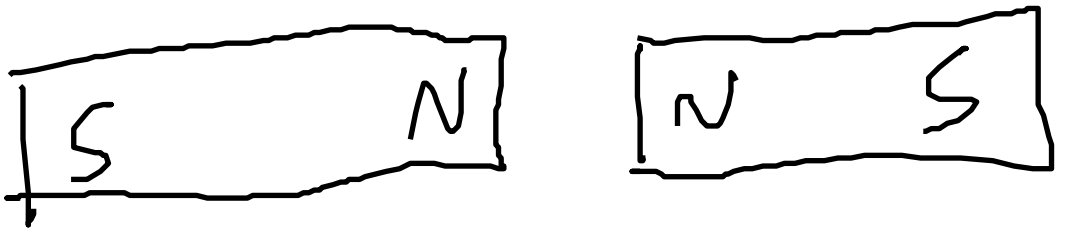
Magnetism

Bar magnets have 2 poles -

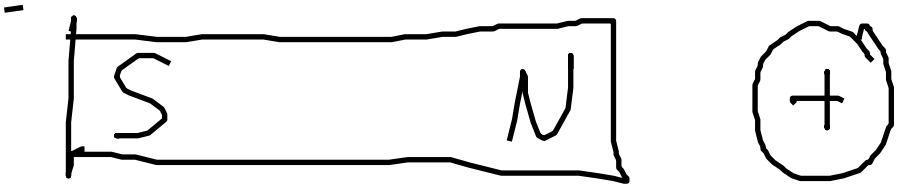


N & S



like poles repel

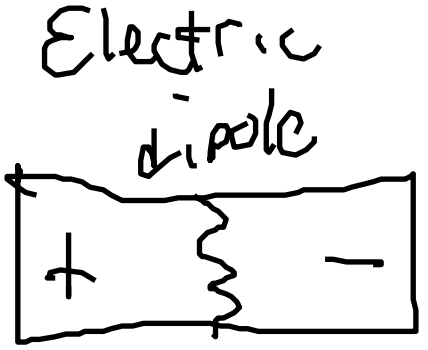
opposite poles attract

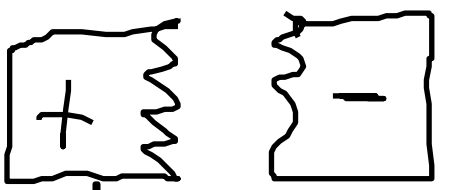


Nothing happens

Poles are not charges

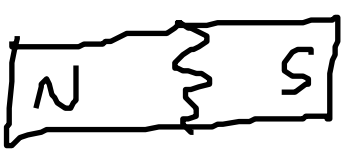
Electric dipole

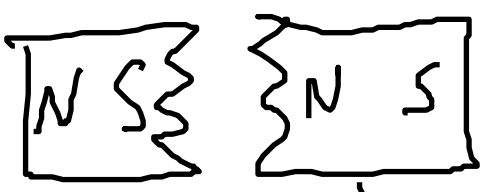




two charges

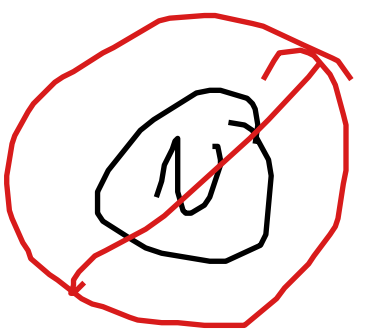
Magnetic dipole





two dipoles

No magnetic "monopoles"



think of magnet as a stack of coins

N & S like heads & tails

Magnetic Field $\vec{B}$

Simplest magnetic object is a dipole

S ⟶ N

like a compass

Strength of $|\vec{B}|$ measured in Teslas $\left(1\,T = 1\,\frac{N}{A_m} = 1\,\frac{V_s}{m^2}\right)$

1 T is roughy the field close to a strong neodymium magnet (in loudspeakers e.g.)

$\vec{B}$ dies away as $\frac{1}{d^3}$ from magnet (dipole field)

1 T is rather large

close to a fridge magnet: 5mT

Earth's field at surface: 50 μT

5×10^{-5} T

MRI machine: 0.5 T - 3T

Research: 60 T

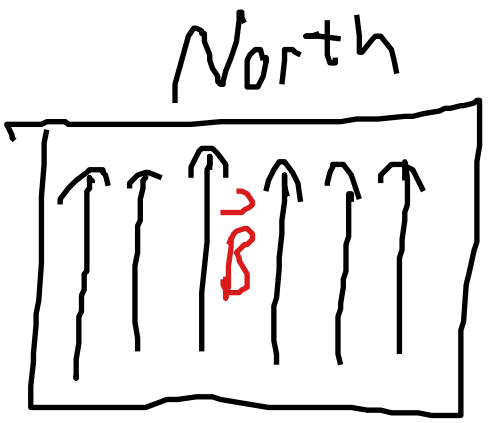
Maximum on earth! 2800 T

(involved explosions)

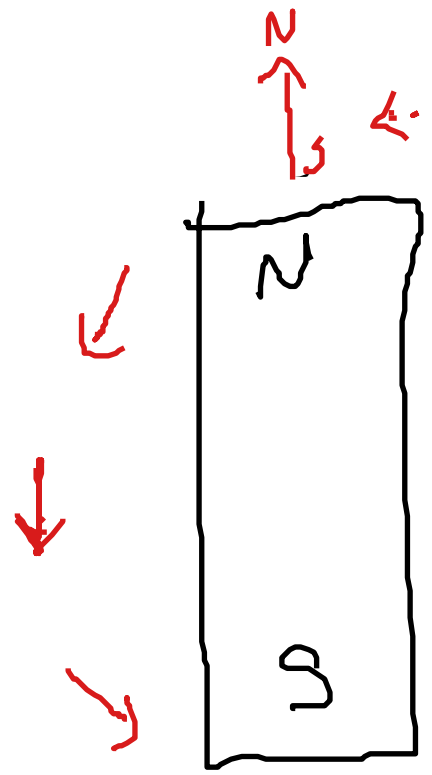
Neutron stars: $10^6 - 10^{11}$ T

Direction of $\vec{B}$

$\vec{B}$ points in direction a compass would point



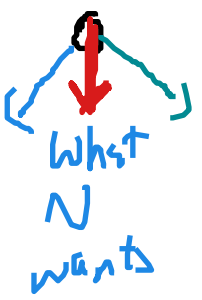
What would a Compass Do?



N is repelled by N

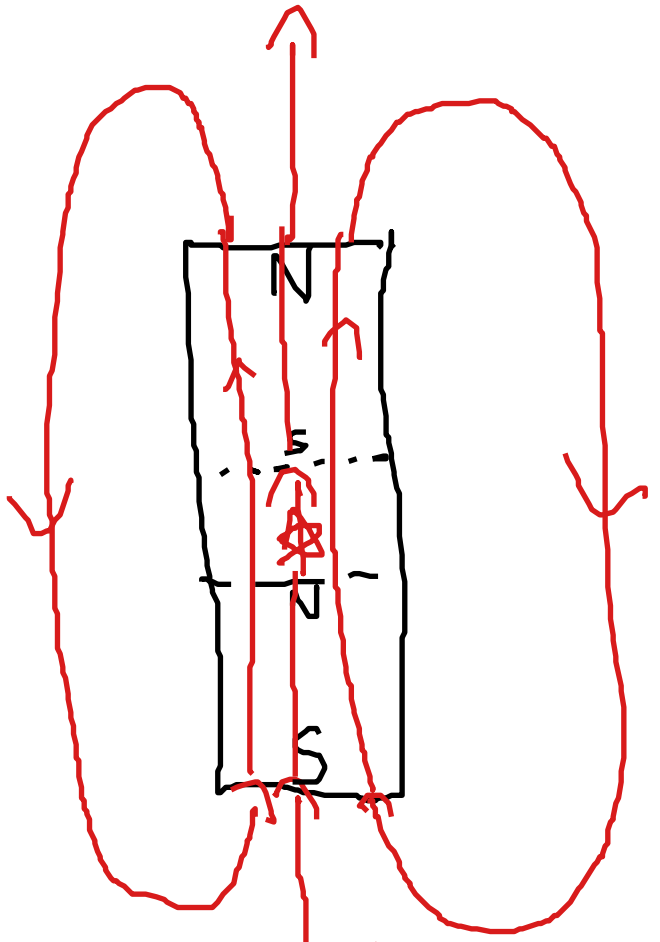
S is attracted to N

points away to make both happy

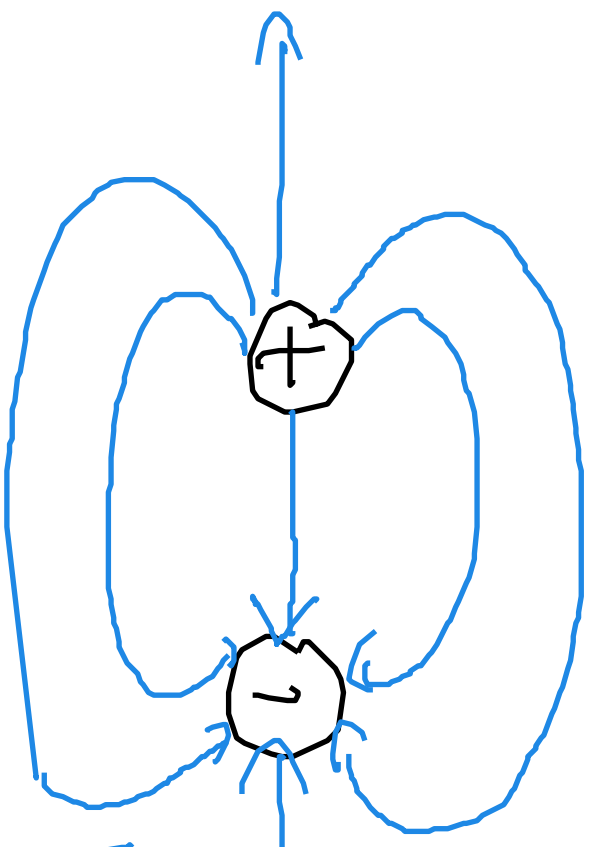


N is attracted to S

S is repelled by S



Magnetic field lines never terminate — loops (no magnetic monopoles)



$\vec{E}$ field lines do terminate at charges