

Physics 100 - February 7, 2007

Make up class - Friday at noon - Hoyt

Presentation Project

Last Time

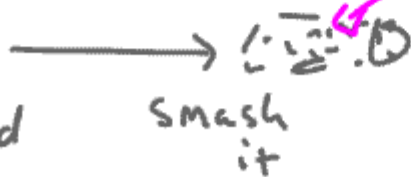
The Atom



Greeks - indestructible building block



Diamond



rip
apart
to smallest
bit

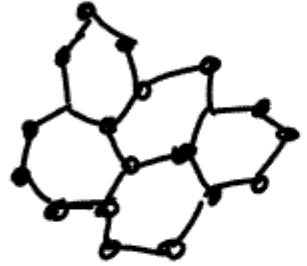
• Carbon ATOM

SAME building block

Carbon atoms arranged as connected
Tetrahedrons (crystal lattice)



→ Diamond



Carbon atoms arranged in planes of
connected hexagons

→ graphite

VAST Amount of evidence supports the idea that
matter is made of Atoms



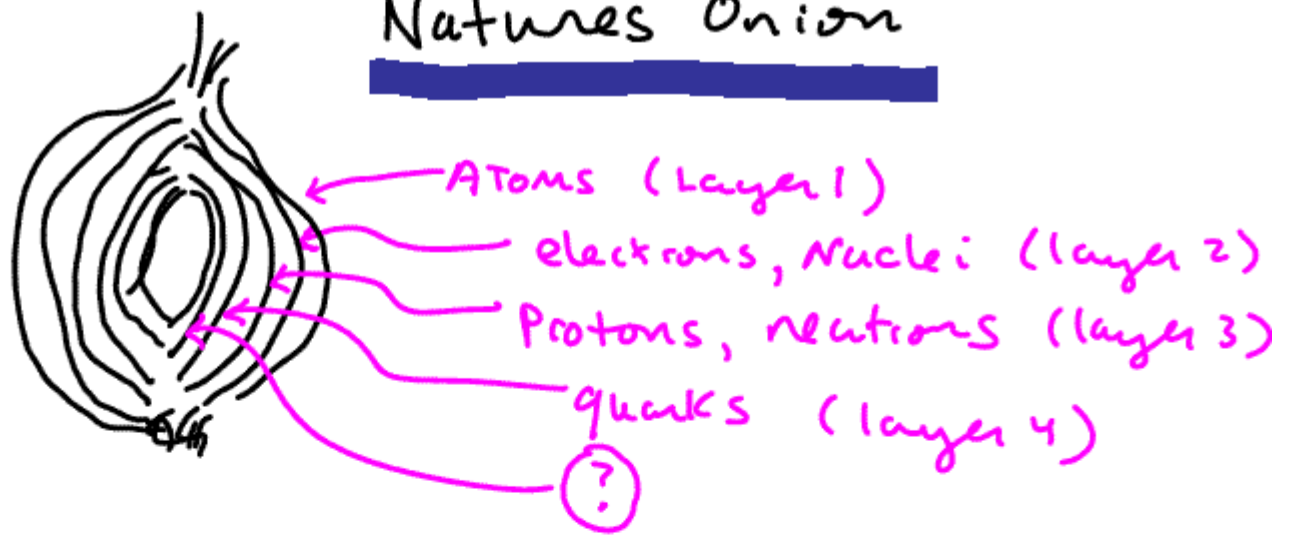
Robert Brown



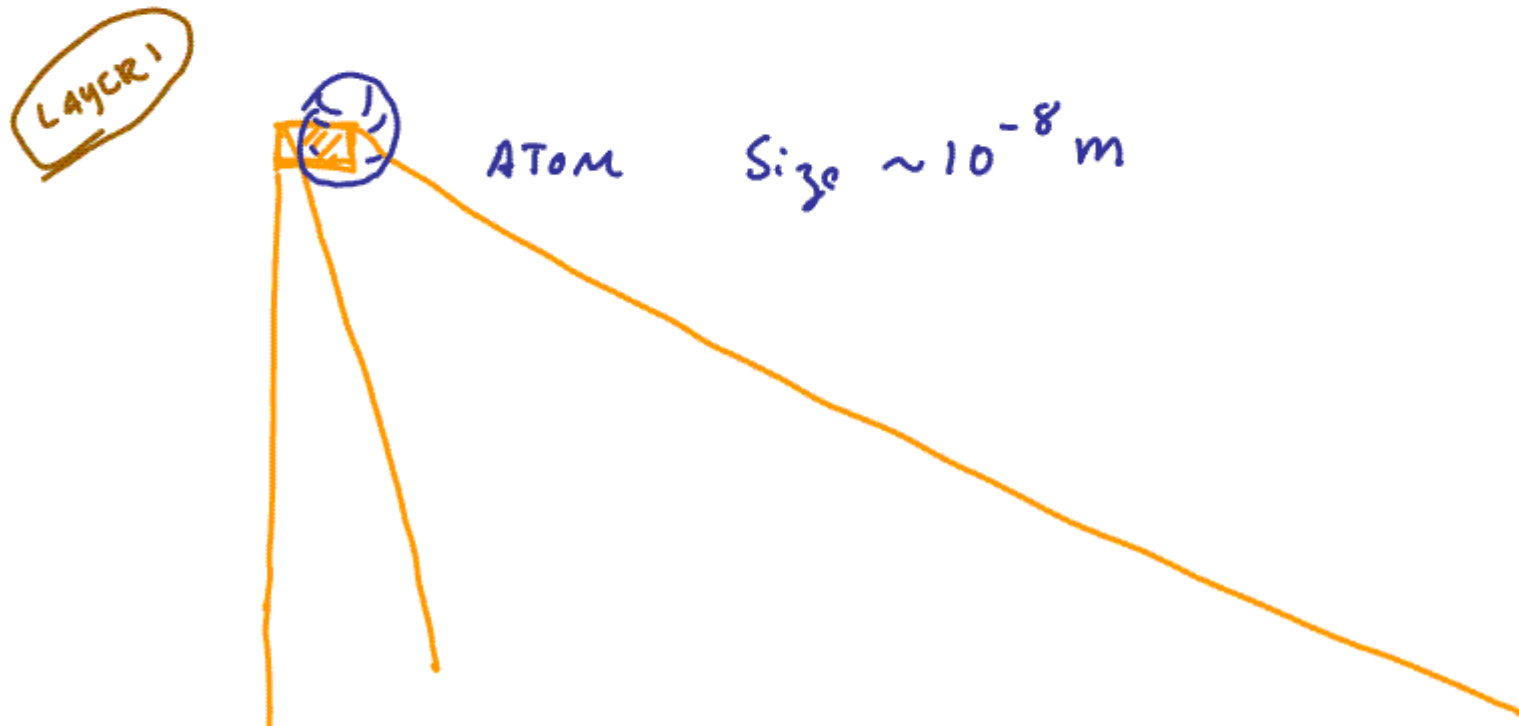
Brownian Motion

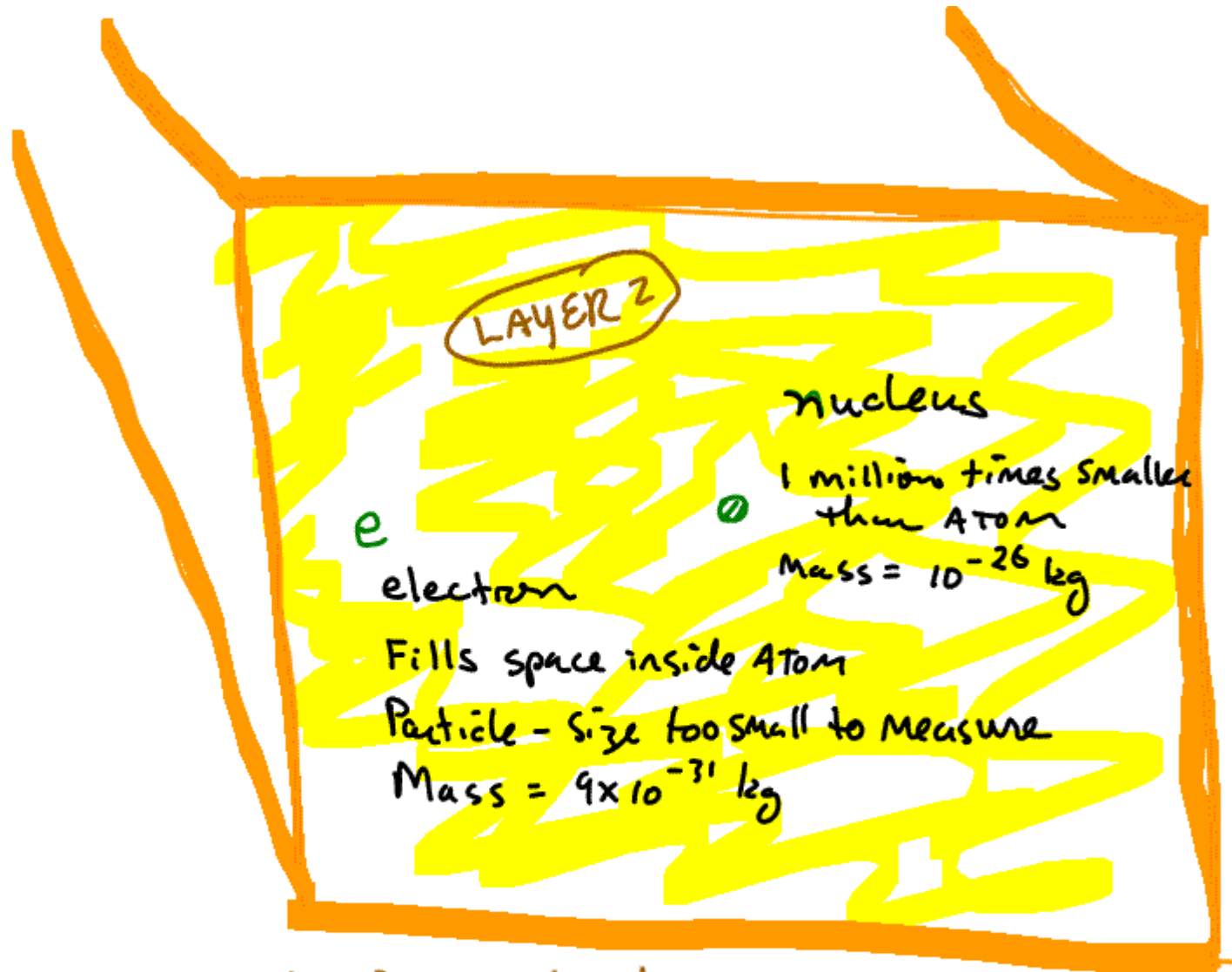
Einstein interpretation
in 1905

Nature's Onion



Let's peel away the layers ...





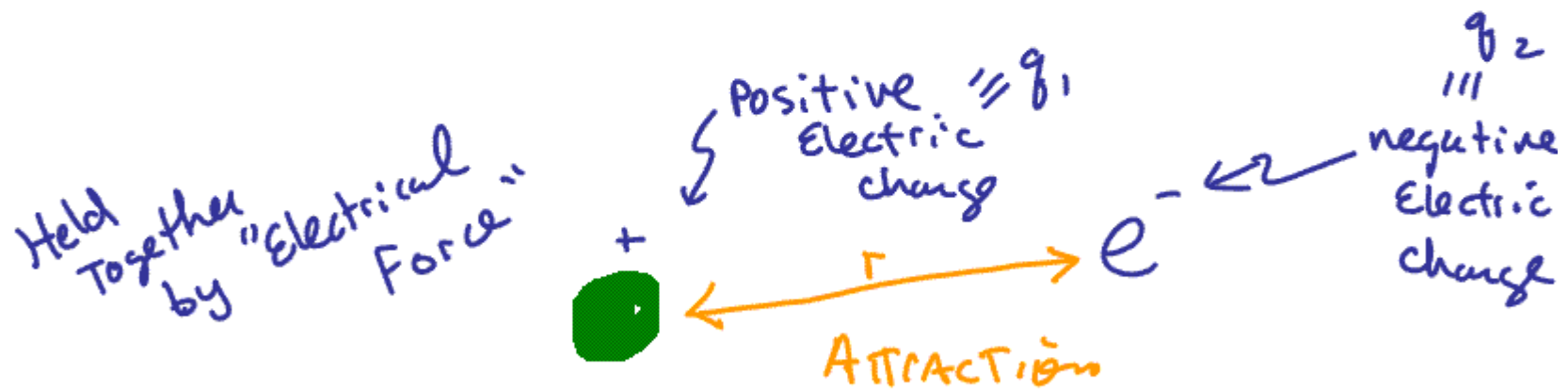
Size :

Will Return to the onion later ...

Atom is to a marble as a baseball to the Earth

Atomic Nucleus is to a marble as something $\frac{1}{100}$ width of human hair is to the earth

Atomic nucleus unimaginably dense

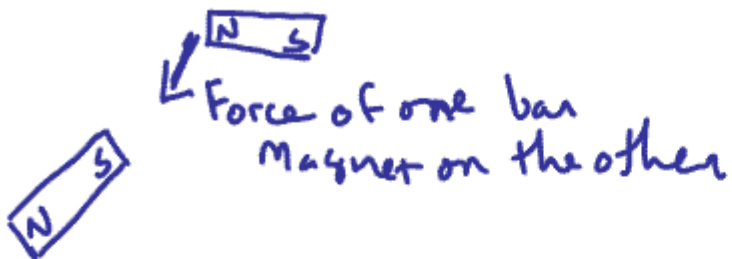


Charles
Coulomb

$$F = \frac{k q_1 q_2}{r^2}$$

magnetism

Magnetic force between bar Magnets



Sodus
10

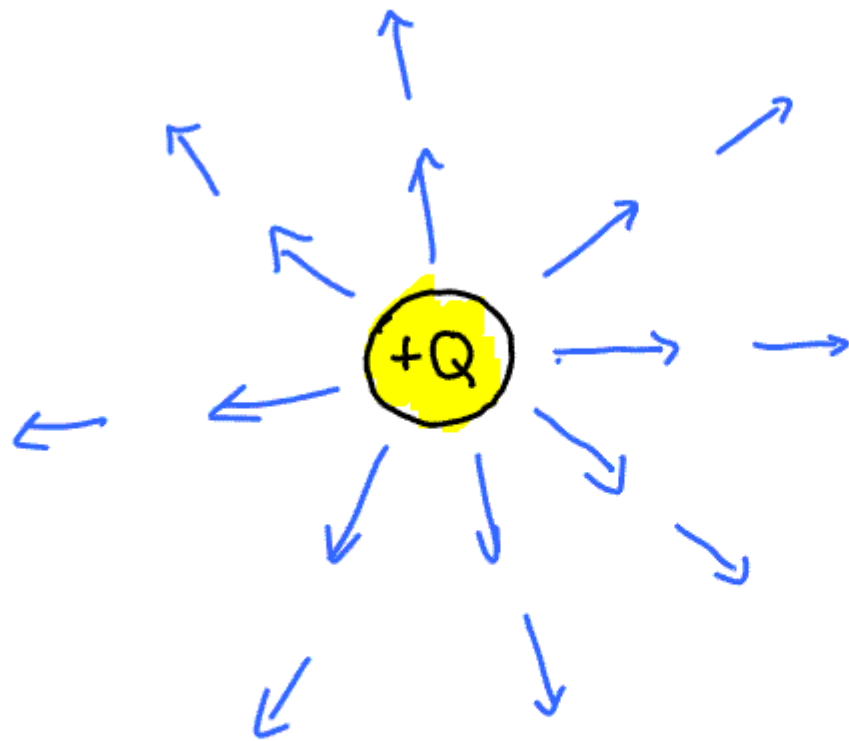
Rochester
2

Fairport
4

Bull
-98

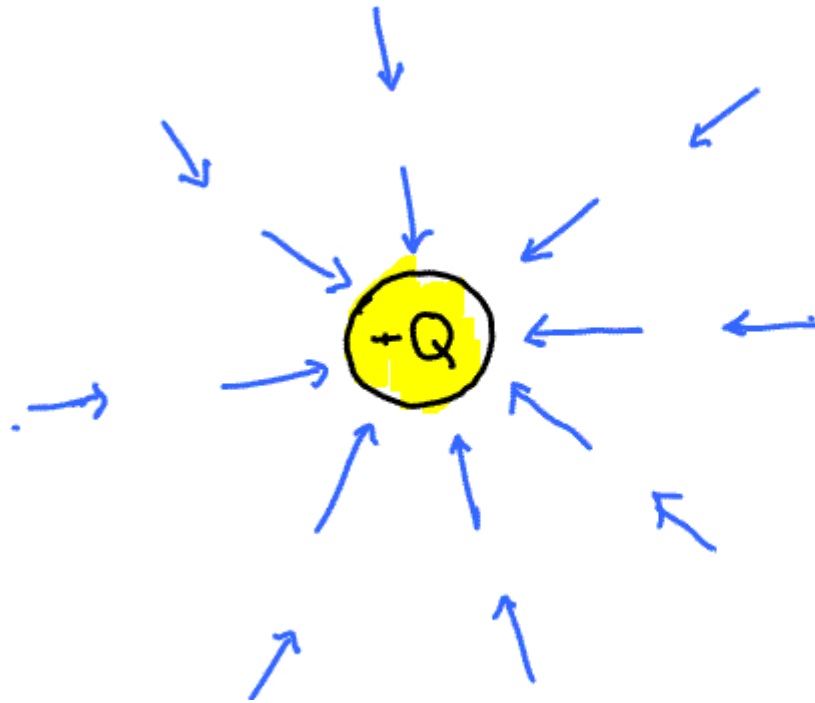
Temperature
Map



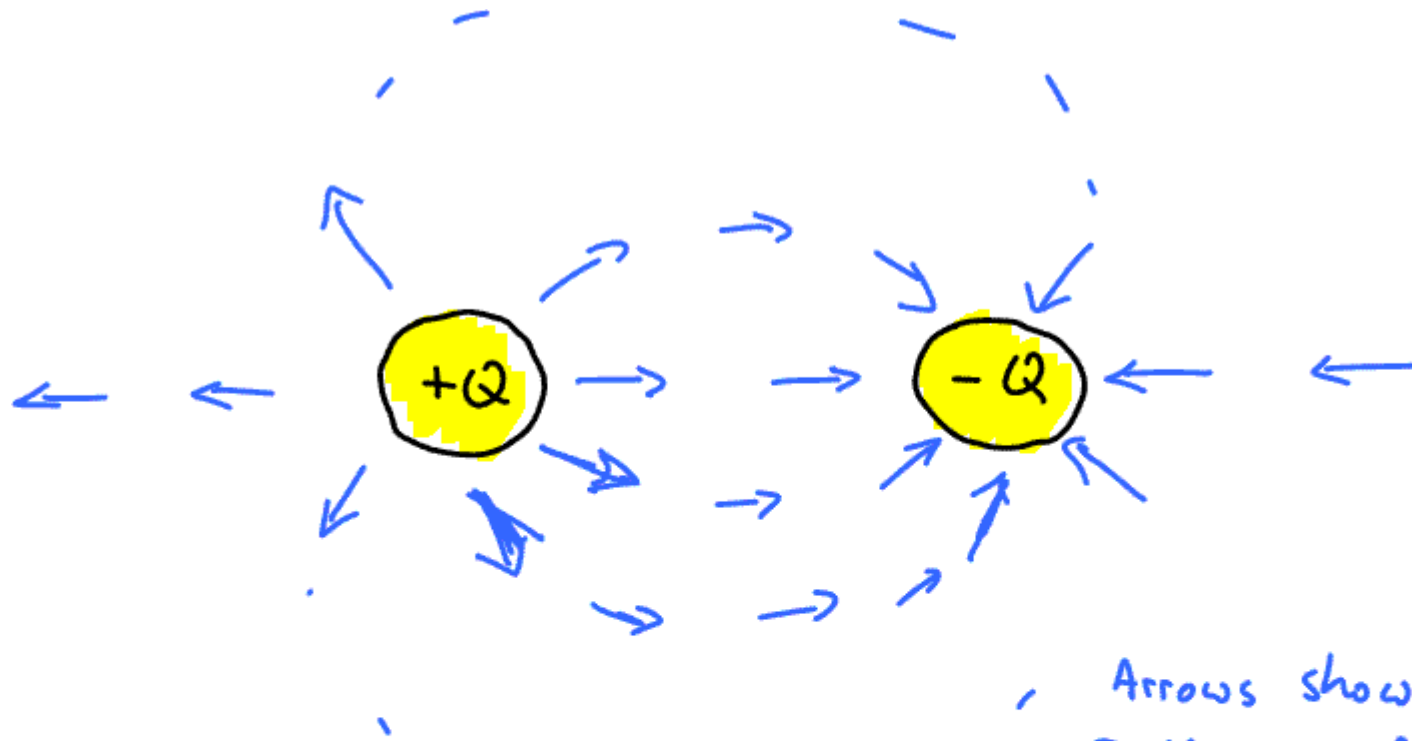


Arrows show
the "electric
field"
of charge Q

Arrows represent the direction and magnitude of
forces on little positive test charges



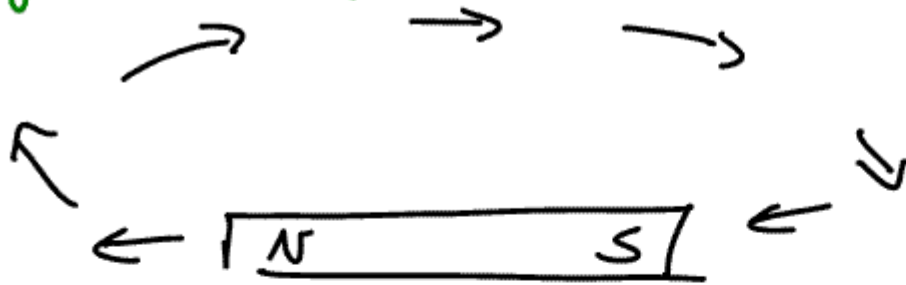
Arrows show
"electric field"
in vicinity of
a negative
electric charge



Arrows show electric field map of this two-charge distribution

Arrows represent the direction and magnitude of force on a little positive "test" charge at that position in space.

CAN play a similar game with magnetic force on a little bar magnet



Magnetic field

Deep relationship between

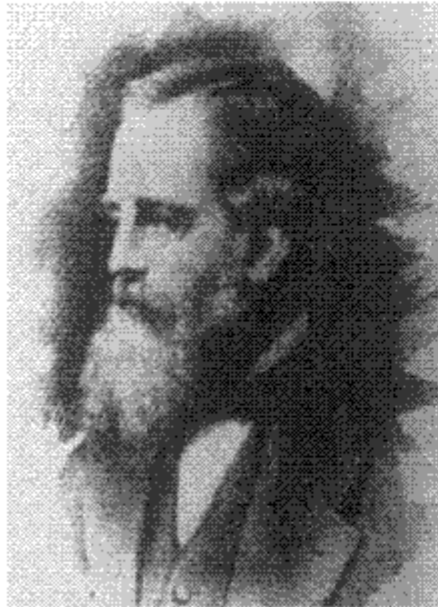
Electric fields $\equiv E$

and

Magnetic fields $\equiv B$

Maxwell's Equations

1873



James Clerk Maxwell

1831-1879 (Edinburgh)

$$\oint_s \vec{E} \cdot d\vec{a} = \frac{Q_{encl}}{\epsilon_0}$$

$$\int_s \vec{B} \cdot d\vec{a} = 0$$

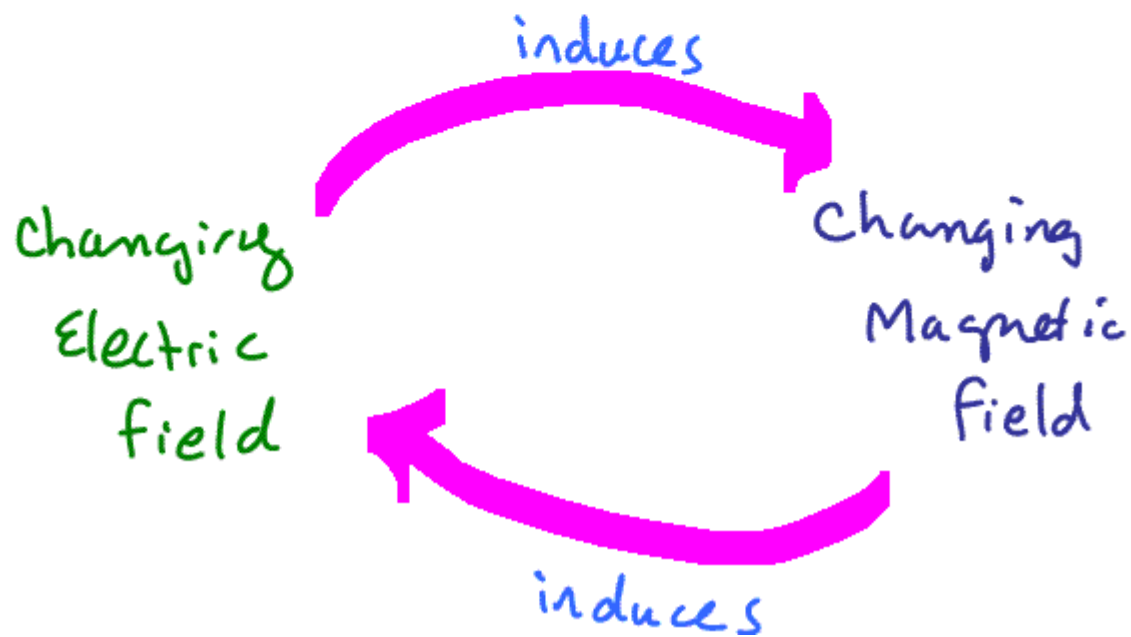
$$\int_c \vec{E} \cdot d\vec{l} = -\frac{d \int_s B \cdot d\vec{a}}{dt}$$

$$\int_c \vec{B} \cdot d\vec{l} = \mu_0 I_{encl} + \mu_0 \epsilon_0 \frac{d \int_s \vec{E} \cdot d\vec{a}}{dt}$$

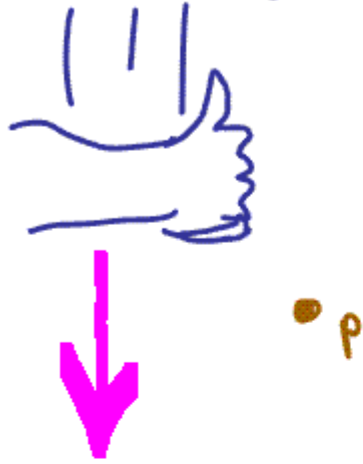
Maxwell's Eqs

illucidate a deep, intimate relationship between
the "electric" and "magnetic" forces
unification \rightarrow electromagnetic force

Also Maxwell's eqns tell us



Fist full of Electric charge



At point P, as fist of charge swoops by, there is a changing electric field.

Maxwell tells us this creates (or induces) a changing magnetic field in the vicinity of P.

This produces a changing electric field . . .
etc.

This cycle of electric and magnetic field creation propagates outward at the speed of light.
In fact . . . This is the essence of light.