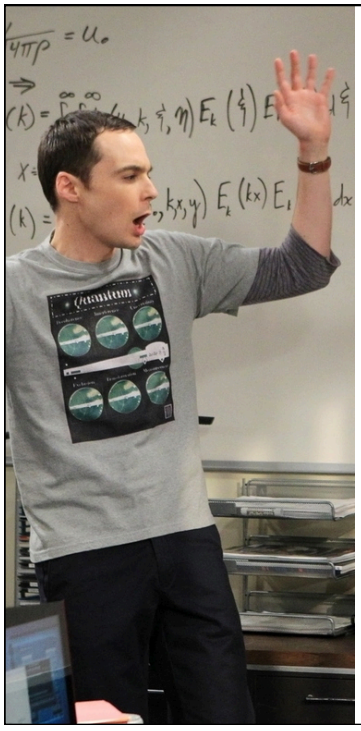
October 10, 2016 Physics 131 Prof. E. F. Redish

- **Theme Music:** Human League
  Together in Electric Dreams
- **Cartoon:** Wiley
  Non Sequitur

10/10/16 Physics 131 **1**



The Equation of the Day

New dimensionality

$$[q] = Q$$

4 **Physics 131**

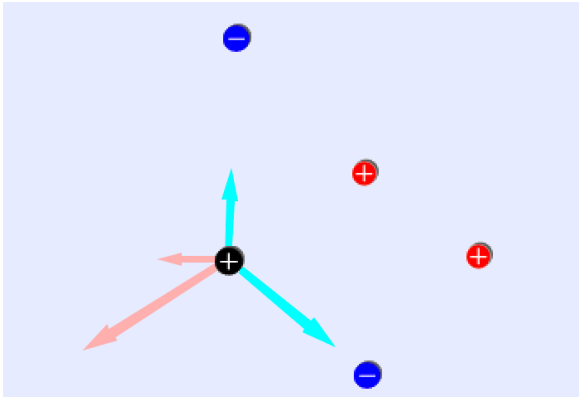
Experiencing Electrostatics

http://phet.colorado.edu/simulations/sims.php?sim=Balloons_and_Static_Electricity

Model: Charge
A hidden property of matter

- Matter is made up of two kinds of electric matter (positive and negative) that have equal magnitude and that cancel when they are together and hide matter's electrical nature.
- Matter with an equal balance is called neutral.
- Like charges repel, unlike charges attract.
- The algebraic sum of postive and negative charges is a constant (i.e, $N_+ - N_- = \text{const.}$)

Exploring charge interactions: Electric Field Hockey



https://phet.colorado.edu/en/simulation/electric-hockey

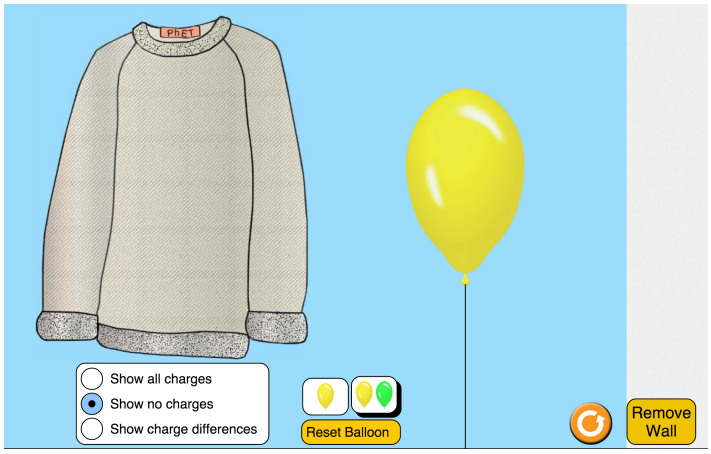
Electric forces: Foothold ideas (basic)

- There are two kinds of charges: + and -.
- Charges of the same type repel each other.
- Charges of different types attract each other.
- The force between charges gets stronger as they get closer, weaker as they get farther away.
- The electric force satisfies Newton's 3rd law.

Conductors and Insulators

- Insulators
  - In some matter, the charges they contain are tightly bound and cannot move around freely.
  - Excess charge put onto this kind of matter tends to just sit there.
- Conductors
  - In some matter, charges in it can move around throughout the object.
  - Excess charge put onto this kind of matter redistributes itself or flows off (if there is a conducting path to ground).
- Unbalanced charges attract neutral matter (polarization)

Exploring charge interactions: Polarization



https://phet.colorado.edu/sims/html/balloons-and-static-electricity/latest/balloons-and-static-electricity_en.html

Quantifying Charge

- Need an operational definition.
- Charge is a new kind of quantity (to M, L, T, add Q).
- Choose our scale:
  A small object has a charge of 1 C (= 1 Coulomb) if two identical such charges held at a distance of 1 m exert forces of 9×10^9 N on each other.

[This corresponds to choosing the constant $k_C = 9 \times 10^9$ N-m^2/C^2.]