- **Theme Music: Maynard Ferguson**

  High Voltage

- **Cartoon: Wiley Miller**

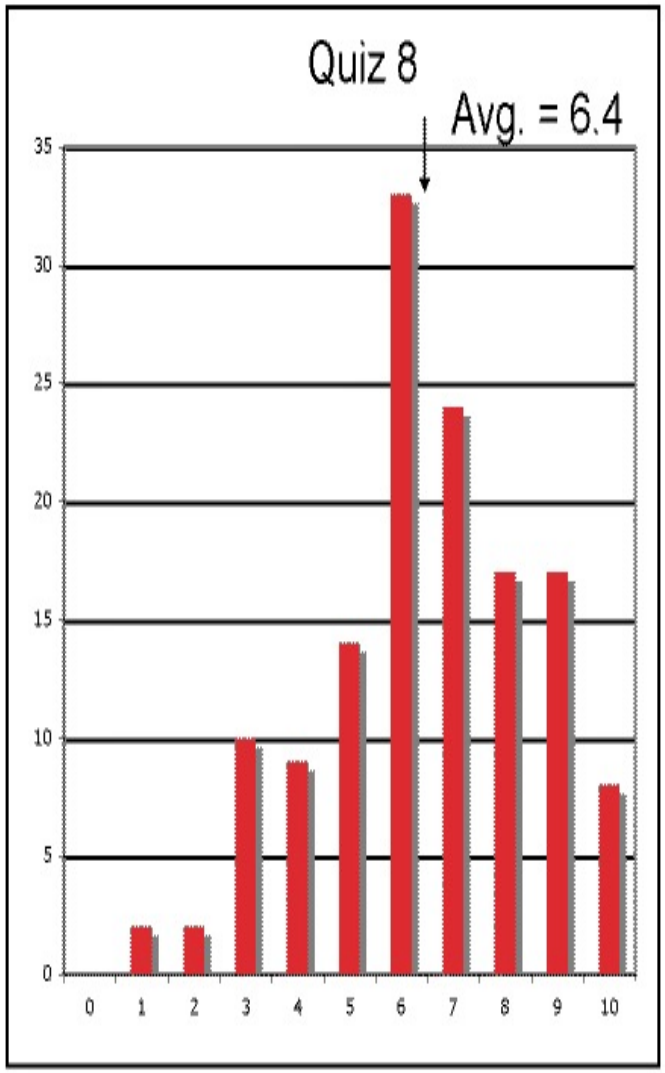
  Non Sequitur

Outline

- Go over Quiz 8
- Electric Potential
- ILD #5: Electrostatic potential and analogies
- Examples

Quiz 8

	8.1		8.2		8.3
a	2%	a>c>b>d	4%	a=b=c=d=e	41%
b	80%	a>c>b=d	15%	a=b>c=d=e	4%
c	7%	b>a>d>c	6%	c>a=b>d=e	16%
d	1%	b>d>a>c	8%	d=e>a=b>c	15%
e	10%	b=d>a>c	6%	a=b>c>d=e	4%
f	0%	c>a>b=d	12%		



Electric potential energy

General case

$$\Delta U_E = -\vec{F}_E \cdot \Delta\vec{r} \qquad \text{(small step)}$$

$$\Delta U_E = -\sum\left(\vec{F}_E \cdot \Delta\vec{r}\right) \qquad \text{(lots of little steps)}$$

$$\Delta U_E = -\int_{start}^{finish} \vec{F}_E \cdot d\vec{r}$$

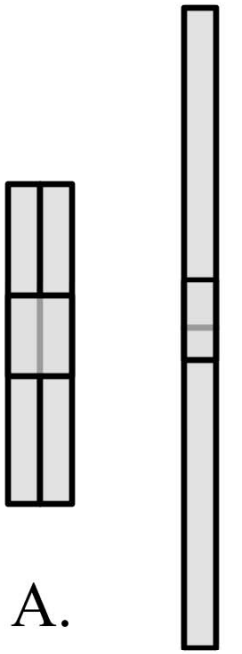
Simplest case (one source charge, one test charge)

$$\Delta U_E = -\int_{start}^{finish} \vec{F}_E \cdot d\vec{r} = -\int_{r_i}^{r_f} \frac{k_C qQ}{r^2} dr = -k_C qQ \int_{r_i}^{r_f} \frac{dr}{r^2} = -k_C qQ\left(\frac{1}{r_i} - \frac{1}{r_f}\right)$$

$$U_E(r) = \frac{k_C qQ}{r}$$

NOT A VECTOR – JUST A NUMBER

ILD #5:
Electrostatic Potential & Analogies



A.

B.

A change in potential energy leads to force

$$\Delta U = -\vec{F} \bullet \Delta \vec{r}$$

$$F = -\frac{\Delta U}{\Delta r}$$

(stepping in the direction of the steepest descent)

- Constant PE → no force
- Change in PE → force (pointing downhill)

Electric Potential

- In the same way that we "removed the test charge" from Coulomb's law to define the electric field, we "remove the test charge" from the electric potential energy to create the electric potential, *V*.

$$\vec{E} = \frac{\vec{F}}{q} \qquad V = \frac{U}{q} \qquad E_x = -\frac{\Delta V}{\Delta x}$$

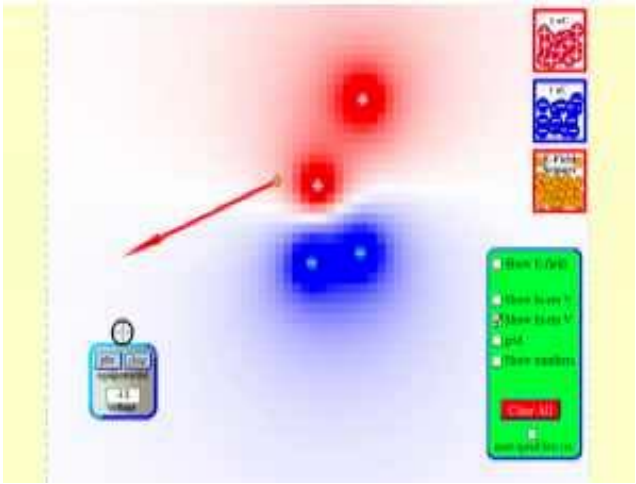
Foothold Ideas: Electric Potential

- For any point in space, $\vec{r}$, the electric potential at the point is the negative of the work required to bring a test charge, from ∞ to $\vec{r}$ divided by q.
- The electric potential is a scalar so it has a sign, but no direction.

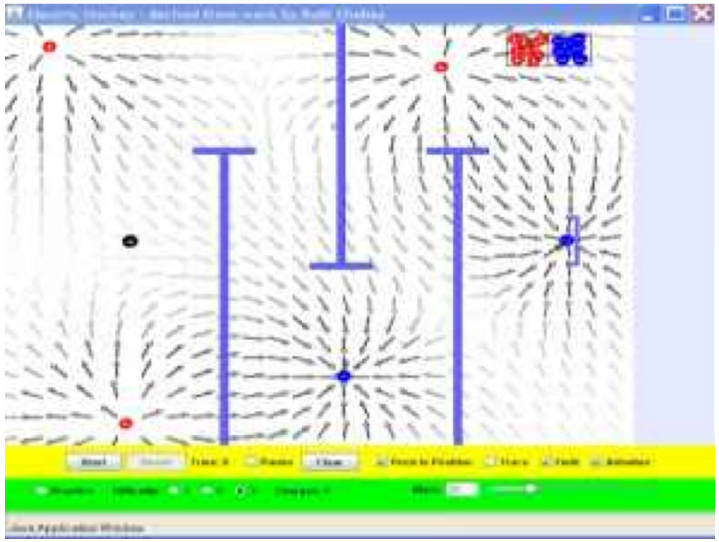
$$V = \frac{U}{q} \qquad E_x = -\frac{\Delta V}{\Delta x} \qquad \Delta V = -\vec{E} \cdot \Delta \vec{r}$$

Explore Potential with PhET Simulations

■ Charges and Fields



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



■ Electric Field Hockey

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