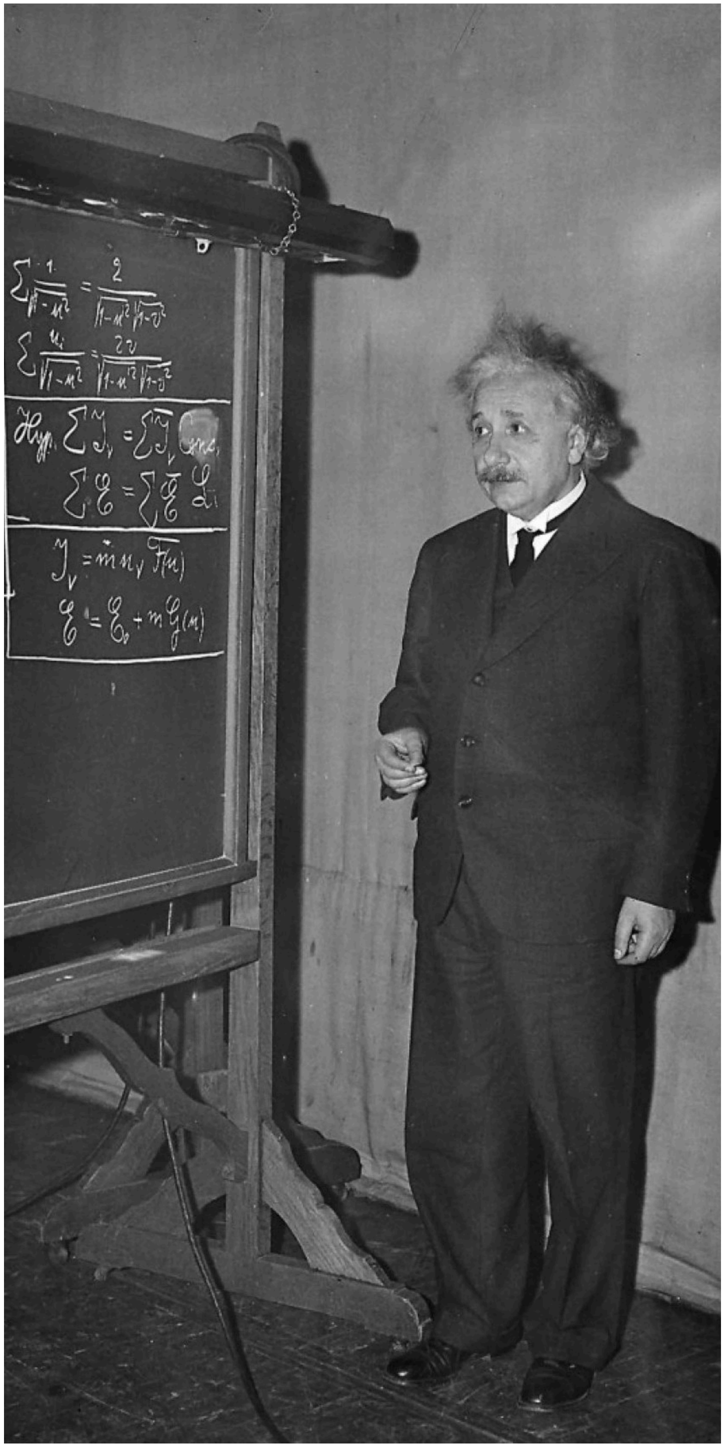
- **<u>Theme Music:</u> Maynard Ferguson**

  High Voltage

- **<u>Cartoon:</u> Wiley Miller**

  Non-Sequitur

What's wrong with this cartoon?



The Equation of the Day

The Electric Potential

$$V\left(\vec{r}\right) = \frac{\Delta U(\vec{r})}{q}$$

$$V\left(\vec{r}\right) = \sum_{j=1}^{N} \frac{k_C q_j}{\left|\vec{r} - \vec{r}_j\right|}$$

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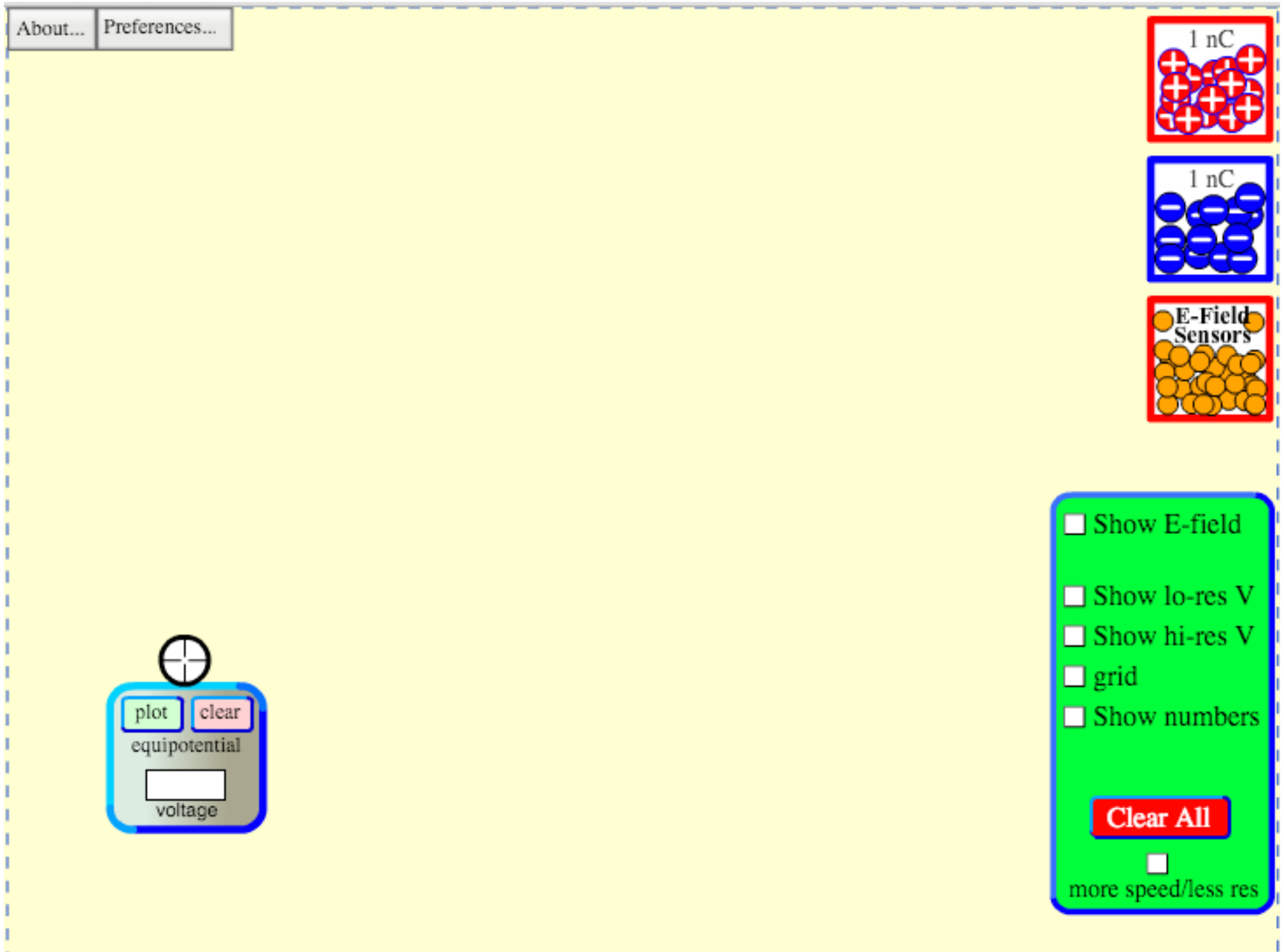
Foothold idea: Fields

- *Test particle*
  – We pay attention to what force it feels.
    We assume it does not have any affect on the source particles.
- *Source particles*
  – We pay attention to the forces they exert and assume they do not move.
- *Physical field*
  – We consider what force a test particle would feel if it were at a particular point in space and divide by its coupling strength to the force. This gives a vector at each point in space.

$$\vec{g} = \frac{1}{m}\vec{W}_{E\to m} \qquad \vec{E} = \frac{1}{q}\vec{F}_{\text{all charges}\to q} \qquad V = \frac{1}{q}U^{elec}_{\text{all charges}\to \text{q}}$$

Explore the potential near a point charge



https://phet.colorado.edu/sims/charges-and-fields/charges-and-fields_en.html

The electric potential

- The electric potential is a tricky concept.
- The electric potential at a given point is NOT the “electric energy per charge”.
- It is the EXTRA electric energy added if a test charge is placed at that given point divided by the amount of that charge.

$$U = \sum_{i>j=1}^{N} \frac{k_C q_i q_j}{r_{ij}}$$

$$U_0\left(\vec{r}\right) = \sum_{i>j=0}^{N} \frac{k_C q_i q_j}{r_{ij}} = q_0 \sum_{j=1}^{N} \frac{k_C q_j}{r_{0j}} + U$$

$$\Delta U(\vec{r}) = q_0 \sum_{j=1}^{N} \frac{k_C q_j}{r_{0j}}$$

$$V\left(\vec{r}\right) = \frac{\Delta U\left(\vec{r}\right)}{q_0} = \sum_{j=1}^{N} \frac{k_C q_j}{r_{0j}}$$

Foothold ideas: Electric potential energy and potential

- The potential energy between two charges is $$U_{12}^{elec} = \frac{k_C Q_1 Q_2}{r_{12}}$$

- The potential energy of many charges is $$U_{12\ldots N}^{elec} = \sum_{i<j=1}^{N} \frac{k_C Q_i Q_j}{r_{ij}}$$

- The potential energy added by adding a test charge q is $$\Delta U_q^{elec} = \sum_{i=1}^{N} \frac{k_C q Q_i}{r_{iq}} = qV$$