



## Electric Fields vs. Potential

Charges influence their surroundings. They do so *at a distance* and *instantaneously*. How can two charges be attracted to each other or repelled by each other with no time for the information to travel between them? Gravity works this way as well. There's no "Wile E. Coyote moment" where you look down and realize you have to fall now. The effect or force of gravity is instantaneous. With electrical charges, we explain this by saying that they alter the space around them somehow, so that when another charge (or an unsupported object) enters that space, the response occurs immediately. Two models to describe how this happens developed:

FIELD	POTENTIAL
<ul style="list-style-type: none"> <li>● <b>field lines</b></li> </ul> <p>→ expressed as a vector: magnitude and direction</p> <p>→ direction is which way a positive test charge would move based on attraction and repulsion of nearby charges</p> <p>→ tied to a location: if you change the location, the magnitude and direction can both change</p> <ul style="list-style-type: none"> <li>● <b>use to describe/explain electric force</b></li> </ul> <p>→ <math>E = \frac{kq_{\text{source}}}{r^2}</math></p> <p>→ <math>F_E = \frac{kq_{\text{source}}q_{\text{object}}}{r^2} = Eq_{\text{object}}</math></p>	<ul style="list-style-type: none"> <li>● <b>absolute potential</b></li> </ul> <p>→ expressed as a scalar: magnitude but <i>no direction</i></p> <p>→ tied to a location: if you change the location, the absolute potential can change</p> <ul style="list-style-type: none"> <li>● <b>use to describe/explain electric energy</b></li> </ul> <p>→ <math>V = \frac{kq_{\text{source}}}{r}</math></p> <p>→ <math>PE_E = \frac{kq_{\text{source}}q_{\text{object}}}{r} = \Delta Vq_{\text{object}}</math></p> <p>absolute potential is most useful in calculating <b>potential difference</b> between two locations: <math>\Delta V = V_f - V_i</math></p> <p>→ potential difference = voltage</p> <p>→ we see potential difference show up in circuits</p>

We can convert from one view of electricity to the other:

$$V = Ed$$

(Multiplying by  $d$ , the distance from the source changes the "r<sup>2</sup>" from FIELD to "r" in POTENTIAL.)

