21.4: Electric Field and Electric Forces

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Def: A charged object produces an electric field around itself. The electric field is a property of space that mediates the electromagentic force, and it is a vector field.

Def: To find what an electric field looks like at a point, we place a **test charge** within the field, which is an imaginary point with negligible mass, and a known charge.

The force exerted on a charged object a by an electric field is given by the equation:

$$\vec{F_a} = q_a \vec{E}$$

where q is the charge of the object and $\vec{E}$ is the electric field vector at the location. The unit of electric field magnitude is N/C (newtons per coulomb).

In the case of a test charge, y substituting the force vector with Coulomb's Law, we get $\frac{1}{4\pi\varepsilon_0}\frac{|q \cdot q_0|}{r^2} = q_0\vec{E}$, and simplifying, we get

$$|\vec{E}| = \frac{q}{4\pi\varepsilon_0 r^2}$$

and we can multiply it by a unit vector pointing from the point charge to the test charge, $\hat{r}$, to get the direction of the field vector as well.