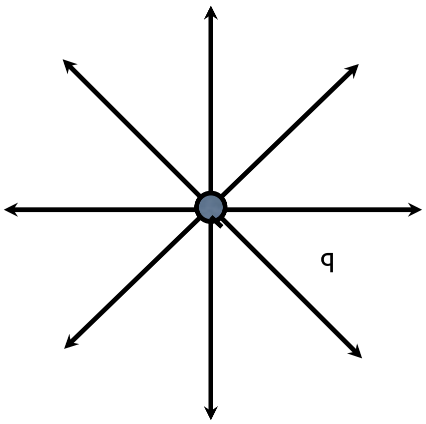
ELECTRIC FIELDS

Place a single, “field-producing” charge out in space.



That charge will generate an *electrical disturbance* in the region around it.

To detect the disturbance, place a “test charge” in the region. As long as the disturbance is there, the test charge will feel a force on it.

If you measure the force on the test charge q, then divide by the size of the test charge, you will end up with a force-related quantity (F/q) that is dependent upon:

--the size of the field-producing charge (the bigger the charge, the bigger the force), and
--the distance from the field-producing charge (the farther away, the smaller the force)

That quantity would additionally have NOTHING TO DO with the size of the *test charge*.

Example: Two point charges in proximity to one another will feel a force between them given by the Coulomb relationship

$$F = k\frac{Q\,q}{r^2}\ ,$$

where “k” is a constant, “Q” is one charge, “q” is the other charge, and “r” is the distance between the two charges.

For the sake of amusement, let' s divide the "q" quantity out of that relationship. That would yield:

$$\frac{F}{q} = k\frac{Qq}{r^2} \Big/ q$$

leaving us with

$$\frac{F}{q} = k\frac{Q}{r^2}$$

Notice first that the function is dependent upon:

--the size of the field-producing charge
--the distance from the field-producing charge

That quantity would additionally have NOTHING TO DO with the size of the *test charge*.

Notice also that the function is really telling us how much FORCE PER UNIT CHARGE is *available* at point "r" . . . whether there is a test charge at the point to feel the effect or not.

This kind of function--the FORCE PER UNIT CHARGE available at a point in space close to a field-producing charge--is called an ELECTRIC FIELD function.

In summary, the magnitude of an electric field function evaluated at a particular point in space is numerically equal to the ratio:

$$E = \frac{F}{q} \, ,$$

where "q" is the size of the test charge that feels the force "F" when put at the point of interest.

Summary: electric field vectors are modified force fields.

Minor Point: the direction of an electric field evaluated at a particular point is DEFINED as the direction a *positive charge* would accelerate if placed at the point of interest and released (assuming all other forces had been turned off)

And lastly, lastly, it certainly wouldn't be the case if we were talking about a single point charge, but it is possible to generate an electrical disturbance, hence an electric field, that changes in magnitude and time in space.

Example: The electric field generated by a radio transmitting antenna (we'll talk more about this shortly).