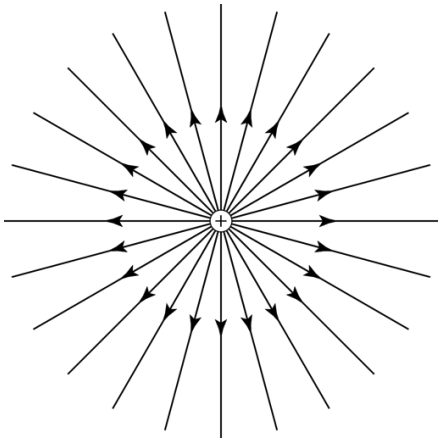
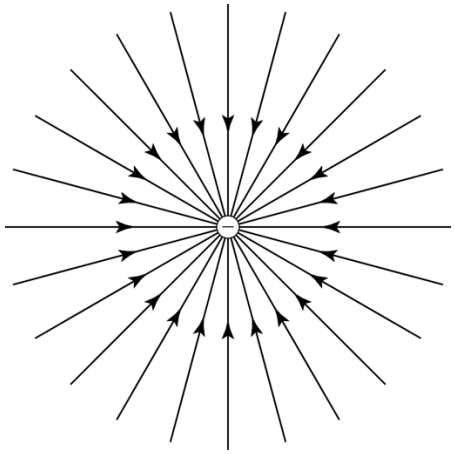
Flipping Physics Lecture Notes:

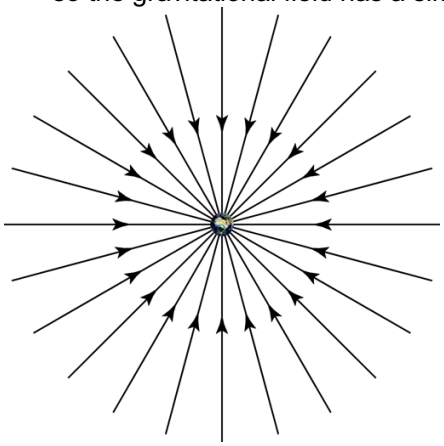
Electric Fields
http://www.flippingphysics.com/electric-fields.html

- If we were to place a positive test charge in an electric field, it would experience an electrostatic force. An electric field is the ratio of the electrostatic force the test charge would experience and the charge of the test charge.
    - A positive test charge is a charge which is small enough not to measurably change the electric field it is placed in. Electric field directions are defined according to the direction of the net electrostatic force on a positively charged test charge.
- The equation for an electric field and its units are: $\vec{E} = \frac{\vec{F}_e}{q} \Rightarrow \frac{N}{C}$
- Notice the electric field and the electrostatic force experienced by a positive charge in the electric field will be in the same direction. (Both electric field and electrostatic force are vectors in the equation.)
- That means the electric field which surrounds a point charge is: $\vec{E} = \frac{\vec{F}_e}{q} \Rightarrow E_{\text{point charge}} = \frac{\frac{kqQ}{r^2}}{q} = \frac{kQ}{r^2}$
- And the electric field maps for **isolated** point charges look like this:

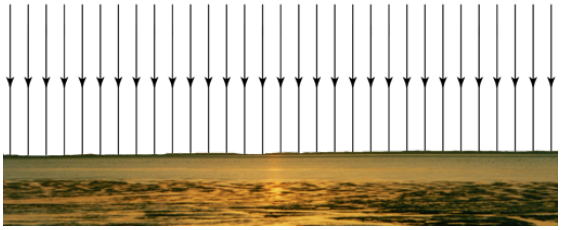


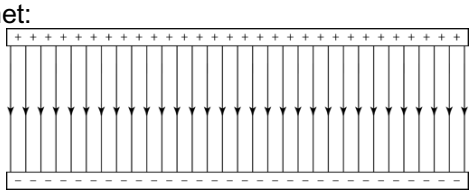


- Notice the similarity to the gravitational field around a planet. The equation has a similar format, so the gravitational field has a similar format: $g = \frac{F_g}{m} \Rightarrow g_{\text{point mass}} = \frac{\frac{GmM}{r^2}}{m} = \frac{GM}{r^2}$



- And the electric field which exists between two large, parallel, oppositely charged plates is similar to the gravitational field close to the surface of a planet:





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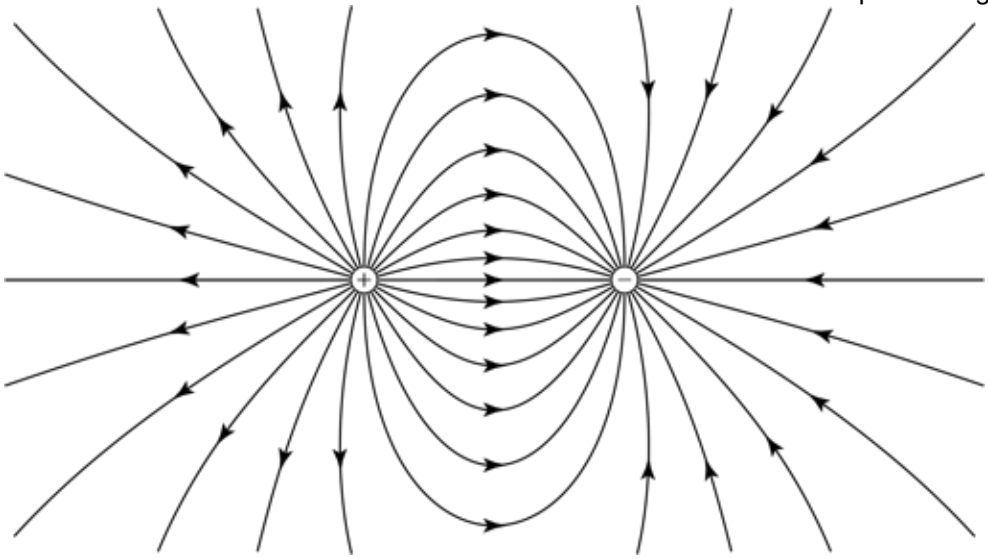
- Remember electric field is a vector which means that the electric field for two point charges which are near one another is the sum of the two individual electric fields for each point charge.



- Electric field maps like the one above are simplified models and vector maps which show the magnitude and direction of the electric field for the entire region.
- Electric Field Lines Basics:
    - In the direction a small, positive, test charge would experience an electrostatic force
    - Electric field lines per unit area is proportional to electric field strength
        - Higher density electric field lines = higher electric field strength
    - Start on a positive charge and end on a negative charge
        - or infinitely far away if more of one charge than another
    - Always start perpendicular to the surface of the charge
    - Electric field lines never cross