Flipping Physics Lecture Notes:
Electromagnetic Induction
http://www.flippingphysics.com/electromagnetic-induction.html

Electromagnetic Induction:

- We have already discussed that moving electric charges create magnetic fields.
- It should be no surprise that moving magnetic poles create electric fields.
    - Notice how these interact with one another!
- When a magnetic field changes over time, this can induce an electric potential difference called an induced emf, this causes charge to flow in a closed loop of wire which is called an induced current. More specifically, the relationship is between a changing magnetic flux and the resulting induced emf in a single closed loop of wire and is described by Faraday's law of electromagnetic induction:
    - Induced emf = the derivative of magnetic flux with respect to time. (magnitudes)

$$|\varepsilon| = \left|\frac{d\Phi_B}{dt}\right|$$

- Substitute in the equation for magnetic flux:
    - N is the number of loops
    - An emf can be induced by changing:
        - Magnitude of the magnetic field.
        - Area enclosed by the loop.
        - Angle between magnetic field and loop area. (θ between $\vec{B}$ and $\vec{A}$)
        - Or any combination of the three.
            - In other words, if the only one of those three ($\vec{B}$, $\vec{A}$, and θ) which is changing is the magnitude of the magnetic field, then the magnitude of the induced emf through one loop of wire is:

$$|\varepsilon| = N\left|\frac{d\Phi_B}{dt}\right| = N\left|\frac{d\left(\vec{B}\cdot\vec{A}\right)}{dt}\right| = N\left|\frac{d\left(BA\cos\theta\right)}{dt}\right|$$

$$|\varepsilon| = \left|A\cos\theta\left(\frac{dB}{dt}\right)\right|$$

- Electromagnetic induction is the process of inducing an electromotive force by a change in magnetic flux.
- Faraday's law is the third of Maxwell's equations which are a collection of equations which fully describe electromagnetism.