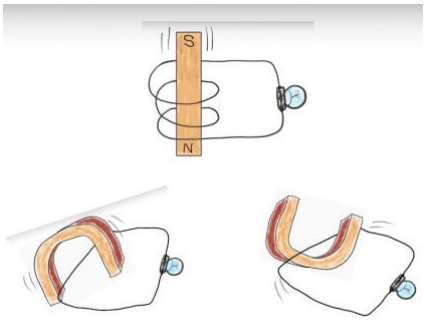
PHYSICS

Induction

- **Historical Review**:
  - Over 13 scientists independently found that the 'Right Hand Rule' works both ways: E□M or M□E.
  - _____ in Italy - Voltaic Cell / _____
  - _____ in Denmark – current produces magnetism
  - _____ in England – _____, _____, _____
  - _____ in USA – electromagnet, then induced current, therefore _____

- **Induction:** voltage is induced by _____ between a conductor and a magnetic field.
  Examples: credit card, traffic light, tape recorder, metal detectors.



Electric current is induced when either a magnetic field moves near a wire or the wire moves relative to the magnetic field.

- **Two of the most important laws in Physics:**
  _____ **Law:** An electric field is created in any region of space in which a magnetic field is changing with time. The magnitude of the induced electric field is proportional to the rate at which the magnetic field changes. The direction of the induced electric field is at right angles to the changing magnetic field.
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- **Better Generators**
  It's more efficient to spin a coil within a horseshoe magnet, than oscillating a magnet past a wire. So generators often _____ coils. This naturally makes AC current because the coil generates in one direction for 180°, then the the other way around.

- **Nikola Tesla**
  - Tesla built _____, _____, and _____ that are still in use today. One design – the _____ uses an iron core wrapped with bundles of copper wire that would spin within strong magnetic fields. A steam or water turbine would cause the spinning.
  - The _____ (MHD) http://en.wikipedia.org/wiki/Magnetohydrodynamic_drive squirts a hot plasma of electrons and positive ions through a magnetic field to generate electricity. It can run at high temperatures and therefore doesn't lose much energy.
  - The _____ is a tuned transformer. It is tuned to make best use of the *resonant frequency* of a circuit to optimize voltage.

- **Transformers**
  - Two coils that are aligned cause a transfer of energy. Put current into the first coil. The magnetic field induced in the first coil extends into the second. This magnetic field generates current in second coil.
  - Note: the fields must change in order to cause induction. These can be changes in: direction or strength. Some ways this can be done is with AC, on/off, rotation, oscillation, or variable fields.
  - The ratio of loops equals the ratio of voltages of the two coils:
    _____ = _____
    and since energy is conserved,
    _____ = _____
    and since power = current * voltage [P = I * E],
    _____ = _____
    therefore, if the voltage goes up in a transformer, the current goes down, and vice versa. Power of 25,000 v is stepped up to 750,000 v and sent through power lines at low current with less loss.

- **Self Induction:** every coil induces its own magnetic field that induces a voltage that opposes the original. This is called a _____ or back emf.