PLTW Engineering

10-12/Faraday's Law

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Lesson: **5/5/2020**

Students will be able to explain the relationship between the magnetic field and the electromotive force.

English physicist Michael Faraday gets the credit for discovering magnetic induction in 1830.

However, an American physicist, Joseph Henry, independently made the same discovery about the same time, according to the University of Texas.

Faraday's Law of Induction describes how an electric current produces a magnetic field and, conversely, how a changing magnetic field generates an electric current in a conductor.

Magnetic induction makes possible the electric motors, generators and transformers that form the foundation of modern technology.

Faraday's law states that the induced voltage in a circuit is proportional to the rate of change over time of the magnetic flux through that circuit.

In other words, the faster the magnetic field changes, the greater will be the voltage in the circuit. The direction of the change in the magnetic field determines the direction of the current.

We can increase the voltage by increasing the number of loops in the circuit.

The induced voltage in a coil with two loops will be twice that with one loop, and with three loops it will be triple.

This is why real motors and generators typically have large numbers of coils.

From previous lessons, we know if we run an electric current through a wire, it will produce a magnetic field around the wire.

The direction of this magnetic field can be determined by the right-hand rule. According to the physics department at Buffalo State University of New York, if you extend your thumb and curl the fingers of your right hand, your thumb points in the positive direction of the current, and your fingers curl in the north direction of the magnetic field.

Faraday's experiments showed that the EMF induced by a change in magnetic flux depends on only a few factors. First, EMF is directly proportional to the change in flux Δ. Second, EMF is greatest when the change in time Δt is smallest—that is, EMF is inversely proportional to Δt. Finally, if a coil has N turns, an EMF will be produced that is N times greater than for a single coil, so that EMF is directly proportional to N.

$$\varepsilon = -N\frac{\Delta \Phi_B}{\Delta t}$$

1. Which university in the USA claim to have the co-founder of Faraday's Law
2. The basis of Faraday's Law explains how an electric current produces what?
3. Using the principle of induction, the faster the magnetic field changes, what other value will increase?
4. How is voltage increased in an induction circuit?
5. Explain the right hand rule as it pertains to current flow.

[Kahn Academy explanation of Faraday's Law](#)

[Demonstration of Faraday's Law](#)