Faraday's Law and Lenz's Law: Virtual Lab
AP Physics C – E&M
Unit 5 Introduction
https://phet.colorado.edu/sims/html/faradays-law/latest/faradays-law_en.html

Enduring Understanding FIE-6:

A changing magnetic field over time can induce current in conductors. (From AP Course and Exam Description)

Objective: I will describe the direction of an induced current in a conductive loop based on a changing magnetic field.

Explore how a changing magnetic field affects the direction of the induced current in a conductive loop, and how the number of turns affects the magnitude of induced emf in the loop. This will be done using a virtual lab activity. Inductors are important in power lines, to protect from short-circuiting during sudden changed in current. Faraday's Law will help us learn how to use inductors in circuits.

Guiding Question: How does the movement of a magnet near or inside a conducting loop cause an induced current in the loop? How do the direction and magnitude change with the number of loops and movement of the magnet?

Comment and fill out the table below. Detail the steps you took to arrive at your data, in the Procedure section.

Claim (what the theory should say):	A magnet near or inside a conductive loop generates an electric current. Breaking down. Magnetic flux changes along the loop as the magnet moves. Faraday's rule states that the induced electromotive force (emf) is proportionate to the change in magnetic flux. ϵ=dtdΦm. Lenz's law: Lenz's law determines the direction of the induced current. The induced current resists changes in magnetic flux. If the magnetic flux increases, the induced current creates a magnetic field that opposes the increase. Induced current generates a magnetic field, which promotes magnetic flux reduction. Loop count and size: The induced emf size is determined by the rate of change in magnetic flux. More loops in the conducting coil increase the total induced emf. Faster movement of the magnet increases the induced emf.
Evidence (what you observed):	Exactly what it says, as the magnet moves, light is generated, if the magnet doesn't move, the light is not generated, hence no electricity. Putting in the North side causes Negative current, while putting in the south side causes positive current. They are different, so it means that the current always work against the change in flux.
Reasoning (why the observation is important and how it holds given your knowledge of magnetism):	Understanding electromagnetic induction is crucial for various applications, including generators, transformers, and electric motors. It allows us to harness electrical energy from changing magnetic fields. Lenz's law ensures that energy conservation is maintained during these processes. It allows me to understand how magnetic levitation trains work, (how it gets the electricity). More loops give you larger induced EMF and greater current since there are more charges experiencing the induced voltage.

Procedure (write down steps or put screenshots of your steps, either is fine):

Postlab Questions

1. Does magnetic field itself induce a current in a loop of wire?
   Yes. This is electromagnetic induction. When the magnetic field inside the loop changes (either owing to the field itself shifting or due to an external magnetic field changing), it produces an electromotive force (emf) in the wire. This induced emf may lead to the passage of an electric current through the loop, even without any direct physical connection to a voltage source.

2. How can you determine whether the voltage will be positive or negative? Is there a rule that may lend you a hand in identifying this?
   When the magnetic flux through the loop grows (due to a magnet approaching or a changing external magnetic field), the induced current resists this increase.
   Conversely, when the magnetic flux drops (due to a magnet moving away or a changing external field lowering), the induced current opposes this decline.

Checklist and feedback: work to complete the first and last columns with your partners, based on the criteria from the middle column. To do this, use your "Reasoning" row and your postlab questions to help you with determining your level of confidence on each criteria.

Goals and Areas of Growth	Proficiency Criteria	Areas of Excellence
We need to work on… Learning more about electromagnetism, reviewing notes to better apply the knowledge in complex situations.	• I can explain how increasing the number of loops in the conductor changes the induced current for a given change in magnetic field. • I can explain how the magnetic flux changes as the magnet gets closer to or farther away from the loop. • I can justify why moving the magnet parallel to the loop causes a very minimal induced current.	Our evidence shows that we can… Do the lab, understand the reasoning behind things.