

PH170: Waves and Electromagnetics Laboratory (0-0-2:1)

Laboratory 6



Ajay Nath

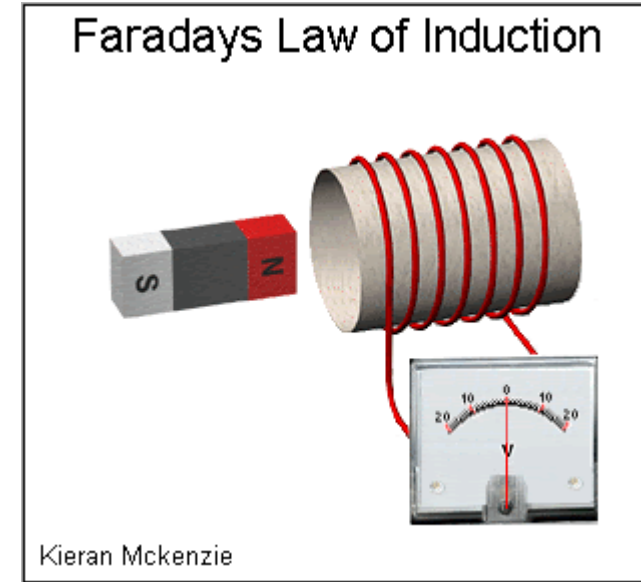
FARADAY'S LAWS OF ELECTROMAGNETIC INDUCTION

I Law : Whenever a conductor is placed in a varying magnetic field, an electromotive force is induced. If the conductor circuit is closed, a current is induced, which is called induced current.

II Law : The induced emf in a coil is equal to the rate of change of flux linkage.

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

Lenz Law : The polarity of induced emf is such that it tends to produce a current which opposes the change in magnetic flux that produced it.



The Simulator

1. Choose the environment

2. Adjust the strength.

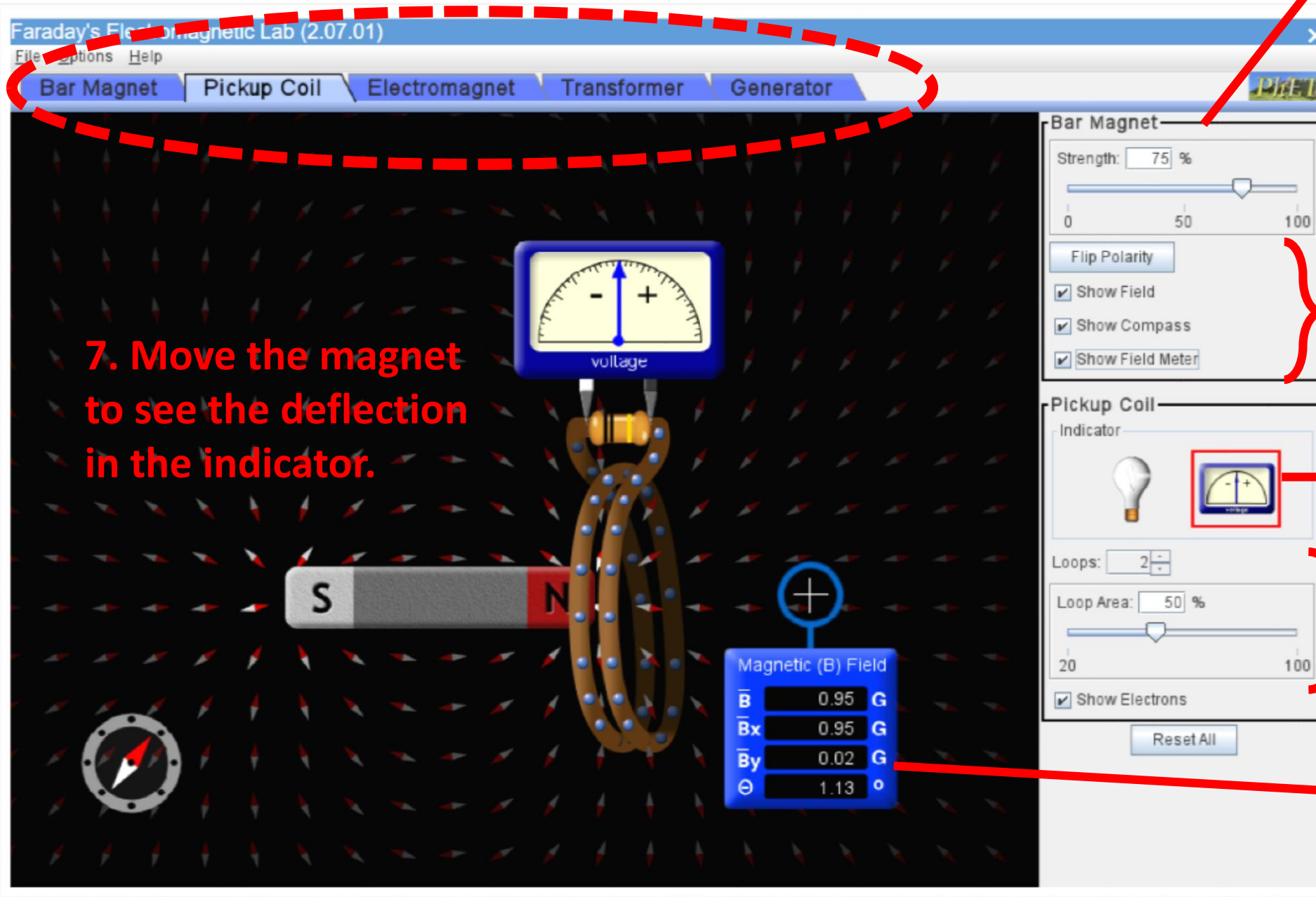
7. Move the magnet to see the deflection in the indicator.

3. Turn on the compass and field meter.

4. Choose indicator.

5. Adjust loop area and number of loops.

6. Measure magnetic field

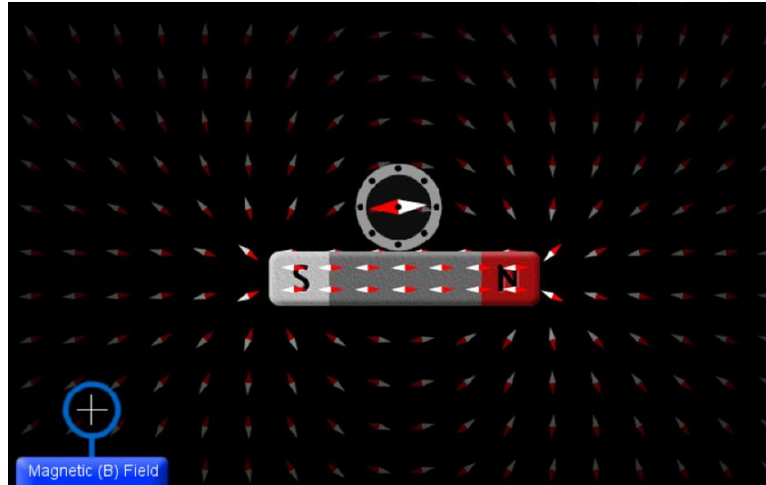


AIM

1. Predict the direction of the magnetic field for different locations around a bar magnet and an electromagnet.
2. Compare and contrast bar magnets and electromagnets.
3. Identify the characteristics of electromagnets that are variable and what effects each variable has on the magnetic field's strength and direction.
4. Relate magnetic field strength to distance quantitatively and qualitatively.
5. Identify equipment and conditions that produce induction.
6. Compare and contrast how both a light bulb and voltmeter can be used to show characteristics of the induced current.
7. Predict how the current will change when the conditions are varied.

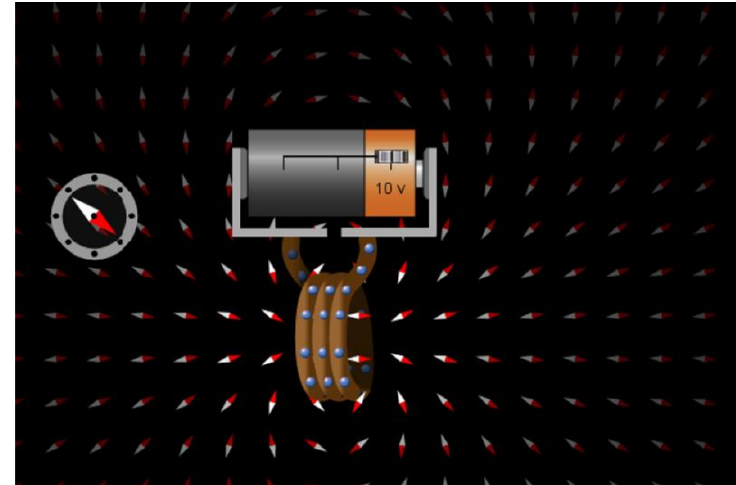
Aim 1 : Predict the direction of the magnetic field for different locations around a bar magnet and an electromagnet.

Aim 2 Compare and contrast bar magnets and electromagnets.



Bar Magnet: Direction of magnetic field outside the magnet is north to south and in opposite direction inside.

1. we cannot change the strength of the magnetic field.
2. permanent magnet that needs no power.
3. Polarity cannot be changed.

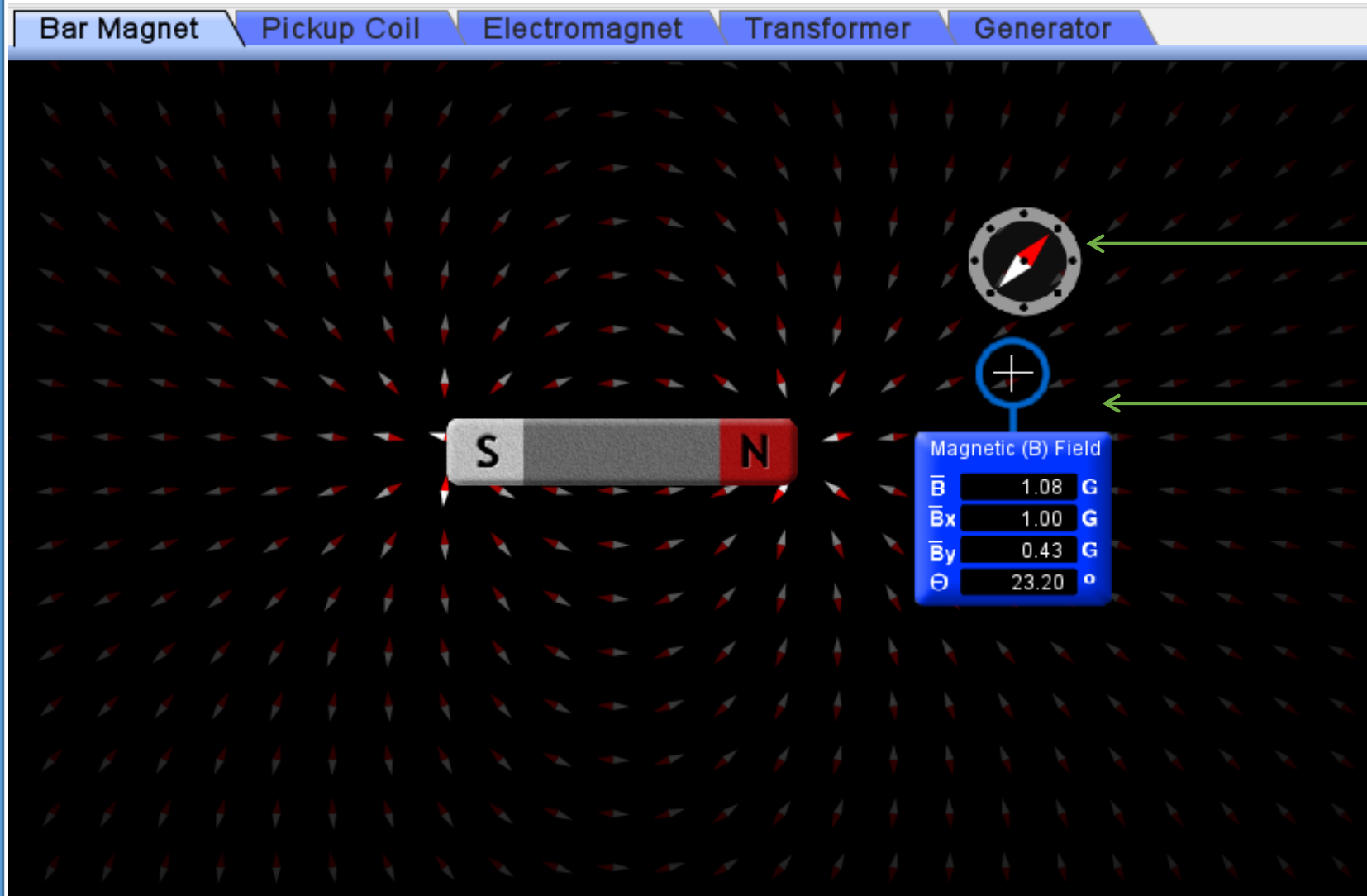


Electromagnet: The direction of magnetic field is curling around the coil.

1. We can change the strength and direction of the magnetic field in the electromagnet.
2. electromagnet requires a continuous supply of current to maintain the magnetic field.
3. Polarity can be changed.

Faraday's Electromagnetic Lab

Step 1: Impact of distance on magnetic field



Step 2: 1) How to increase the intensity
2) Effect of no. of turns and area of coil ?

The screenshot shows the PhET 'Magnet and Compass' simulation interface. The 'Pickup Coil' tab is selected, which is circled in green. The simulation area displays a bar magnet with 'S' (South) and 'N' (North) poles, a pickup coil with a light bulb, and a magnetic field vector plot. A data box shows the magnetic field components: $B = 0.18$ G, $B_x = -0.10$ G, $B_y = 0.15$ G, and $\theta = 122.29^\circ$. The 'Pickup Coil' panel on the right includes an 'Indicator' section with a light bulb and a voltmeter icon, both circled in green. Below this, the 'Loops' are set to 2 and the 'Loop Area' is set to 50%. The 'Show Electrons' checkbox is checked. A 'Reset All' button is at the bottom of the panel.

Bar Magnet

Strength: 75 %

0 50 100

Flip Polarity

☒ Show Field

☒ Show Compass

☒ Show Field Meter

Pickup Coil

Indicator

☒ Light Bulb

☒ Voltmeter

Loops: 2

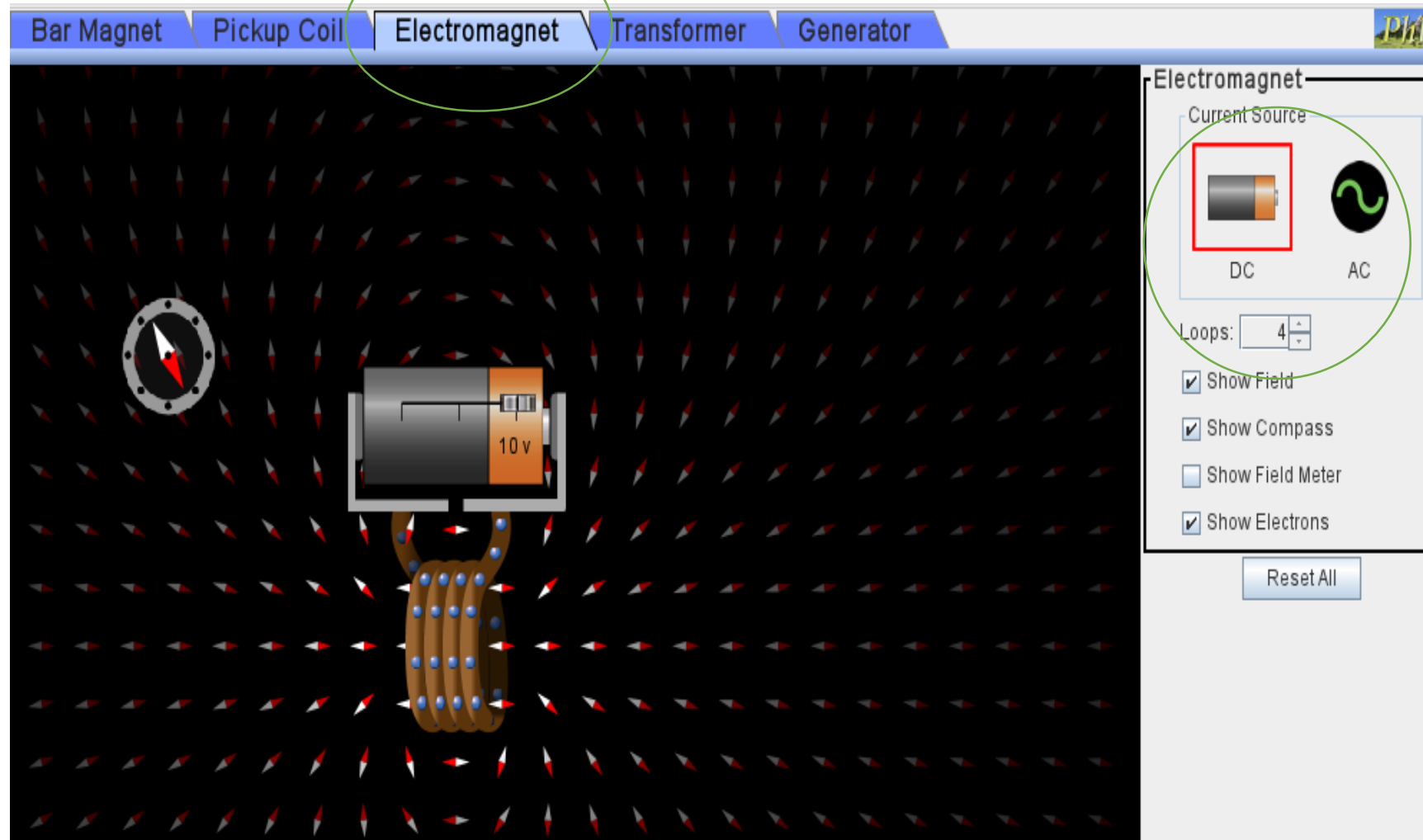
Loop Area: 50 %

20 100

☒ Show Electrons

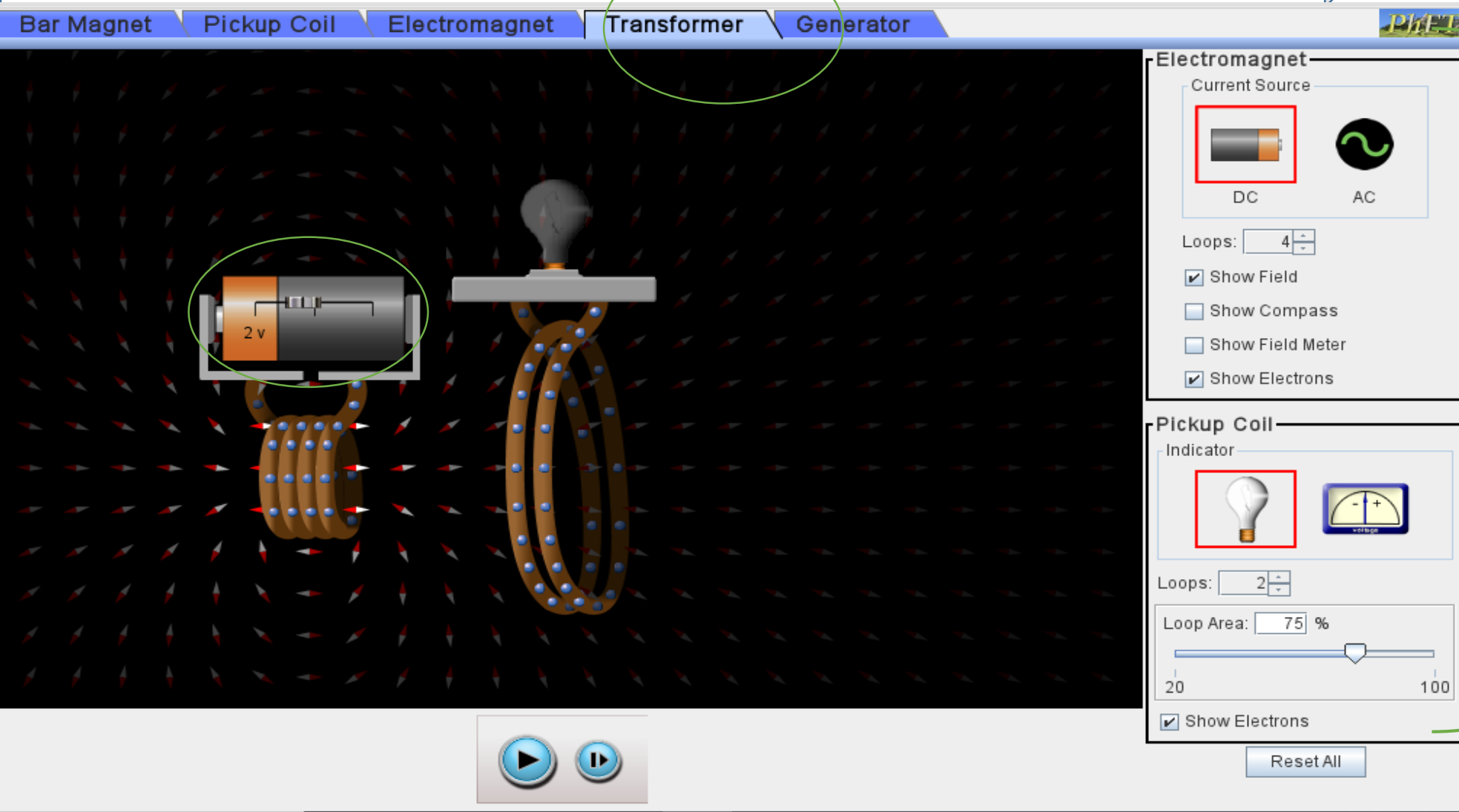
Reset All

Step 3: Impact of different current source



Step 4: Impact of varying the smaller coil

Bar Magnet Pickup Coil Electromagnet **Transformer** Generator



Electromagnet

Current Source

DC AC

Loops: 4

☒ Show Field

☐ Show Compass

☐ Show Field Meter

☒ Show Electrons

Pickup Coil

Indicator

Light Bulb Voltage Meter

Loops: 2

Loop Area: 75 %

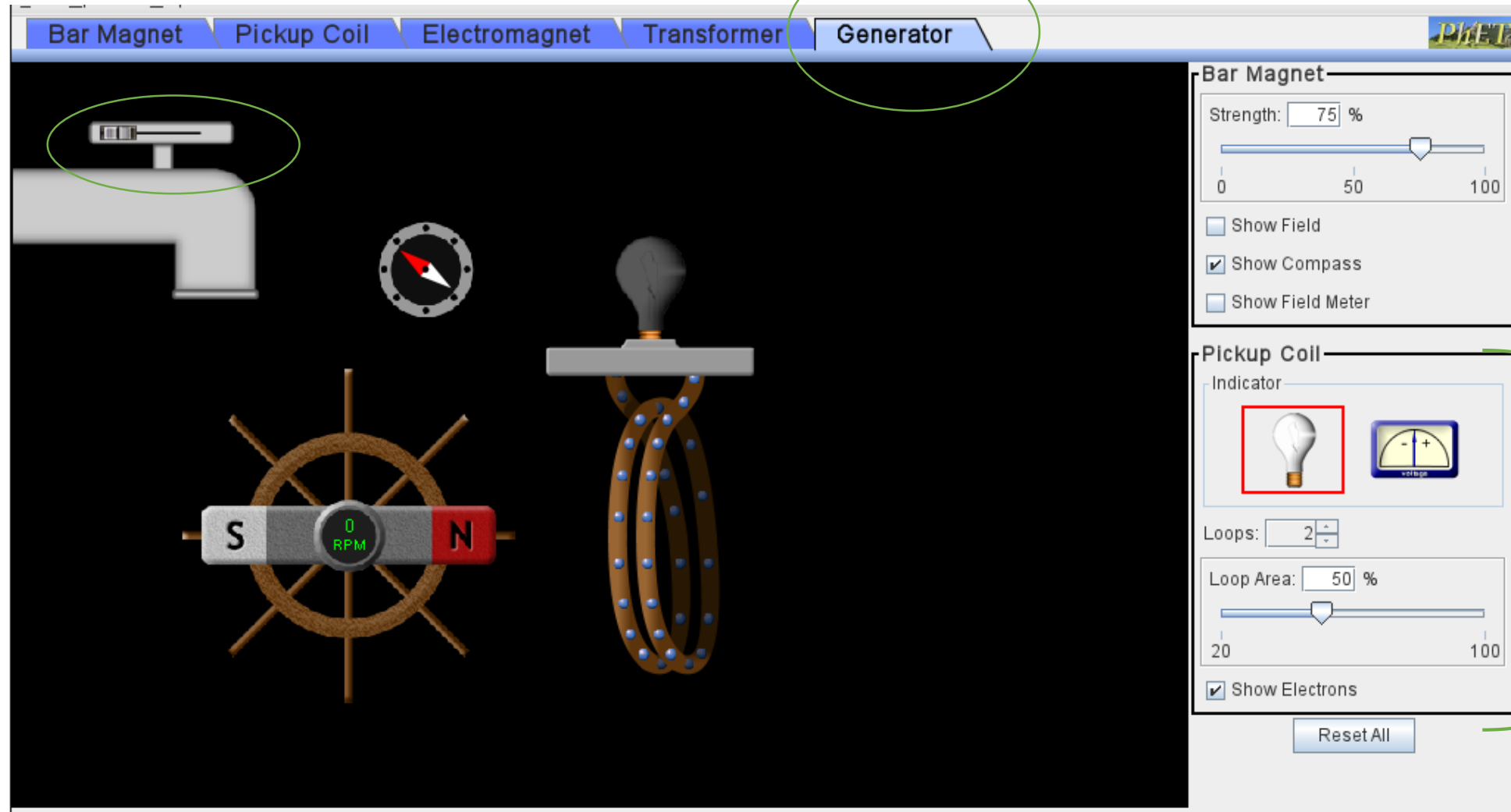
20 100

☒ Show Electrons

Reset All

Variable

Step 5: Analysis the effect of rotating magnet



Thank You