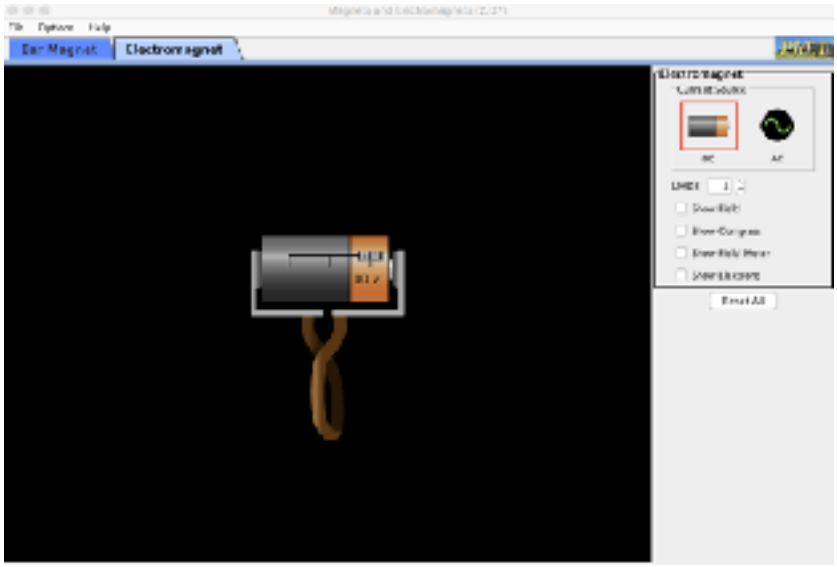
Solenoids

In this activity students will be exploring solenoids using the “Magnets & Electromagnets” PhET simulation.

Open the simulation by clicking on the link:

https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets

Take a look at the explanatory video via YouTube:
https://youtu.be/gCFQ7HTO0XU



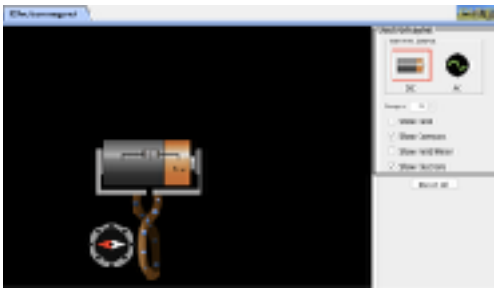
Learning Objectives

By the end of these activities it is hoped that students will have an acquired the following skills:

- Following explicit instructions to gain acquired knowledge.
- Exploring magnetic fields in current carrying wires
- What is the relationship between magnetic field strength and number of loops?

Author: Simon Lees 2017

Activity 1: Exploring magnetic fields in a current carrying wire.



- Set up the scenario as shown in the diagram opposite with one loop, a compass and the voltage on the battery switched to 0V.
- Move the voltage to the right to 10V and you will see the electrons moving.
- Using your arrow move the compass around the solenoid loop in an anticlockwise direction.
- **What do you notice happens to the red end of the needle?**

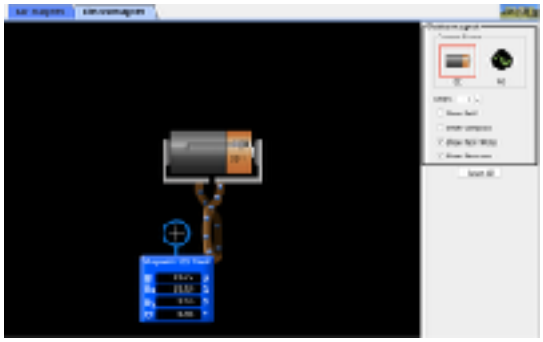
- Now move the voltage switch to the far left. You will notice that the terminals have changed. Start with the compass on the left and move it anticlockwise around the loop.
- **What do you notice happens to the red end of the needle?**

- Now remove the compass and click the show field button. Take a screenshot of what you see with the voltage at 10V moved left or right and place in the space below.
- **Does the pattern look familiar if so how?**

Screenshot of magnetic field

Author: Simon Lees 2017

Activity 2: How is magnetic field strength affected by coil number?



- Have a single loop chosen and also choose the magnetic field meter and place it in the position shown in the diagram opposite.
- Turn the voltage to 5V by pushing the slider in the battery to the right.
- Note the field strength by looking at the top number ONLY in the meter. Place this number in table 1.
- Repeat this but for 10V and place the value in table 1.
- Now repeat for 5V and 10V but adding two loops and place the results in table 1.
- Repeat same process for 4 loops.

Table 1:

NUMBER LOOPS	5V	10V
1		
2		
3		
4		

- **What pattern do you notice between number of loops and magnetic field strength**

- Now change the terminals by moving the slider to the left at 5V and 10V and do the same process with the increasing the loops and measuring the field strength. Place the data in table 2.

Table 2:

NUMBER LOOPS	5V	10V
1		
2		
3		
4		

- **Is the magnetic field strength affected in the same way as the data collected in table 1.**

- **Come up with a basic relationship that links number of loops and magnetic field strength.**

As you increase the voltage the current increases.

- **What is the relationship using the data collected in table 1 and 2 between current and magnetic field strength?**

A number of loops of wire now constitutes a solenoid.

SUMMARY:

- **Complete table 3 to show what must happen to increase/decrease magnetic field strength, B.**

	Increase B	Decrease B
Number of loops		
Current		

- **Research from the internet or from class how else you can increase the magnetic field strength of a solenoid**
