

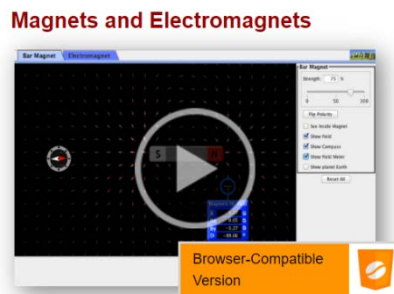
## PhET Magnetic Field from a Solenoid

The direction of the magnetic field around a straight wire is given by a right hand rule. If you bend a wire into a coil, you can use that geometric fact to produce a device called a solenoid that has a constant magnetic field throughout its interior. Solenoids are critical to all kinds of electronic devices because of that property. Here we work a bit with a simulation of a solenoid.

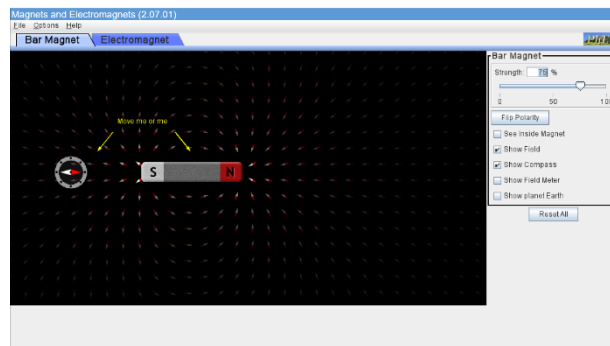
Start here:

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

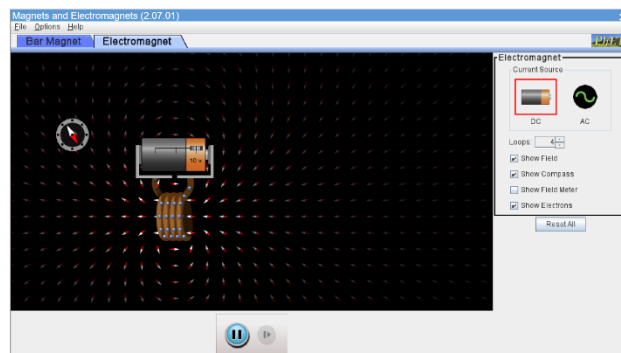
Click on the play button:



When this comes up:



click on the "Electromagnet" tab so you see this:



You should have the “Show Field” and “Show Electrons” boxes on the right side of the screen clicked. You can leave “Show Compass” on if you like – it is harmless. The red and white symbols in the screen are supposed to look like little compass needles – the red end shows the direction of the magnetic field.

Take some time to make sense of the direction of the magnetic field through the solenoid. Keep in mind that the solenoid is a long straight wire that is twisted into a coil. Also keep in mind that the right hand rule for a long straight wire that we’ve discussed in class is for **conventional current**. The simulation shows electrons flowing – the conventional current is in the opposite direction (since it assumes that positive charges are flowing and electrons are negatively charged).

Reverse the direction of the current by reversing the voltage source, which is portrayed in the simulation by the battery. Does the direction of the magnetic field reverse, too?

Click the “Show Field Meter” box on the right side of the screen. Place the cross-hairs of the meter inside the solenoid. Over how much of the volume inside the solenoid is the magnetic field strength and direction (which you can read from the x and y components on the meter) constant? Does the field strength drop off quickly outside the solenoid?

Now change the number of loops – the control for the number of loops is on the right side of the screen. How does the magnetic field inside the solenoid depend on the number of loops?

Answer these questions in a Word document, convert your Word document to pdf and submit it via Canvas.