

Write this title into your notebook.

5.14 MAGNETIC FIELDS AND ELECTRIC CURRENT

The diagrams illustrate magnetic fields. On the left, a straight wire with current flowing upwards (indicated by a '+' sign) has concentric circular magnetic field lines around it. In the middle, a circular loop of wire with current flowing clockwise has a magnetic field that points into the page. On the right, a solenoid (coiled wire) has a magnetic field that points to the right through its center.

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- A magnetic field is created whenever an electric current flows through a conductor.
- This is **electromagnetism**.
- The conductor can be a:
 - "straight-line conductor" (straight wire) or
 - solenoid (coiled wire)

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A Solenoid:

- Is a wire wrapped around a core.
- When a current flows through the wire ... a magnetic field is generated in the core.

The diagram shows a solenoid with a core, with magnetic field lines passing through it. A small photo shows a person sitting on a large metal object, possibly a transformer or a large solenoid.

Electromagnet

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Cores:

- A **Core** is the object that is inserted into the solenoid, creating an electromagnet.
 - Must be easy to align or misalign the domains
- Different **ferromagnetic metals** can be used for the core: iron, nickel or cobalt.
 - **Iron** is most commonly used because when you turn off the electricity it demagnetizes easily!
 - **Steel** is usually not used because it is difficult to demagnetize.

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5.15 The Left Hand Rules

- This rule will help you determine the direction of the magnetic fields created by an electric current.
 - **The 1st Left Hand Rule** is used with a straight wire (uncoiled).
 - **The 2nd Left Hand Rule** is used with a solenoid (or coil)
 - **Remember electrons flow from - to + !!!!**

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#1 Straight Line Conductors (Uncoiled)

1. **Find the + and - ends of the wire**
2. **Point your thumb in the direction of the electron flow (towards + end)**
3. **Your fingers are pointing in the direction of the field**

The diagram shows a hand with the thumb pointing up and fingers curled. A vertical wire is shown with a '+' sign at the top and a '-' sign at the bottom. A red arrow points downwards from the '+' sign, labeled "Direction of the electron flow".

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#2 Solenoids (or coils)

1. Find the + and - ends of the wire
2. Draw arrows on the front of the coil pointing in the direction of the electron flow (towards +).
3. Place your hand on the page with your fingers pointing in the direction of the electron flow.
4. Your thumb will point towards the **north** end of the solenoid.

Up behind the core and Down in front of the core.

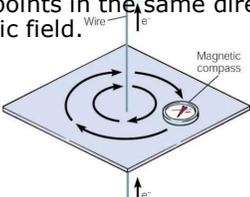


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5.15 continued

- Remember that straight line conductors:
 - Do not have a North or South Pole.
 - The magnetic field flows in a continuous circle around the wire.
 - The compass points in the same direction as the magnetic field.



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5.16 Electromagnetic Induction

- Is the process where you use a moving magnetic field to produce an electrical current. (p171)

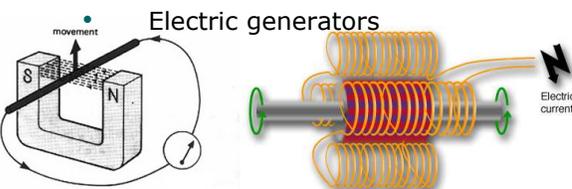


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- This is achieved by:
 - Moving a conductor perpendicularly inside a magnetic field
 - Moving a magnet around a conductor
 - eg. Hydro electricity

Electric generators



5.17 Factors that affect the magnetic field strength of an electromagnet.

- The core material**
 - Made of ferromagnetic material
 - Low magnetic resonance (easy to realign domains)
- The current intensity**
 - Higher current = stronger magnetic field
- Number of loops** (number of turns)
 - More turns = stronger field.

Important

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5.18 Mathematical Relationship

To find the strength of the electromagnet the following equation is used:

$$F = IN$$

F = force or strength of the electromagnet
I = the current intensity traveling through the wire
N = the number of loops around the core

Remember

