Watch the video below and then discuss with a partner what you observed and possible explanations for your observation.

Copper Pipe and Neodymium Video Clip [2:17]

So, what's happening?

- **As the magnet is falling, the magnetic field generated by the magnet is moving through the copper.**
- **The movement of the magnetic field generates an electric current inside the pipe.**
- **Any time there is an electric current flowing, that electric current is generating its own magnetic field.**
- **The tiny magnetic fields of the electric current are repelling the magnet.**

Essential Question:

How can currents and magnets exert forces on each other?

Standard:

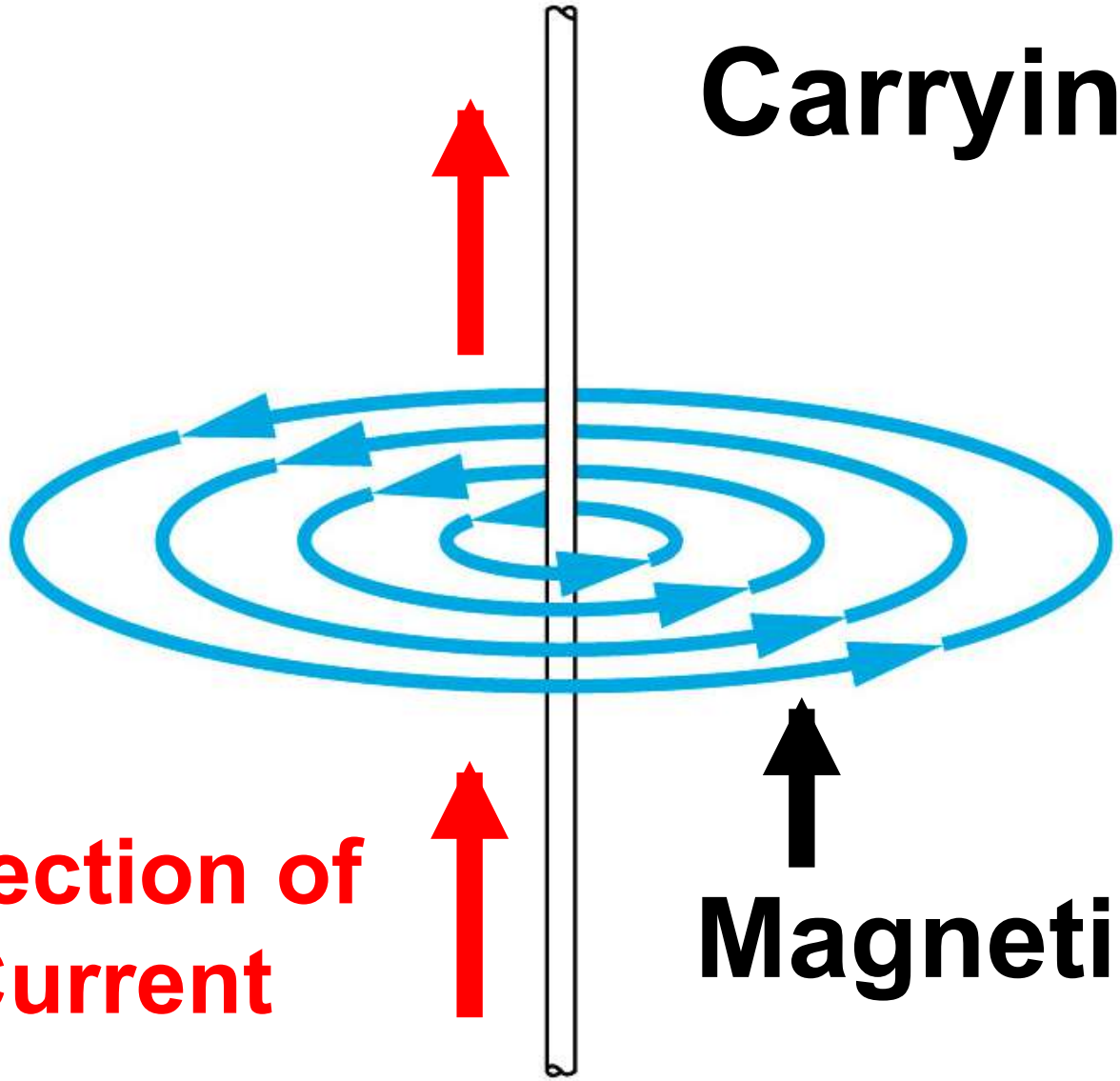
S8P5c. Plan and carry out investigations to identify the factors (e.g., distance between objects, magnetic force produced by an electromagnet with varying number of wire turns, varying number or size of dry cells, and varying size of iron core) that affect the strength of electric and magnetic forces.

Concepts for Review

- The movement of electrons causes some materials to be magnetic
- The movement of electrons causes electric charges
- The movement of electric charges produces a magnetic field
- An electric current flows when electric charges move in a wire
- A wire that contains an electric current is surrounded by a magnetic field

- Play chapter 4, lesson 2 “tutor” video from the online textbook

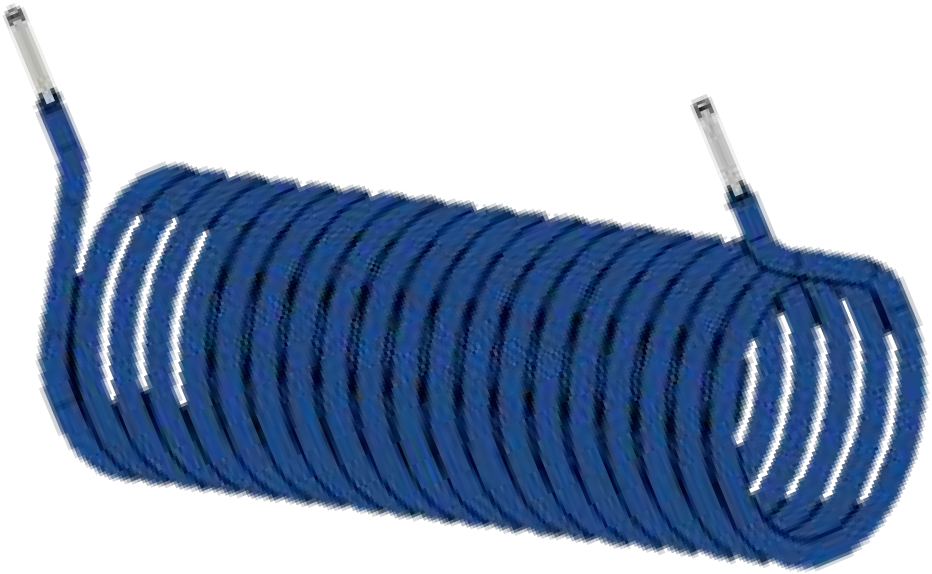
Current Carrying Wire



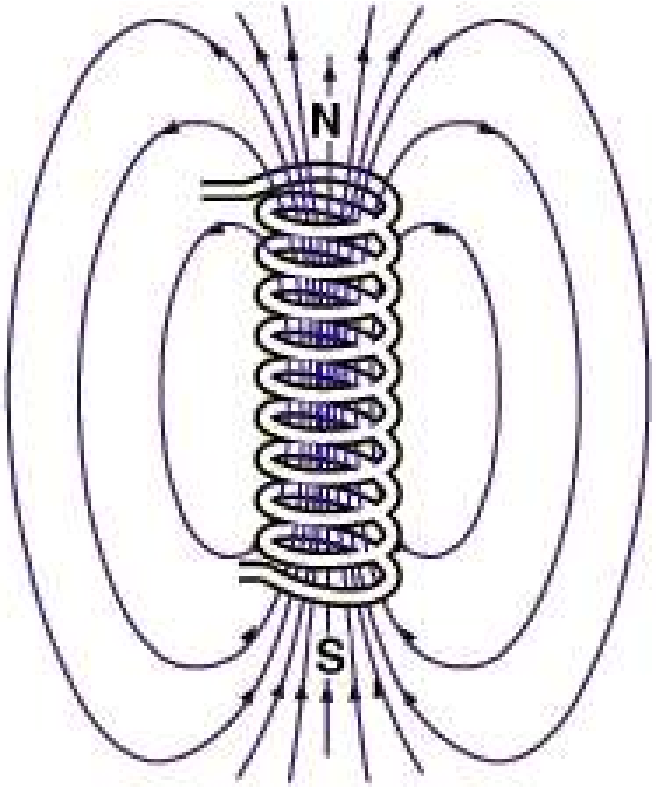
Direction of Current

Magnetic Field

What happens to the magnetic field if a current carrying wire is coiled (in loops)?

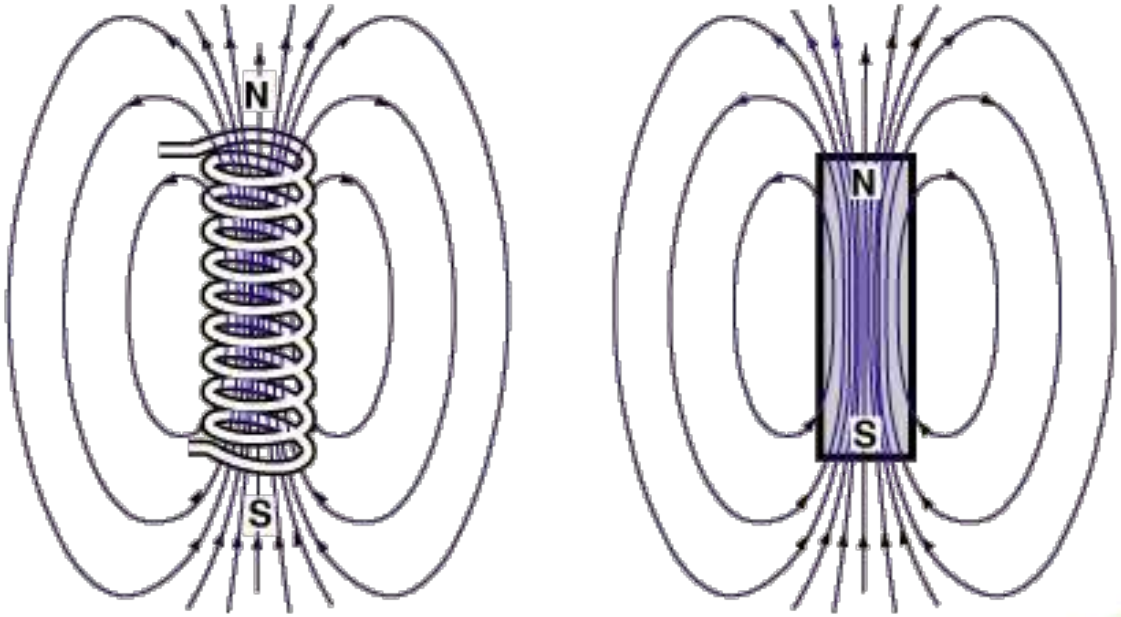


A single loop of wire carrying a current does not have a very strong magnetic field.

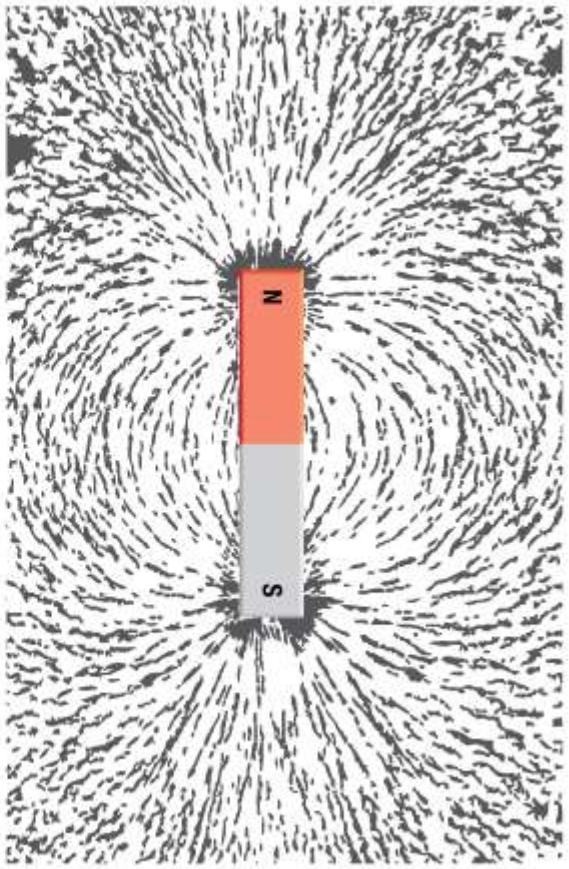


However, if you form many loops into a coil, the magnetic fields will combine creating a much stronger field.

In fact, the magnetic field around a coil of wire produces a magnetic field similar to that of a bar magnet.



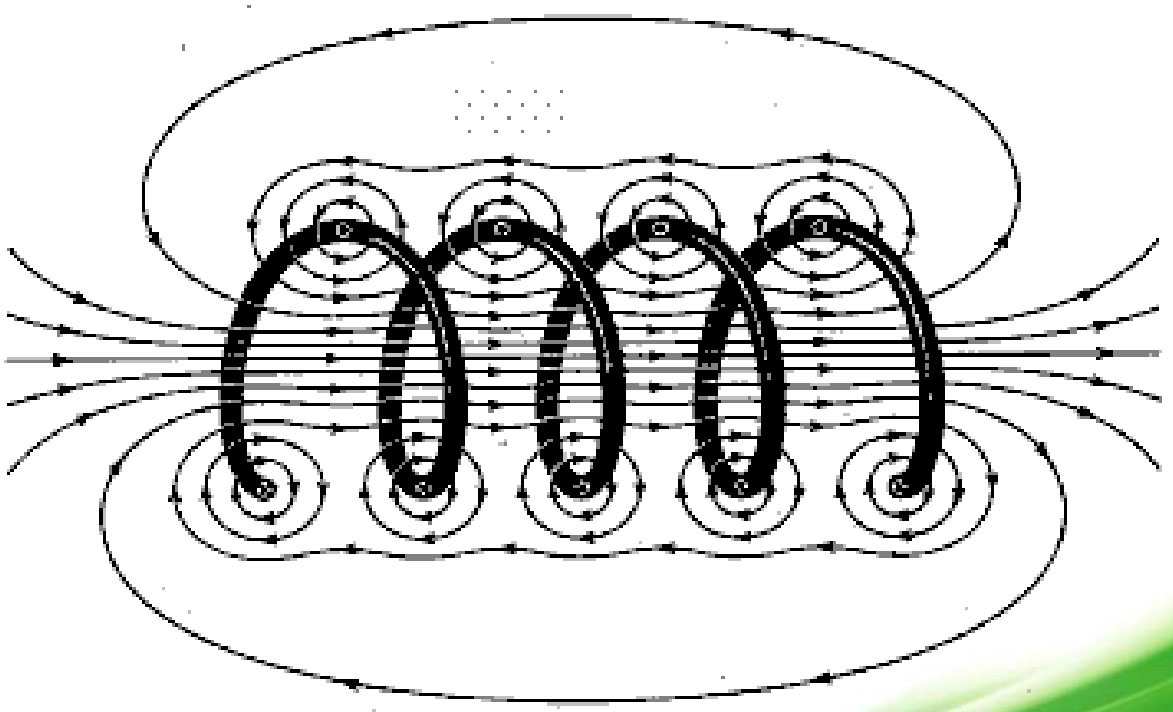
The diagrams below demonstrate the magnetic field of coiled wire (with an electric current) and a bar magnet using iron filings.



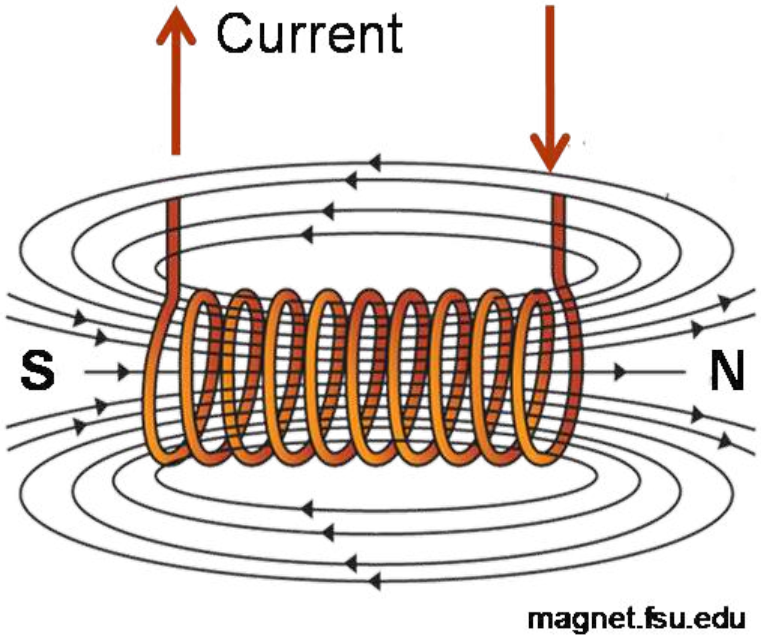
The strength of the magnetic field of a coiled wire increases as more loops are used *and* as the current in the wire is increased.

How could you increase the current?

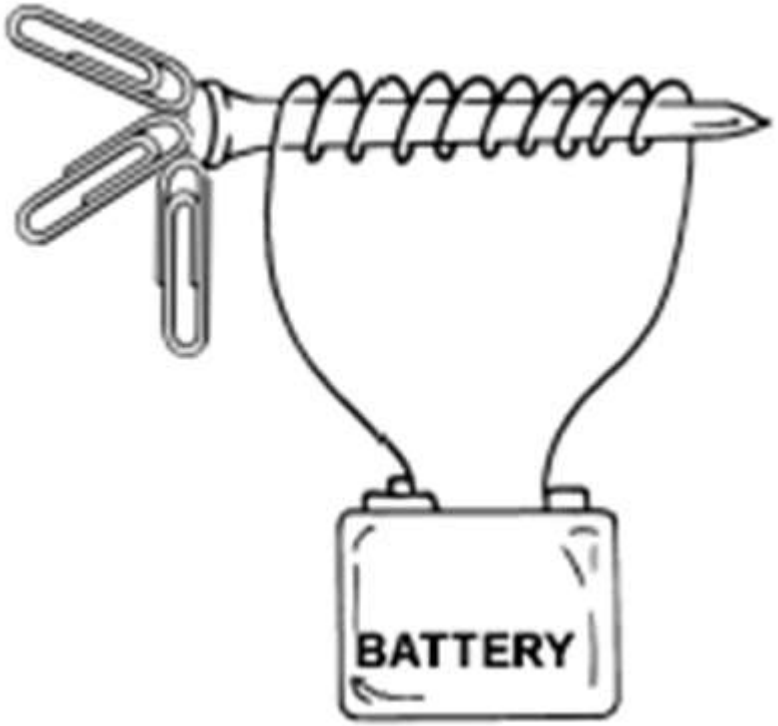
Increase the size or number of batteries.



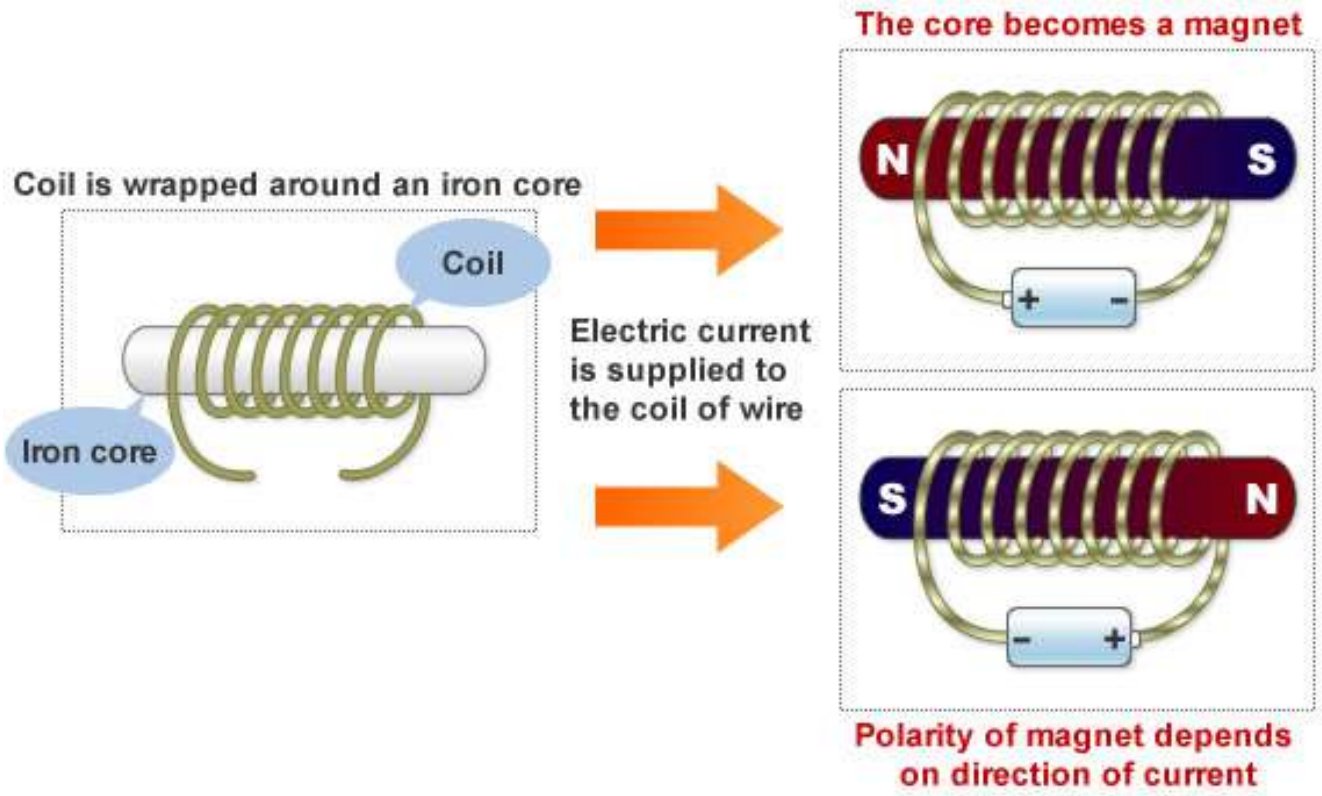
An electric current can produce a magnetic field; therefore, electricity can be used to make a magnet.



An Electromagnet is a current carrying wire wrapped around an iron core.



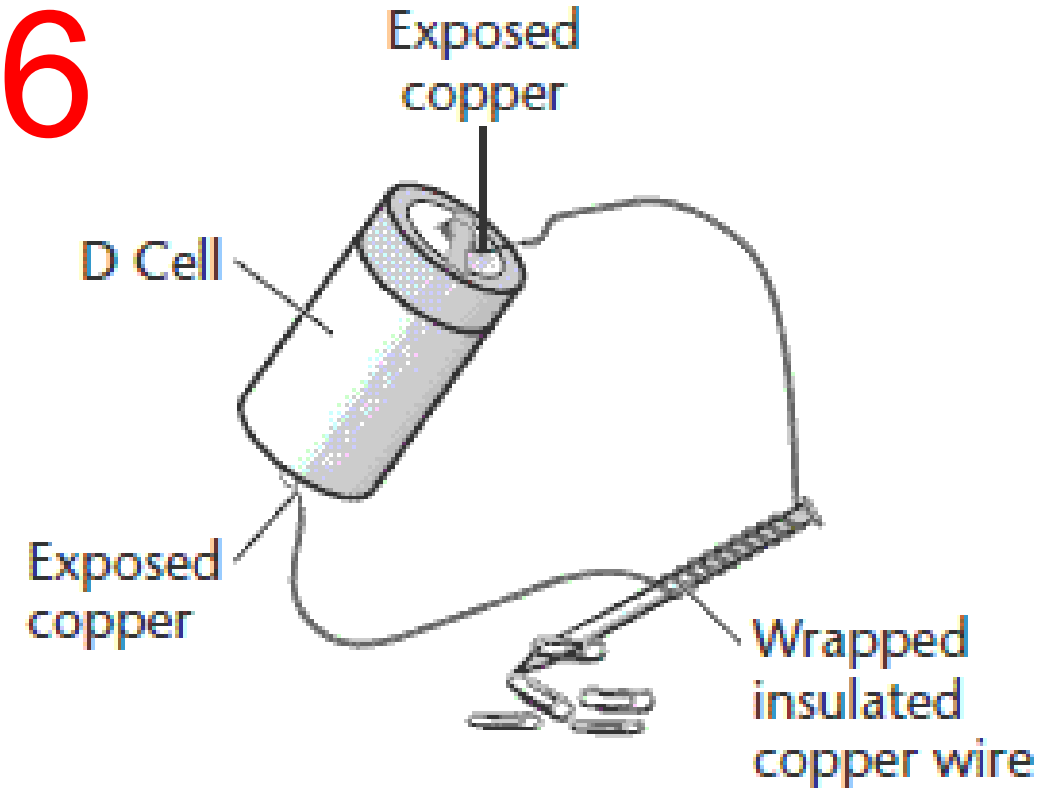
How an Electromagnet Works



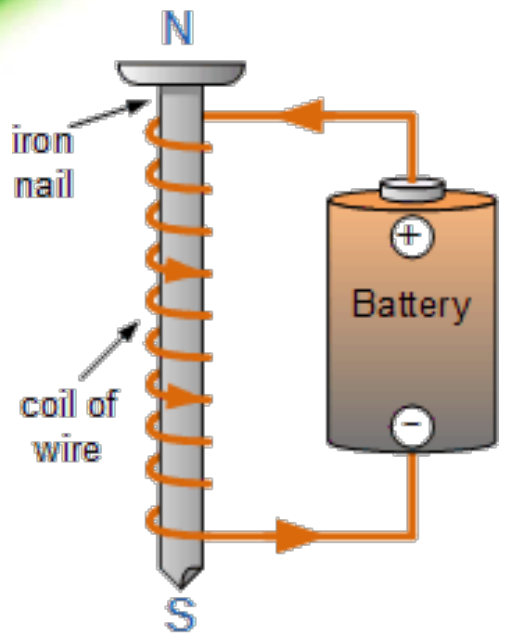
The magnetic field of the electric current in the wire makes the domains inside the iron core line up, magnetizing the core.

The magnetic field of the wire plus the magnetic field of the iron core makes the magnetic field of the electromagnet a hundred times stronger.

#6



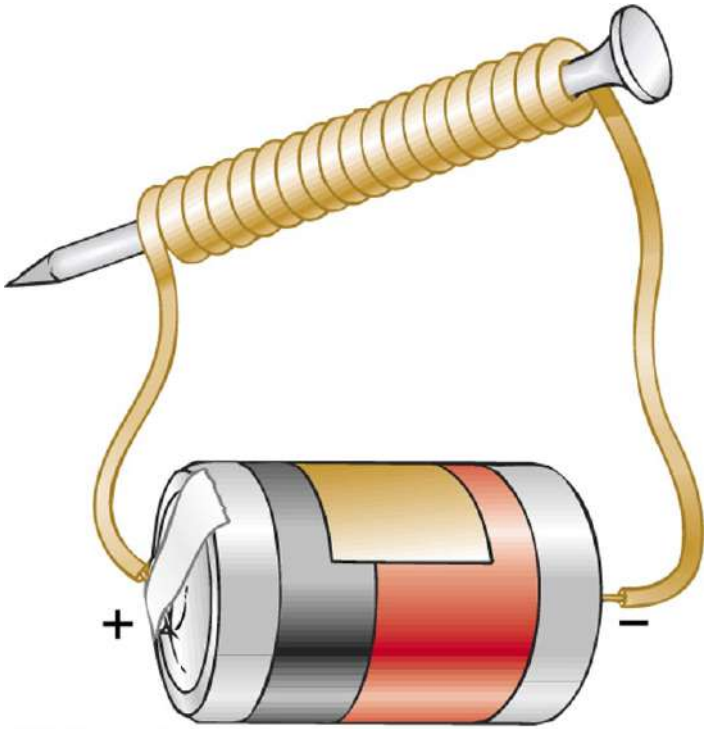
Make an Electromagnet



How can you make an electromagnet stronger?

***To make an electromagnet even stronger, increase the number of loops in the wire, increase size of iron core or increase the electric current in the wire.

Electromagnets are very useful. Why?

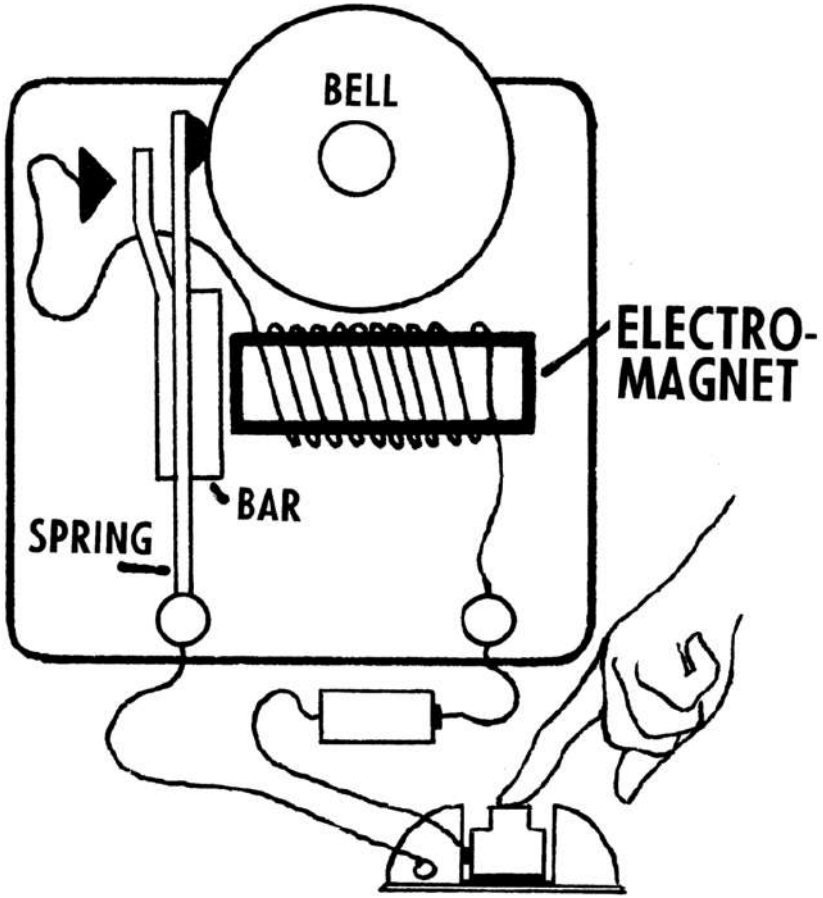


Electromagnets

- Electromagnets attract things only when a current exists in the wire

- So, electromagnets can be turned on and off as needed (temporary magnet)

Uses of Electromagnets



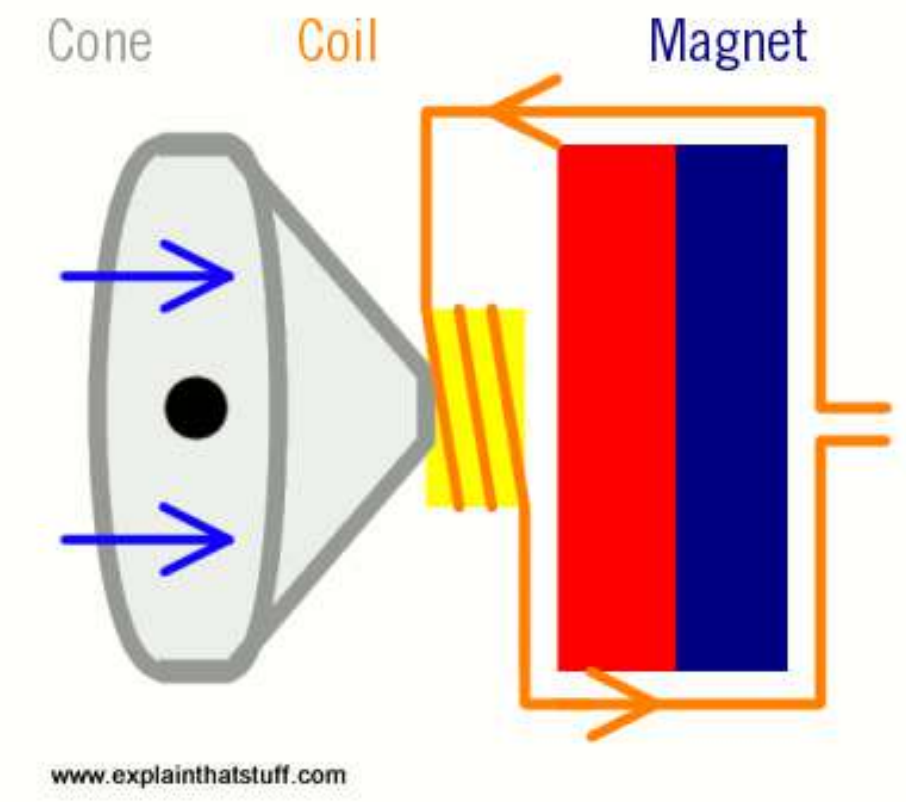
http://home.howstuffworks.com/home-improvement/repair/doorbell3.htm
[scroll down to view animation]

(instead of above link, show “using electromagnets” video from online text, ch.4-2)

Uses of Electromagnets

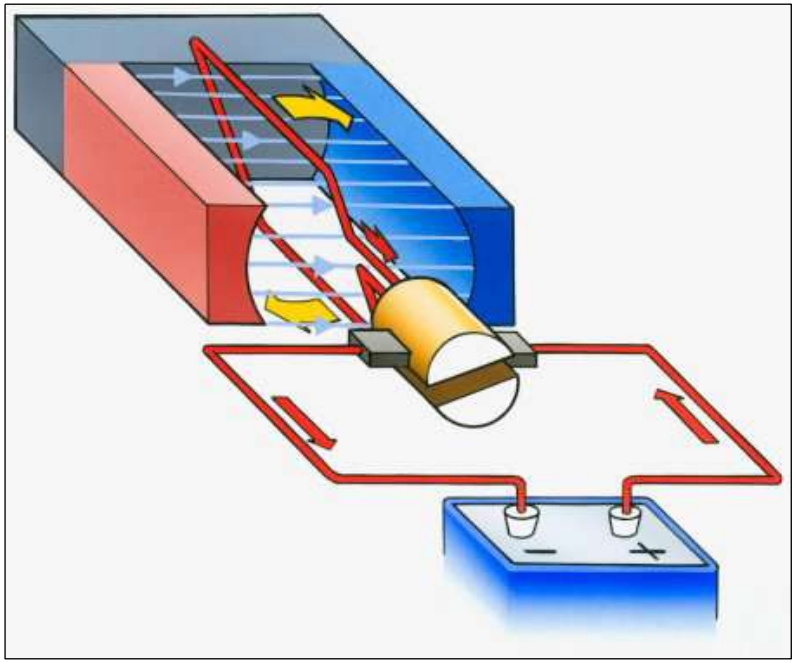
Loud Speaker - The inner part is fixed to an iron coil that sits just in front of a permanent magnet. When you hook up the loudspeaker to a stereo, electrical signals feed through the speaker cables into the coil. This turns the coil into a temporary magnet or **electromagnet**. **As the electricity flows back and forth in the cables, the electromagnet either attracts or repels the permanent magnet**.

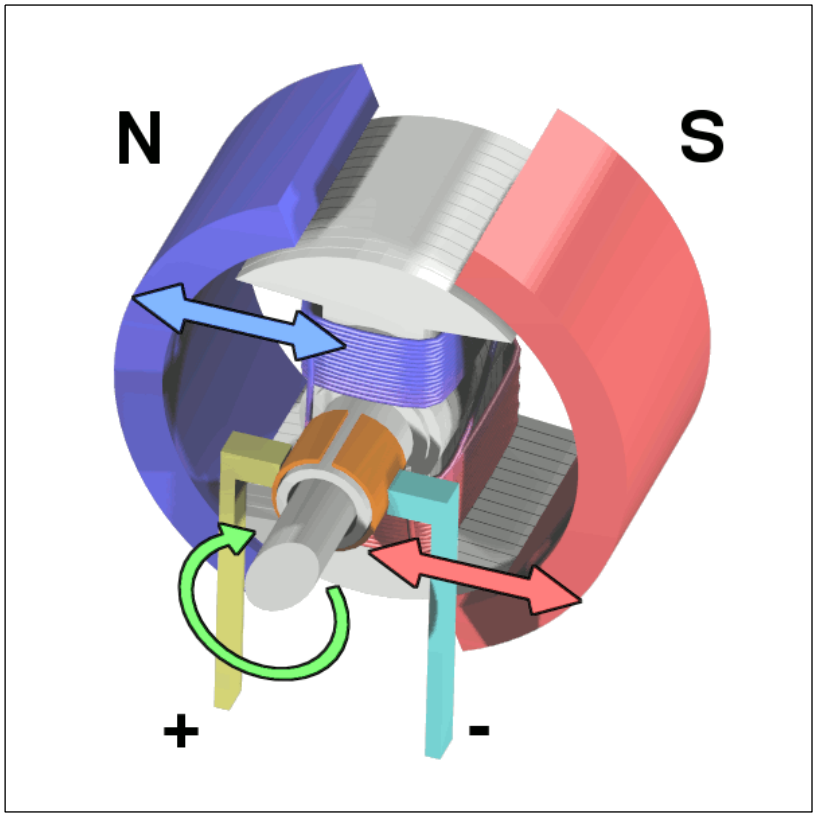
p. 137



#9

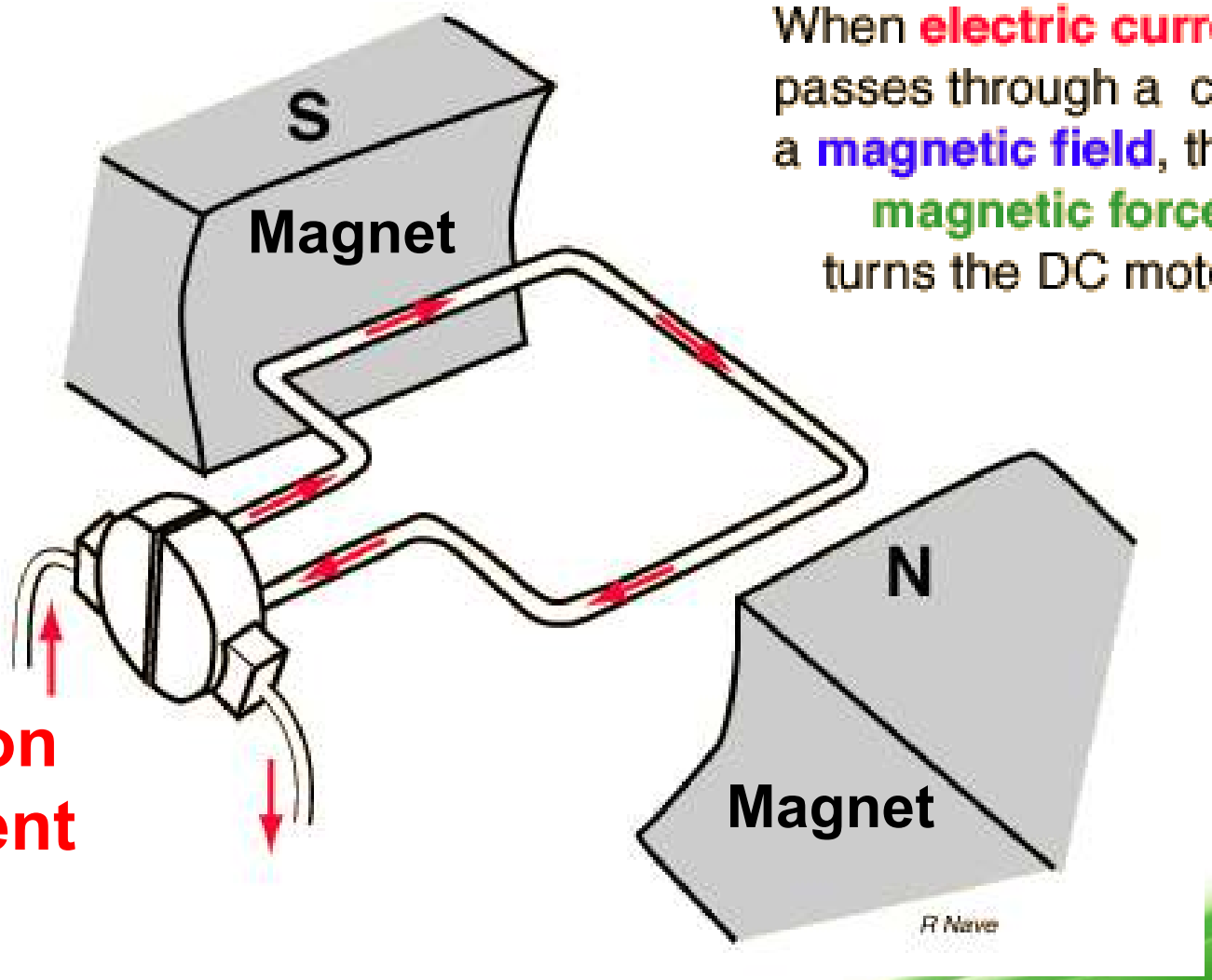
Electromagnets are used in electric motors: to transform electrical energy to mechanical energy- alternating attraction and repulsion between a permanent magnet and electromagnet causes an electric motor to rotate.





Electromagnets in an Electric Motor

When **electric current** passes through a coil in a **magnetic field**, the **magnetic force** turns the DC motor

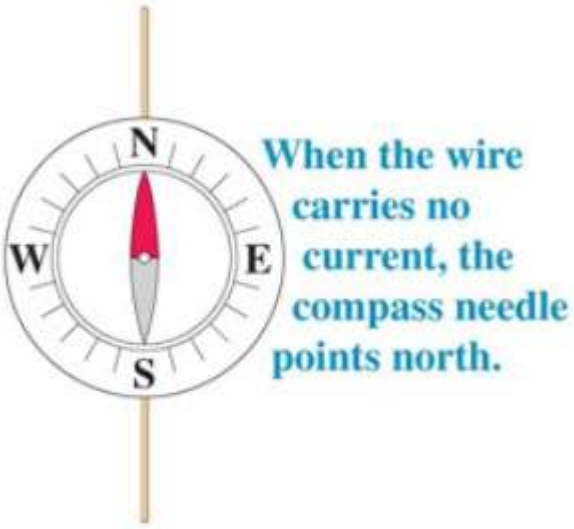


Direction of Current

A compass needle is a magnet (a weak one), and it tends to line up in such a way as to point its "north pole" towards the North Pole of the planet.

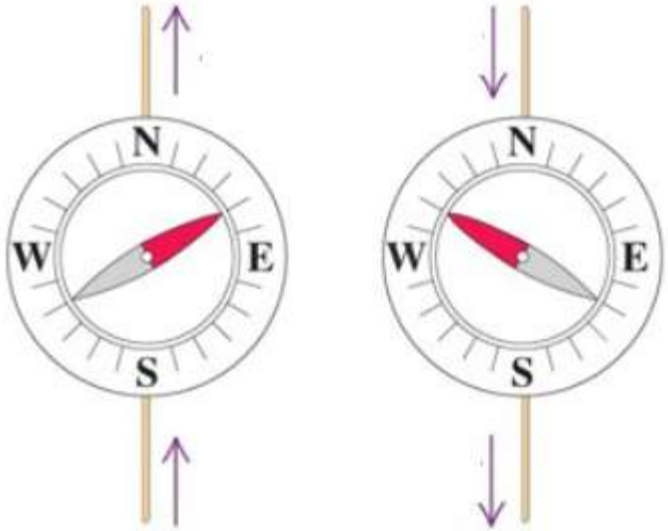
Based on what you have learned so far, what do you think will happen if you put the compass near a wire carrying an electric current? Why? Discuss with a partner.

The electric current produces a magnetic field. The magnetic field created by the current will interfere with the magnetic field the compass experiences when it is brought near enough.



When the wire carries no current, the compass needle points north.

When the wire carries a current, the compass needle deflects. The direction of deflection depends on the direction of the current.

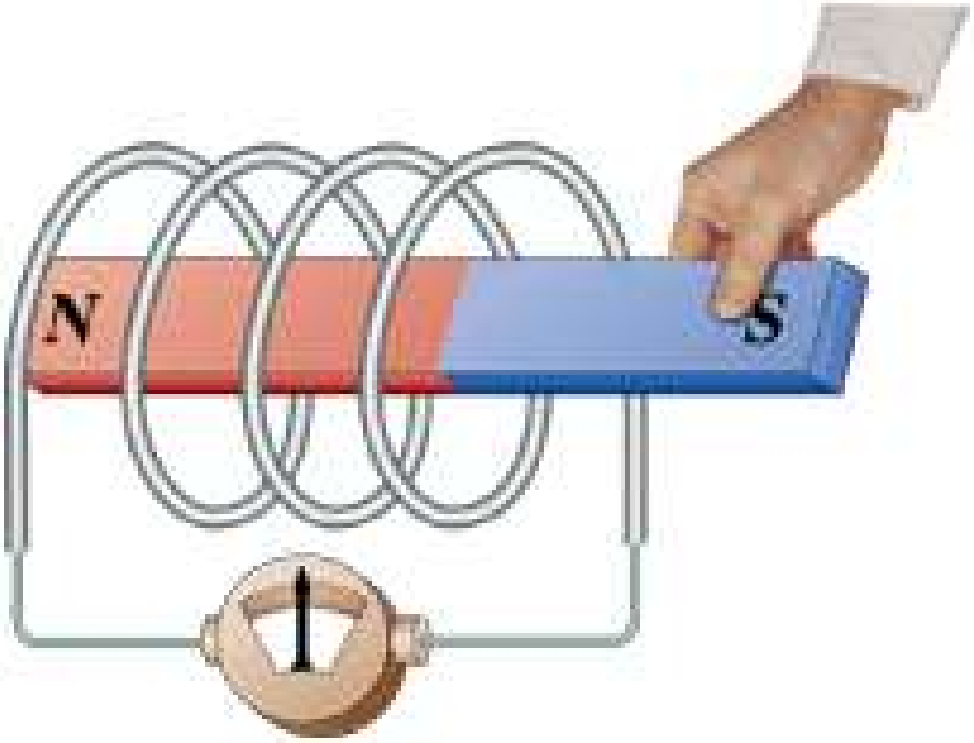


What was
our discovery
in the activating
strategy?

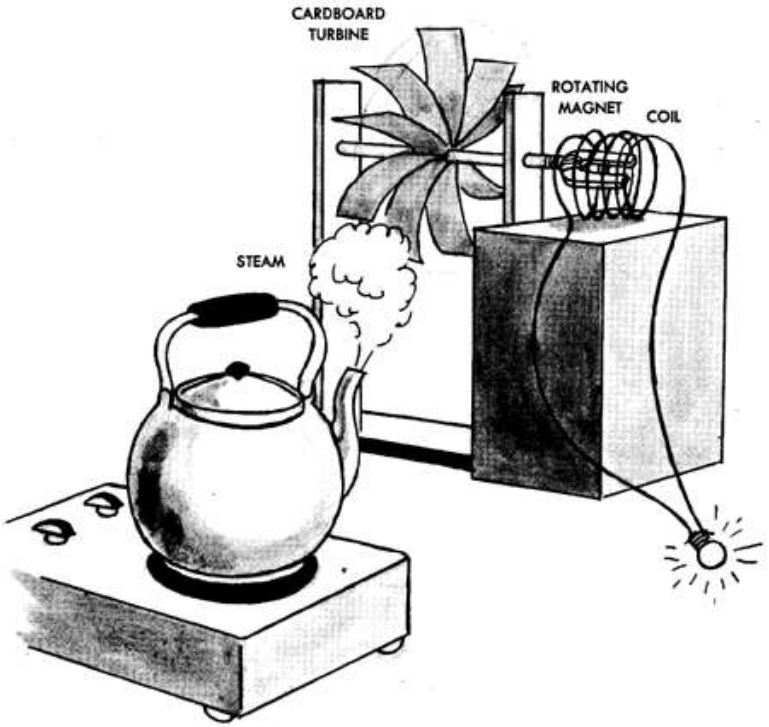
When the magnet moved through the copper pipe, an electric current was created.

A magnet can produce an electric current; therefore, magnets can be used to make electricity.

p. 143-144



What has to happen to the magnet in order to create an electric current?



There has to be movement. In this case, the wire does not already have a current in it.

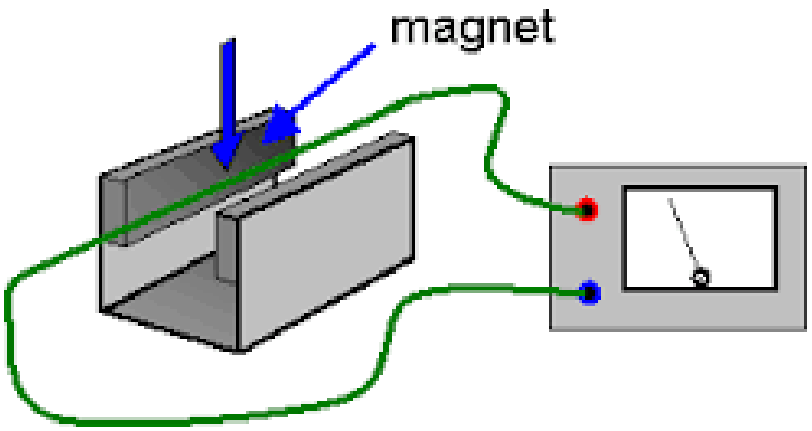
#11

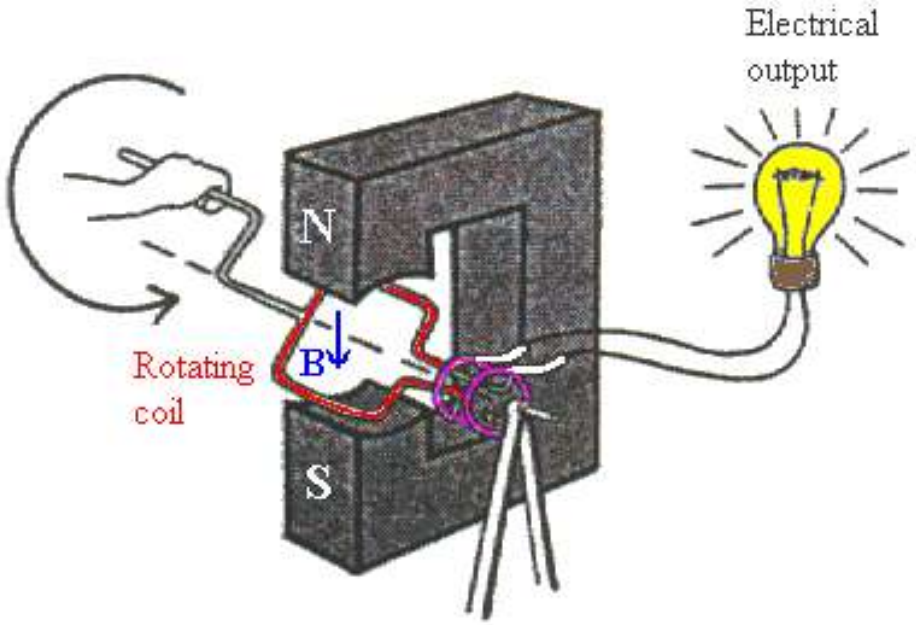
The movement of the magnet though will generate the current.

(video, online text, ch.4-3 “electromagnetic induction”)

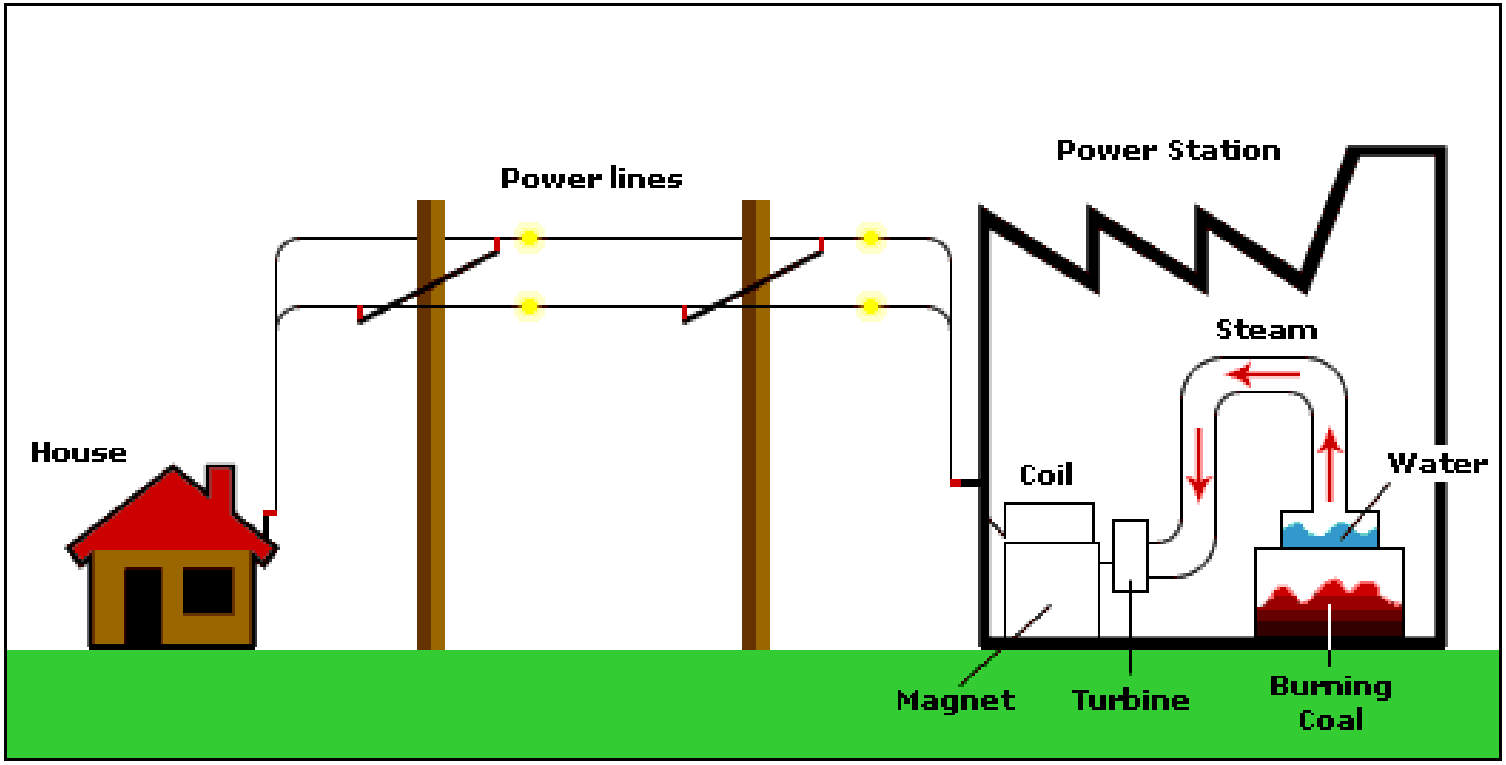
#11

The movement of wire through a magnetic field also produces an electric current in the wire.

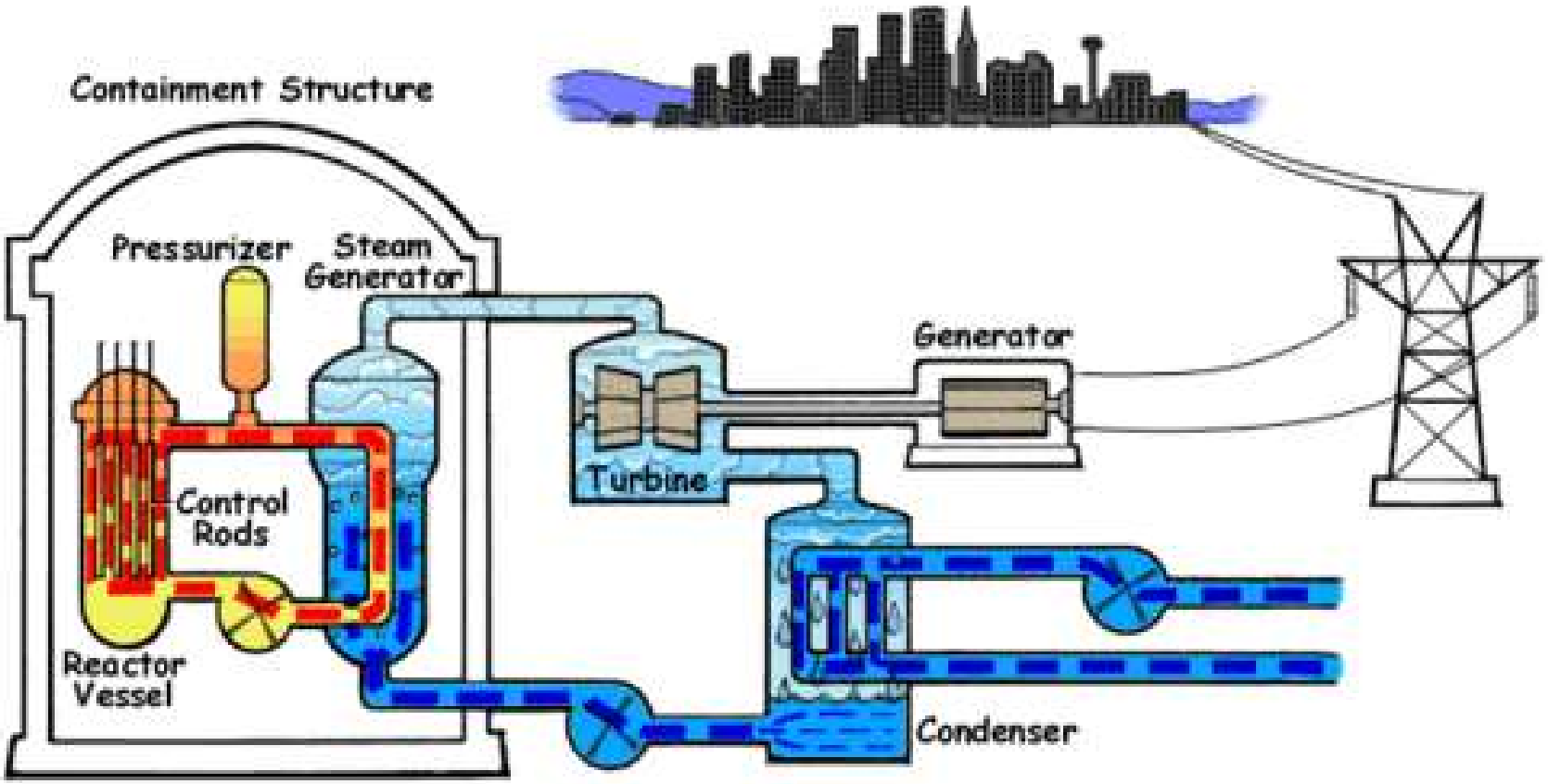




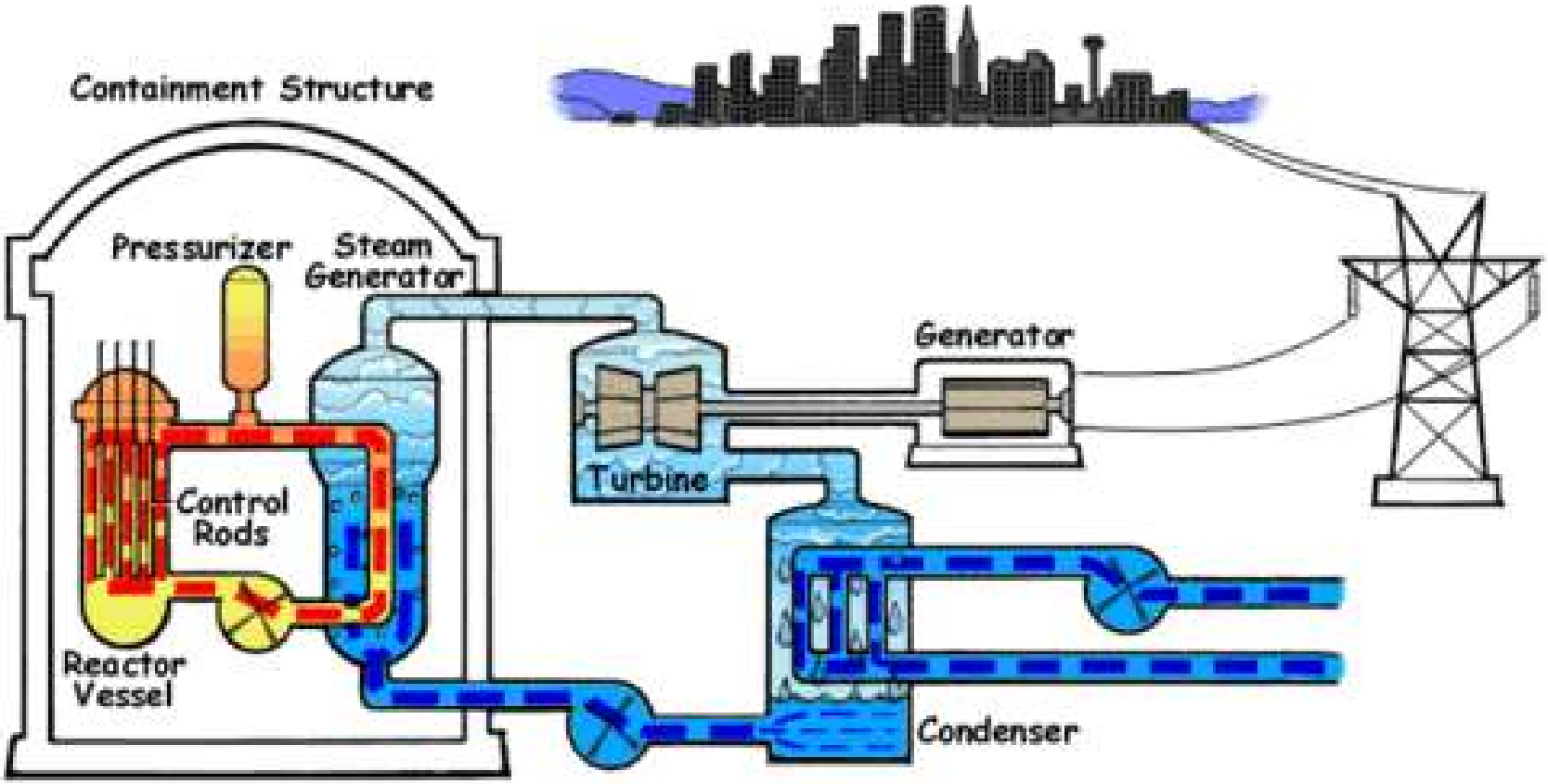
A Magnet being used to make Electricity



Generators convert mechanical energy to electrical energy by using magnets.

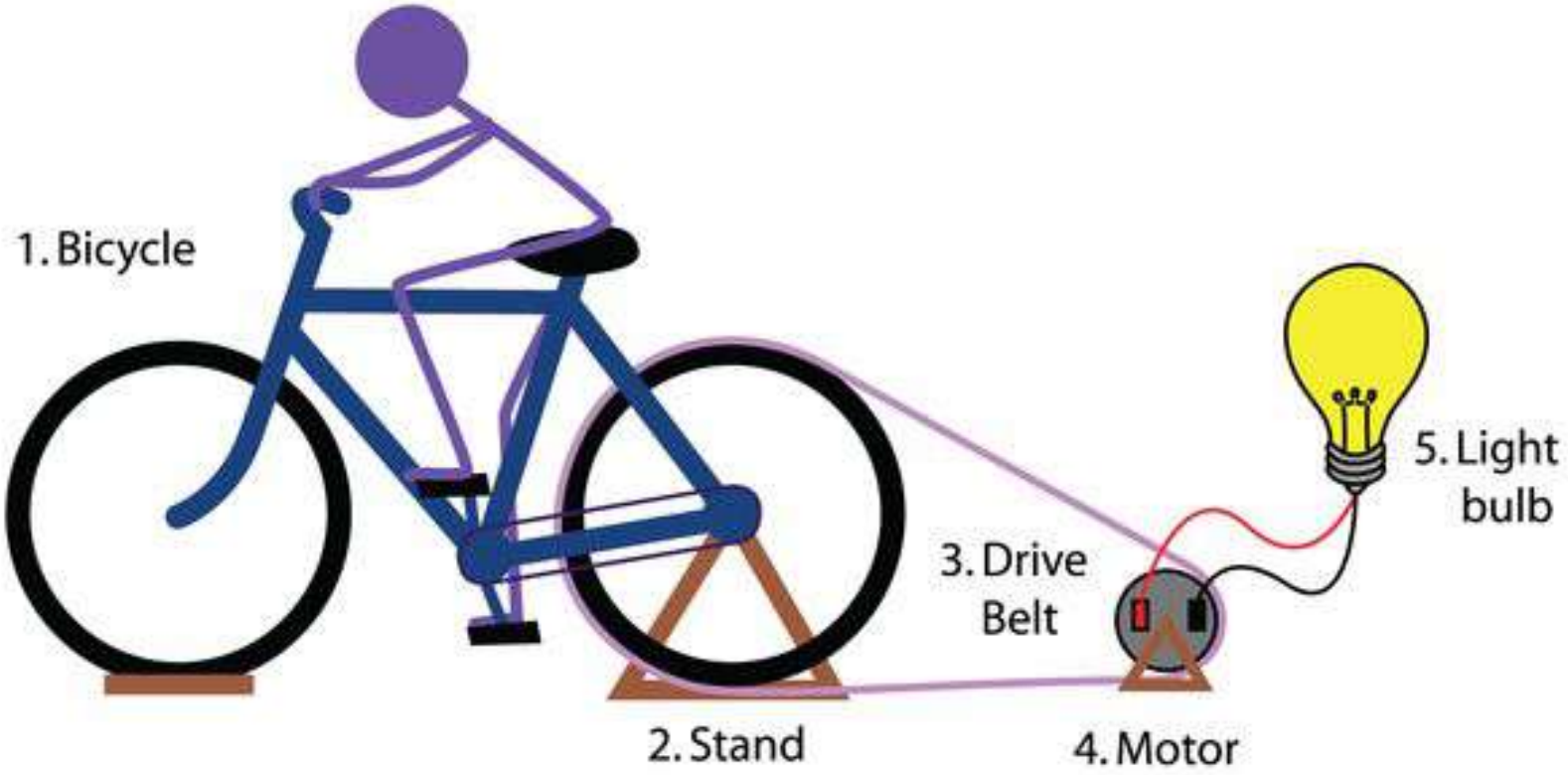


The water is converted into steam which is used to create the mechanical energy that is converted to electricity in the generator.



(video, online text, ch.4-3 “transformers”)

In this case, the bicycle is providing the mechanical energy the gets converted to electrical energy.



Magnetism: Motors and Generators [1:59]: https://www.youtube.com/watch?v=d_aTC0iKO68

Summarizer

**write answers on back of notes!

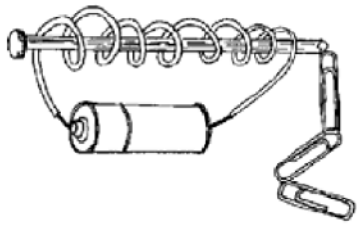
Currents and Magnets Summarizer Name _____ Date _____

1. Explain how currents and magnets exert forces on each other.

_____

_____

2. Identify the illustration to the right and explain its usefulness.



_____

_____

_____

3. A motor is used to convert _____ to _____.

4. A generator is used to convert _____ to _____.