Name ______________________________ Section ___________________

Period 16 Activity Sheet: Motors

16.1 How Do Direct Current (DC) Electric Motors Work?

Spinning rotors. In this activity, we see why the rotor of an electric motor spins.

a) Place a permanent magnet on a plastic spinner and make the magnet spin by holding another magnet nearby. The magnets simulate a motor.

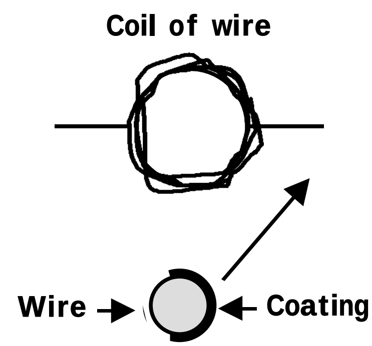
Could you make a practical motor using only permanent magnets? Explain why or why not.

b) Place a solenoid near the magnet on the spinner. Make the magnet spin by alternately connecting and disconnecting the solenoid from a 3 battery tray.

Could you make a practical motor using electromagnets (like the solenoid) and a continuous, unchanging current? Explain why or why not.

c) What type of current is required to make a motor run? _________________

Activity 16.2: How Can You Make a Simple Motor?



End view of wire with coating scraped from one side of one end.

a) **Building a motor.** Refer to the model on your table.

1) Cut a 3 meter length of coated wire.
2) Wrap the wire into a circle 3 to 4 cm in diameter, leaving 4 cm of wire protruding from each side of the circle.
3) Use sandpaper to carefully scrape the coating off of **one side** of one end of the protruding wire. Scrape all of the coating off of the other end of the wire.
4) Place the wire circle on a paper clip support stapled to a wooden block.
5) Use connecting wires to attach the positive end of a 3 battery tray to one side of the metal support and the negative end to the other side of the support.
6) Hold a strong magnet near the coil of wire and start the coil spinning with your finger.

b) **How does the motor work?**

1) Why must you scrape the coating off of the ends of the wire? Why do you scrape it from only one side of one of the ends?

2) What provides a changing magnetic field in this motor?

3) What keeps the wire coil spinning?

Activity 16.3: How Does the St. Louis Motor Work?

St. Louis motor: Connect the St. Louis motor to a 3-battery tray.

1) Does the St. Louis motor run better when the like poles (both north poles or both south poles) or the unlike poles (one north and one south pole) of its two magnets are oriented in the same direction?

2) Remove one permanent magnet and adjust the remaining magnet until the motor runs. Does the rotor turn more rapidly using one or two permanent magnets? ___________________________

3) What makes the St. Louis motor's rotor move initially?

4) What makes the rotor continue to spin? Why doesn't the rotor turn until its poles are aligned with the opposite poles of the permanent magnets and then stop?

5) We have found that a changing current is necessary to make a rotor spin. The St. Louis motor is connected to an unchanging direct current source. What causes a changing current in a direct current motor? ____________________

16.4 Do Alternating Current Motors Need Commutators?

a) **Synchronous motor:** Connect a solenoid to the screws on the base of a step-down transformer. Plug the transformer in the power strip. Hold a magnaprobe (a permanent magnet that spins and is attached to a handle) vertically at one end of the solenoid's metal core. Use your finger to start the mangnaprobe spinning.

Explain why the magnaprobe continues to spin.

b) **Universal motor are AC motors with commutators:** Your instructor will demonstrate a motor that operates on alternating current, but uses a commutator. Explain how this motor differs from a DC motor, such as the St. Louis motor, and from a synchronous AC motor.

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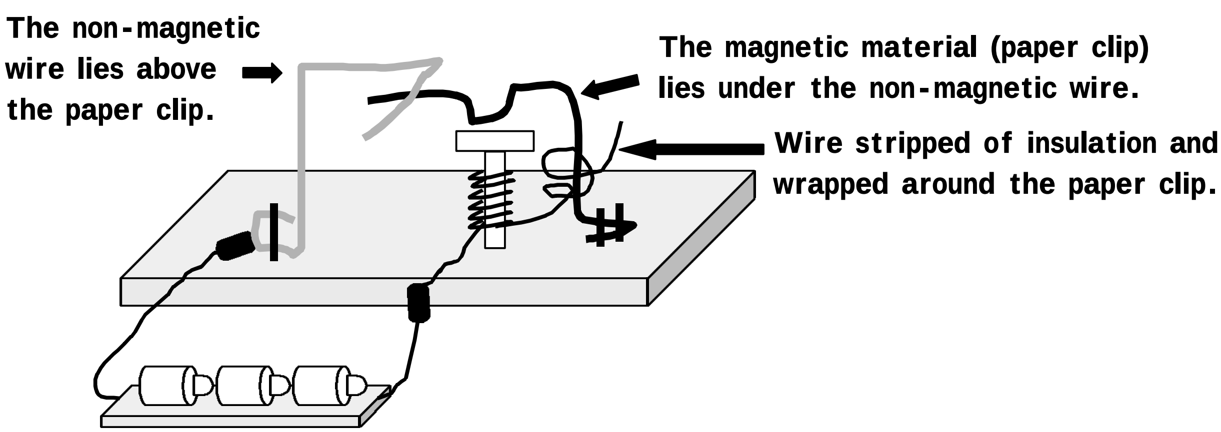
Activity 16.5: Building a Buzzer

a) Directions for Building the Buzzer

Step 1

1) Cut off approximately 3 meters of coated copper wire from the wire spool. With a piece of sandpaper, remove the insulating coating from about 1 inch of one end of the wire. Be sure to remove all the insulation so that electrical contact can be made.
2) Let the end of the wire extend several inches beyond the edge of the wood strip that is farther from the nail. With the wire next to the wood, begin wrapping the wire around the nail, distributing the wire evenly along the length of the nail.
3) Wrap the wire until all but 4 inches of the wire have been used. Finish winding with the last turn of wire at the bottom of the nail.
4) Using sandpaper, remove the insulation from about 1 inch of the other end of the wire so that both ends have been stripped of insulation.
5) Which component of your buzzer did you just make? ___________________



Step 2

1) Bend the paper clip so that it looks like the buzzer model on your table.
2) Position the base of the paper clip on the board. Staple the base of the paper clip to the board so that the staple straddles the two smaller parts of the paper clip. You may need more than one staple.
3) Bend the nonmagnetic wire to look like the model. Position the wire on the board so that the loop is over the top of the nail. Make sure that the top end of the clip extends just slightly above the end of the paper clip.
4) Staple the wire to the board.

Step 3

1) Take one end of the copper wire wrapped around the nail and wrap it several times around the base of the paper clip. Make sure the cleaned portion of the copper wire is in contact with the paper clip. After wrapping the wire, you may want to secure it to the board with a staple.

2) Attach one clip lead from a 3-battery tray to the far end of the nonmagnetic wire and the other clip lead to the free end of the coil of wire wrapped around the nail.

3) If adjusted properly, the buzzer should begin to buzz when the clip leads are connected. (You may need to adjust the position of the nonmagnetic wire relative to the nail head and the paper clip.)

b) How does the buzzer work?

1) What type of circuit results when the paper clip and wire are not in contact?

2) Why is it necessary for the paper clip and the nonmagnetic wire to break contact?

3) What causes a changing current in the buzzer?

4) What causes the paper clip to move up and down?

5) On the diagram below, identify the components of the buzzer.