Name _____ Date _____ Period _____

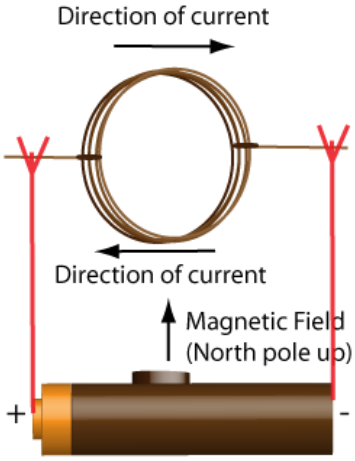
Lab: Making Simple Motor

CONCEPTUAL PHYSICS: UNIT 6

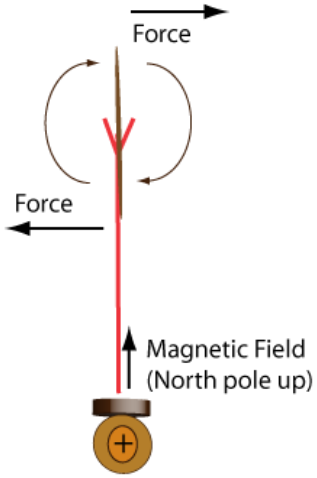
Introduction: Flick a switch and get instant power—how our ancestors would have loved electric motors! You can find them in everything from electric trains to remote-controlled cars—and you might be surprised how common they are. How many electric motors are there in the room with you right now? There are probably two in your computer for starters, one spinning your hard drive around and another one powering the cooling fan. If you're sitting in a bedroom, you'll find motors in hair dryers and many toys; in the bathroom, they're in extractor fans, and electric shavers; in the kitchen, motors are in just about every appliance from clothes washing machines and dishwashers to coffee grinders, microwaves, and electric can openers. Electric motors have proved themselves to be among the greatest inventions of all time. Let's pull some apart and find out how they work!

Background: The basic idea of an electric motor is really simple: you put electricity into it at one end and an axle (metal rod) rotates at the other end giving you the power to drive a machine of some kind. How does this work in practice? Exactly how do your convert electricity into movement? To find the answer to that, we have to go back in time almost 200 years.

Suppose you take a length of ordinary wire, make it into a big loop, and lay it between the poles of a powerful, permanent horseshoe magnet. Now if you connect the two ends of the wire to a battery, the wire will jump up briefly. It's amazing when you see this for the first time. It's just like magic! But there's a perfectly scientific explanation. When an electric current starts to creep along a wire, it creates a magnetic field all around it. If you place the wire near a permanent magnet, this temporary magnetic field interacts with the permanent magnet's field. You'll know that two magnets placed near one another either attract or repel. In the same way, the temporary magnetism around the wire attracts or repels the permanent magnetism from the magnet, and that's what causes the wire to jump. (http://www.explainthatstuff.com/electricmotors.html)



** the coil is wound clockwise

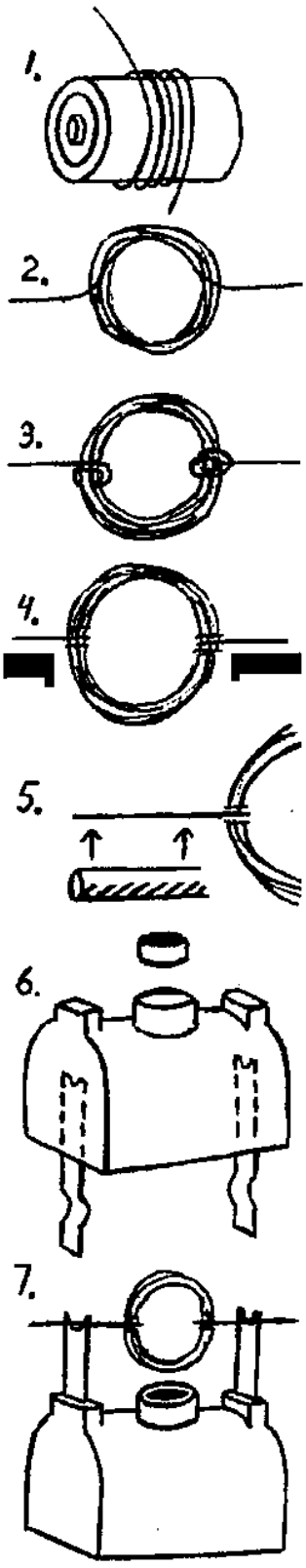


Materials:

- "The World's Simplest Motor" kit
- D-battery
- Razor blade knife (to scrape off enamel coating of wire)
- Wire cutters

Procedure:

1. Form groups of three and obtain a "World's Simplest Motor" kit, a D-battery, and a razor blade knife.
2. Unwrap the wire and straighten out any bends. Leaving about 2 inches straight, (about length of a D-cell battery), wrap the wire around the battery to form a coil (**Figure 1**) Unwrap a small amount from the 2nd end so that you now have about two inches of wire sticking out from either side. (**Figure 2**)
3. Each end of the wire is wrapped tightly around the coil for two turns. (**Figure 3**) This will keep the coil together. The two ends should stick out directly opposite of each other and should be at least 1 inch long. Excess can be trimmed or wrapped around the coil as additional turns.
4. The wire is covered with an enamel coating for insulation. Hold the coil vertically and then rest one of the wire ends on a flat surface. (**Figure 4**) Using the edge of a metal support, **scrape the enamel coating off the entire top half of the wire end**. Turn the coil slightly as you scrape so the the top half of the wire is scraped bare. Do not scrape the bottom half of the wire. Repeat this for the 2nd wire sticking out from the opposite end of the coil. **The enamel is left on the bottom half of each wire.** (**Figure 5**)
5. Slide the metal supports (U-end first) up through the slots in the plastic base. The bump in the metal faces towards the battery. The battery is pushed in and must touch both metal supports. (**Figure 6**) Set the magnet into the round holder.
6. Set the coil ends into the "U" of the supports and your motor is ready to run. Give the armature a gentle spin (**Figure 7**) If it does not continue to turn, try the opposite direction. After the motor works, the very ends of the wire can be bent to help keep the coil centered. If the motor does not work, check to see if the shiny side of the wires are both facing up when the coil is vertical. (**Figure 5**) Also, make sure the wire ends of the coil are centered. (**Figure 3**)
7. Try changing the shape of the armature (coil) and see how it affects the motion of the spinning coil. (*The motor works because electricity runs through the coil of wire, and a magnetic field is formed. This magnetic field only forms when the bare wire touches the metal supports. You can feel this by holding the coil in place with the shiny ends down against the metal supports. The coil pushes away from the ceramic magnet with enough force to turn it all the way around. As the coil turns around, it becomes charged again and gets another push. This process happens again and again to keep the motor turning.)*
8. Reverse the direction of the battery and see how it effects the direction the motor is spinning.
9. Add a small piece of masking tape (*4mm wide X 25mm long*) to the wire ends to make a circling flag. Investigate how this affects the motion of the spinning motor.



(Instructions from: https://www.arborsci.com/)

CONCLUSION QUESTIONS:

1. Were you successful on your first attempt to get you simple motor running? If not, what did you do to fix it?

2. What was the purpose (function) of the D-battery in "The World's Simplest Motor"? (*What does the electricity provided by the battery produce as it flows through the coil of wire?*)

3. What was the purpose of the magnet in "The World's Simplest Motor"? (*What did the magnet create?*)

4. Explain what provides the force to make the coil of wire spin. (*Be specific and include the terms: battery, electrical current, wire coil, magnet, magnetic fields, attract or repel*)

4. What happened to the motion of the motor when you changed the shape of the coil of wire?

- Was there an optimum shape?

5. What happened when you reversed the direction of the battery?

- Why did this happen?

6. What happened to the speed of the motor when you added the small tape flags on each end?

- Explain why the speed changed.

7. How could you modify your motor so that it would spin faster? (*List at least two ways*)

8. What would you do to create a stronger (more powerful) motor? (*List at least two ways*)