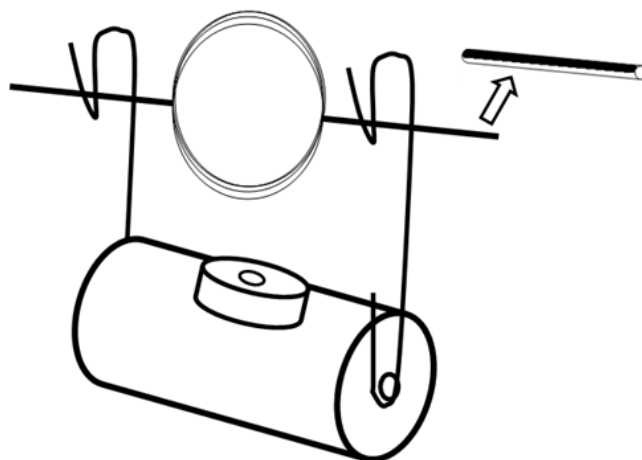


Simple Electric Motor

It's true-when you build something yourself you understand it much better because you've seen the parts come together and you see how they interact. As this lesson shows, electric motors are not hard to build or understand. Pick up a couple of rolls of magnetic wire (18-22 gauge) beforehand and have students cut their own 105 cm-long piece before assembling.



Materials per student: 1 disc magnet, D-cell battery, 2 regular sized paper clips, 105 cm magnetic wire (item #WW63641M22 at sciencekit.com), sand paper, scissors, ruler

Procedure:

1. Wind the wire 8 turns around the battery, leaving a tail a few centimeters long on each end.
2. Remove the coil from the battery and wind the tail 2 times around opposite sides of the coil.
3. Cut the tails so they are 2 ½ centimeters long.
4. Using your folder to protect the table, sand off the red enamel entirely from one of the tails. *This tail will be all copper.*
5. On the other tail, sand the enamel from the top half only. Lay it flat and drag sandpaper across the top side, as shown above. The bottom half will remain shiny red.
6. Center and straighten the armature (coil). Hold it by the tails and twirl. If it doesn't spin smoothly, correct the tail positions so it does. *A floppy loop will not spin.*
7. To form the supports for the armature, open 2 paper clips and bend a hook in the large end, as shown.
8. Hold one support to each end of the D cell.
9. Set a magnet on the cell as shown; it will cling to the steel battery.

To get your motor running:

1. Set the coil armature in the paper clip supports.
2. Adjust the coil so it spins close to, but doesn't touch, the magnet (almost brushes it).
3. Give the armature coil a gentle push to get it going.
4. You have succeeded if the armature spins by itself for 10 seconds!

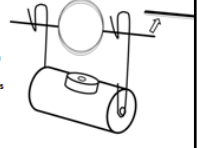
Not Working? Read on:

1. Make sure the coil swings close to, but does not touch, the magnet.
2. If it "bobs" but won't spin:
 - a. re-adjust the tails so they're perfectly balanced when you spin it in your fingers
 - b. vary the magnet- turn it around and then over
 - c. vary the paper clips slightly
3. If your armature isn't even "bobbing" then it isn't getting electricity:
 - a. sand the all-bare tail again. A speck of enamel could still be there
 - b. shave off another strip of enamel from the half/half tail
4. Try turning the coil around the other way, to reverse the poles
5. Exchange your battery for another (borrow one from someone who's motor is working)

Come back and visit InteractiveScienceTeacher.com to upgrade this lesson with:

Student Handout

Answers-to Handout

<div style="text-align: center; border: 1px solid black; padding: 5px;"> <p>BUILD A SIMPLE ELECTRIC MOTOR</p> </div> <p>Materials per person: 1 D-cell magnet, D-cell battery, 2 regular sized paper clips, 100 ohm magnetic wire, sand paper, scissors, ruler</p>  <p>Procedure:</p> <ol style="list-style-type: none"> 1. Wind the wire 3 turns around the battery, leaving a tail a few centimeters long on each end. 2. Remove the coil from the battery and wind the tail 2 times around opposite sides of the coil. 3. Cut the tails so they are 2.5 centimeters long. 4. Using your folder to protect the table, sand off the red enamel <u>entirely</u> from <u>one</u> of the tails. This tail will be all copper. 5. On the other tail, sand the enamel from the <u>bottom half only</u>. Lay it flat and drag sandpaper across the top side, as shown in the right. The bottom half will remain shiny red. 6. Center and straighten the armature (coil). Hold by the tails and swirl. If it doesn't spin smoothly, correct the tail positions so it does. A floppy loop will not spin. 7. To form the supports for the armature, open 2 paper clips and bend a hook in the large end, as shown. 8. Hold one support to each end of the D-cell. 9. Set a magnet on the cell as shown; it will cling to the steel battery. <p>To get your motor running:</p> <ol style="list-style-type: none"> 1. Set the coil armature in the paper clip supports. 2. Adjust the coil so it spins close to, but doesn't touch, the magnet (almost brushes it). 3. Give the armature coil a gentle push to get it going. 4. You have succeeded if the armature spins by itself for 10 seconds! <p>Not Working? Read on:</p> <ol style="list-style-type: none"> 1. Make sure the coil swings close to, but does not touch, the magnet. 2. If it "bobs" but won't spin: <ol style="list-style-type: none"> a. re-adjust the tails so they're perfectly balanced when you spin it in your fingers b. vary the magnet- turn it around and then over c. vary the paper clips slightly 3. If your armature isn't even "bobbing" then it isn't getting electricity: <ol style="list-style-type: none"> a. sand the all-bare tail again. A speck of enamel could still be there b. shave off another strip of enamel from the half/half tail 4. Try turning the coil around the other way, to reverse the poles 5. Exchange your battery for another (borrow one from someone whose motor is working) <p style="font-size: small; text-align: center;">At the end of the period lock your armature (coil) on a ring in your folder.</p>	<p>Oh, no! Your teacher accidentally hit the "scramble" button just as the explanation for the motor was being typed. We need your help! Put the pieces back together to reform the 3 paragraph explanation for our simple motor.</p> <p style="text-align: center;">complete with a north and a south pole its poles now interact with the poles on the fixed magnet on the battery. current runs through the loop making it a temporary magnet. When copper on both tails touch the support, and the loop is pulled down. Now the like poles approach. The momentum causes the loop to swing through First, the 2 magnets' opposite poles attract, and after it swings through it is pushed up and away, and it flips over.</p> <p style="text-align: center;">until the current is stopped The cycle runs push/pull/push/pull/pull/pull/pull/pull and the loop is no longer a magnet.</p> <div style="border: 1px solid black; height: 100px; width: 100%;"></div>	<p style="text-align: center;">ANSWERS- Motor Explanation</p> <p style="text-align: center;">complete with a north and a south pole. Its poles now interact with the poles on the fixed magnet on the battery. current runs through the loop making it a temporary magnet. When copper on both tails touch the support, and the loop is pulled down. Now the like poles approach. The momentum causes the loop to swing through First, the 2 magnets' opposite poles attract, and after it swings through it is pushed up and away, and it flips over. until the current is stopped The cycle runs push/pull/push/pull/pull/pull/pull/pull and the loop is no longer a magnet.</p> <p style="font-size: x-small; text-align: center;"><i>When copper on both tails touch the support, current runs through the loop making it a temporary magnet, complete with a north and a south pole. Its poles now interact with the poles on the fixed magnet on the battery.</i></p> <p style="font-size: x-small; text-align: center;"><i>First, the 2 magnets' opposite poles attract, and the loop is pulled down. The momentum causes the loop to swing through and it flips over. Now the like poles approach, and after it swings through it is pushed up and away.</i></p> <p style="font-size: x-small; text-align: center;"><i>The cycle runs push/pull/push/pull/pull/pull/pull/pull until the current is stopped and the loop is no longer a magnet.</i></p>
--	---	---