



The Motor Effect

current, electromagnet, magnetic field, right-hand rule

Electricity and Magnetism Unit

A fan spins to keep you cool. An engine purrs to move your car forward. A refrigerator hums to keep your food cold. You know how to make these things work, right? Just flip a switch! Step on the pedal! Plug it in! Easy. But when we take all of these machines apart, what makes them spin? Inside most everything around you that spins and whirs is a motor, but they're tough to see unless you pull them apart. I don't want you to get in trouble for tearing apart your fan, so I'm going to make this easy on you. I'm going to turn you into electricity so you can see how a motor works from the inside. That way, you can just travel where the wires take you. Magnetism will take care of all the spinning.

As electricity, you move all over the place. You hum through the school walls. You bolt down from the clouds as lightning. You move through a wire in the middle of this motor. You move through metals like a stream or river. A **current** is a flow of electricity, or electrons, through something. As you move through the middle of the motor, you feel it start spinning. Around you are all these magnets, but . . . wait a second . . . why are the magnets pushing you in circles? Believe it or not, anything that you move through as electricity will turn into a magnet. You can make the wire you move through into a stronger magnet if more current flows through. With less of you moving through the wire, it becomes a weaker magnet.

If you have ever played with a magnet before, you know that it does not need to touch things to make them move. From under a table, you can make metal things move around on top of the table without touching them. Weak magnets might need to touch a paper clip to move it, but strong magnets can pull a paper clip from a foot away! You do not need me to tell you this. You are in the middle of a motor, spinning around really fast because of the magnets around you. A **magnetic field** is a space around something where there is a magnetic force. Small magnets make small fields around them, but the Earth has its own field

that goes thousands of miles into space! Anytime you move through a wire as electricity, you make one of these fields around you. Have you ever heard a humming noise in speakers when they are plugged in?

That noise can come from the magnetic field in the wires around them. Good thing electricity never needs to rest.

When you move through the middle of this motor, you are making a different kind of magnet than the ones you see sticking to a fridge, but you both work in the same way. In the motor, you follow a wire in circles around a piece of metal. By moving around in these circles, you make a field that pushes out in all directions. If we turn the power off, the field will go away and the magnets around you will stop pushing on you. An **electromagnet** is a metal that turns into a magnet when a current passes through it. If you make circles around a piece of metal with a wire, you can make it even stronger. Think of it like a mummy, with metal in the middle and wire making circles around it. If we put this together with other magnets, they will push on each other and we use that pushing to make a motor spin!

You cannot see the field around the wires, so how can we find the direction of the magnetic field that moves our motor? Maybe you should turn back into a person for a second . . . We'll use the thumb on our right hand to point in the direction the electricity moves in the wire. These fields move in a circle around the wires and the fingers of our right hand will now point in the direction of the field. Easy! The **right-hand rule** is a way of seeing the direction of a magnetic field by pointing your thumb in the direction of the current and looking at where your other four fingers are pointing. Again, this is really easy: If your thumb is pointing in the direction of the current, along the wire, your other fingers will be curling around in a circle.

The direction your palm is facing and where your fingers are pushing is the direction of the magnetic field and can help you figure out how the wire will spin! Got it? Great. You can turn back into electricity now.

How does a fan work? How about your car? Your refrigerator? They all use motors. These work by using a current, electricity running through a wire, to make a magnetic field. If we wrap this wire around a piece of metal, we can make it into a magnet. This electromagnet then spins, because its pushed away by another magnet. If you ever need to figure out which way the electromagnet is going to push the wire that runs your motor, you can use the right-hand rule. Just open your hand and stick your thumb up.

Now imagine your thumb is running along the wire, your fingers are curling around the wire and you can see which directions the magnetic field will be going. Got it? Great. I guess I didn't need to turn you into a bit of electricity after all.

References:

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