



Student Content Brief – Introductory Level

Electric Motors

Background Information

To help you navigate your Sea Perch, there are three propellers powered by three small motors. But what makes a motor spin to power the propellers? Magnets! Magnets play an integral role in making motors spin, so in order to understand how the electric motors in your Sea Perch operate, you will need to learn about magnets.

Introduction to Electric Motors

Magnets have been used for centuries to help people navigate the globe. You have seen them holding papers on a refrigerator or spinning the needle in a compass. Magnets produce magnetic fields that attract certain metals (iron, nickel, cobalt). This magnetic effect comes from a special alignment of the atomic structure of the material.

All magnets have two poles, a north pole and a south pole. Magnets follow the rule that opposites attract and like poles repel. So if you try to put two magnets together, south pole to south pole or north pole to north pole, they will push away from or repel one another. If you try to put a north pole close to the south pole of another magnet, the magnets will attract or move towards one another.

Electric fields are created by charged particles like protons and electrons. These charged particles can push and pull on each other with the electrostatic force. The electrostatic force depends on the size of the charges and how close they are to each other. When you rub a plastic comb in your wool sweater and then hold it over tiny pieces of paper, they are attracted to the comb. They are pulled together by the electrostatic force. Charged particles follow the same rule as magnets. Opposite charges attract and like charges repel each other. When charged particles move along a wire, an electric current is produced. This current is what runs electrical appliances and the motors on your Sea Perch.

Hans Christian Oersted discovered the relationship between mechanical force, magnetism, and electricity through a series of experiments in the early 1800's. He noticed that when a current flowed through a wire, it moved the needle in a nearby compass. After much thought and more experimentation, he reasoned that this meant the current flowing in the wire produced a magnetic field. Later it was discovered by other scientists that when a wire with current running through it is placed in a magnetic field, a force pushes on the wire. This force is the basis for the electric motor.

The size of the force is given by the equation:

$$F = iL \times B$$

Where F is the force, B is the magnetic field strength, L is the length of the wire, and i is the current. This force can create a torque on your motor and makes it spin. Torque is the tendency for a force to cause an object to rotate around an axis.

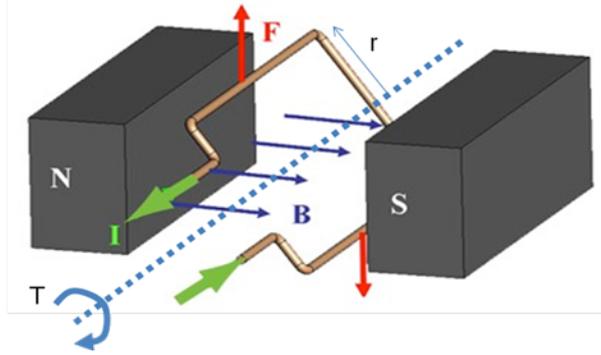


Figure 2: Schematic diagram of a coil of wire conduction current in a magnetic field.

Adapted from: http://hades.mech.northwestern.edu/wiki/index.php?title=Brushed_DC_Motor_Theory

How Electric Motors Relate to your Sea Perch

Your Sea Perch has three motors connected to a control box, which is connected to a power supply. The current from the power supply flows into each motor. There are small magnets inside each motor. As the current flows through loops of wire inside the magnets a force causes the motor to spin. This in turn spins your propellers as you navigate the Sea Perch through the water.

You will need to think about where to place your motors on the Sea Perch. You will also want to think about how to make your motors spin in specific directions and at different speeds.

Additional Resources

- If you would like to learn more about electric motors, please visit the following URL: http://en.wikipedia.org/wiki/Dc_motor