Make Motion Work

Trace energy through a simple motor and its load.

PHY.5.8 "Enrichment: Design and construct a simple motor to develop an explanation of how the motor transforms electrical energy into mechanical energy and work."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where electrical energy enters the motor, circle the parts that make the coil turn, and number the steps that show how the turning motor does work on another object.

A Motor That Lifts a Flag

1. Imagine a motor that can wind a thread and lift a tiny paper flag. Start with insulated copper wire wound into a balanced coil, leaving two straight ends that act as an axle. Rest those ends in two bent paper clips connected to opposite terminals of a single 1.5-volt battery. Place a small magnet beneath the coil without letting it touch. On each axle end, remove the insulation from only the same half of the wire's surface. The exposed halves must face the same direction. Keep metal contacts apart except through the coil, and disconnect the battery if anything feels warm.

2. When the exposed copper touches the paper clips, the battery drives current through the coil. Current in the magnet's field experiences a force. Because current travels in opposite directions along two sides of the coil, the magnetic forces on those sides create a turning effect called torque. During part of each turn, the insulated halves meet the clips and interrupt the current. The moving coil coasts through that gap, then contact returns and the magnetic forces drive it onward in the same direction. A gentle starting push may be needed if the coil stops in an unhelpful position.

3. For a useful test, tie a fine thread to an axle end beyond its paper-clip support. Let the thread's free end hold a small paper flag. If the rotating axle winds the thread and raises the flag, the motor exerts an upward force through the thread while the flag moves upward. That is mechanical work on the flag, not just visible spinning. The battery supplies electrical energy; some becomes motion of the coil and lifted flag, while some warms the wire and contacts. A heavier flag may rise more slowly or stall the coil because lifting it demands more torque. Disconnect the battery before changing the load.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why does the motor need both bare and insulated portions on each axle end?

2. How do the battery, magnet, and coil together produce rotation?

3. Why does raising the flag show that the motor does work, rather than only spins?

4. Why might replacing the flag with a heavier one slow or stall the motor?

3 YOUR TURN

Your own words

Design a version of this motor that pulls a lightweight cardboard gate sideways instead of lifting a flag. Describe one change to the build, a test for work on the gate, and the energy path from the battery to the moving gate, including one energy loss.

ANSWER KEY

Make Motion Work

HIGH SCHOOL · PHY.5.8

PART 1 · READ AND MARK

Underline where electrical energy enters the motor, circle the parts that make the coil turn, and number the steps that show how the turning motor does work on another object. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why does the motor need both bare and insulated portions on each axle end?	**The bare portions let current flow and produce torque. The insulated portions interrupt the current so the coil can coast through part of a turn before the magnetic forces drive it onward.**
2	How do the battery, magnet, and coil together produce rotation?	**The battery drives current through the coil. The magnet's field exerts forces on the current-carrying sides, creating torque that turns the coil.**
3	Why does raising the flag show that the motor does work, rather than only spins?	**The motor pulls upward on the flag through the thread, and the flag moves upward. A force acting through that distance does mechanical work on the flag.**
4	Why might replacing the flag with a heavier one slow or stall the motor?	**Lifting the heavier flag demands more torque. The motor may turn more slowly or be unable to lift it.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would replace the hanging flag with a lightweight cardboard gate that can slide across a smooth desk. A thread tied to the axle would run horizontally to the gate. I would mark the gate's starting position, connect the battery briefly, and check whether the turning axle pulls the gate past the mark. The battery supplies electrical energy to the coil. Forces from the magnet's field turn the coil and axle, which pull the thread. The thread does work by pulling the gate through a distance. Some energy warms the wire and contacts.

Accept other practical gate setups if the student identifies a force that moves the gate through a distance. The explanation should connect electrical energy to rotation, work on the gate, and an energy loss.