Forces, Motion & E**n**ergy **8 Lab Practical**

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- Balloon
- Ping pong ball
- Magnet kids can break in half
- Hammer
- Paper clips (small)
- Small compass
- Confetti
- Nail wrapped in magnet wire
- Sandpaper
- 12V DV motor
- Bi-polar LED
- D-cell battery
- Thick magnet (not to be broken)

Lab Practical: *Note: Answers given in italics!*

1. Design an experiment that demonstrates each of Maxwell's four equations, and explain each principle as you demonstrate it.

Maxwell's 4 Equations explained in everyday language are:

a. *Maxwell's First Equation*
   - *Like charges repel; opposites attract*
   - *The proton has a positive charge, the neutron has no charge (neutron, neutral get it?) and the electron has a negative charge. These charges repel and attract one another kind of like magnets repel or attract. Like charges repel (push away) one another and unlike charges attract one another. Generally things are neutrally charged. They aren't very positive or negative, rather have a balance of both.*
   - *Experiment: Rub your head with a balloon and hold the charged balloon near your head so that your hair sticks to the balloon. Is there glue on the balloon? Why does your hair stick to the balloon? Answer: The positively charged hair sticks to the negatively charged balloon.*

b. *Maxwell's Second Equation*
   - *All magnets have two poles*
   - *Magnets are called dipolar which means they have two poles. The two poles of a magnet are called north and south poles. The magnetic field comes from a north pole and goes to a south pole. Opposite poles will attract one another. Like poles will repel one another.*
   - *Experiment: What happens if you cut (or break) a magnet in half? The new magnets will each sport their own North-South poles!*

c. *Maxwell's Third Equation*
   - *Invisible magnetic fields exert forces on magnets AND invisible electrical fields exert forces on objects*
   - *A field is an area around an electrical, magnetic or gravitational source that will create a force on another electrical, magnetic or gravitational source that comes within the reach of the field. In*

fields, the closer something gets to the source of the field, the stronger the force of the field gets. This is called the inverse square law.

- *Experiment: To see how magnetic fields exert forces, play with a couple of magnets and see where the magnetic field is. Where on the magnet do paper clips attach? Use a compass to show you the direction of the lines of force.*
- *Experiment: Notice how your hair sticks up when you build up a static electrical charge. You can build up a charge on dry days by rubbing your hair with a balloon, and bringing the balloon next to a ping pong ball on a smooth, flat surface and you'll find the objects follow the balloon when placed near an electrical field.*

d. *Maxwell's Fourth Equation*

- *Moving electrical charges (fields) generate magnetic fields AND changing magnetic fields generate electrical fields (electricity).*
- *Refer to "Maxwell's Fourth Equation" experiment for experiment ideas. You want the student to show you two things: how a moving magnet creates an electrical field (spinning the shaft of a motor that has an LED connected to the terminals is one way to do this), and also that a moving electrical charge creates a magnetic field (hooking up a wire-wrapped nail to a battery will turn the nail into an electromagnet is one demonstration of this principle).*

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Student Exam

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Lab Practical:

1. Design an experiment that demonstrates each of Maxwell's four equations, and explain each principle as you demonstrate it.