a WOW Lab BLUEPRINT

Marble Generator

Inquiry Approaches

Initial Inquiry

What is electric current?

Electric current is the flow of electrons through a circuit.

When a light switch is flipped on, why does the light turn on? What has changed from when the light switch was in the "off" position?

Flicking on a light switch closes the circuit that the light is attached to. Since the circuit is closed and attached to a voltage source, current flows through the circuit. When the light switch is in the "off" position, the circuit is open. Current will not flow through an open circuit because there is no path through which it can flow.

What is a magnet?

A magnet is a material that produces a magnetic field. Magnets have a north and a south pole.

If a magnet is moved, what happens to its magnetic field?

Its magnetic field changes position. If a magnet is brought closer to another magnet, the two magnets will either attract or repel as their magnetic fields interact. A change in magnetic field in the presence of a wire coil can also produce an electric current, as demonstrated in the activity.

How can a magnetic field be created in the absence of a magnetic piece of metal?

Electric current will generate a magnetic field. The marble generator shows how a magnetic field generates an electric current; however, the inverse works as well. If you take a circuit with a coil in it, run a current through it, and put a ferromagnetic piece of metal in the middle of the coil, the metal will act as a magnet (so long as it stays in the coil).

Experimental Procedure Inquiry

What would happen if the marble was held perfectly still in the middle of the coil?

If the marble is not moving, the magnetic field is constant; no current is induced in the circuit. If the coil is connected to a light, the light will not turn on.

What happens to the current when the marble is rolled through the coil very quickly?

The magnetic field changes very quickly, producing a stronger current than if the marble is rolled through the coil slowly.

What would happen if magnets of different sizes (but made of the same material) were rolled through the coil?

The sizes of the magnets have a direct relationship with the magnetic fields of the magnets and with the force and current that they can produce. Larger magnets would produce a stronger current.

What kind of energy does the rolling marble have? What kind of energy does the marble generator produce?

The rolling marble has kinetic energy. The marble generator produces electrical energy.

a WOW Lab BLUEPRINT

Marble Generator - Inquiry Approaches

In-Depth Inquiry

What causes charge to move? In other words, what causes a current to flow?

Current must have a closed loop to flow in a circuit. Current will not flow through a straight piece of wire that is unconnected at one end, since there is nowhere for the electrons to travel. Current will not simply flow through any closed loop of wire; there must be a difference of electric potential in the loop. Charge moves because it wants to find the lowest electric potential, much like water flows downhill to find the lowest gravitational potential energy. Electrical potential can come in the form of a voltage source, such as a battery, or a change in magnetic field through a coil in the circuit, such as a magnetic marble dropped through the coil.

What are the differences between a circuit with a light switch and the marble generator? Do they have any similarities?

Both can have a current flow through them so that a light will turn on. The marble generator, once set up, is always a closed circuit; however, the circuit is not connected to a voltage source. To produce a current flow, the magnet is rolled through the coil which changes the magnetic field. The circuit with the switch has a voltage source but it is not always a closed loop. To allow for current flow, one only needs to close the loop by flipping the light switch to the "on" position.

A current is made up of many of electrons flowing through a circuit, moving from a higher electric potential to a lower one. What would happen if just one electron was picked up and dropped into a magnetic field?

If an electron is placed in a magnetic field and given no initial kick or force, it will just sit there. Think about how placing a magnetic marble in the middle of the generator coil and keeping it still does not produce a current in the coil. This is because the magnetic field needs to change (relative to the electrons) in order for there to be a force.

How can the stationary electron be forced to move?

If the magnetic field is moved in the presence of a still electron, the electron will move due to the changing electric field.

What happens if a moving electron is placed in the presence of a magnetic field, for example by firing the electron into the field?

A few things may happen. If the electron is fired into the field so that it is moving parallel to the field, there will be no force exerted. If the electron is fired perpendicular to the magnetic field, it will move in a circle and then exit the field. The field exerts a force on the electron because the field is changing from the point of view of the moving electron.