Key Physics Concepts

Section Summaries	Physics Principles
Section 1 Generating Electricity With a simple hand generator, wires, and light bulbs, students investigate electric circuits and electrical energy. Using the hand generator introduces them to the concept that electricity is the result of converting one form of energy into another. The operation of a light bulb is also investigated.	**Electricity** **Generator** **Closed circuit** **Energy sources**
Section 2 Modeling Electricity: The Electron Shuffle Students develop a qualitative model of electricity, including how current flows in series and parallel circuits, and how electrical energy is delivered to devices by playing the part of electric charges as they move through a circuit.	**Electric charge (coulomb),** **Electric energy** **Electric current** **Resistance** **Series circuit, Circuit symbols**
Section 3 Series and Parallel Circuits: Lighten Up The Electron Shuffle model is used again to investigate current, resistance, and how electrical energy behaves in a parallel circuit. Comparisons between series and parallel circuits are investigated. Fundamental charges are also discussed.	**Series circuit** **Parallel circuit** **Electric energy** **Electric current** **Resistance** **Fundamental charges**
Section 4 Ohm's Law: Putting up a Resistance Students design an experiment to determine the resistance of an unknown resistor. Proper use of a voltmeter and ammeter are utilized, and the students set up a series circuit to determine the current for a series of voltages applied to the resistor. Graphing the relationship between voltage and current for a resistor demonstrates Ohm's law. The process is repeated for other resistors, and then for an unknown.	**Voltage** **Current** **Resistance** **Voltmeter** **Ammeter** **Black box**
Section 5 Electric Power: Load Limit Students create a simple fuse to see how fuses work. The teacher then connects a group of appliances to a power strip until a fuse in the circuit blows. The students then calculate the load limit of a household circuit and the watts required by appliances, comparing these to the limits given in the challenge. This also introduces the use of terms and equations for calculating power.	**Voltage** **Current** **Power** **Power rating** **Load limit**
Section 6 Current, Voltage, and Resistance in Parallel and Series Circuits: Who's in Control? Students assemble a parallel circuit to explore how switches control the flow of electricity through various sections of the circuit. They then use a voltmeter and ammeter to determine the voltage and current for the elements of a parallel circuit, as well as the circuit as a whole. Finally, they mathematically examine voltage, current flow, and total resistance in series and parallel circuits, while being introduced to circuit diagrams.	**Switches** **Parallel circuit** **Series circuit** **Voltage equations** **Current equations** **Resistance equations** **Power equations** **Circuit analysis**

Key Physics Concepts

Section Summaries	Physics Principles
Section 7 Laws of Thermodynamics: Too Hot, Too Cold, Just Right Students investigate the laws of heat transfer by mixing hot and cold water in different proportions. The concept of specific heat is developed as the students use hot metal to warm cold water. Conservation of energy is then discussed as the students calculate energy transfers between various materials. The difference between heat and temperature is emphasized while the laws of thermodynamics and entropy are discussed.	**Heat transfer** **Temperature** **Specific heat** **Zeroth law of thermodynamics** **First law of thermodynamics** **Entropy** **Second law of thermodynamics** **Heat engines**
Section 8 Energy Consumption: Cold Shower Electricity used by water heaters is the focus of this activity, which also reinforces concepts of energy transfer. Students investigate the amount of energy in joules needed to raise the temperature of water, and then calculate the efficiency of different water heaters. They also consider alternate solutions to the expectation of hot water in a home.	**Heat transfer** **Electric energy** **Voltage** **Current** **Power, Efficiency**
Section 9 Comparing Energy Consumption: More for Your Money Students conduct an experiment in which they determine and compare the power consumption and efficiency of three systems that could be used to heat water. They apply collected data to confirm their response to the challenge in which they recommend appliances for the universal home. Methods of heat transfer are discussed, including convection, conduction, and radiation.	**Heat transfer** **Electric energy** **Power** **Efficiency** **Convection** **Conduction** **Radiation**