Conceptual Sequence for *Electrical Energy and Circuit Design*

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Pre-Assessment
Students have ideas, preconceptions, and misconceptions about energy and electricity.

Part I Electrical Energy

- Rubbing an object generates static electricity.
- Energy is associated with static electricity.
- Electrical energy can be transferred and transformed.
- Rubbed objects can become electrically charged.
- Like electric charges repel each other and opposite electric charges attract each other.
- Modeling is an important tool in science to account for observations.
- A closed path is needed for energy to be transferred in an electric circuit.
- Switches are used to open and close circuits.
- Electrical energy is transferred in a circuit when there is a current in the circuit.
- A simple series circuit has one closed path; a parallel circuit has multiple closed paths.

Part II Electrical Components

- The current is the same at all points in a series circuit.
- Current divides among parallel lines in a circuit.
- Current flows in one direction in a battery-powered circuit.
- The brightness of a lightbulb depends on the voltage across the bulb.
- Connecting batteries in series increases the voltage across a circuit.
- Connecting batteries in parallel does not increase the voltage across a circuit.
- The brightness of a lightbulb depends on the current through the lightbulb.
- A water-battery model can demonstrate voltage and current relationships in series and parallel battery arrangements.
- Power is the rate of using or supplying energy.
- Electric power is the product of current and voltage.
- The electrical energy used by a device is the product of its power rating and the time it operates.
- Different electrical appliances use electrical energy at different rates.
- The cost of operating an appliance is the product of the kilowatt-hours of energy it uses and the cost per kilowatt hour.
- Electrical devices are made using a variety of electrical components.
- A resistor can be used to control the current through a device.
- Resistors transform electrical energy into heat.
- Resistance is determined by dividing the voltage across a device by the current through the device.
- The resistance of a wire is directly proportional to its length and inversely proportional to its diameter.
- Diodes allow current to flow through them in one direction.
- Capacitors store electrical energy.
- Solar cells convert light energy into electrical energy and can power circuits.

Part III Electrical Systems

- A system is a group of interrelated components designed to achieve a desired goal.
- Feedback is information used to monitor or control a system.
- Feedback systems are closed systems.
- Control systems regulate the operation of devices.
- Feedback control systems are self-adjusting systems.
- Technological design is a process to develop solutions to technological problems.
- Technological designs apply scientific principles.
- Technological designs must satisfy performance criteria within the limits imposed by constraints.
- Sharing knowledge is an important aspect of scientific research.

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