Conductors and Logic Circuits

Conductors: This experiment will be used to teach about conductors and insulators with a hands-on demonstration that invites children to “fix” a broken circuit by bridging a gap with various materials.

Materials needed:
- 9v battery
- Computer fan (or other fan that can run on 9v)
- Insulated wire
- Alligator clips
- Board of wood (or equivalent mounting surface)
- Electrical tape
- Scrap pieces of aluminum, steel, spare change, and other kinds of metal
- Various other materials to be tested (plastics, magnets, pickle, other organic items)

Constructing the circuit:
1. Tape the battery to the mounting surface, and attach two alligator clips with wire to the leads.
2. Attach one of the wires to the fan, and the other to a piece of aluminum.
3. Attach a second piece of aluminum to another piece of wire, and the end of that wire to the fan. Secure the two pieces of aluminum about 1.5cm apart on the mounting surface.

Now the circuit is ready to be used. Try connecting the gap with each of the various materials and see what works. Guess which items will complete the circuit. What kind of materials work best? Which ones don’t work, and why not? Do you have anything in your pockets that might work?
**Logic Circuits:** In the second half of the experiment, microchips and switches are used to demonstrate some of the simplest building blocks of computer hardware--logic gates.

Materials needed:
- 6v battery
- prototyping board
- Microchips with Not, And, & Or gates
- Insulated wire
- LEDs (at least 5)
- Resistors (for LEDs and chips)
- Push-button Switches (at least 10)
- Alligator clips (or wires with clips built in)
- Board of wood (or equivalent mounting surface)
- Drill

Constructing the logic gates:
1. First, make three simple examples of a NOT gate, an AND gate and an OR gate (label as AND/OR to avoid confusion) using either simple circuitry with the switches or the microchips. These should each have a single LED that lights up when the gate is open.
2. Drill holes for the switches/LEDs in the wood board and mount them.
3. Draw diagrams of each gate next to the switches/LEDs, and hide the circuitry for simplicity.
4. Next, design a logic puzzle with 5 or so input switches with the goal of lighting up an LED at the end of the puzzle. Use the proto-board and alligator clips to connect all the switches and LEDs.
5. Drill holes for the logic puzzle and mount it.
6. Draw a diagram of the puzzle and again hide the circuitry—this should be accessible if the experimenters want to see what is going on inside.

The experimenters should first try the single gates to see how they work, and should become familiar with the pictures and behaviors of each one. Then they can try to figure out the logic puzzle and all the different ways it can be solved. Explain how logic gates are some of the smallest building blocks of computers, calculators, etc. and how there can be thousands and even millions of them on a single computer chip.