Electric Circuits in Household Appliances

Topic

Household appliances use simple electrical circuits.

Introduction

Household appliances contain electrical circuits. The circuit in any appliance contains four basic parts: a power source, conductors, a switch, and a load. The power source can be a generator, wall outlet, or battery. *Conductors* are made of wires, most of which are copper or aluminum, covered with plastic or rubber insulation to keep the electricity from contacting other materials. The switch turns the current on or off and makes the appliance easy to use. The load in an appliance can be as simple as a lightbulb or as complex as a motor. A schematic of a typical appliance is shown in Figure 1.

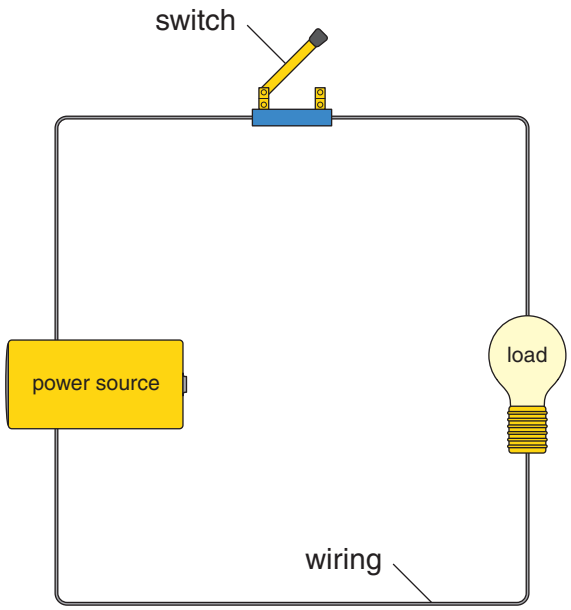


Figure 1

Some circuits also contain a thermostat, a temperature-sensitive switch. On a heater, a thermostat can be set so that when a certain temperature

is reached, the circuit opens, interrupting the flow of electricity to the heating element and switching off the heating cycle. In a refrigerator or air conditioner, the thermostat does the opposite; it switches the appliance on when the temperature gets high.

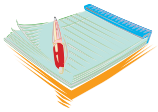
Some of the simplest appliances are flashlights, table lamps, and electric fans. A flashlight is made of a case, batteries, wiring, and a lightbulb. A table lamp has an electrical cord that attaches to the internal wiring, a switch, and a lightbulb. An electric fan contains an electrical cord attached to internal wiring, a switch, and a motor.

A hair dryer is also a relatively simple appliance. When the hair dryer is plugged into an electrical outlet and switched on, current flows to the heating element, causing it to get hot. Current flowing to a motor turns the blades of a fan, which blow the hot air out the barrel of the hair dryer.

In this experiment, you will take apart a small appliance and examine its electrical components.

Time Required

55 minutes



Materials

- discarded appliance such as a flashlight, table lamp, electric fan, toaster, coffee pot, heating pad, or vacuum cleaner
- small screwdriver
- reference books or access to Internet sites about the wiring in electrical appliances
- science notebook

Safety Note **Please review and follow the safety guidelines. When you take apart electrical appliances, do not plug them into an electrical outlet.**

Procedure

1. Select a household appliance from the materials supplied by your teacher.
2. Take the appliance apart so that you can examine the wiring inside, using the screwdriver if necessary.
3. Locate the internal wiring and trace its path. In your science notebook, draw a diagram of the appliance's wiring. Label the parts that you can identify.
4. Find out how this type of appliance works by using reference books or the World Wide Web to research the way it is wired. Summarize your findings in your science notebook.
5. Using the information gathered in your research and your diagram of the appliance's wiring, share your findings with the class.

Analysis

1. What are the basic components of an electrical circuit in a small appliance?
2. What kind of appliance did you take apart? What are the components of this appliance?
3. You bought a small room heater at the department store. When you tested it at home, you found that it heats continuously. What component might be missing or damaged in this heater?
4. Your vacuum cleaner recently stopped working. You notice that the cord looks like it has been mangled. Suggest one reason why the vacuum may not be functioning.
5. If your hair dryer did not have a switch, how could you turn it off?

What's Going On?

Electricity moves through circuits when there is a complete path to and from the electrical source. The wiring of electrical circuits in all small appliances is very similar. Devices in appliances carry out one of three basic types of jobs: heating, movement, or control. Heating is provided by a resistance element, often a series of wires like those in toasters and heaters that get hot when current flows through them. Movement can be rotation, sucking, or blowing, all of which are provided by a motor that moves air with a fan. Movement is needed in hair dryers, vacuums, blenders, and pumps. Control is provided by devices like switches and thermostats, which regulate what happens in the circuit.

Want to Know More?

See Our Findings.

OUR FINDINGS

ELECTRIC CIRCUITS IN HOUSEHOLD APPLIANCES

Analysis

1. A power source, conductors, a switch, and a load
2. Answers will vary. The components will include a power source, conductors, a switch, and a load.
3. The thermostat.
4. The cord might be broken. If so, electricity cannot travel from the electrical outlet to the vacuum.
5. By unplugging it.

SAFETY PRECAUTIONS

Review Before Starting Any Experiment

Each experiment includes special safety precautions that are relevant to that particular project. These do not include all the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is necessary that you read and remain mindful of the General Safety Precautions that follow. Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Materials can spill, break, or even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following the basic safety guidelines during the entire experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. For one reason, we want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical.

Read the safety precautions here and at the beginning of each experiment before performing each activity. It is difficult to remember a long set of general rules. By rereading these general precautions every time you set up an experiment, you will be reminding yourself that lab safety is critically important. In addition, use your good judgment and pay close attention when performing potentially dangerous procedures. Just because the text does not say “be careful with hot liquids” or “don’t cut yourself with a knife” does not mean that you can be careless when boiling water or punching holes in plastic bottles. Notes in the text are special precautions to which you must pay special attention.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking an unnecessary risk can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the individual experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone. When you are working off site, keep in

groups with a minimum of three students per group, and follow school rules and state legal requirements for the number of supervisors required. Ask an adult supervisor with basic training in first aid to carry a small first-aid kit. Make sure everyone knows where this person will be during the experiment.

PREPARING

- Clear all surfaces before beginning experiments.
- Read the instructions before you start.
- Know the hazards of the experiments and anticipate dangers.

PROTECTING YOURSELF

- Follow the directions step-by-step.
- Do only one experiment at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure there is adequate ventilation.
- Do not horseplay.
- Keep floor and workspace neat, clean, and dry.
- Clean up spills immediately.
- If glassware breaks, do not clean it up; ask for teacher assistance.
- Tie back long hair.
- Never eat, drink, or smoke in the laboratory or workspace.
- Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult.

USING EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives or other sharp-pointed instruments with care.
- Pull plugs, not cords, when removing electrical plugs.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.

- Clean up broken glassware immediately.
- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use alcohol-filled thermometers, not mercury-filled thermometers.

USING CHEMICALS

- Never taste or inhale chemicals
- Label all bottles and apparatus containing chemicals
- Read labels carefully.
- Avoid chemical contact with skin and eyes (wear safety glasses, lab apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING SUBSTANCES

- Wear safety glasses, apron, and gloves when boiling water.
- Keep your face away from test tubes and beakers.
- Use test tubes, beakers, and other glassware made of Pyrex™ glass.
- Never leave apparatus unattended.
- Use safety tongs and heat-resistant gloves.
- If your laboratory does not have heat-proof workbenches, put your Bunsen burner on a heat-proof mat before lighting it.
- Take care when lighting your Bunsen burner; light it with the airhole closed, and use a Bunsen burner lighter in preference to wooden matches.
- Turn off hot plates, Bunsen burners, and gas when you are done.
- Keep flammable substances away from flames and other sources of heat.
- Have a fire extinguisher on hand.

FINISHING UP

- Thoroughly clean your work area and any glassware used.
- Wash your hands.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Do not dispose of materials in the sink unless instructed to do so.
- Clean up all residues and put them in proper containers for disposal.
- Dispose of all chemicals according to all local, state, and federal laws.

BE SAFETY CONSCIOUS AT ALL TIMES!