



Making a Lightbulb

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Topic

Resistance



Time

40 minutes



Safety

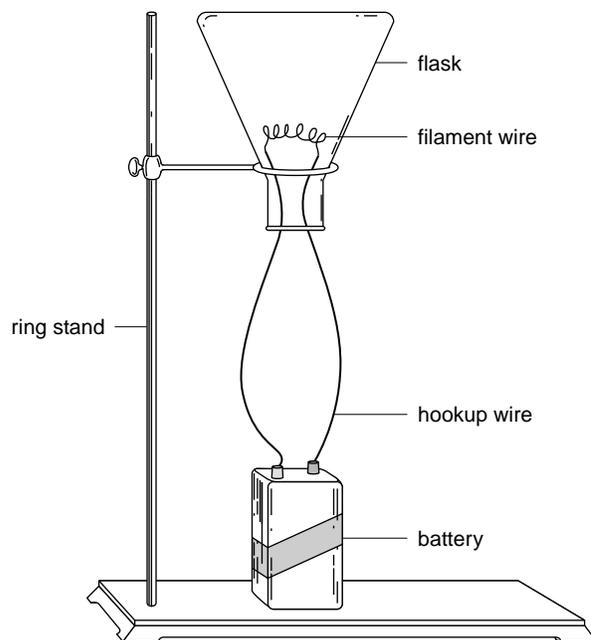
Adult supervision is required. Ask an adult who is knowledgeable about electricity to help you. Please click on the safety icon to view the safety precautions. Working with electricity is potentially hazardous. Care should be taken in setting up circuits to avoid shock. When taking apart circuits, disconnect batteries first and wait for the filament to cool before handling.

Materials

ring stand with ring clamp	two-holed stopper
piece of cabled picture-hanging wire, 12 cm long	250-mL flask
pencil	12-V lantern battery
copper bell wire (or other hookup wire)	steel wool

Procedure

1. Assemble a ring stand and ring clamp as shown in the illustration.
2. Unwind one strand of the cabled picture wire, and wrap this around a pencil to make a filament.
3. Attach the ends of the filament wire to two pieces of hookup wire, as shown in the illustration.
4. Place a 250-mL flask upside down in the ring clamp.
5. Pass the hookup wire through the holes in the stopper.
6. Darken the room.
7. Put the stopper with the filament wire into the flask, and attach the hookup wires to the battery.
8. Check connections if the bulb doesn't light.
9. Unwind two strands of the cabled wire and twist them together.



10. Detach the battery wires, wait for the filament to cool, and replace the filament with the two-strand wire. Repeat the experiment. Observe and record any changes in the light. Then repeat the experiment again, using four twisted strands of the wire.
11. Repeat the experiment again, using steel wool for the filament.
12. Explain any variations you found in the brightness of the bulb as you changed the thickness of the filament wire.
13. Describe what happened to the steel wool filament. What use might such a filament serve?

What's Going On

The thinnest filament glows the brightest because it has higher resistance than a thicker filament. You can describe the filament as a pipe through which electrons flow. Since the inside of the wire or pipe resists the flow, electrons will meet more resistance in a thin wire than in a thick one because more come in contact with the inside of the wire. The resistance builds up heat to the point of incandescence. The steel wool glows for the shortest time and burns out quickly. It acts in a manner similar to a fuse, melting and opening the circuit when too much current is conducted.

Connections

Resistance is any condition limiting the flow of electrons. We make use of this electrical friction in many ways. One of the most common is in the incandescent lightbulb. Within the bulb is a thin wire or filament. When the light is turned on (the electrical circuit is closed), resistance builds up heat in the wire, which becomes so hot it gives off light. Several factors influence resistance, including the type, length, and thickness of the wire. In this experiment, you saw how thickness affects resistance and how it can be used to produce bulbs of different brightness. The thinner the wire, the higher the resistance and the brighter the light.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say “be careful with hot liquids” or “don’t cut yourself with the knife” does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don’t use your mouth to pipette; use a suction bulb.
- 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 only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

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

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES