theme: education & communication

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Helen has to find stories from all sorts of places, about all sorts of things, for all sorts of different readers.

Your editor has asked you to write an article about filament lightbulbs – why do they suddenly blow when you flick a switch, but rarely when they're already on? Before you can write about this for other people, you need to do some research to find out the answer for yourself!

Procedure: Investigating how resistance changes in a filament bulb

In a filament light bulb, an electric current passes through a very thin wire, the **filament**. It creates so much heat that the filament glows.

- Find out which metal the filament is made from. Why is this particular metal used?
- Find out what gas is inside the glass bulb. Why this gas?

The current generates heat because of the filament's **resistance** – it's not easy for the electricity to get through. The resistance changes with temperature.

1 Connect the circuit shown.

Fig 1

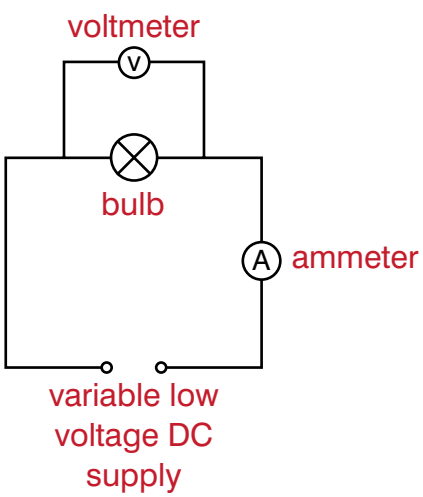
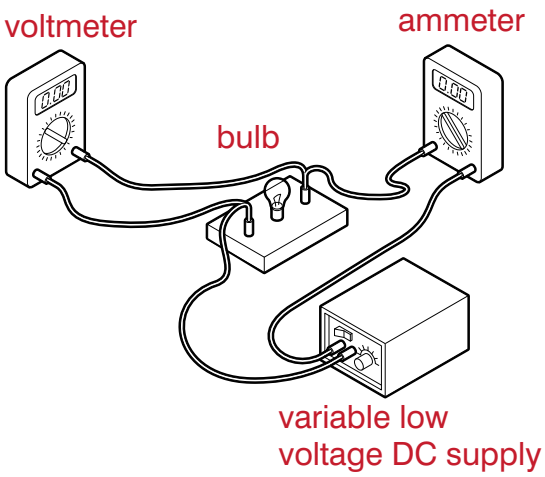


Fig 2



2 Set the voltage to 1 V and switch on.

3 Read the voltmeter and ammeter. Record the readings in the **1 V** column.

4 Note how brightly the filament glows. Record this in the table.

5 Increase the voltage to 6 V. Read both meters again. Record the voltage, current and brightness in the **6 V** column.

6 Increase the voltage to 12 V. Record the meter readings and brightness in the **12 V** column.

7 Calculate the resistance at each setting.

$$\text{resistance (in ohms)} = \frac{\text{voltage (in volts)}}{\text{current (in amps)}}$$

For example, if the voltage was 3 V and the current was 0.3 A, the resistance would be 3 ÷ 0.3 = 10 Ω

Record the values in the table.

	Intended voltage 12 V		
	Voltage setting		
	1 V	6 V	12 V
Current (A)			
Brightness			
Filament resistance (Ω)			

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Comparing results

How does the resistance of filament change for different levels of brightness?

What happens to the current when the resistance is lower?

Q&A - Switching on a light bulb

- What is the connection between brightness and the temperature of the filament?

As the temperature of the filament increases, so does its brightness.

- When a light bulb is first switched on, the filament is cold. How does this affect the current?

*This current heats up the filament in about 0.1 second. The filament suddenly gets very hot and expands. This is **thermal shock**. It happens every time the bulb is switched on.*

- Once the filament is white hot, what happens to the resistance and the current?

While the bulb is on, metal gradually evaporates from the surface of the white hot filament. After a thousand or so hours of use, part of the filament becomes too thin. When next switched on, the thermal shock breaks it.

- Just at the moment that the filament breaks, electricity sparks across the tiny gap. This causes the flash when the bulb blows. Suggest what causes the ping that you hear.

Writing your article

Use the information you have gathered to write a short article. Explain what causes light bulbs to blow at the moment of switching on, not when they are already switched on.

Write in a suitable style, using words that your audience would understand. Explain the scientific terms that you use.

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Reducing the problem

The following scientific developments have helped to reduce the problem of breaking filaments:

- using a different gas inside the glass bulb
- quartz-halogen bulbs
- using a dimmer switch

Note: Low energy (or compact fluorescent) bulbs have **no** filament. They work in a different way.