Defibrillator

Energise Anything!

Did you know?

Automatic defibrillators – like the ones in our animation – save lives every day. There are defibrillators in public places and offices all over the country as well as in hospitals and ambulances. Scientists first used electricity as a heart defibrillator in 1899 although a method that didn't involve opening up the chest cavity wasn't invented until 1957.

Science scene-setter

Low-frequency alternating current (like mains electricity) can send the heart in to an irregular, ineffective heartbeat (called ventricular fibrillation). A defibrillator works by discharging an electrical charge across the heart to stop the irregular heartbeat, contract the heart muscle and hopefully give it the chance to start beating regularly again.

The challenge

Find out what why an electric shock is dangerous, set up an electrical circuit and explore how a defibrillator works.

Learning outcomes

- Understand the effect of electricity on the body
- Outline how a defibrillator works
- Practical skills: create a defibrillator circuit
- Outline the dangers associated with the use of defibrillators.

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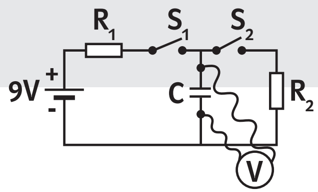
Key activity steps

1 Research

Watch our animation Electricity is electrifying: eonenergy.com/secondary

- Then ask your students to find – or show them – a video demonstration of a spark flowing from a Van de Graaf generator. There are plenty on the internet
- Briefly explain how the Van de Graaf machine generates static electricity by transporting charge to its large sphere. An extremely large voltage can be built up (200,000 volts) – enough to create a spark that can jump across a narrow air gap. Because the current is small, the shock is not dangerous
- Mains electricity has a lower voltage (230 volts) but it is the current (measured in amperes or mA) that determines the damage to the body that can occur. 5 mA is accepted as the maximum harmless current
- Discuss in a small group the potential effects of an electric shock on different parts of the body – for example: the skin at the point of contact, the nervous system, and the muscles, including the heart.

2 Design



Tell your students they are going to make their own circuit to act like a defibrillator.

- Set up the circuit as shown in the diagram.

3 Test

Use a voltmeter to measure the 'shock' from the circuit – instead of a real, live human.

- Ask the students to turn on the power supply once they have set up the circuit
- Close switch S_1 and observe the voltmeter. The voltage should rise quickly at first and then more slowly. At first the potential difference across the capacitor is high. Then as the capacitor stores electric charge, the voltage across it increases and the rate of flow of charge drops
- When there is no further change in the voltage, the capacitor is fully charged. In a defibrillator, the charge is slow as the capacitor can store a relatively high voltage from a low voltage source
- To quickly discharge the capacitor, open S_1 and close S_2 so the capacitor discharges through R_2 – just as a defibrillator would.

4 Reflect

- Did your circuit work?
- Work out the time constant for charging and discharging the capacitor. Use the equations $\tau_1 = R_1C$ and $\tau_2 = R_2C$
- What are the potential dangers of a defibrillator. How can these be protected against?

Equipment and resources

- ✔ Van de Graff generator or appropriate video clip: practicalphysics.org/experiments-van-de-graaff-generator.html or www.exploratorium.edu/science_explorer/sparker.html
- ✔ Class sets of: 9V power supply (or 9V batteries), voltmeter, capacitor (C = 10 μF), changeover switch (or two switches), resistor 1 (R_1 = 100 kΩ) and resistor 2 (R_2 = 10 kΩ), connecting leads

E.ON's Energise Anything has already engaged over 25,000 young people. We asked some of their teachers to describe it in three words. Here's what they said most often!

Interested in this? They could be...

- A bioengineer – apply engineering principles or equipment to medicine
- A cardiac electrophysiologist – as a specialist in electrical activity of the heart, diagnose problems and advise on treatment
- A medical supplies manufacturer – research, design and manufacture medical equipment
- A tribologist – as a mechanical engineer, explore how surfaces interact with other, for example: design artificial joints.

Share our careers page and film to show where a love for STEM could take your students: **eonenergy.com/stickwithstem**