theme: fashion & textiles

activity: medical compression – make a pressure sensor

activity outline

Pupils make their own pressure sensor using different types of fabric. They then calibrate their sensor and create a calibration curve, so they can use the sensor to take pressure measurements.

If there’s time, pupils can use their calibrated sensor to investigate the pressure exerted by different types of clothing and dressings, such as compression socks and TubiGrips™.

curriculum links

KS3 Programme of Study

1.1 Scientific thinking
b. critically analysing and evaluating evidence from observations and experiments

1.2 Applications and implications of science
a. exploring how the creative application of scientific ideas can bring about technological developments and consequent changes in the way people think and behave

2.1 Practical and enquiry skills
a. use a range of scientific methods and techniques to develop and test ideas and explanations
b. assess risk and work safely in the laboratory, field and workplace
c. plan and carry out practical and investigative activities, both individually and in groups.

2.2 Critical understanding of evidence
b. evaluate scientific evidence and working methods

2.3 Communication
a. use appropriate methods, including ICT, to communicate scientific information and contribute to presentations and discussions about scientific issues

3.1 Energy, electricity and forces
a. energy can be transferred usefully, stored, or dissipated, but cannot be created or destroyed
b. forces are interactions between objects and can affect their shape and motion
c. electric current in circuits can produce a variety of effect

GCSE subject criteria physics

- physics as an evidence-based discipline
- how and why decisions about science and technology are made
- the importance of working accurately and safely
- hazard identification and risk assessment
- risk factors and risk assessment in the context of potential benefit
- the generation and control of electrical power and the relationship between power, current and voltage
- electrical circuits, including the relationship between resistance, current and voltage
activity: medical compression – make a pressure sensor

**equipment list**

**Per pupil, or pair:**

To make the pressure sensor:
- cotton fabric (an old sheet or t-shirt will be fine)
- conductive fabric (suppliers include www.proto-pic.co.uk/, www.kitronik.co.uk and www.mindsetsonline.co.uk)
- piezo-resistive material (brand names include Velostat and Linqstat – an online search should find some suppliers, although many are based in the USA. A much cheaper alternative is ESD Black Conductor Bags; an eBay search returns a few results for these).

NOTE: Pupils will only need a few cm² of each fabric. You may choose to cut this for them, to avoid too much waste.

- scissors
- pen
- ruler
- glue (superglue or fabric glue are both good)
- **optional: needle and thread**

To calibrate the pressure sensor:
- multimeter
- two crocodile clips
- leads
- about 10 two-pence coins

**Extension: using the pressure sensor:**
- variety of compression socks, tights, TubiGrips™, bandages, etc.

**possible approach**

Pupils could work individually or in pairs. It’s likely to require more than one lesson to complete the task; perhaps one lesson to make and calibrate the pressure sensor, and another to test it.

Introduce the activity by discussing medical textiles. Allow pupils to read this article by Lisa Macintyre: http://www.futuremorph.org/my-future-finder/fashion-textiles/medical-compression-products/

**Making the pressure sensor**

Pupils may need some help cutting the pieces of fabric to size. The pupil sheet includes an illustration as a guide; pupils don’t have to follow this exactly. Indeed, pupils may be encouraged to make pressure sensors that are different shapes and sizes, to investigate whether this makes any difference to their sensitivity range. Pupils may also investigate the difference between using multiple layers of piezo-resistive material.

For speed and ease, the pupil sheet instructs pupils to use fabric glue. However, pupils may want to use a needle and thread to sew their sensors together.

**health and safety**

This activity has been trialled by Future Morph. The authors have made every reasonable effort to ensure it is safe when conducted as instructed. However, Future Morph assumes no responsibility for any damage or injury caused or sustained while performing these activities to the full extent permitted by law. Parents, guardians, and/or teachers should supervise pupils who undertake these experiments and activities, and complete a full risk assessments before carrying out any practical work.
underlying science: basic principles

Piezo-resistive materials are semiconductors which experience a change in resistance when mechanical stress is applied. So, when the pressure sensor is pressed, the multimeter shows a decrease in resistance.

If a 9 V battery is added to the circuit, and the multimeter is set to read current, pupils will see that the current increases when the pressure sensor is pressed.

This is because \( V = IR \) (if \( R \) decreases and \( V \) remains constant, \( I \) will increase).

Conductive fabrics are, as the name suggests, fabrics which allow an electric current to flow through.

possible extensions

Pupils could be tasked with making a test rig to work out how much pressure is exerted by different types of garment and dressing. They might, for example, team up with the D&T department to make ‘prosthetic’ limbs with a pressure sensor attached. Similarly, pupils might use their pressure sensors to test how much pressure is exerted by the straps on their school bags.

Pupils could also investigate other uses for conductive and piezo-resistive fabrics.

demonstration video

You can watch a video of this practical here:

http://animoto.com/play/zS7CWDJku5vlGqgUrcxMNw

This is for demonstration purposes only: pupils should follow the step-by-step instructions given on the pupil sheet if they are to do the experiment themselves.