

## Electrical circuits 6: Bioelectricity

### Components

NAME	DESCRIPTION	AUDIENCE
	<i>Bioelectricity</i> teachers guide	The guide provides teachers with suggestions on how to use a video and series of fact sheets to elaborate on students' understanding of the role of electricity in living organisms.
	<i>Jordan's journey</i> video	A video shows how a cochlear implant has changed the recipient's life. This is followed by an explanation of how the device works.
	<i>Platypus electroreception</i> fact sheet	A fact sheet describes how the platypus uses electrolocation to hunt prey.
	<i>Electric eels</i> fact sheet	A fact sheet describes how electric eels produce electric pulses.
	<i>Pacemaker</i> fact sheet	A fact sheet describes how a pacemaker keeps the heart pumping.
	<i>Electricity in the body</i> fact sheet	A fact sheet describes how nerves use electricity to transmit messages through the body.

### Purpose

To show that electrical currents (pulses) are a vital part of some biological phenomena, and that current electricity is found in biological situations.

### Outcomes

Students:

- describe how animals, including humans, use electric currents in biological processes;
- make comparisons between common usage of electricity and ways it works in biological systems; and
- provide their own explanations as to how electrical impulses are used to stimulate the sensation of hearing.

### Activity summary

ACTIVITY	POSSIBLE STRATEGY
The teacher initiates a discussion about electricity in everyday life before showing the video, <i>Jordan's journey</i> .	teacher-led whole class discussion
Show students a video containing information from Ear Science Institute Australia, <i>Jordan's journey</i> .	students view video
WARNING: this video shows surgical procedures.	
Class engages in follow-up discussion, as suggested in the teacher notes.	whole class or in small groups
Students read the fact sheets and use the information in the chosen strategy (see teacher notes below).	students work individually or in groups

## Teacher notes

### Jordan's journey

Before showing the video, *Jordan's journey*, teachers may ask 'How is electricity used in everyday life?' The ensuing discussion may or may not touch on electricity in living things, but should highlight what students know about electric circuits and current electricity.

Students then watch the video with the question in mind, 'How is electricity used in this case to stimulate hearing?'

After the video, the teacher may ask students to discuss similarities and differences in the way electricity is used in living and non-living systems. Students may achieve this by completing a table summarising their ideas, or through informal discussion.

This activity should raise questions that students wish to answer through subsequent learning experiences.

### Fact sheets on bioelectricity

Suggested ways of use:

- They may be adapted for use as comprehension exercises. In this case teachers may formulate questions to accompany the text.
- Create a presentation. Groups of students are allocated one of the fact sheets and instructed to create a presentation consisting of six slides. The presentation may include text and illustrations that summarise content of a fact sheet. Students may then present their completed tasks to the remainder of the class.
- Create a podcast. Allocate a fact sheet to groups of students who then create a two-minute podcast. The presentation may include audio and visual components. Students may then present their completed podcasts to the remainder of the class.
- Produce a movie. If required technology is available, groups of students may be allocated one of the fact sheets, which would form the basis for a movie on the topic. The resulting movie may be shown to other members of the class.
- Generalisation activity. Students study the fact sheets, *Electric eel* and *Platypus electrolocation*, and respond to the following questions:
  - Which of the animals do you consider could inflict the greatest harm on prey? Explain your answer.
  - List voltages (from highest to lowest) that these animals produce.
  - Is there a common method in which animals produce electricity? Explain your answer.

## Sources of further information

### Platypus electroreception

- Grant, T. (2007). *Platypus*. Australia: CSIRO Publishing, Australian Natural History Series.
- Manger, P.R., & Pettigrew, J.D. (1995). Electroreception and the feeding behaviour of platypus (*Ornithorhynchus anatinus*: Monotremata: Mammalia). *Philosophical Transactions of the Royal Society London B*, 347, 359–381.
- Pettigrew, J.D. (1999). Electroreception in monotremes. *The Journal of Experimental Biology*, 202, 1447–1454.
- Scheich, H., Langner, G., Tidemann, C., Coles, R.B., & Guppy, A. (1986). Electroreception and electrolocation in platypus. *Nature*, 319, 401–402.
- Warren, W.C. et al, (2008). Genome analysis of the platypus reveals unique signatures of evolution, *Nature*, 453, 175–183.

### Electric eels

- Moller, P. (1995). *Electric fishes – history and behaviour*, Fish and fisheries series 17. London: Chapman & Hall.
- Evans, D.H. (Ed). (1998). *The Physiology of fishes* (2nd ed.) New York: CRC Press.
- Xu, J. & Lavan, D.A. (2008) Designing artificial cells to harness the biological ion concentration gradient. *Nature nanotechnology*, 3, 666–670. Retrieved 18 June, 2009, from <http://www.nature.com/naturenanotechnology>.
- Bauer, R. (1979) Electric organ discharge (EOD) and prey capture behaviour in the electric eel, *Electrophorus electricus*. *Behavioral Ecology and Sociobiology*, 4, 311–319.

### Electricity in the body

- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (c2008). *Molecular Biology of the Cell* (5th Edition). New York: Garland Science.
- Hartline & Coleman (2007). Rapid conduction and the evolution of giant axons and myelinated fibers. *Current Biology*, 17 (1), 29–35.
- Hodgkin, A.L., & Huxley, A.F. (1952). A quantitative description of membrane current and its application to conduction and excitation in nerve. *Journal of Physiology*, 117, 500–544.

### Pacemaker

- Heart Foundation, <http://www.heartfoundation.org.au>
- British Heart Foundation, <http://www.bhf.org.uk>
- Medline Plus, <http://www.nlm.nih.gov/medlineplus/pacemakersandimplantabledefibrillators.html>

## Technical requirements

The teacher guide and fact sheets require Adobe Reader (version 5 or later), which is a free download from [www.adobe.com](http://www.adobe.com).

A modern browser (eg Internet Explorer 9 or later, Google Chrome, Safari 5.0+, Opera or Firefox) is required to view the video. A high quality MP4 version of the video is available by download from the SPICE website.

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Email: [spice@uwa.edu.au](mailto:spice@uwa.edu.au)  
Phone: (08) 6488 3917

Centre for Learning Technology (M016)  
The University of Western Australia  
35 Stirling Highway  
Crawley WA 6009

## Associated SPICE resources

*Electrical circuits 6: Bioelectricity* may be used with related SPICE resources to address the broader topic of electricity.

DESCRIPTION	LEARNING PURPOSE
<i>Electrical circuits (sequence overview)</i>  This learning pathway shows how a number of SPICE resources can be combined to teach the topic of electricity.	
<i>Electrical circuits 1: Lightning</i>  Students are engaged in the topic of electricity through observing and exploring lightning.	Engage
<i>Electrical circuits 2: Static electricity</i>  Students explore the effects of charge through a series of laboratory experiments.	Explore 1
<i>Electrical circuits 3: Current electricity</i>  Students construct circuits using simple electrical components.	Explore 2
<i>Electrical circuits 4: Circuit rules</i>  Students use an interactive learning object to record observations and derive rules for circuits.	Explain 1
<i>Electrical circuits 5: Measuring electricity</i>  Models and analogies are introduced to help students understand concepts around properties of electricity and how it is quantified.	Explain 2
<i>Electrical circuits 6: Bioelectricity</i>  Four fact sheets and a video provide examples of how electricity is used in living organisms, including humans.	Elaborate