**teacher guide**

**Electrical circuits 1:**

**Lightning**

# Components

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|  | NAME | DESCRIPTION | AUDIENCE |
|  | *Lightning*teacher guide | This guide includes suggestions on teaching strategies, discussion points and associated resources. | teachers |
|  | *Lightning strikes!*video | This video contains images of lightning strikes. | students |
|  | *Lightning facts*fact sheet | This fact sheet includes facts about lightning and its effects. | students |

Purpose

To **Engage** students in an aspect of electricity through observing and exploring lightning.

# Activity summary

Outcomes

Students:

* provide their own models for lightning strikes, and
* offer their own reasons why electrical charge is responsible for lightning strikes.

Teachers:

* find out what students already know about lightning and electrical charge, through discussion.

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| ACTIVITY POSSIBLE STRATEGY |
| Teacher-directed discussion about lightning strikes, their cause and occurrence. The teacher shows images of actual lightning strikes to students (video: *Lightning strikes!*). | whole class discussion |
| Students read fact sheet, *Lightning facts*, in conjunction with video and answer questions put to them by teacher. | whole class with teacher input |

Using the video, *Lightning strikes!*

The video shows different types of lightning. Before showing the video, students could be instructed to examine frames in the video closely and be prepared to contribute to a post-presentation discussion.

Pose the following questions to students:

* What common condition causes all lightning strikes?
* Why does lightning sometimes appear to travel downwards and on other occasions upwards?
* Several different types of lightning strike are shown in the video. Identify and describe them.

The purpose of the discussion is to lead students into activities that investigate the nature of charge and effects of separation of charge.

Using the fact sheet, *Lightning facts*

Ask students the following questions as they read the fact sheet.

* What conditions are necessary to produce a lightning strike?
* Why is it dangerous to swim in the ocean during a thunderstorm?
* Why, in a golf tournament, is play suspended during a thunderstorm?
* Why do most lightning strikes occur outdoors in open areas?
* Why do aircraft that meet certification standards not experience serious problems if struck by lightning?

The table below contains a time log of clips and images included in the video, *Lightning strikes!*

High-speed photography in this video used a camera that captured images at 7200 frames per second.

Playback has been slowed by a factor of about 240.

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| TImE (S) | DESCRIPTION OF IMAGE |
| 00:00–00:07 | titles |
| 00:07–00:22 | clouds |
| 00:22–00:44 | turbulent motion in clouds |
| 00:44–00:50 | lightning captured with high-speed videoStepped leaders, between 15 and 50 m long, develop along ionised channels in the air. Many stepped leaders move towards the ground until one pathway results in a single return stroke. This return stroke transfers charge with a higher current and therefore hotter discharge that produces the familiar flash of lightning. |
| 00:50–01:22 | positive flash filmed near Red Shirt, South Dakota, USAAs the positive leader gradually moves towards the ground many ‘dart’ or ‘recoil’ leaders flash momentarily. These dart leaders are less intense than the main leader and discharge within the clouds. Finally the return stroke flashes upwards, making use of the positive leader channel. |
| 01:22–01:52 | upward lightning from a tower in Rapid City, South Dakota, USADuring this sequence, positive stepped leaders progress upwards from radio masts. Subsequently, dart leaders discharge downwards along some of the previously established ionised channels in the air. |
| 01:52–02:01 | Multiple stepped leaders move downwards towards the ground until one of the channels is used for the bright, powerful return stroke. |
| 02:01–02:04 | cloud-to-cloud lightning over Darwin’s central business district |
| 02:04–02:16 | This sequence shows stepped leaders moving upwards across the sky. The sequence is repeated in slow motion. |
| 02:17–02:41 | various images of development of leaders, of lightning strikes and cloud-to-cloud lightning |
| 02:42–02:54 | clouds |

# Technical requirements

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.

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

# References

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5. Rupke, Edward J. (20 August, 2001). What happens when lightning strikes an airplane? *Scientific American,* Ask the Experts. Retrieved on 19 August, 2008 from [http://www.scientificamerican.com/article.](http://www.scientificamerican.com/article) cfm?id=what-happens-when-lightni
6. Science@NASA (June 18, 1999). *Human Voltage: What happens when people and lightning converge*. Retrieved on 19 August, 2008 from <http://thunder.msfc.nasa.gov/> primer/

# Associated SPICE resources

*Electrical circuits 1: Lightning* may be used with related SPICE resources to address the broader topic of electricity.

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| DESCRIPTION | LEARNING PURPOSE |
| *Electrical circuits (sequence overview)*This learning pathway shows how a number of SPICE resources can be combined to teach the topic of electricity. |  |
| *Electrical circuits 1: Lightning*Students are engaged in the topic of electricity through observing and exploring lightning. | **Engage** |
| *Electrical circuits 2: Static electricity*Students explore the effects of charge through a series of laboratory experiments. | **Explore 1** |
| *Electrical circuits 3: Current electricity*Students construct circuits using simple electrical components. | **Explore 2** |
| *Electrical circuits 4: Circuit rules*Students use an interactive learning object to record observations and derive rules for circuits. | **Explain 1** |
| *Electrical circuits 5: Measuring electricity*Six measurements that relate to electricity are explained and related to electrical safety: charge, current, electric potential, resistance, power and energy. | **Explain 2** |
| *Electrical circuits 6: Bioelectricity*Four fact sheets and a video provide examples of how electricity is used in living organisms, including humans. | **Elaborate** |

# Acknowledgements

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Lightning footage from BBC Worldwide Australia, used under licence. High-speed lightning footage by Tom Warner, used under licence from Sky Fire Productions, Inc.

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* ‘Lightning behind power lines’ by T J Smith, [www.sxc.hu/photo/336368](http://www.sxc.hu/photo/336368)
* ‘Lightning 5’ by Neil Gould, [www.sxc.hu/](http://www.sxc.hu/) photo/419190
* ‘Lightning strikes Perth 3’ by Simon Morris, [www.sxc.hu/photo/549607](http://www.sxc.hu/photo/549607)
* ‘Lightning strikes’ by Miguel Bastos, [www.sxc.hu/photo/653941](http://www.sxc.hu/photo/653941)
* ‘Power of nature’ by Ronny Beleïn, [www.sxc.hu/photo/657395](http://www.sxc.hu/photo/657395)
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