teacher guide

Electrical circuits 1: Lightning

Components

	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.

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.

Activity summary

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.

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 video Stepped 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, USA As 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, USA During 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.

References

1) Australian Bureau of Meteorology and Emergency Management Australia (2000). *Severe Thunderstorms: Facts, Warnings and Protection*. Retrieved on 25 August, 2008 from http://www.bom.gov.au/info/thunder/

2) NASA's Global Hydrology and Climatology Center. (n.d.). *Lightning Detection From Space: A Lightning Primer.* Retrieved on 25 August, 2008 from http://thunder.msfc.nasa.gov/primer/

3) National Lightning Safety Institute (n.d.). Retrieved on 19 August, 2008 from http://www.lightningsafety.com/nlsi_info.html

4) National Weather Service (n.d.). *Lightning Safety.* Retrieved on 25 August, 2008 from http://www.lightningsafety.noaa.gov/

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.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.

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**

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