teachers guide

Molecular evidence for evolution 2: Primates

Components

	NAME	DESCRIPTION	AUDIENCE
	Primates teachers guide	The guide explains how the learning objects can build students' understanding of the way anatomical evidence is used to determine evolutionary relationships.	teachers
Start	*Primate trends* learning object	This learning object enables students to explore the anatomy of five primate skulls and make conclusions about primate relatedness.	students
Start	*Virtual zoo* learning object	This learning object contains video footage of four primates in captivity. After viewing it, students may make physiological and behavioural observations.	students
	Primate relations worksheet	This two-part worksheet collates information from both learning objects to explore evolutionary evidence of primate relatedness.	students

Purpose

To **Explore** how anatomical and behavioural evidence can be used to determine evolutionary relationships.

Outcomes

Students:

- identify selected areas of primate skulls;
- describe some anatomical features of skulls, and behavioural characteristics for selected primates;
- make observations of trends in primate skull characteristics; and
- make decisions about evolutionary relationships, using collected evidence.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students use the learning object, *Primate trends*, to determine how primates may be related, then complete worksheet, *Primate relations* – Part 1: Primate trends.	individually or in pairs
Students visit Perth Zoo to observe gibbons and orang-utans. They may use the worksheet, *Primate relations* – Part 2: Virtual zoo, to record observations of four primates to help determine how primates may be related. and/or Students use the learning object, *Virtual zoo*, and use the worksheet, *Primate relations* – Part 2: Virtual zoo to make observations of four primates to help determine how primates may be related.	whole class, individuals or pairs

Using the learning objects

Primate trends

Primate trends enables students to view skulls one, two or four at a time. Using buttons under the **View** heading, students select a specific orientation for skulls they are viewing, then select buttons under **Highlight** to choose features of interest. Only relevant highlights are available for some views. The VR function (under the **View** heading) enables students to spin a skull, providing unique views of each skull.

The most practical way for students to work through this learning object is to compare four skulls at a time (**Quad** button), for each characteristic.

To begin, draw the scale bar in each skull's section (bottom right-hand corner), to students' attention. The scale indicates that skulls are different sizes, even though they are depicted as equal sizes in the learning object. Recognising this is important when considering relative cranial capacities as, for example, an average gorilla skull may be 2.5 times the size of an average gibbon skull. As they work, students enter required information into the table on worsheet, *Primate relations* – Part 1: Primate trends.

Each characteristic has parameters associated with it and students should take care to ensure skulls are rated correctly (according to their observations).

Virtual zoo

Virtual zoo provides video footage of four primates featured in this resource: orang-utans, gorillas, chimpanzees and gibbons. Four Australian Zoos are featured: Perth Zoo, Monarto Zoo, Melbourne Zoo and Taronga Zoo. Gorilla footage is the same for both Melbourne and Taronga zoos as each contributed footage to the combined video. Monarto and Taronga Zoos both contributes footage of chimpanzees.

Using this learning object students view movies for each primate, and enter observations into the worksheet, *Primate relations* – Part 2: Virtual zoo.

Students compare results from *Primate trends* and *Virtual zoo* to determine which primates are most closely related. Other resources in *Molecular evidence for evolution* will demonstrate more reliable methods of determining evolutionary relationships, through use of molecular techniques.

Technical requirements

Primate trends require a modern browser (eg Internet Explorer 7 or later, Google Chrome, Safari 4.0+, Opera or Firefox). *Virtual zoo* requires Internet Explorer 9+, Google Chrome, Safari 4.0+, Opera or Firefox). The learning objects can be placed on a web or file-server and run either locally or remotely in a web browser.

High quality versions of the learning objects are available on CD-ROM or download from the SPICE website.

The teachers guide and worksheet require Adobe Reader (version 5 or later), which is a free download from www.adobe.com. The worksheet is also available in Microsoft Word format.

Image credits

skulls
Chimpanzee, gorilla and gibbon skull images were obtained from the Digital Morphology Museum created by Kyoto University. Whilst every effort was made to match skulls with the zoo species featured in *Virtual zoo*, limitations of software and skull availability meant that compromises were necessary. The species of gibbons featured in *Virtual zoo* are the Javan gibbon, *Hylobates lar,* and the white-cheeked gibbon, *Nomascus leucogenys*. The specimen featured in *Primate trends* is the agile gibbon, *Hylobates agilis*. The human skull is authentic and hooks are in place due to skull cap removal during autopsy.

male chimpanzee
'PRICT No. 344, *Pan Troglodytes*' by Digital Morphology Museum, KUPRI, Kyoto University, Japan, viewed August 2011, www.pri.kyoto-u.ac.jp/dmm/WebGallery/dicom/dicom.html?ex_no=317

male gibbon
'PRICT 275, *Hylobates agilis*', by Digial Morphology Museum, KUPRI, Kyoto University, Japan, viewed August 2011, www.pri.kyoto-u.ac.jp/dmm/WebGallery/dicom/dicomProperty.html?id=275

male gorilla
'PRICT 317', *Gorilla gorilla*', by Digial Morphology Museum, KUPRI, Kyoto University, Japan, viewed August 2011, http://www.pri.kyoto-u.ac.jp/dmm/WebGallery/dicom/dicomProperty.html?id=317

male orang-utan
'PRICT 513, *Pongo abelii*', by Digital Morphology Museum, KUPRI, Kyoto University, Japan, viewed November 2011, www.pri.kyoto-u.ac.jp/dmm/WebGallery/dicom/dicomProperty.html?id=513

Virtual zoo
'Close-up, chimp (*Pan troglodytes*) using stick to get termites, Gombe Stream National Park, Tanzania' by Bill Wallauer / gettyimages.com.au, 82778606, used under licence, http://www.gettyimages.com.au/detail/video/chimp-using-stick-to-get-termites-gombe-stream-stock-video-footage/82778606

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Thank you to Judith Henke and the Melbourne zoo for providing footage of gorillas.

Thank you to Ruth Hall and Zoos South Australia for providing footage of chimpanzees.

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Associated SPICE resources

Molecular evidence for evolution 2: Primates may be used in conjunction with related SPICE resources to teach the topic of molecular evidence for evolution.

DESCRIPTION	LEARNING PURPOSE
Molecular evidence for evolution (overview)	
Molecular evidence for evolution 1: Mammal evolution A card game engages student interest in evidence used to determine evolutionary relationships between eutherians (placental mammals).	**Engage**
Molecular evidence for evolution 2: Primates Students use interactive learning objects to explore how anatomical evidence may be used to determine relatedness.	**Explore**
Molecular evidence for evolution 3: Evolutionary trees The use of molecular evidence to determine relatedness between species is explained. Students draw evolutionary trees to represent relatedness.	**Explain**
Molecular evidence for evolution 4: Viral evolution Students use the Influenza Research Database to investigate virus evolution. This bioinformatics database is an authentic research tool used to compare genetic sequences of virus strains, and to construct cladograms to draw conclusions about their relatedness.	**Elaborate**