FAQs for Secondary School students

KANGAROOS

What is the most important thing I should know about kangaroos?

That is a tough question since the answer depends on what you might consider "important". Kangaroos are mammals, but they diverged and evolved independently from the eutherian (placental) mammals for the last 130 million years or so. They have adopted a reproductive strategy of short pregnancy, and a poorly developed young that undergoes much of its development during a relatively long lactation. That differs from the general eutherian mammal like cats, dogs, horses, and humans which tend to have longer gestation, well developed young, and less emphasis on development during lactation (guinea pigs – or cavies as they are known – are so well developed at birth they can wean immediately!)

What is one unique characteristic that only kangaroos have?

There you have us stumped. There is probably not one **single** unique characteristic. There are some anatomical things like epipubic bones that eutherian mammals lack but that other marsupials possess. Big hind legs is another characteristic, but other species like kangaroo-rats (these are eutherians, not marsupials) also have that characteristic. Kangaroos have pouches, which are interesting, but again, that is a characteristic they share with many other marsupials. The phenomenon of embryonic diapause may be the trait that answers your question (see below for more details). Embryonic diapause is a slowing or a halt in early embryo development, and although over 100 species of mammal possess this capability, kangaroos do diapause brilliantly. More information on this phenomenon is outlined elsewhere on this website, under **'Wallaby Reproduction'** at:
http://kangaroo.genomics.org.au/public/tammar/?Tammar_wallabies:Tammar_Reproduction

The animals we study in the Centre, tammar wallabies, are the model kangaroo species. They can hold their embryos dormant as a blastocyst, with absolutely no growth, for up to 11 months! Then, when required, they can turn them on again in an instant. In other species with diapause there is still some growth, not the complete halt that we see in kangaroos.

What is one mystery about kangaroos that researchers have not yet discovered?

Why only one? Our senior researchers at the Centre have been studying kangaroos for several decades each, and we are all still discovering new things! For example, how do kangaroos hold their embryos in diapause? What signals from the uterus break diapause and get the embryo growing again? If we can understand how this control of cell growth and development is achieved, perhaps we can use this knowledge to help control cell growth in diseases. Can we halt cell growth in cancers? Can we make cells that normally do not divide once we have become fully developed (for example, heart muscle cells) to start to divide again – perhaps to repair damage after a heart attack?

What was the most interesting thing you have found about kangaroos through your study and research of them?

So many things… how to decide? Some of our work over the last 10 years or so has been on sexual differentiation. As you may know, whether mammals become male or female is governed by whether they inherit XX or XY chromosomes from their parents. The model for

sexual development used to be that the early embryo was neither male nor female, but 'indifferent', with an undifferentiated gonad and primordial of both male and female reproductive duct systems. At some stage in embryonic development in embryos with a Y chromosome, a gene on the Y triggers a cascade of changes that turn the undifferentiated gonad into a testis. Marsupials played a critical part in identifying this gene, called *SRY*. The testis makes hormones that suppress the female primordial and stimulate the male parts. In females, without the Y, the gonad will remain undifferentiated a little longer before transforming into an ovary, which makes no hormones. Without the hormones the male parts regress, and the female parts, without the inhibitory hormones, develop. So the scheme was believed to be: Genes → hormones → body sex.

However, with our wallabies we showed that this scheme worked for some things, but that some sex differences – notably formation of mammary glands and pouch in females vs. scrotum in males – were not controlled by hormones, but instead, directly by genes. These are not necessarily the same genes that regulate gonadal differentiation. So the situation is: Genes → body sex.

Since then, we and others have uncovered a whole set of sex-differences that are not related to testicular or ovarian hormones in eutherian mammals (including humans). Some of these differences relate to growth differences, some are small anatomical differences, and some relate to the brain and its function. We really need to re-think our concepts of sex differentiation, when "brain sex" may be different to "reproductive anatomy" sex.

I have been reading about kangaroos, and I would like to ask about kangaroos producing different kinds of milk at the same time for their offspring.

As marsupials undergo such a wide span of development in the pouch they need different milk composition at different stages. Some kangaroos can have an older young outside the pouch sucking milk of one type, whilst at the same time, there is a new young in the pouch getting another, very different type of milk! This tells us that the milk composition is not controlled by hormones in the circulation (since both glands see the same blood circulation), but we are still unclear exactly how this fine control is achieved.

What is the significance of a kangaroo's big legs and the shape of its body? How does that helps them in hopping?

The big hind legs help the kangaroo move around by hopping, which may look like hard work but is not really – they store energy in the tendons and ligaments as they come down and then use this energy to go up – a bit like a pogo stick. At typical speeds, the kangaroo's hop is very efficient indeed.

For more information on this topic, refer to:
http://www.bio.davidson.edu/people/midorcas/animalphysiology/websites/2005/Shelton/Hopping.htm

For a more technical paper, go to:
http://jeb.biologists.org/cgi/reprint/160/1/209.pdf

http://kangaroo.genomics.org.au

For more educational information, go to 'Resources' at:
http://kangaroo.genomics.org.au