

RZSS
BRINGING CONSERVATION TO LIFE

Giant Pandas - Reproduction
Higher Biology – Physiology and Health

For further activities
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Beyond the
Panda 熊猫后续



Giant Pandas Reproduction

Higher Biology: Pregnancy

materials revised from the Education Scotland giant panda website & developed in partnership with RZSS



SCILT Scotland's National Centre for Languages



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Background Information

Are giant pandas poor breeders?

It is sometimes wrongly assumed that wild giant pandas are poor breeders based on the low reproductive performance of captive pandas.

However, wild panda populations have survived for millions of years. The main threat is habitat loss and in particular the increasing isolation of the pandas into small populations. Having once been found all over south east of China, the giant pandas are now only found in isolated pockets in Sichuan, Gansu and Shaanxi.



Current isolated areas of giant panda distribution - shown in red



Historic giant panda distribution - shown in red

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Is timing important?

There is only one opportunity per year for the female panda to mate, usually during spring time. The female panda has a window of between two and three days to conceive. The length of the giant panda's gestation period is not exact, it can range from 82 to 225 days (approx. 3-8 months) from mating to birth due to delayed implantation.

Reproduction in the wild

Giant pandas usually rear just one young every two to three years. A female may have about seven cubs in her lifetime.

Sometimes giant pandas give birth to twins but the mother usually abandons the weaker cub and concentrates her energy on rearing one cub.

Background Information (continued)

Reproduction in captivity

Attempts to breed giant pandas in captivity began in China in 1955, but it was not until 9th September 1963 that Ming Ming, the first ever captive bred giant panda was born at Beijing Zoo.

As there is only a small window of opportunity for conception, artificial insemination is often used to support mating.

What are giant panda cubs like?

The giant panda is the smallest newborn of any non-marsupial mammal. It weighs around 120g at birth and is about 15cm in length. It is pink and doesn't look like a giant panda. At about 15 days, black patterns begin to develop and by about 30 days, they start looking like the pandas we are familiar with. However, they cannot open their eyes until six or seven weeks old and do not develop their hearing until around 60 days.

Panda cubs live with their mothers until they are 18 months to two years old, then fend for themselves in the wild.



Newborn giant panda



One month old giant panda

Yang Guang and Tian Tian at RZSS Edinburgh Zoo

Urine samples are analysed from Tian Tian to try to establish her fertile period, whether mating or artificial insemination has been successful and when or if the embryo has implanted.

Female giant pandas usually breed from about 5 years old and males from about 7 years. If successful the fertilised egg divides into a ball of cells called a blastocyst. The blastocyst does not immediately implant in the uterus but is maintained in a state of dormancy until implantation takes place. This is known as delayed implantation or embryonic diapause.

Physiology and Health

Hormonal Control of Reproduction.

Development of a follicle and the endometrium in the uterus.

Roles of FSH, LH, oestrogen and progesterone in the menstrual cycle.

Development of a follicle, the corpus luteum and the endometrium.

Follicular and luteal phases.

Blastocyst implantation.

Negative feedback control through pituitary gland, FSH and progesterone, leading to menstruation.

Key Skills, Knowledge and Understanding:

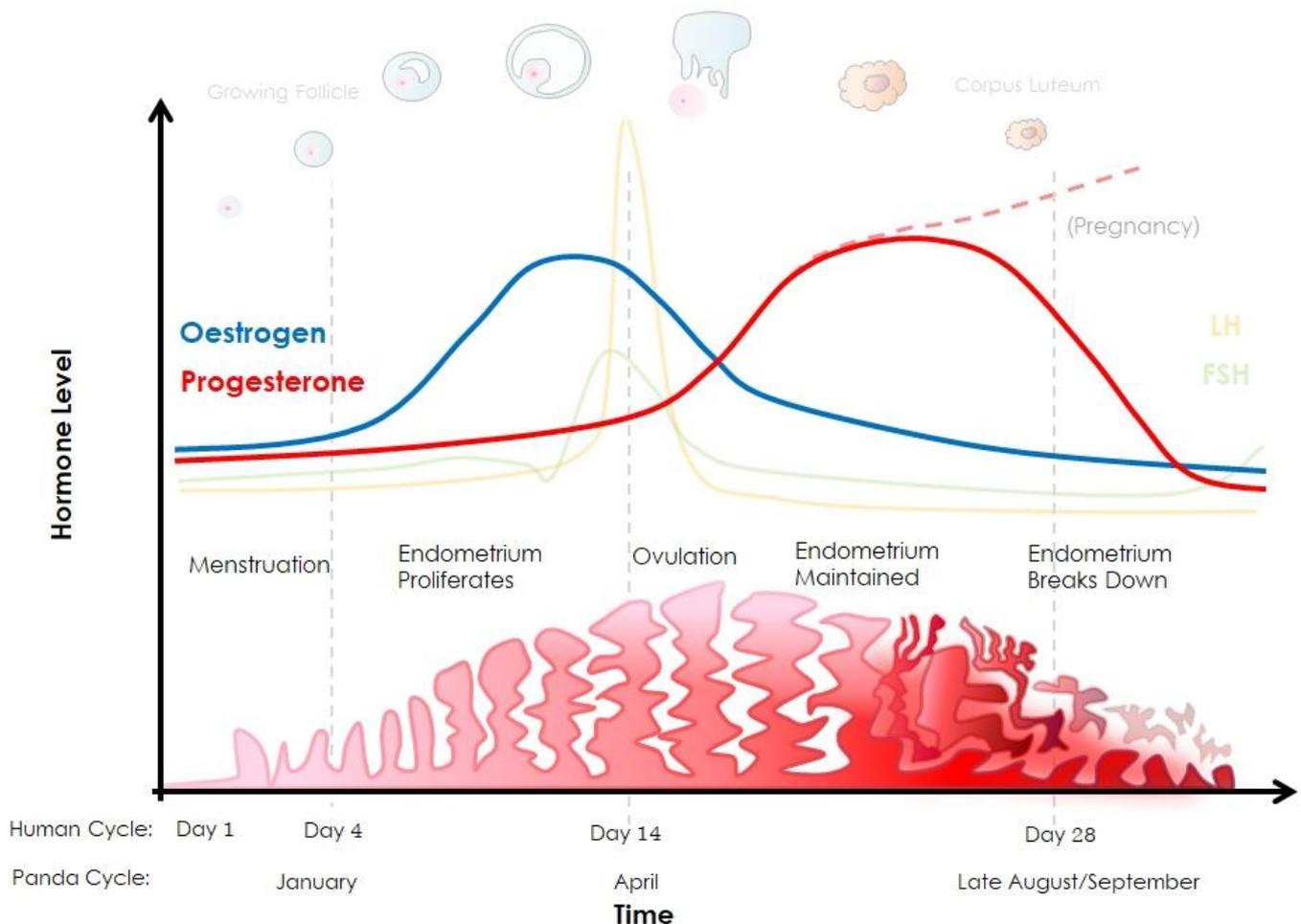
- Applying knowledge of human biology to new situations and analysing information.
- Processing the information/data collected (using calculations and units where appropriate).
- Drawing valid conclusions and giving explanations supported by evidence/justification.
- Communicating finding/information effectively.

Human Menstrual Cycle

- In human females, the cycle takes roughly 28 days. The first day of menstruation regarded as day one.
- In the first half of the cycle (the follicular phase), the follicle stimulating hormone (FSH) secreted by the pituitary gland, stimulates the production of a follicle in the ovary which produces oestrogen.
- Oestrogen stimulates the lining of the uterus (the endometrium) to proliferate in preparation for a pregnancy.
- Approximately half-way through the cycle, oestrogen levels peak which stimulates a surge of luteinising hormone (LH) from the pituitary. The surge of LH triggers the release of the egg at ovulation.
- In the second half of the cycle (the luteal phase), the remains of the ovulatory follicle develop into the corpus luteum which secretes progesterone.
- Progesterone maintains the uterine lining and promotes further vascularisation of the endometrium in preparation for the implantation of a blastocyst if the egg has been fertilised.
- In the normal cycle (non-pregnant), increasing levels of progesterone from the corpus luteum cause LH levels to decrease via negative feedback on the pituitary. This decrease in LH leads to the degeneration of the corpus luteum which in turn results in a decrease in progesterone levels. As progesterone levels decrease, the endometrium begins to breakdown and subsequently menstruation begins. Then the cycle starts again.
- If a pregnancy is established, the corpus luteum is rescued from degeneration by a hormone called human chorionic gonadotrophin (hCG) which is produced by cells of the early embryo – hCG is what is measured in pregnancy tests. The corpus luteum continues to produce progesterone to support the endometrium and prevent menstruation.

Giant Panda Cycle

- Female giant pandas are mono-oestrous which means they only have one cycle per year, compared with human females which have approximately 12 cycles per year.
- The fertile period in female giant pandas is only 12-36 hours (once a year) which is a relatively narrow window compared to human females which have a window of 5-7 days each month.
- Just like in human females, the hormones oestrogen and progesterone play an important role in controlling the cycle.
- Staff at RZSS Edinburgh Zoo have worked closely with panda breeding specialists from China and with experts from the University of Edinburgh MRC Centre for Reproductive Health at the Queen's Medical Research Institute (QMRI).
- During the breeding season, they analyse daily urine samples from Tian Tian to measure levels of oestrogen and progesterone to help work out when she enters her fertile period. They can then decide whether to breed her or perform assisted reproduction techniques such as in vitro fertilisation (IVF) and artificial insemination (AI).



Data:

Week Beginning	Week No.	Oestrogen (ng/mL)	Progesterone (ng/mL)
28-Feb	1	2.2	9.3
03-Mar	2	2.6	10.6
10-Mar	3	2.3	9.2
17-Mar	4	2.6	8.6
24-Mar	5	2.7	6.7
31-Mar	6	8.3	2.3
07-Apr	7	21.5	1.9
15-Apr	8	1.9	9.2

Task:

- Using real data collected from enzyme-linked immunosorbent assays (ELISA) of Tian Tian's urine (above), plot the changes in oestrogen and progesterone levels over time. Remember to label your axes and give your graph an appropriate title.
- Based on your graph, can you identify her fertile period?

Other associated material to download:

Human & giant panda menstrual cycle compared

Tian Tian urinary hormone data (*includes graph derived from above data*)