Reproduction and its Hormonal Control

Different mammals have different patterns of reproduction

- Eg mammals, rats and mice can breed all year round, whereas others have distinct breeding seasons. This is to ensure that the young are born when food is abundant. The timing of the breeding season is regulated by a biological clock, which is probably adjusted by seasonal changes in day length.

In mammals the gametes (sex cells) are:

- small motile male gametes (sperm) which is produced in large quantities
- larger, non-motile food storing female gamete (ovum) which is produced in much smaller numbers

Gametogenesis is the formation of gametes

- sperm production is called spermatogenesis
- where the eggs are formed (matured) is called oogenesis

In the females of all mammals, there is a cycle known as:

- Oestrous cycle → ovulation, when the female is most fertile
- Menstruation cycle → the uterus lining in all mammals undergoes a similar pattern of thickening during a reproductive cycle. However if fertilisation does not occur, the uterine lining of primates breaks down and it is discharged with blood through the vagina, whereas the uterine lining of non-menstruating mammals is reabsorbed and there is no excessive bleeding. The discharge of blood is called menstruation.
Hormonal Control of the Female Menstrual Cycle

- Lasts approximately 28 days in Humans.
- It is controlled by the interaction of several hormones. The action of one hormone is used to stimulate or inhibit the production of another. Hormones are chemical messengers, produced and secreted by organs, which travel via the blood, and exerts some influence upon a target tissue.
- Events are divided into three phases: follicular phase, ovulatory phase, and the luteal phase
  - The **follicular phase** is the first part of the menstrual cycle, where one or more follicles start to develop into a mature female gamete. The follicle cells surround the oocyte (developing egg cell), and produce hormones that trigger other responses
  - The **Ovulatory phase** is when the oocyte is released (follicle cells remain in the ovary) from the ovary and passes down the fallopian tube and towards the uterus
  - The **Luteal phase** most of the follicle cells remain in the ovary after ovulation. They continue to develop and form a structure called the corpus luteum, as a result more hormones are produced

The ovaries are organs that are responsible for the development of female gametes. At birth around 400 000 cells have reached prophase of the first meiotic division and are called **primary oocytes (often called follicles)**. Each month after puberty, one of these cells completes its development into an ovum.

Oestrogen, released from the maturing follicles, causes the uterine epithelial lining to proliferate in preparation for a fertilised egg. Progesterone released from the corpus luteum will further mature the uterine lining causing it to enter the secretory phase which will be able to interact with the blastocyst should fertilisation occur. These hormonal changes plus many others controlled by the pituitary lead to the monthly menstrual cycle of females.
At the start of the oestrous cycle, the pituitary gland (in the brain) secretes follicle-stimulating hormone (FSH)

FSH triggers development of one or more follicles in the ovary

As the follicle grows in size, oestrogen is secreted

Inhibits further production of FSH

Stimulates the pituitary gland to secrete lutenising hormone (LH)

Stimulate growth and repair of the uterine lining

As the follicular stage progresses, the developing follicle increases in size and becomes a mature follicle

Oestrogen levels increase rapidly

Triggers further release of LH (high concentration of LH in the blood)

Ovulation

Oocyte leaves the ovary and passes into the fallopian tube

Female is fertile

The high concentrations of LH that brings about ovulation has an affect on the follicle cells that remain in the ovary

Corpus luteum secretes some oestrogen and a large amount of progesterone

Progesterone stimulates mammary glands and uterus in anticipation of pregnancy

If the Oocyte is not fertilised within 36 hours, it dies

At day 28, a lack of progesterone brings about another menstruation

High concentrations of oestrogen and progesterone inhibit production of FSH and LH

Without FSH and LH the cells of the corpus luteum gets smaller – and less progesterone and oestrogen is secreted

With less oestrogen and progesterone, the FSH is no longer inhibited, and the cycle can start again
Menstrual Cycle Summary

1) Control by hypothalamus
   - Hypothalamus
   - Releasing hormone
   - Inhibited by combination of estrogens and progesterone stimulated by high levels of estrogen
   - FSH
   - LH

2) Pituitary hormones in blood
   - LH peak triggers ovulation and corpus luteum formation
   - FSH
   - LH

3) Ovarian cycle
   - Growing follicle
   - Mature follicle
   - Ovulation
   - Corpus luteum
   - Degenerating corpus luteum
   - Pre-ovulatory phase
   - Post-ovulatory phase

4) Ovarian hormones in blood
   - Estrogen
   - Progesterone
   - Estrogen
   - Progesterone

5) Menstrual cycle
   - Endometrium
   - Menstruation
   - Days

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### SUMMARY OF EFFECTS

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<tr>
<th>HORMONE</th>
<th>EFFECTS</th>
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| FSH         | • stimulates the growth & development of the follicle  
              • stimulates secretion of oestrogen  
              • enhances effect of LH in stimulating ovulation |
| LH          | • stimulates the final development of the follicle  
              • stimulates ovulation  
              • stimulates the development of the corpus luteum  
              • stimulates production of progesterone |
| Oestrogen   | • stimulates repair of uterine lining  
              • at high conc. inhibits FSH, however during 'pituitary hormone surge' it stimulates further FSH production  
              • as conc. peaks stimulates release of LH |
| Progesterone| • maintains uterine lining  
              • inhibits release of FSH  
              • inhibits release of LH  
              • fall in conc. results in menstruation  
              • fall in conc. removes inhibition of FSH and a new cycle begins. |

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**Diagram:**

- **Follicle Stimulating Hormone (FSH)**
  - Stimulates growth and development of follicle
  - Inhibits production of Oestrogen
  - Stimulates production of Ovaries

- **Pituitary Gland**
  - Causes ovulation and consequent development of a corpus luteum
  - Stimulates production of Lutenising Hormone (LH)

- **Ovaries**
  - Stimulates production of Oestrogen
  - Maintains the lining of the uterus wall in anticipation for pregnancy

- **Oestrogen**
  - Causes repair of the lining of the uterus walls

- **Progesterone**
  - Inhibits production of Oestrogen
  - Maintains the lining of the uterus wall in anticipation for pregnancy