



X-Sheet 14

Gametogenesis and Hormone Control

Gametogenesis and Hormone Control

Key Concepts

Reproduction takes place as three processes:

- Gametogenesis – production of the gametes (in Males = Spermatogenesis and in females = Oogenesis)
- Fertilization – fusion of the gametes
- Embryo development – mitosis of the cells of the zygote for growth and development.

Hormonal control of Spermatogenesis:

The hypothalamus releases gonadotrophin-releasing hormone (GnRH), which stimulates the pituitary gland to release two hormones jointly called **gonadotrophins**. The two gonadotrophins are:

- follicle stimulating hormone – **FSH**, which stimulates spermatogenesis
- luteinising hormone – **LH**, which stimulates the synthesis of the hormone testosterone by the Leydig cells in the testes.

Hormonal control of Oogenesis:

- Hormones control the 28 day **menstruation cycle**. Usually only one egg is released per cycle. Should both ovaries release an egg cell and both are fertilized, the result is paternal twins (unidentical). The menstruation cycle affects the ovaries and the uterus.
- **Gonadotrophin releasing hormone** (GnRH) stimulates the anterior pituitary gland to release follicle stimulating hormone (FSH) into the blood.
- **FSH** is transported to the ovaries (target organ) where it stimulates the development of the follicle.
- Granulosa cells in the developing follicle produce **oestrogen**. Oestrogen has two target organs namely the uterus and the anterior pituitary gland.
 - Oestrogen causes the development of the endometrium in the uterus to prepare it for pregnancy.
 - Oestrogen inhibits the secretion of FSH by the anterior pituitary gland so that no further follicles are produced during the pregnancy. High oestrogen levels will trigger the secretion of luteinising hormone (LH).
- **LH** is released into the blood and is transported to the ovary, causing ovulation. **LH** stimulates the Graafian follicle to develop into the corpus luteum.
- The corpus luteum secretes **oestrogen and progesterone**.
 - Progesterone ensures that the thickening of the **endometrium** is maintained and **glandular activity** is stimulated.
 - Progesterone **inhibits** the anterior pituitary gland from releasing LH. The release of progesterone causes the slight **rise in temperature** just after a female has ovulated.
- If fertilization does not take place, the corpus luteum will **degenerate** causing a decrease in the levels of oestrogen and progesterone. The endometrium breaks down and tears away from the walls of the uterus, causing the bleeding associated with **menstruation**. This lasts for about five days.

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Terminology & definitions

Corpus luteum: structure that results when the Graafian follicle releases the egg cell during ovulation. The corpus luteum also secretes progesterone if the egg is fertilized

Follicle stimulating hormone: (FSH) produced by the anterior lobe of the pituitary gland and causes the maturing of the follicle surrounding the oocyte and stimulates the supply of nutrients

Gametogenesis: the formation of gametes

Gonadotrophic hormones: hormones secreted by the pituitary gland to control reproductive cycles and processes in males and females

Luteinising hormone (LH): a hormone produced by the anterior lobe of the pituitary gland that stimulates the release of oestrogen into the bloodstream which causes ovulation

Menstrual cycle: this cycle begins with menstruation and continues for 28 days. It is controlled by hormones to co-ordinate the release of the mature egg cell with the readiness of the uterus for implantation, if fertilization takes place

Menstruation: when there is no fertilization, the lining of the uterus is shed to prepare for the next cycle. This results in a flow of blood that lasts for approximately 5 days

Oestrogen: a hormone secreted by the ovaries, causing ovulation

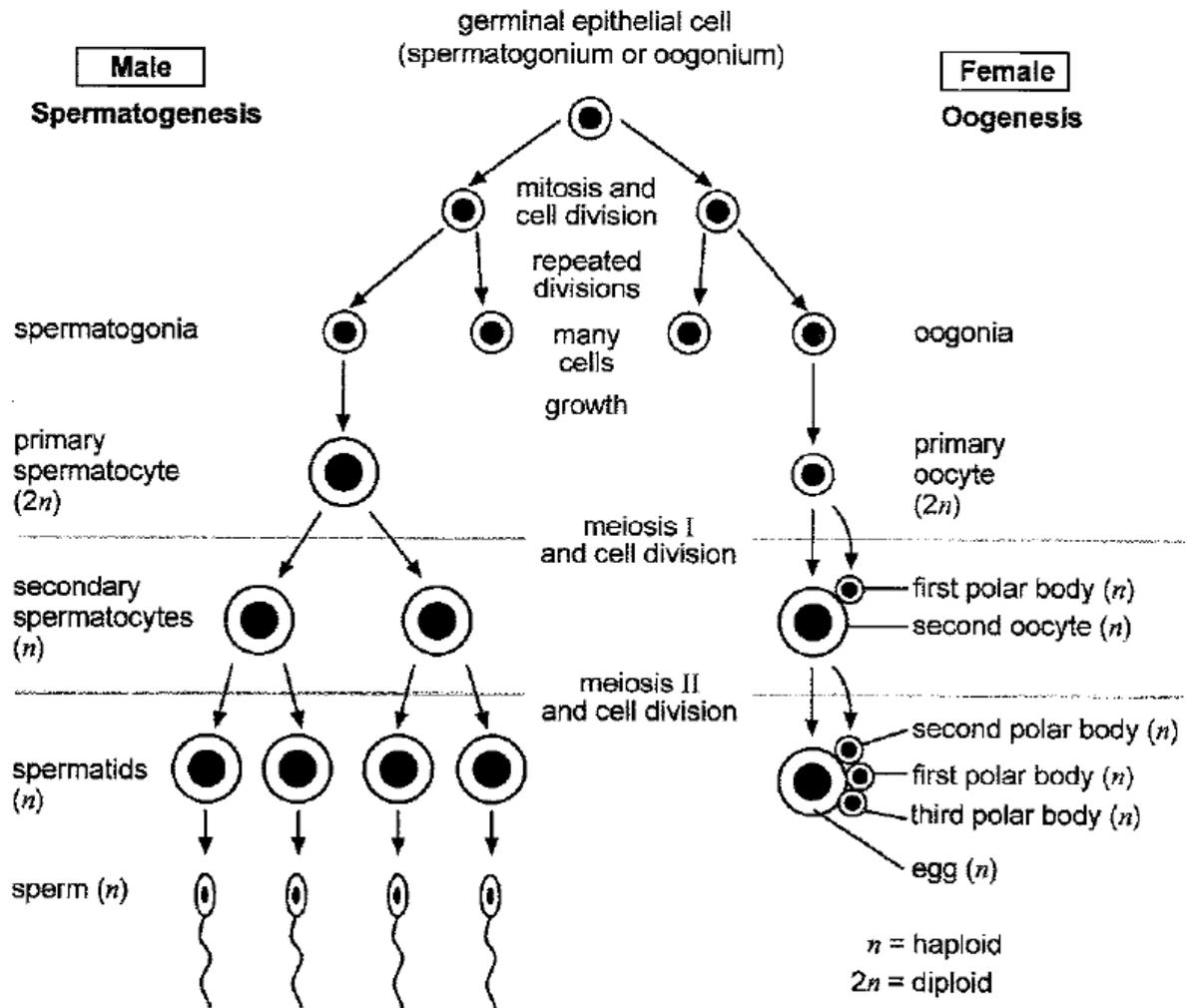
Oogenesis: the process to produce haploid egg cells in the follicles of the ovary

Progesterone: a hormone secreted by the corpus luteum when the egg cell is fertilized to ensure pregnancy

Diagrams:

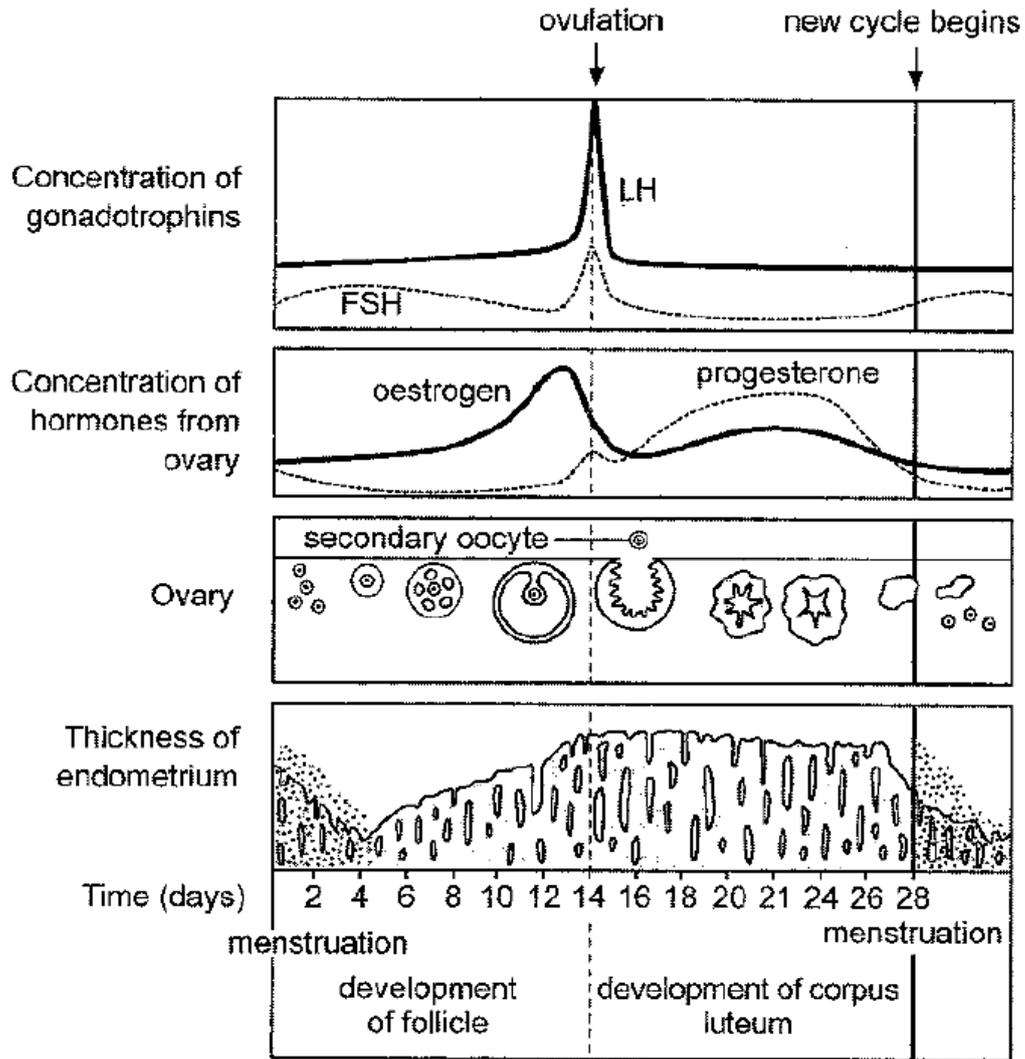
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Gametogenesis showing Spermatogenesis and Oogenesis



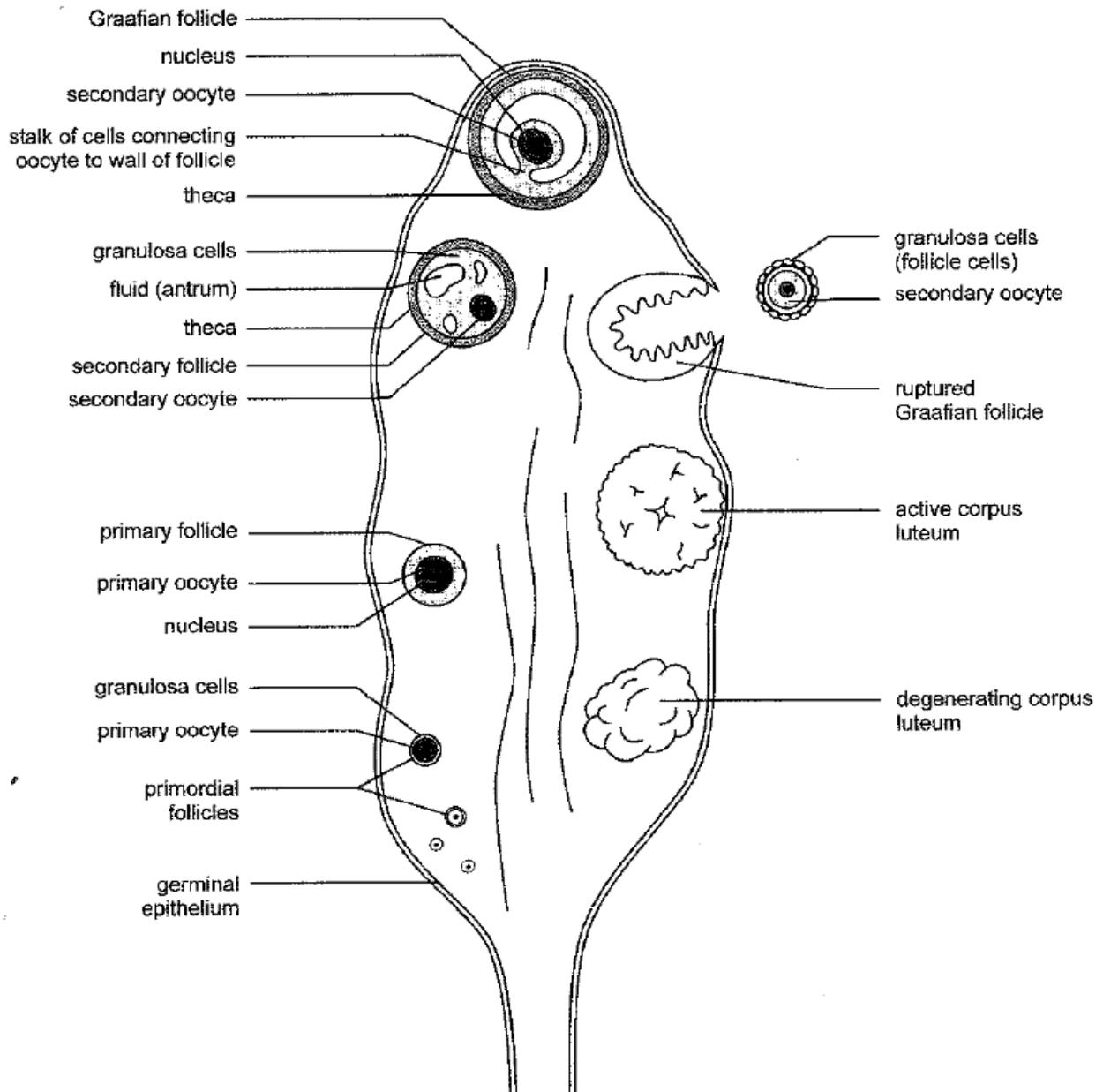
Schematic representation of gametogenesis

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Changes occurring during the menstrual cycle, showing levels of the hormones FSH, LH, oestrogen and progesterone

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Section through a human ovary showing the stages in the development of the Graafian follicle, ovulation and the formation and degeneration of the corpus luteum

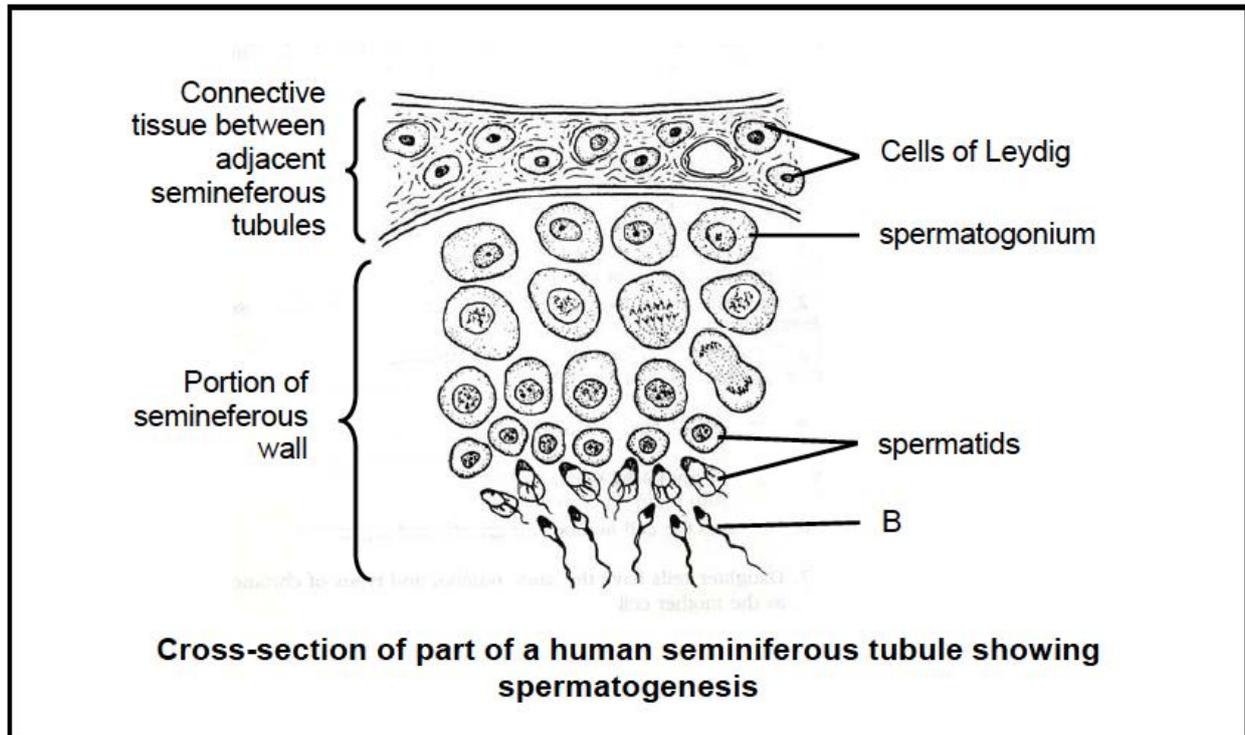
Make sure that you know these diagrams, as they are often asked in examinations.

X-ample Questions

Question 1:

The diagram below represents a cross-sectional view of a human seminiferous tubule in which spermatogenesis is occurring. Study the diagram and answer the questions that follow.

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- 1.1. Name the hormone produced by the cells of Leydig. (1)
- 1.2. Name ONE function of the hormone named in QUESTION 1.1. (1)
- 1.3. How many chromosomes are in each of the following?
 - a) Spermatogonium cell (1)
 - b) Spermatid (1)
- 1.4. Explain the importance of spermatogenesis as a mechanism to introduce **variation** by referring to prophase 1 and metaphase 1. (4)

Question 2

(Taken from NSC Life Science Preparatory Examination 2008 Paper 1)

The basal body temperature is the temperature taken in the morning when factors such as exercise, eating, drinking or emotional disturbances have no influence. In women the basal body temperature drops just before ovulation and then increases sharply a day later. During menstruation, the temperature drops again to normal. If the temperature stays high, pregnancy is presumed. Josephine and Patsy, two young healthy women, recorded their basal body temperature for 28 days from the first day of menstruation. The results are shown in the table below. Study the table and answer the questions that follow.

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BASAL BODY TEMPERATURE OF JOSEPHINE AND PATSY FOR 28 DAYS

DAY OF MENSTRUAL CYCLE	BODY TEMPERATURE (°C)	
	Josephine	Patsy
1	36,5	36,4
2	36,2	36,3
3	36,2	36,3
4	36,2	36,3
5	36,2	36,3
6	36,2	36,3
7	36,3	36,2
8	36,2	36,2
9	36,3	36,2
10	36,2	36,2
11	36,2	36,2
12	36,2	36,2
13	36,1	36,1
14	36,5	36,5
15	36,6	36,5
16	36,7	36,6
17	36,8	36,7
18	36,8	36,7
19	36,9	36,7
20	36,9	36,6
21	37,0	36,7
22	37,1	36,4
23	37,1	36,3
24	37,2	36,3
25	37,1	36,3
26	37,0	36,2
27	37,2	36,3
28	37,2	36,2

- 2.1 On which day of the menstrual cycles of the two women did ovulation occur? (1)
- 2.2 What is the difference between the basal body temperatures of Josephine and Patsy on day 28 of their menstrual cycles? (2)
- 2.3 These measurements were made at the same time each day in the same room and while each woman was wearing the same type of dressing gown. Explain why these precautionary measures were necessary. (2)
- 2.4 By interpreting the data in the table:
- a) Which of the two ladies is pregnant? Give a reason for your answer. (2)
- b) Explain how basal body temperature could be used as a method of contraception. (2)
- c) Explain ONE disadvantage of using the basal body temperature as method of contraception. (2)

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X-ercise

Provide the correct Biological term for the following statements:

1. The release of a ripe ovum from the ovary of a female mammal.
2. The remainder of the Graafian follicle, after fertilization in the female ovary.
3. The hollow organ in mammals in which the embryo develops.
4. The diploid cell in the follicle of the ovary which forms the ovum after meiosis.
5. The monthly cyclic secretion of blood and lining of the uterus when fertilization is incomplete.
6. The hormone produced by the anterior lobe of the pituitary gland that causes the maturing of the follicle surrounding the oocyte and stimulates the supply of nutrients.
7. The process to produce haploid egg cells / ova in the follicles of the ovary.
8. A hormone produced by the anterior lobe of the pituitary gland that stimulates the release of oestrogen into the bloodstream which causes ovulation.
9. A hormone secreted by the ovaries, causing ovulation.
10. A hormone secreted by the corpus luteum when the egg cell/ovum is fertilized, to ensure pregnancy.

Answers to the X-ercise:

1. Ovulation
2. Corpus luteum
3. Uterus
4. Primary oocyte
5. Menstruation
6. FSH
7. Oogenesis
8. LH
9. Oestrogen
10. Progesterone