

Life Sciences

Part 1

CLASS TEXT & STUDY GUIDE

Liesl Sterrenberg, Helena Fouché & Grace Elliott

GRADE

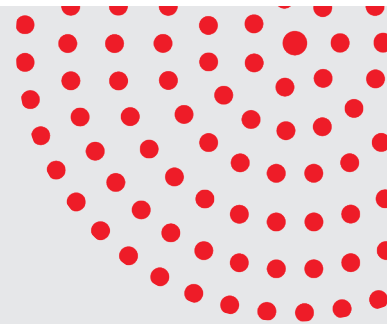
12

CAPS

3-in-1



THE
ANSWER
SERIES *Your Key to Exam Success*



Grade 12 **Life Sciences** 3-in-1 Part 1 CAPS

CLASS TEXT & STUDY GUIDE

This book is PART 1 of a SET of 2 Life Sciences study guides comprehensively covering the Grade 12 CAPS curriculum.

It contains the 1 Knowledge Area examined in Paper 1 (National final exam):

- Life Processes in Plants and Animals

Key Features:

- Comprehensive, accessible notes per module
- Carefully selected, graded questions and answers per module
- 'Rapid-fire' questions for key concepts and terms
- Clear, explanatory diagrams
- Up-to-date, relevant material

As you work methodically through this study guide, you will become increasingly prepared to achieve excellent results in your exams.



Life Sciences

Part 1

Liesl Sterrenberg, Helena Fouché & Grace Elliott

Also available

GRADE 12 LIFE SCIENCES PART 2

- Life at the Molecular, Cellular and Tissue level
- Diversity, Change and Continuity



THIS CLASS TEXT & STUDY GUIDE INCLUDES

- 1 Notes
 - Life Processes in Plants and Animals
- 2 Questions & Rapid Fire Questions
- 3 Detailed Memos

ALL
the content
you need
for
PAPER 1

E-book
available 

CONTENTS

<i>What is Life Sciences?</i>	<i>i</i>
<i>Aims in Life Sciences</i>	<i>i</i>
<i>Life Sciences Grade 12</i>	<i>ii</i>
<i>Final Exam</i>	<i>ii</i>
<i>Skills</i>	<i>iii</i>
<i>Action Verbs</i>	<i>xii</i>

Life Processes in Plants and Animals 1 - 139

Unit 1 Reproduction in Vertebrates	2
Unit 2 Human Reproduction	8
Unit 3 Responding to the Environment: Humans	27
Unit 4 Human Endocrine System	60
Unit 5 Homeostasis in Humans	68
Unit 6 Responding to the Environment: Plants	78
Questions	83
Rapid Fire Questions	112
Memo	117
Rapid Fire Memo	138

WHAT IS LIFE SCIENCES?

Life Sciences is the scientific study of living things from molecular level to their interaction with one another and the environment.

- ▶ Living systems exhibit levels of organisation from molecules to biomes.
- ▶ Life on earth is dynamic, with homeostasis maintaining balance at every level of organisation.
- ▶ Life is characterised by changes over time.

AIMS IN LIFE SCIENCES

Specific Aim 1: Knowing Life Sciences
(concepts, processes, phenomena, mechanisms, principles, theories, laws, models, etc.)

Specific Aim 2: Investigating phenomena in Life Sciences

Specific Aim 3: Appreciating and Understanding the History, Importance and Applications of Life Sciences in Society.



OVARIES

- ▶ The **primary female sex organs** are a pair of ovaries situated in the pelvic cavity on either side of the uterus.
- ▶ An ovary is an almond-shaped organ about 3.5 cm long which is held in position in the pelvic cavity by various ovarian ligaments.
- ▶ Each ovary is surrounded by a layer of diploid (2n) **germinal epithelium** that divides to produce haploid (n) **ova** by the process of **oogenesis**.

Functions of the ovaries

- ▶ The ovaries produce and release **ova**.
- ▶ They produce the female hormones **oestrogen** and **progesterone**.

ORGANS RESPONSIBLE FOR THE TRANSPORT AND CARE OF THE OVUM AND ZYGOTE

Fallopian tubes

- ▶ The two Fallopian tubes extend from each ovary to the uterus.
- ▶ The funnel-shaped opening on the ovarian side, the **infundibulum**, is fringed by a series of finger-like projections called the **fimbriae**.
- ▶ The walls of the Fallopian tube, as well as the infundibulum, are lined with **ciliated epithelium**.

After the immature ovum (secondary oocyte) is released by the ovary, it is drawn into the Fallopian tube by the sweeping action of the cilia of the ciliated epithelium. The infundibulum with its fimbriae twists around the ovary to ensure that the immature ovum enters the Fallopian tube.

Functions of the Fallopian tubes

- ▶ The Fallopian tubes transport the immature ovum as well as the developing zygote in the direction of the uterus by means of the sweeping action of cilia and muscular contractions (peristalsis) of the involuntary muscle layer.
- ▶ This is the site of fertilisation and the first divisions of the zygote.

Uterus

- ▶ The uterus is a hollow, pear-shaped organ.
- ▶ The wall of the uterus consists of three layers, i.e. an outer **serous layer** (membranous), a **muscular layer** of smooth, involuntary muscle and the **endometrium** (mucous membrane) that lines the uterus on the inside.
- ▶ The endometrium (lining of the uterus) thickens by becoming more vascular and glandular in preparation for the implantation of the fertilised ovum.
- ▶ The uterus narrows into the **cervix**, a neck region rich in glands.

Function of the uterus

- ▶ The uterus is responsible for the care of the embryo (known as the foetus after 8 weeks) from implantation to birth.



Vagina

- ▶ The vagina is a muscular tube of about 8 - 9 cm that opens to the exterior at the **vulva** (external female genitalia).



Vulva? The external female genitalia: inner labia, outer labia, clitoris and the opening of the vagina.

- ▶ The vagina of a virgin is partially closed by a membrane, the hymen.
- ▶ Physical exercise, use of tampons, a medical examination or trauma may damage the hymen.

Functions of the vagina

- ▶ During intercourse the penis releases sperm (in semen) directly into the vagina.
- ▶ The vagina forms the birth canal to deliver a baby.

PUBERTY IN GIRLS

- ▶ In girls, puberty starts from the age of 10 - 12 years.
- ▶ The ovaries start secreting the hormones, **oestrogen** and **progesterone**.
- ▶ These hormones help to prepare the endometrium in the uterus for the implantation of the embryo.

Main changes

- ▶ The following **secondary sexual characteristics** develop under the influence of oestrogen:
 - ▶ increase in fat deposited below the skin
 - ▶ widening of the hips
 - ▶ development of breasts
 - ▶ increase in height
 - ▶ development of eggs in the ovaries
 - ▶ start of menstruation
 - ▶ growth of body hair: pubic and armpit hair
 - ▶ skin becomes more oily (may develop acne)
 - ▶ behavioural changes, e.g. mood swings, emotional outbreaks and changed sleeping patterns

Secondary sexual characteristics?
(see p. 10)



GAMETOGENESIS

- ▶ Gametogenesis is the formation of gametes (sperm and eggs) in the sex organs (gonads: testes and ovaries).
- ▶ Two types of gametogenesis are distinguished:
 - ▶ **Spermatogenesis**
 - ▶ **Oogenesis**

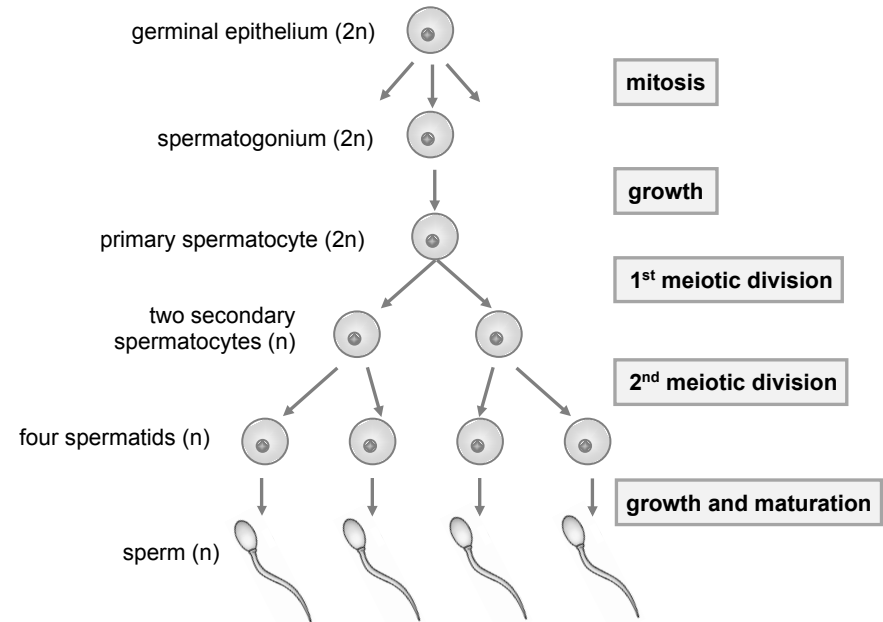
SPERMATOGENESIS

- ▶ Spermatogenesis is the formation of **sperm** from the germinal epithelial cells that line the seminiferous tubules of the testes.
- ▶ This process starts during puberty and continues throughout the male's lifetime.

Process of spermatogenesis

- ▶ The **diploid germinal epithelial cells** lining the seminiferous tubules divide **mitotically** and give rise to the **diploid spermatogonia** (singular: spermatogonium).
- ▶ The spermatogonia (2n) **grow** and develop into **diploid primary spermatocytes**.

- ▶ The primary spermatocytes (2n) undergo **meiosis** and, after the first meiotic division, each gives rise to two **haploid secondary spermatocytes**.
- ▶ After the second meiotic division, the secondary spermatocytes (n) divide to form four **haploid spermatids**.
- ▶ The spermatids (n) grow and mature to develop into **haploid sperm**.



Diagrammatic representation of spermatogenesis

Use the diagram of the cross-section through the seminiferous tubules of the testis on p. 10 together with this diagram when studying spermatogenesis.

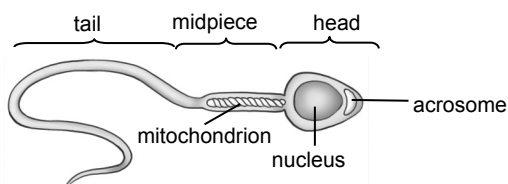
After the sperm is formed, it is not yet mature or ready to fertilise an ovum. The sperm matures in the epididymis where it is stored until it is released in ejaculation or reabsorbed.



Structure of a sperm cell

A sperm cell is microscopic in size and consists of three parts, i.e. **head**, **midpiece** and **tail**:

- ▶ The **head** contains the haploid cell nucleus with the male genetic material (23 chromosomes), as well as an **acrosome** at the front. The **acrosome** is a sac containing lytic enzymes that dissolve the yolk/vitelline membrane of the secondary oocyte to allow the sperm to penetrate.
- ▶ The **midpiece** contains many mitochondria that provide energy for locomotion.
- ▶ The **tail** performs whip-like movements that propel the sperm through the seminal fluid.



If sperm are not released, they eventually die and degenerate in the epididymis.

Oogenesis

- ▶ Oogenesis is the formation of **ova** from the germinal epithelial cells that form the outer layer of the ovaries.
- ▶ The first stages of development occur before birth in the ovaries of the female foetus.
- ▶ Thus the number of ova in each ovary is pre-determined at birth.
- ▶ They remain dormant (resting) until puberty.
- ▶ Oogenesis begins in the foetus, continues through puberty and ends with menopause.

Menopause? The time in a woman's life, at about 50 years of age, where menstruation stops, indicating the end of fertility.

Process of oogenesis

Before birth:

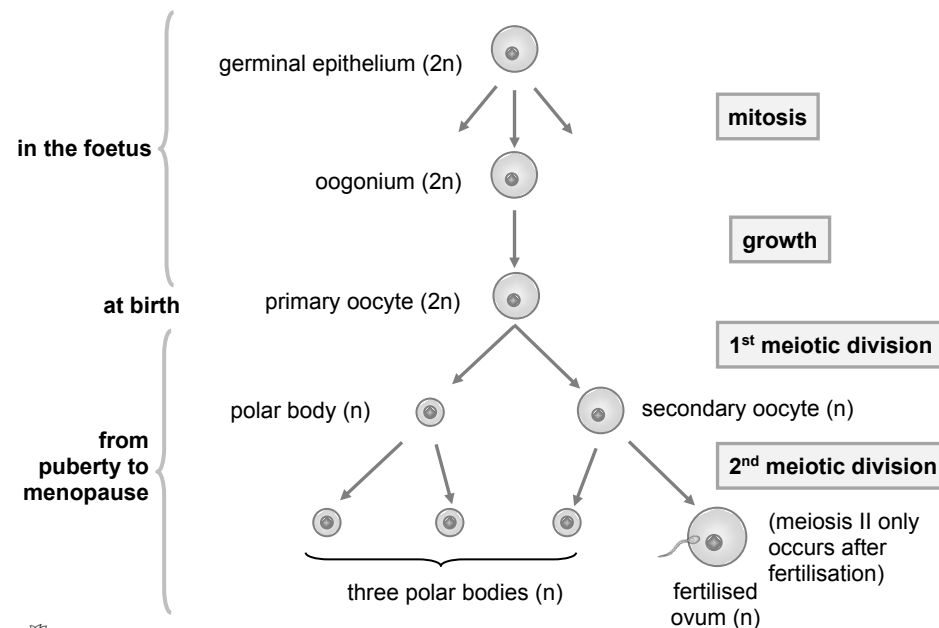
- ▶ The **diploid germinal epithelial cells** that form the outer layer of the foetal ovary, divide by **mitosis** and give rise to **diploid oogonia**.
- ▶ The oogonia (2n) **grow** and develop into **diploid primary oocytes**.
- ▶ The primary oocytes (2n) remain dormant from birth until puberty.

At puberty:

- ▶ The primary oocyte (2n) undergoes **meiosis**, and after the first meiotic division each gives rise to a larger, **haploid secondary oocyte** and a smaller, **haploid polar body**.
- ▶ The secondary oocyte (n) is released from the ovary in a process called **ovulation**.
- ▶ The second meiotic division only occurs if a sperm fertilises the secondary oocyte (n).
- ▶ After the second meiotic division, the secondary oocyte (n) divides into two daughter cells: a larger **haploid ovum** and another **polar body (n)**. Sometimes the first polar body also divides to form **two polar bodies**.
- ▶ Oogenesis thus produces **four haploid cells**, i.e. **three polar bodies** and a **haploid ovum**.



Of the four cells formed only the larger ovum survives. The smaller three polar bodies degenerate and disappear.

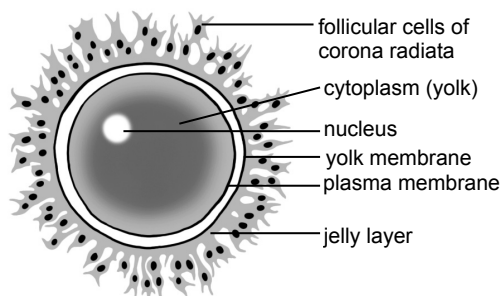


Diagrammatic representation of oogenesis

*Use the diagram of the section through the ovary (on p. 17) together with this diagram when studying oogenesis. This process is also discussed in more detail in the section on the **Menstrual cycle and hormonal control** (on p. 16).*

Structure of the ovum (egg cell)

The ovum is one of the largest cells in the body. It has a haploid **nucleus** with 23 chromosomes. The **cytoplasm** of the ovum is known as the **yolk** and provides a reserve source of nutrients for the fertilised ovum. The cytoplasm is enclosed by a **plasma membrane**.



Surrounding the plasma membrane is the vitelline or **yolk membrane**, which becomes impermeable after fertilisation and is then known as the **fertilisation membrane**. A **jelly layer** surrounds the yolk membrane and remains for some time after fertilisation. It provides protection to the early developmental stages of the fertilised egg cell. An outermost granular layer, called the **corona radiata**, consists of follicle cells that surrounded the secondary oocyte prior to ovulation. During fertilisation it is dissolved by enzymes that are released by the sperm.

MENSTRUAL CYCLE AND HORMONAL CONTROL



*The menstrual cycle of the female consists of the **ovarian cycle** (see below) and **uterine cycle** (see p. 17) and progresses over a period of about 28 days.*

OVARIAN CYCLE

- There are cyclical changes in the ovary, known as the ovarian cycle. It is divided into the follicular phase (development of the follicle), **ovulation** (release of the oocyte) and the luteal phase (development of the corpus luteum).
 - Development of the primary follicles into mature **Graafian follicles** (day 1 - 14)
 - Rupturing of the follicle and release of the immature ovum in **ovulation** (day 14)
 - Formation of the **corpus luteum** (from day 15)

See the section through the ovary on p. 17, oogenesis on p. 15 and the summary diagram on p. 19.



► In the ovaries of a **foetus**:

- The **germinal epithelial cells** (2n) that form the outer layer of the ovary divide by mitosis and form **oogonia** (2n) (singular: oogonium).
- Each **oogonium** (2n) is surrounded by a granular layer made up of a layer of cells from the germinal epithelium. The oogonium together with its granular layer is known as the **primary follicle**.
- Inside the primary follicles, the oogonia **grow** into **primary oocytes** (2n).

► At **birth**:

- There are between 700 000 to 2 million **primary oocytes** (2n) in the primary follicles in a baby girl's ovaries.
- The **primary oocytes** (2n) remain in a resting phase until puberty.



Most of the primary oocytes degenerate during childhood. Approximately 400 000 are present in the ovaries of a girl at puberty.

► At **puberty**:

- At 10 - 12 years of age, the **hypophysis** starts to secrete the hormone **FSH** (follicle stimulating hormone), which stimulates development of primary follicles into Graafian follicles.
- Only one follicle develops to full maturity in every cycle. The others degenerate.
- Fluid collects in the follicle cavity; the follicle enlarges and is eventually surrounded by two layers of connective tissue, called the **theca**. This mature follicle is known as a **Graafian follicle**.
- The developing follicles secrete increasing amounts of **oestrogen**, the hormone responsible for the secondary female sexual characteristics as well as the development of the endometrium (lining of the uterus) for the implantation of the embryo.
- The **primary oocyte** (2n) divides by **meiosis I** into two cells: a larger cell, the **secondary oocyte** (n) and a smaller cell, the **polar body** (n).
- The mature Graafian follicle moves to the surface of the ovary where it forms a slight protuberance. The follicle increases in size as the production of follicle fluid increases and eventually the wall of the ovary ruptures.

- ▶ A haploid **secondary oocyte** (immature ovum) is released.

*This release of a haploid secondary oocyte (immature ovum) ± every 28 days, is known as **ovulation**.*



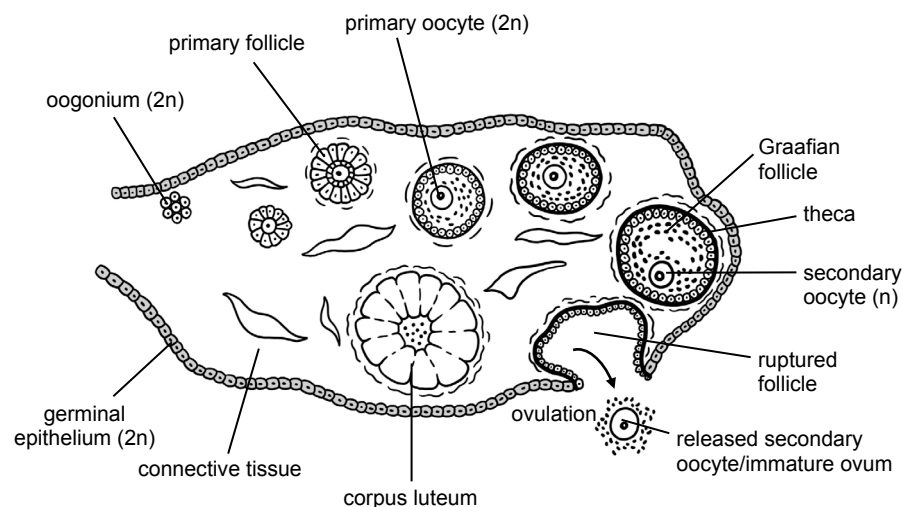
- ▶ Ovulation usually takes place on the 14th day after menstruation started.
- ▶ Ovulation is stimulated by the hormone **LH** (luteinising hormone), which is secreted by the hypophysis.



The high levels of oestrogen secreted by the Graafian follicles stimulate the release of LH for ovulation.

- ▶ After ovulation, the remains of the Graafian follicle develop under the influence of the hormone **LH**, into a mass of yellow cells known as the **corpus luteum**.
- ▶ The corpus luteum secretes **progesterone** and a little **oestrogen** (see hormone graphs on p. 19) to maintain the endometrium for implantation.
- ▶ If the released secondary oocyte is not fertilised, the corpus luteum degenerates until only a small scar remains.
- ▶ If fertilisation does occur, the corpus luteum continues to function and maintain the endometrium until the 12th week of pregnancy.

In this section you learnt about hormones: FSH, oestrogen, LH and progesterone. The control exerted by these hormones is discussed on p. 18.



Section through the ovary to show the ovarian cycle



The different developmental stages of the follicles and the division of the germinal epithelium cells are shown in the preceding diagram.

UTERINE CYCLE

- ▶ The **endometrium** (inner lining) of the uterus is rich in glands and blood vessels.
- ▶ From puberty to menopause the endometrium undergoes monthly cyclical changes, known as the **uterine cycle**.
- ▶ After ovulation the uterus must be ready for implantation and nutrition of the fertilised ovum.
- ▶ The female hormones **oestrogen** and **progesterone** (secreted by the ovary) are responsible for thickening the endometrium.
- ▶ If fertilisation does not occur, the thickened and vascularised tissue of the endometrium is not needed for implantation.
- ▶ The upper layers of the endometrium break down; are shed and discarded together with the unfertilised, immature ovum (secondary oocyte) to exit the body via the cervix and vagina.
- ▶ This process is known as **menstruation**.

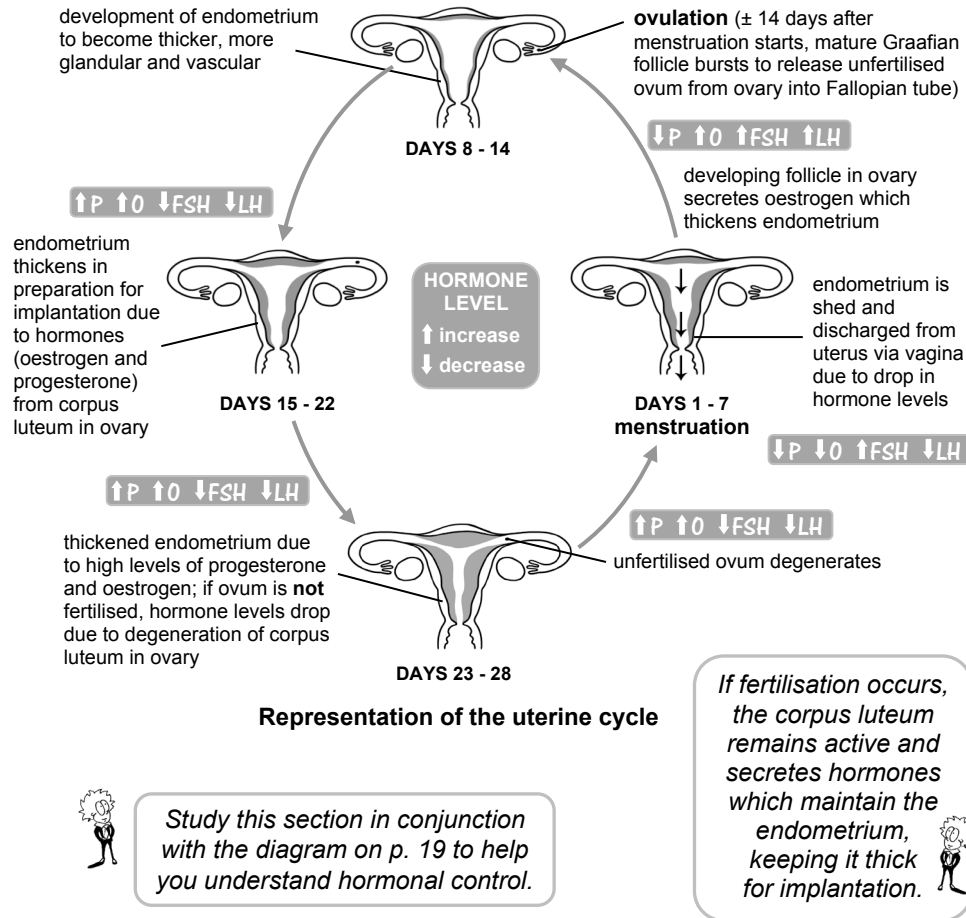
Vascularised? *It is developed with blood vessels.*



The start of menstruation (shedding/breakdown down of the endometrium of the previous cycle), is called Day 1.



- ▶ Menstrual blood consists of endometrial tissue, blood and mucous.
- ▶ Menstruation lasts for about 4 - 6 days.
- ▶ The endometrium in the uterus immediately starts to thicken once more to prepare for the arrival of the next, possibly fertilised, ovum.
- ▶ Some individuals may experience pain during menstruation, which may be relieved by a healthy diet and daily exercise, while others have little or no side-effects.



HORMONAL CONTROL OF THE MENSTRUAL CYCLE

- ▶ The hypophysis secretes the hormone **FSH** (follicle stimulating hormone).
 - ▶ FSH stimulates the development of primary follicles in the ovary into mature Graafian follicles.
- ▶ Developing follicles secrete the female hormone **oestrogen**.
 - ▶ Oestrogen stimulates the development of endometrial tissue, resulting in a thickened endometrium.
 - ▶ Oestrogen inhibits the release of FSH, thus inhibiting the development of more follicles, so that only one follicle matures at a time.

- ▶ High levels of oestrogen just before Day 14, stimulate the hypophysis to secrete **LH** (luteinising hormone) and **FSH** (follicle stimulating hormone).
 - ▶ LH stimulates the process of ovulation.
 - ▶ Under the influence of LH, the ruptured follicle is transformed into a corpus luteum.
 - ▶ FSH causes a surge of growth in the Graafian follicle which stimulates ovulation - the release of the secondary oocyte.



*Graphs of **hormone levels** during the menstrual cycle show a peak of **oestrogen** just before Day 14, followed by peaks of **FSH** and **LH** to stimulate ovulation around Day 14 (see p. 19).*

- ▶ The corpus luteum produces **progesterone** and small amounts of **oestrogen**.
 - ▶ Progesterone and oestrogen play a role in the thickening of the endometrium.
 - ▶ Progesterone inhibits the release of FSH, so that only one follicle matures at a time.
 - ▶ Progesterone also inhibits the secretion of LH and thus prevents further ovulation.
- ▶ After Day 14 the endometrium thickens considerably due to the effects of oestrogen and progesterone. Development of blood capillaries (vascularisation) and glands increase the thickness in preparation for implantation of the fertilised ovum.
- ▶ If fertilisation does not occur, the corpus luteum starts degenerating from Day 24 of the cycle.
- ▶ The production of **progesterone** (and oestrogen) stops due to the breakdown of the corpus luteum, which leads to the following:
 - ▶ Shedding of the endometrium causes menstruation.
 - ▶ Secretion of FSH is no longer inhibited. FSH is released to stimulate the development of new follicles in the ovary, and the entire cycle starts over again.



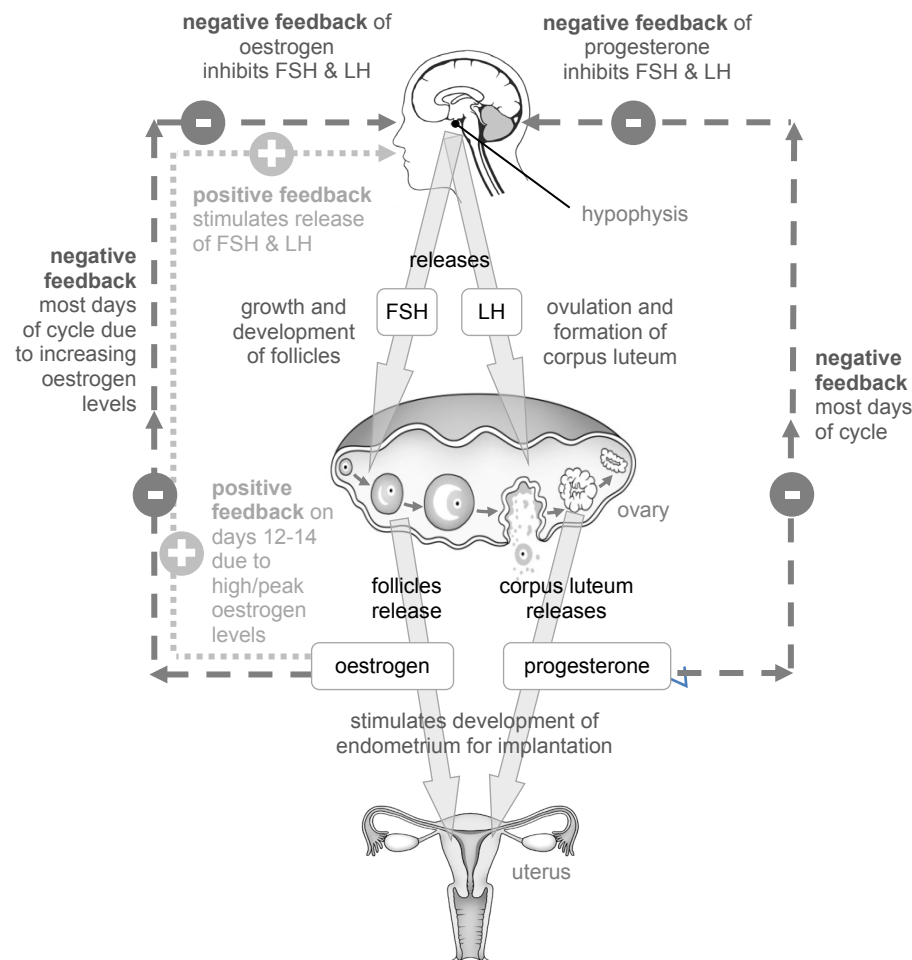
*FSH and LH are known as **gonadotropic** hormones, because they stimulate the gonads (sex glands).*

- ▶ The interaction between different hormones illustrates the principle of **negative feedback**.

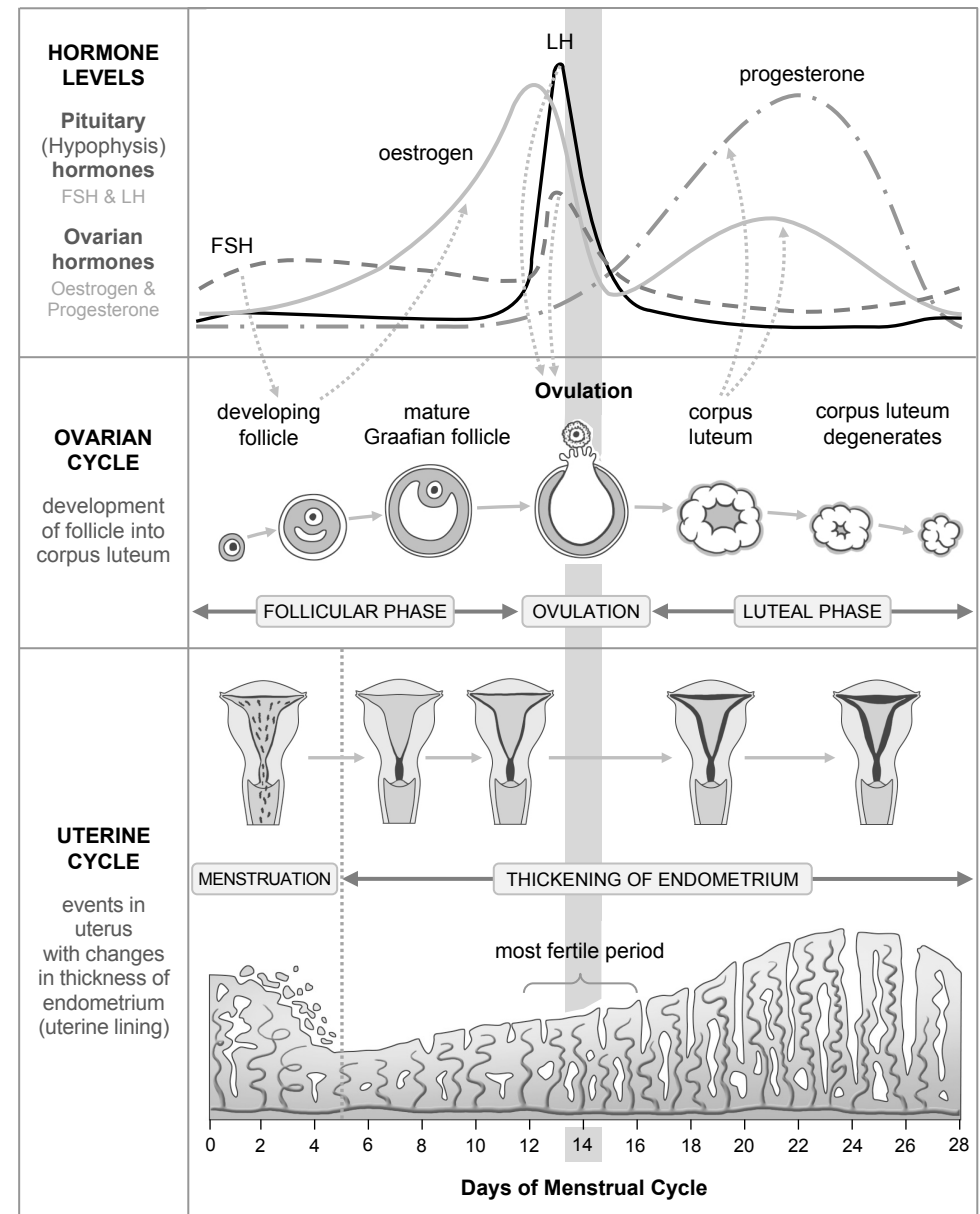
Negative feedback? *An increase in the level of one hormone will result in a decrease or the complete inhibition of the secretion of another hormone.*



- Negative feedback is illustrated in the interaction between hormones of the menstrual cycle as follows:
 - Increasing levels of **oestrogen**, secreted by the developing Graafian follicle, inhibit release of **FSH** by the hypophysis. This prevents the development of further follicles in the ovary.
 - Increasing levels of progesterone and oestrogen, secreted by the corpus luteum, inhibit the release of FSH and LH from the hypophysis. This prevents the development of any other follicles as well as ovulation.
 - Once the corpus luteum degenerates, **oestrogen** and **progesterone** levels in the blood will drop. Therefore, the secretion of FSH and LH is no longer inhibited, their concentration rises, and the process starts over again.



Interaction of the hormones that control the menstrual cycle



Hormonal regulation of the ovarian and uterine cycles

FERTILISATION AND DEVELOPMENT OF THE ZYGOTE

FERTILISATION

- ▶ In sexual intercourse (**copulation**) the erect penis is placed inside the female vagina and semen is released.
- ▶ The release of semen is known as **ejaculation**.



During each ejaculation, up to 5 ml of semen is released, containing about 500 million sperm cells.

- ▶ The sperm in the semen enter the cervix, pass through the uterus and enter the **Fallopian tube**.
- ▶ The **secondary oocyte** (immature ovum) released during ovulation, is normally fertilised in the first third of the Fallopian tube.
- ▶ The sperm cell propels itself by means of the tail, using the energy from mitochondria in the midpiece and fructose in the semen.
- ▶ A large number of sperm surround the secondary oocyte (immature ovum) and attach to it.
- ▶ The acrosome of the sperm secretes **lytic enzymes** that digest the outer layer of follicle cells ('corona radiata') around the secondary oocyte.
- ▶ The head of one sperm penetrates the yolk membrane of the secondary oocyte and the tail is discarded.
- ▶ The yolk membrane becomes impenetrable to other sperm cells and is now called the **fertilisation membrane**.
- ▶ The secondary oocyte (n) immediately undergoes the **second meiotic division** and gives rise to the mature **ovum** (n) and a **polar body** (n).
- ▶ The **haploid nucleus of the sperm cell fuses with the haploid nucleus of the mature ovum**. The newly formed diploid (2n) nucleus has two sets of chromosomes. One set (23 chromosomes) from the male gamete and one set (23 chromosomes) from the female gamete. This fertilised ovum is now called a **zygote**.

See oogenesis summary on p. 15.



Fertilisation is the fusion of the haploid nucleus of a sperm with the haploid nucleus of the ovum to form a diploid zygote.

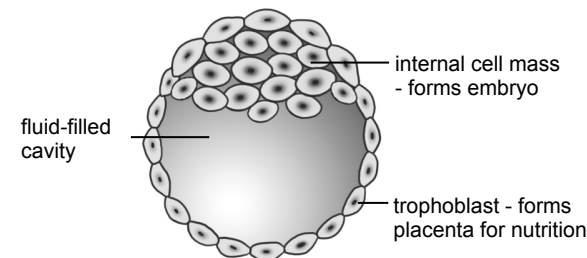
During fertilisation a diploid zygote is formed in the Fallopian tube.



DEVELOPMENT OF ZYGOTE TO BLASTOCYST

- ▶ The zygote passes through the Fallopian tube to the uterus by means of peristaltic movements (caused by contraction of the smooth muscles). The cilia of the tube's mucous membrane also help to move the zygote.

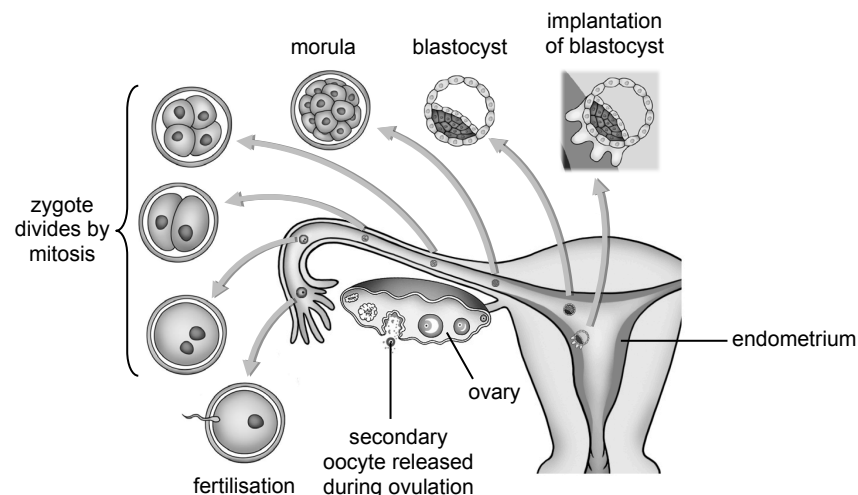
- ▶ **Mitosis** occur in the zygote as it moves towards the uterus. One cell becomes two, two becomes four, then eight, etc. until a ball of cells, the **morula**, is formed.



Structure of the blastocyst 6 - 7 days after fertilisation

- ▶ The morula continues to divide as it reaches the uterus and forms a mass of cells arranged around a central fluid-filled cavity. This hollow sphere is called a **blastocyst**.
- ▶ The external layer of the blastocyst is known as the **trophoblast** and plays a role in the nutrition of the embryo. The **internal cell mass** gives rise to the **embryo**.

The entire process of development from zygote to blastocyst lasts approximately 3 - 7 days.



Development of the zygote until implantation

IMPLANTATION AND PREGNANCY

Implantation of the blastocyst into the endometrium of the uterus gives a positive test for **pregnancy**.

IMPLANTATION

- ▶ The blastocyst remains in the uterus for about 2 - 5 days before it is implanted in the endometrium.
- ▶ The trophoblast cells secrete enzymes that break down the epithelium of the endometrium. The blastocyst becomes embedded in the endometrium. This process is called **implantation**.
- ▶ Due to the action of **oestrogen** and **progesterone**, the endometrium is thick and very vascular (rich in blood vessels).
- ▶ The trophoblast develops finger-like projections (villi) that grow into the endometrium. These villi, together with the maternal endometrium, form the placenta, which secretes large quantities of progesterone during pregnancy.



The placenta releases progesterone when it takes over the role of the corpus luteum in the 12th week of pregnancy.

- ▶ High levels of progesterone ensure a thick endometrium and thus maintain the pregnancy and prevent menstruation.

PREGNANCY (GESTATION)

Pregnancy is the period from fertilisation to birth. In humans pregnancy lasts approximately 40 weeks.

Further development of the embryo

- ▶ As the blastocyst develops, the trophoblast forms several membranes around the embryo. These membranes (chorion, amnion and allantois) are called **extra-embryonic membranes**.

*You already know that the developmental stages of the zygote up to and including the first eight weeks after fertilisation are referred to as the **embryo**. From the ninth week all the organs are differentiated and the embryo is called a **foetus**. In the foetus, growth and specialisation occur from the ninth week until birth.*



Parts of the developing embryo

Chorion

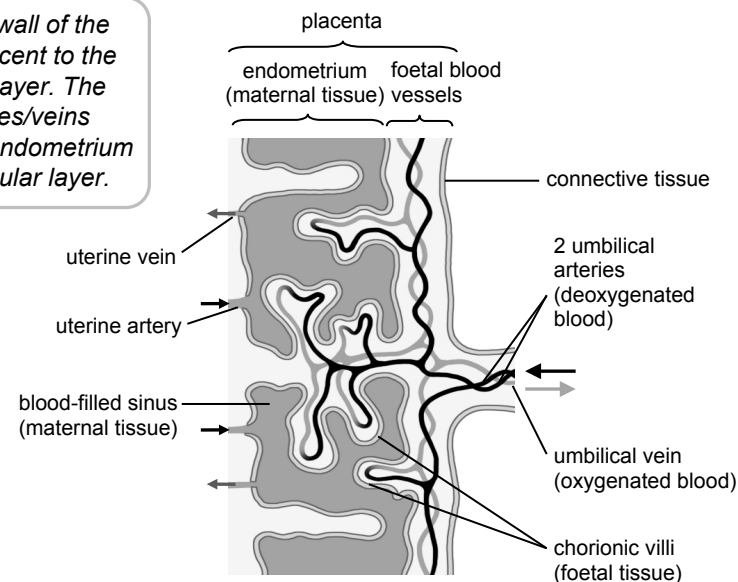
- ▶ The chorion is the outermost extra-embryonic membrane surrounding the embryo.
- ▶ During implantation, finger-like projections of the trophoblast, called **chorionic villi**, develop around the blastocyst.
- ▶ Most of the villi disappear, but where the chorion is attached to the uterine wall, the villi enlarge and become more vascular (develop more blood vessels) to form the foetal tissue of the placenta.

Placenta

- ▶ The endometrium forms large blood-filled spaces (sinuses), giving it a spongy appearance. The villi of the chorion grow into these blood-filled sinuses of the maternal tissue and are thus surrounded by maternal blood.
- ▶ This temporary vascular tissue, consisting of maternal tissue (decidua) and embryonic tissue (villi), is called the **placenta**.
- ▶ The maternal blood and foetal blood are in close contact, but never mix. A transfer of substances takes place by diffusion via the thin membranes separating the maternal blood and foetal blood.



The muscular wall of the uterus lies adjacent to the endometrium layer. The uterine arteries/veins enter/leave the endometrium from this muscular layer.



Structure of the placenta

► The **placenta** performs the following **functions**:

► **Nutrition of the embryo**

Dissolved nutrients, such as glucose, amino acids, fatty acids, dissolved mineral salts, water and vitamins, are transported from the placenta via the umbilical cord to the foetus.

► **Excretion**

Metabolic waste products such as urea are transported from the foetus via the umbilical cord to the placenta.

► **Gaseous exchange**

Oxygen (O₂) is transported from the placenta to the foetus, and carbon dioxide (CO₂) from the foetus to the placenta.

► **Acts as a microfilter**

The placenta prevents the entry of pathogenic organisms into the blood of the foetus. Antibodies in the maternal blood are allowed to pass through, providing the foetus with passive immunity. Pathogens, such as those causing German measles and the HI virus, however, may cross the placental barrier and infect the foetus.



HIV positive mothers may transfer the virus to their babies via the placenta.

► **Endocrine function**

After the 12th week of pregnancy the placenta takes over the function of the corpus luteum. It secretes a little oestrogen and large quantities of progesterone, which:

- maintain a thickened endometrium (prevent menstruation)
- maintain pregnancy

Umbilical cord

► The foetus is connected to the placenta by an umbilical cord. The umbilical cord consists of **two arteries** and one **vein** surrounded by connective tissue.

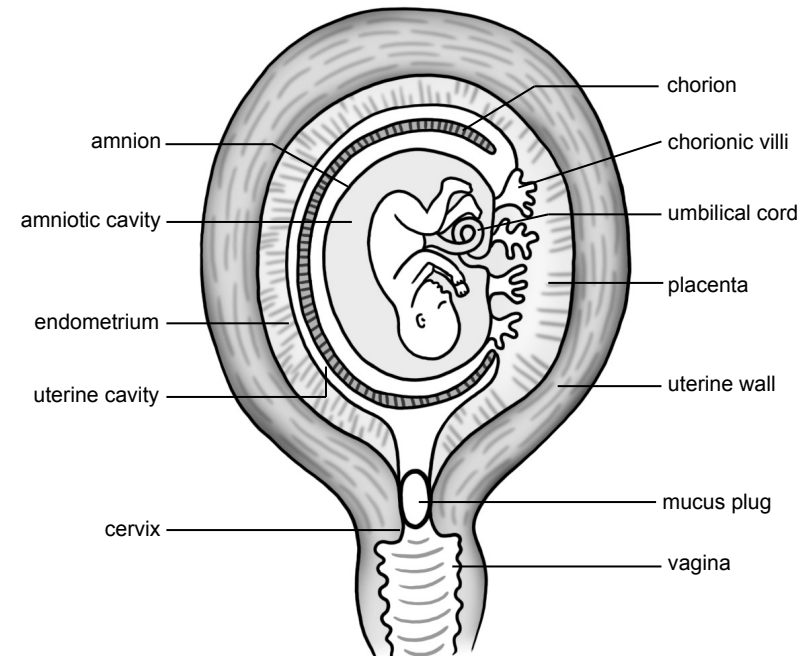
► The **umbilical cord** performs the following **functions**:

- The two umbilical arteries **carry deoxygenated blood** (O₂-poor) and waste products from the foetus **to the placenta**.
- The umbilical vein **carries oxygenated blood** (O₂-rich), rich in nutrients, **from the placenta** to the foetus.

Amnion

- The amnion is a tough, extra-embryonic membrane lining the chorion and surrounding the foetus.
- The amnion encloses the **amniotic cavity**, which is filled with **amniotic fluid**. The amniotic fluid contains water as well as discarded foetal cells, waste products and micro-organisms.
- The amniotic fluid performs the following **functions**:
 - It provides the **watery medium** in which the foetus can **freely move** and develop.
 - It **protects** the foetus from **shocks, dehydration** and **temperature changes**.

*The **allantois** (excretion and gaseous exchange) and **yolk sac** (nutrition) are **non-functional** in the human foetus. They only function in the early embryo stages before the **placenta** develops to perform these functions. They eventually form part of the umbilical cord which connects with the placenta.*



Developing foetus enclosed by embryonic membranes (amnion and chorion)