Foreword

Dear student,

Before you lies the booklet for Theme 1b of Semester 1 of Year 1 Medicine at the University of Manchester. Slim Academy has summarized the most important study material for you, so that you can study as pleasantly as possible. We wish you the best of luck with your studies!

Quality
Because we want to keep the quality of our summaries as high as possible, we are very interested in your feedback. For this reason, we will send you an email two weeks after you receive the summary, asking you to evaluate it. You would really help us by filling it out. If at any other time you have comments, tips, or suggestions for improvement, please email us at **s.dejong@slimacademy.nl** — we'll get to work on it right away!

Working at Slim Academy
Slim Academy is always looking for motivated students! Would you like to help us by summarizing and reviewing summaries? Then the role of **Study Hero** might be perfect for you. You can work from home, receive a generous payment, and gain a study-related side job that looks great on your CV. Interested? Send your motivation letter and CV to **s.dejong@slimacademy.nl**.

Reproduction prohibited
Studying together is, of course, effective. So be sure to tell your friends about Slim Academy's summaries. However, reproduction and sharing of this summary with third parties is strictly prohibited. If you want us to continue offering these materials, please don't share this summary with others — encourage your fellow students to get their own copy.

We wish you lots of success with your studies and your exams!

Team Slim Academy

P.S. This summary has been written based on the author's own interpretation. It remains a summary and should be seen as a supplement to the required study materials — not a replacement

Table of content

Fertilisation, Pregnancy, and Parnutrition

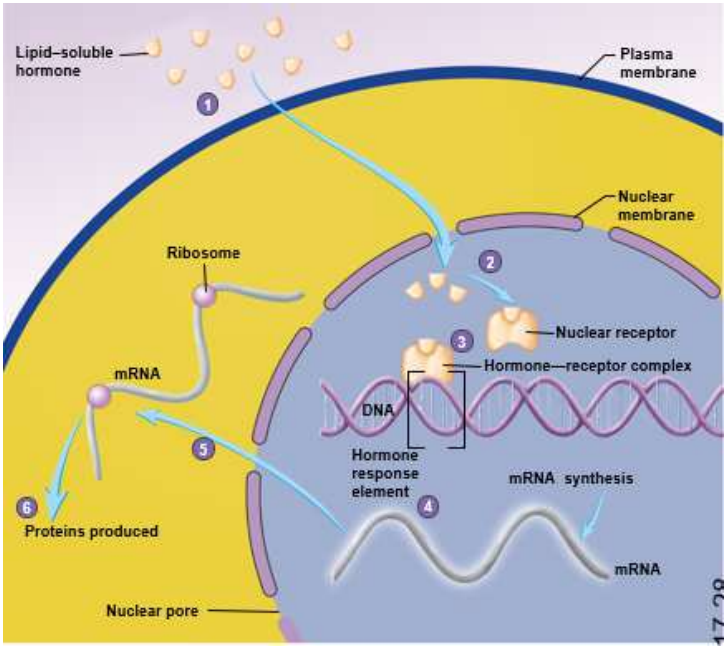
Each chapter is based on the respective ILO. The ILO's can be found on Canvas. Because of copyright protection we will no longer copy the ILO's in this booklet. We recommend you find yourself the ILO's and keep them next to the summary.

Chapter 1 - Steroid hormones

Introduction
This chapter describes the sequence of events that allow a steroid hormone to carry out its function. Different triggers for its release will be described, as well as cellular events that result from its binding to its cognate receptor and its effects on specific body tissues. Oestrogen and progesterone will serve as examples.

Steroid hormones
Steroid hormones are derived from cholesterol, which is a lipid, and are hydrophobic. This means that they require a **transport protein** to move through the bloodstream but they can directly enter cells by passing through the phospholipid bilayer and they bind to intracellular nuclear receptors.

Mechanism
The steroid hormone crosses the phospholipid bilayer to enter the cell. It then binds to nuclear receptors inside the cell. Once bound, the chaperone proteins dissociate. A **dimer** forms and moves to the **nucleus** to enter it via a pore. The dimer binds to the hormone response element of the DNA in the nucleus, and the transcription rate of the **target gene** is altered.



Mechanism of lipid-soluble hormones. *Source: https://quizlet.com*

Gonadal steroid hormones include oestrogen, progesterone and androgens which are produced in the ovaries. Oestrogen is produced in **granulosa cells** which surround the follicle, androgens are produced in the **thecal cells** and progesterone is produced by the **corpus luteum** after ovulation. These hormones are produced and released throughout the **female reproductive cycle** to trigger specific cellular events in tissues.

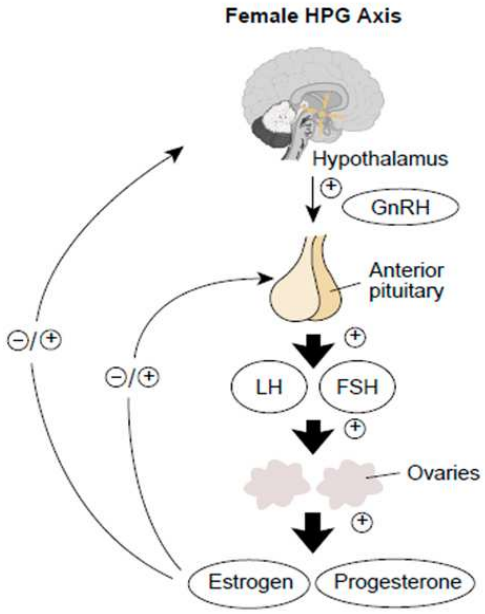
Hypothalamic-Pituitary-Gonadal Axis
This describes the sequence of events which leads to the release of oestrogen and progesterone.

Firstly, fat cells secrete the hormone **leptin**. Leptin stimulates the arcuate nucleus of the **hypothalamus** to secrete another hormone called kisspeptin which acts on the pre-optic nucleus of the hypothalamus. It stimulates the hypothalamus to produce and release GnRH (gonadotrophin releasing hormone) in a pulsatile manner.

GnRH acts on the anterior pituitary gland and stimulates it to release **FSH** (follicle stimulating hormone) and **LH** (luteinising hormone). FSH and LH move in the bloodstream to the ovaries. LH acts on the thecal cells of developing follicles and stimulates the conversion of cholesterol to androgens. FSH then acts on granulosa cells and stimulates the conversion of androgens to oestrogen which is catalysed by the **enzyme P450 aromatase**.

After ovulation, the empty ovarian follicle transforms into the **corpus luteum** and this structure is maintained by LH. The corpus luteum produces progesterone.

The HPG axis also involves a **feedback system** in response to the release of oestrogen and progesterone so that oestrogen and progesterone levels fluctuate during different phases of the reproductive cycle. The different levels of oestrogen and progesterone stimulate specific environmental conditions which are favourable in different stages of the cycle.



Female HPG Axis. *Source: geekymedics.com*

Follicular/Proliferative Phase
During this phase the production of oestrogen is stimulated by a negative feedback response to lower oestrogen levels at the start of this phase. In response to lower oestrogen levels, the hypothalamus secretes more GnRH in a pulsatile manner. GnRH acts on the anterior pituitary gland to secrete more FSH and LH which drive granulosa cell proliferation and follicular development and stimulate the production of oestrogen as described above.

When oestrogen levels are high enough, the negative feedback response causes less GnRH to be released by the hypothalamus so that the secretion of FSH and LH is limited and only one follicle is selected for maturation and ovulation.

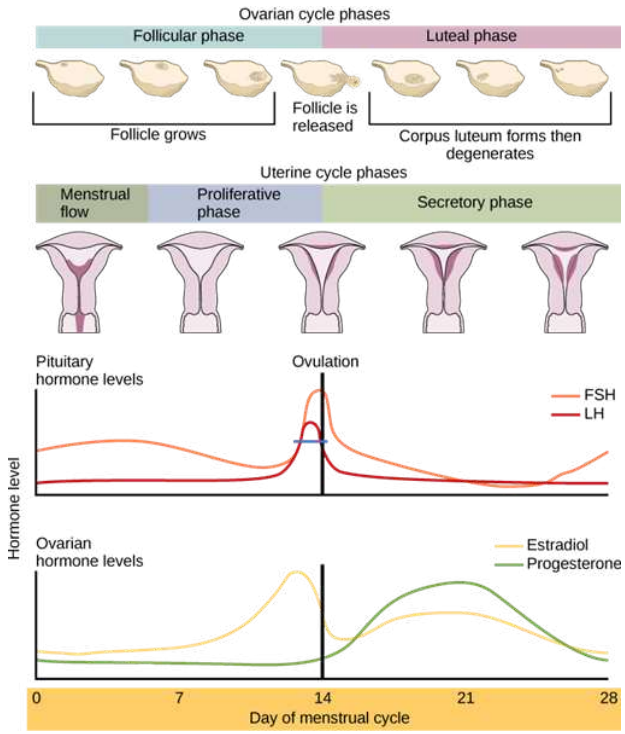
Oestrogen production is dominant in this phase, which causes the cervical mucus to be thin and watery. This makes the environment ideal for sperm penetration towards the end of this phase nearing ovulation. Oestrogen also stimulates the endometrial lining to thicken which involves **angiogenesis** (development of new blood vessels) and it also stimulates glands to enlarge for more hormone release and progesterone receptor presentation to increase.

Ovulation
High oestrogen levels here cause a positive feedback response and trigger the surge in LH and FSH. In response to high oestrogen levels, the hypothalamus secretes more GnRH in a pulsatile manner. GnRH acts on the anterior pituitary gland to secrete more FSH and LH which stimulate the production of oestrogen as described above. The surge in LH leads to the ovulation of the dominant follicle.

Luteal/Secretory Phase
After ovulation, the corpus luteum is left, which is maintained by LH and produces progesterone. There is a negative feedback response to the high levels of progesterone and less GnRH is released by the hypothalamus. This causes less FSH and LH to be released so the levels of these hormones become low.

The dominance of progesterone production by the corpus luteum causes glandular secretion and stimulates the spiral arteries to develop in the endometrial lining. The endocervical mucus thickens under the influence of progesterone.

Menstruation
As levels of FSH and LH become low, eventually oestrogen and progesterone levels also become low as the corpus luteum regresses. The endometrium then sheds as oestrogen and progesterone are no longer in high enough levels to maintain the endometrial lining.



Ovarian Cycle. *Source: https://courses.lumenlearning.com*

Slim Summary!

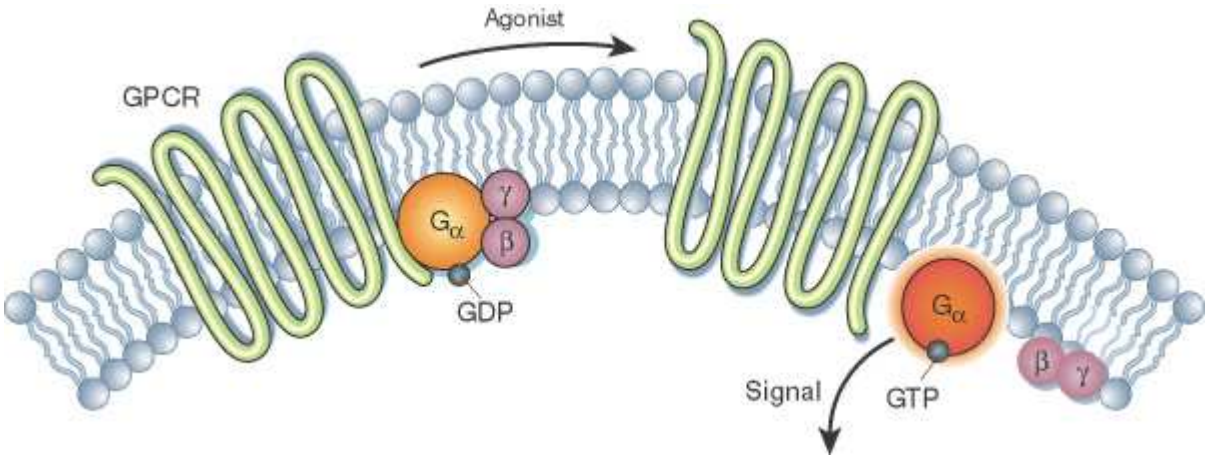
- Steroid hormones such as oestrogen and progesterone are lipid-based molecules that readily diffuse across cell membranes and bind to nuclear receptors within the cell. This interaction subsequently alters gene transcription and drives specific cellular responses;
- Regulation of their release is orchestrated by the hypothalamic-pituitary-gonadal (HPG) axis, which involves a sequential cascade: leptin stimulates kisspeptin, which prompts GnRH release; this, in turn, stimulates FSH and LH secretion, leading to ovarian production of oestrogen (primarily from granulosa cells) and progesterone (from the corpus luteum);
- Throughout the menstrual cycle, fluctuations in oestrogen and progesterone are critical for governing follicle development, ovulation, and endometrial preparation. Oestrogen predominates during the follicular phase, while progesterone is the primary hormone in the luteal phase. The withdrawal of both hormones ultimately results in menstruation.

Chapter 2 - Mechanisms of action

Introduction
This chapter describes how to differentiate the mode of action of steroid and protein-based hormones at the level of receptor binding and downstream mechanism of action.

Binding
In contrast to steroid hormones, protein-based hormones are hydrophilic and cannot cross the phospholipid bilayer. They must bind to extracellular receptors and usually need a **second messenger** in the cell to bring about its effects. Examples of protein-based hormones include FSH and LH which bind to GPCRs (G-protein coupled receptors) on granulosa and thecal cells respectively. These GPCRs use cAMP as a second messenger.

Mechanism
The hormone binds to the GPCR and activates it. It interacts with the **G_s protein of the receptor** and activates it by replacing GDP with GTP. The **alpha subunit** of the GPCR dissociates and binds to **adenylate cyclase** to activate it. Adenylate cyclase causes more cAMP to be produced. cAMP phosphorylates and activates protein kinase A which activates target genes in the DNA.



Mechanism of GPCRs. *Source: https://www.nature.com/scitable/topicpage/gpcr-14047471/*

Slim Summary!

- Protein hormones such as FSH and LH are hydrophilic and therefore interact with membrane-bound receptors rather than passing through the cell membrane like steroid hormones. Specifically, FSH and LH bind to G protein-coupled receptors (GPCRs) located on granulosa and thecal cells;
- This receptor engagement activates the Gs protein, which in turn stimulates adenylate cyclase to elevate intracellular cAMP levels. The rise in cAMP activates protein kinase A, leading to downstream modulation of gene expression within the target cells.

Chapter 3 - Hormones during the menstrual cycle and pregnancy

Introduction
This chapter explains the levels of several hormones during the pregnancy, as well as a regular menstrual cycle. The hormones include progesterone, oestrogen, FSH, LH and inhibin.

Estrogen
Estrogen plays a central role in the development and maintenance of the endometrium, particularly the stratum functionalis, and is key for promoting vascularization and the formation of spiral arteries within the endometrial tissue. It maintains the health of the vaginal epithelium and supports the motility of the fallopian tubes.

Estrogen is also fundamental for the **development of secondary female sex characteristics**. In the context of labor, estrogen increases the sensitivity of the myometrium to oxytocin, thereby facilitating the onset and progression of **rhythmic uterine contractions**. Additionally, estrogen stimulates the production of prostaglandins in uterine tissues, the amnion, and the chorion, which collectively contribute to cervical softening and dilation, enhance uterine contractility, and increase myometrial responsiveness to oxytocin. Estrogen aids in cervical ripening via **upregulation of collagenase activity**, which remodels cervical connective tissue, and by promoting the formation of gap junctions in the myometrium, allowing for more coordinated uterine contractions and increased calcium influx to support muscle contraction. It also promotes the release of **pro-inflammatory cytokines**, which further assist in cervical ripening and tissue remodeling. The level of estrogen rises steadily throughout pregnancy, initially produced by the corpus luteum and later by the placenta, peaking near term to optimize uterine blood flow, stimulate **prostaglandin synthesis**, and prepare the uterus for labor. Following delivery, estrogen levels decrease sharply, thereby enabling lactation to commence.

Progesterone
Progesterone is essential for **thickening and stabilizing the endometrial lining** and supporting endometrial vascularization. It stimulates the endometrial glands to secrete histotroph, which contains glucose oligomers and glycoproteins, providing **nutritional support** to the early embryo. Progesterone suppresses uterine contractility and maintains uterine quiescence to support early pregnancy. It also contributes to the **production of cervical mucus** and decreases the uterus's responsiveness to oxytocin. As labor approaches, functional withdrawal of progesterone occurs, permitting increased activity of prostaglandins and oxytocin, which leads to uterine contractions. During labor, progesterone facilitates **cervical ripening and dilation** through enzymatic and mediator-driven processes that soften the cervix, and it supports the formation of myometrial gap junctions and increased calcium influx. Its production increases continuously from conception, initially by the corpus luteum and subsequently by the placenta after roughly 10 weeks. Progesterone maintains uterine relaxation throughout pregnancy, but near term, functional withdrawal permits the onset of labor. After delivery, progesterone levels decline rapidly, allowing for the **initiation of milk production**.

Inhibin
Inhibin A is mainly produced by the **corpus luteum** during the luteal phase of the menstrual cycle and, during pregnancy, by the placenta (specifically the syncytiotrophoblast). It serves as a biomarker of placental function and provides negative feedback regulation on FSH secretion.

Inhibin B is secreted by **granulosa cells** during the follicular phase and helps maintain low FSH concentrations by acting on the anterior pituitary, ensuring proper follicular development and regulation. During pregnancy, inhibin A concentrations rise steadily, peaking in the third trimester, and serve as an indicator of placental health, whereas inhibin B levels decline due to reduced follicular activity.

Relaxin
Relaxin facilitates preparation of the endometrial lining for implantation and plays a role in promoting **angiogenesis**. It maintains the corpus luteum, ensuring continued progesterone production, and downregulates oxytocin receptors, thereby delaying uterine contractions. Relaxin also enhances the **flexibility of pelvic ligaments and joints**, particularly at the pubic symphysis, to facilitate **parturition**. Further, it contributes to cervical ripening and acts as a vasodilator by increasing nitric oxide production, which improves uterine and placental blood flow. Relaxin also increases **cardiac output** during pregnancy.

Anti-Müllerian Hormone (AMH)
AMH is a glycoprotein produced by **granulosa cells of ovarian follicles**. Its primary function is to maintain the **ovarian reserve** by inhibiting the activation of primordial follicles and modulating their sensitivity to follicle-stimulating hormone (FSH). In this way, only follicles most likely to mature are recruited for ovulation. Clinically, AMH serves as a biomarker for ovarian reserve: elevated levels are associated with conditions such as **polycystic ovary syndrome** (PCOS), while low levels suggest diminished ovarian reserve, often seen with advancing age. AMH is integral to the regulation of follicular development, menstrual cycles, and overall reproductive function. During pregnancy, AMH levels decrease due to suppressed ovarian activity, with levels rising again postpartum as ovarian function resumes.

HPG Axis
The hypothalamic-pituitary-gonadal (HPG) axis is regulated in part by **leptin**, a hormone produced by adipose tissue that reflects the body's energy stores available for reproduction. Leptin receptors located on **kisspeptin neurons** in the hypothalamus facilitate the pulsatile release of gonadotropin-releasing hormone (GnRH) when leptin levels are sufficient. This process initiates and maintains menstrual cycles. Conversely, low leptin levels inhibit GnRH secretion, resulting in menstrual irregularities or delayed menarche.

Human Placental Lactogen (HPL)
HPL plays a significant role in maternal metabolic adaptation during pregnancy. It enhances **maternal lipolysis**, mobilizing fatty acids as an energy source, and induces insulin resistance to ensure that maternal glucose remains available to the fetus. HPL is important for supporting **fetal growth and placental development**, and together with prolactin, promotes mammary gland maturation in preparation for lactation. HPL concentrations increase progressively throughout pregnancy, peak during the third trimester, and decline rapidly after delivery.

Oxytocin
Oxytocin is critical for the initiation and progression of labor through its stimulation of uterine contractions. It operates via a **positive feedback mechanism**: cervical stretching increases oxytocin release, which in turn intensifies contractions until delivery is achieved. Oxytocin also promotes **prostaglandin synthesis**, further enhancing uterine contractility. During lactation, oxytocin mediates **milk ejection** by inducing contraction of myoepithelial cells in the breast following infant suckling. Postpartum, oxytocin assists with uterine involution. While oxytocin levels are relatively stable during pregnancy, uterine sensitivity to the hormone increases near term due to rising estrogen. Oxytocin levels rise during labor and remain elevated briefly after birth to support lactation and uterine recovery.

Fetal Adrenal Glands, CRH, and Cortisol
The fetal adrenal glands consist of a definitive zone producing glucocorticoids and mineralocorticoids, such as aldosterone, and a fetal zone responsible for **dehydroepiandrosterone sulfate** (DHEA-S) synthesis. Corticotropin-releasing hormone (CRH), secreted by both the placenta and hypothalamus, regulates fetal adrenal function by stimulating adrenocorticotropic hormone (ACTH) production, which in turn promotes **cortisol release**. Increasing CRH levels are implicated in the timing of labor. Cortisol is essential for fetal energy homeostasis, immune regulation, and the maturation of vital organs, including the lungs (via surfactant production), liver, gastrointestinal tract, and kidneys. It also facilitates **glycogen storage** in the fetal liver and contributes to placental estrogen synthesis, as DHEA-S from the adrenal gland is converted to estrogen by the placenta, promoting uterine contractility and cervical ripening. Furthermore, cortisol modulates the maternal immune response to **prevent fetal rejection**. Both CRH and cortisol concentrations rise throughout gestation, peaking near term and decreasing rapidly postpartum.

Luteinizing Hormone (LH)
LH is secreted by the anterior pituitary gland and targets the gonads. In females, LH induces ovulation and stimulates the ovarian synthesis of estrogens and progestins, such as progesterone. The secretion of LH is governed by GnRH released from the hypothalamus.

Slim Summary!

- Hormonal regulation is central to both the menstrual cycle and pregnancy, involving a complex interplay of hormones such as oestrogen, progesterone, FSH, LH, inhibin, relaxin, AMH, and HPL, all orchestrated by the hypothalamic-pituitary-gonadal axis;
- Oestrogen and progesterone have pivotal roles, maintaining the endometrial lining, supporting gestation, and preparing the uterus for labor. Placental hormones, including HPL, relaxin, CRH, and cortisol, further contribute by facilitating fetal development and enabling maternal physiological adaptations;
- Feedback mechanisms, mediated by factors like inhibin, leptin, and GnRH, are essential for sustaining hormonal equilibrium, regulating ovarian function, and ensuring the integrity of reproductive processes throughout both the menstrual cycle and pregnancy.

Chapter 4 - Oogenesis, fertilisation, and cleavage

The process of oogenesis, fertilisation and cleavage have been discussed in the first booklet.

Slim Summary!

- Oogenesis is the process in which a diploid oogonium develops into a haploid ovum through meiosis, completing only after fertilisation;
- Fertilisation is the fusion of the sperm and ovum nuclei to form a diploid zygote;
- Cleavage is the rapid series of mitotic divisions of the zygote, producing smaller cells called blastomeres that form the early embryo (blastula).

Chapter 5 - Human chorionic gonadotrophin (hCG)

Introduction
In this chapter, the role of chorionic gonadotrophin in pregnancy recognition and maintenance is discussed.

The hCG in early pregnancy
Human chorionic gonadotropin (hCG) plays a critical role in early pregnancy. Produced by syncytiotrophoblast cells following implantation, hCG's principal function is to sustain the **corpus luteum**, which in turn secretes progesterone and estrogen. These hormones are essential—they maintain the endometrial lining, inhibit menstruation, and foster a supportive uterine environment for embryonic development.

hCG secretion begins approximately six to eight days post-fertilization and increases rapidly, doubling every **48 to 72 hours** in the early weeks of gestation. Peak concentrations occur between the eighth and eleventh week, after which levels decline and stabilize as the **placenta assumes full endocrine responsibility**.

Clinically, hCG serves as the **definitive biomarker** for pregnancy detection in both urine and blood tests. Its presence in maternal blood is detectable as early as eight days after ovulation, with urine detection following soon after. These tests specifically target **hCG's beta subunit**, which distinguishes it from related hormones such as luteinizing hormone, follicle-stimulating hormone, and thyroid-stimulating hormone.

During pregnancy
Beyond corpus luteum maintenance, hCG is involved in several key developmental processes. It promotes **differentiation of cytotrophoblasts, stimulates testosterone production** in male fetuses through Leydig cell activation, and modulates the maternal immune response to prevent fetal rejection. The subsequent decline in hCG after the first trimester reflects the placenta's takeover of hormone production and maintenance of pregnancy.

Abnormal hCG levels can signal **complications**. Low early hCG may suggest threatened miscarriage, ectopic pregnancy, or delayed implantation. Elevated levels may indicate multiple pregnancies or pathologies such as molar pregnancy or gestational trophoblastic disease. Consequently, monitoring the trajectory of hCG concentrations is clinically significant; in typical intrauterine pregnancies, hCG levels double approximately every 48 to 72 hours in early gestation. Deviations from this pattern prompt further investigation to identify underlying issues.

Slim Summary!

- HCG is produced by the syncytiotrophoblast, sustaining the corpus luteum, differentiation of cytotrophoblasts;
- Peak concentrations occur within the eight and eleventh week – placenta assumes full role following this;
- HCG is a definitive biomarker for pregnancy detection – abnormal levels may indicate fetal complications.

Chapter 6 - The first trimester

Introduction

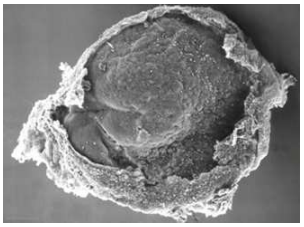
This chapter builds onto theme 1a, describing the events in the first trimester of a pregnancy, in chronological order. Major morphogenic events are summarized.

Moment	Event
Day 3/4	Morula formed
Day 5/6	Blastocyst formed
Day 8/9	Implantation, Bilaminar Disc forms
Day 14/15	Gastrulation
Day 15	Embryo elongates
Day 17	Nervous system starts to develop, cephalic and caudal regions form
Day 19	Neural tissue forms, somites start to appear
Day 22	Heartbeat starts
Day 27-28	Circulation starts
Week 4	Otic and optic placodes visible, forelimb then hindlimb buds visible
Week 5	Embryo is approximately 2mm long
Week 7	Hand and foot visible
Week 8	Digits appear
Week 9	All essential structures initiated, growth period begins
Week 12	First trimester ends

General timeline. *Source: Slimacademy*

Human gastrula

The embryo changes shape between days 15 and 19 to form a **cephalic** (head) and **caudal** (tail) end in an **elongated** structure compared to the previous disc-like structure.

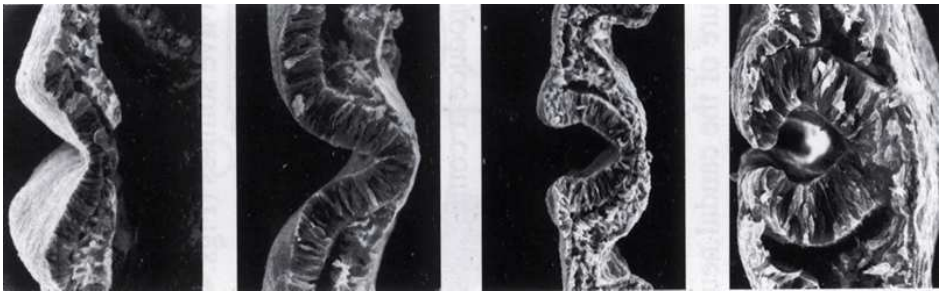


Embryo at Days 15-17. *Source: https://php.med.unsw.edu.au/embryology/index*

Embryo at Days 17-19. *Source: https://php.med.unsw.edu.au/embryology/index*

Nervous System
After gastrulation around 19-21 days post-fertilisation the nervous system starts to develop. Neural tissue forms from the **ectoderm** with the neural plate forming in the **cephalic region** and the **neural tube** forming along the dorsal region which will go on to form the spinal cord.

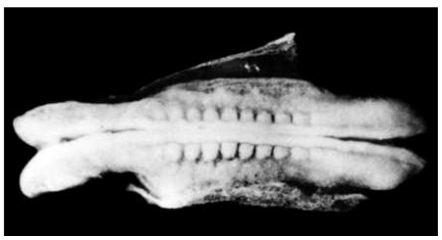
The neural plate rolls to form a tube and **neural crest cells** form at the boundary with the ectoderm at 23-26 days post-fertilisation. There are two openings in the tube called **neuropores** at the cephalic and caudal ends. These can fail to close and cause defects such as **anencephaly** and **spina bifida** respectively.



Formation of the neural tube. *Source: https://php.med.unsw.edu.au/embryology/index*

Neural crest cells migrate out of the dorsal neural tube and are incorporated in many tissues to form **neurones** and supporting cells in the **peripheral nervous system**.

Somite Development
Somites start to form around Day 19 alongside the neural tube and they develop successively from anterior to posterior. There are 44 pairs of somites in total and they go on to form muscle, vertebral and rib bones.



Somite development. Source: https://php.med.unsw.edu.au/embryology/index

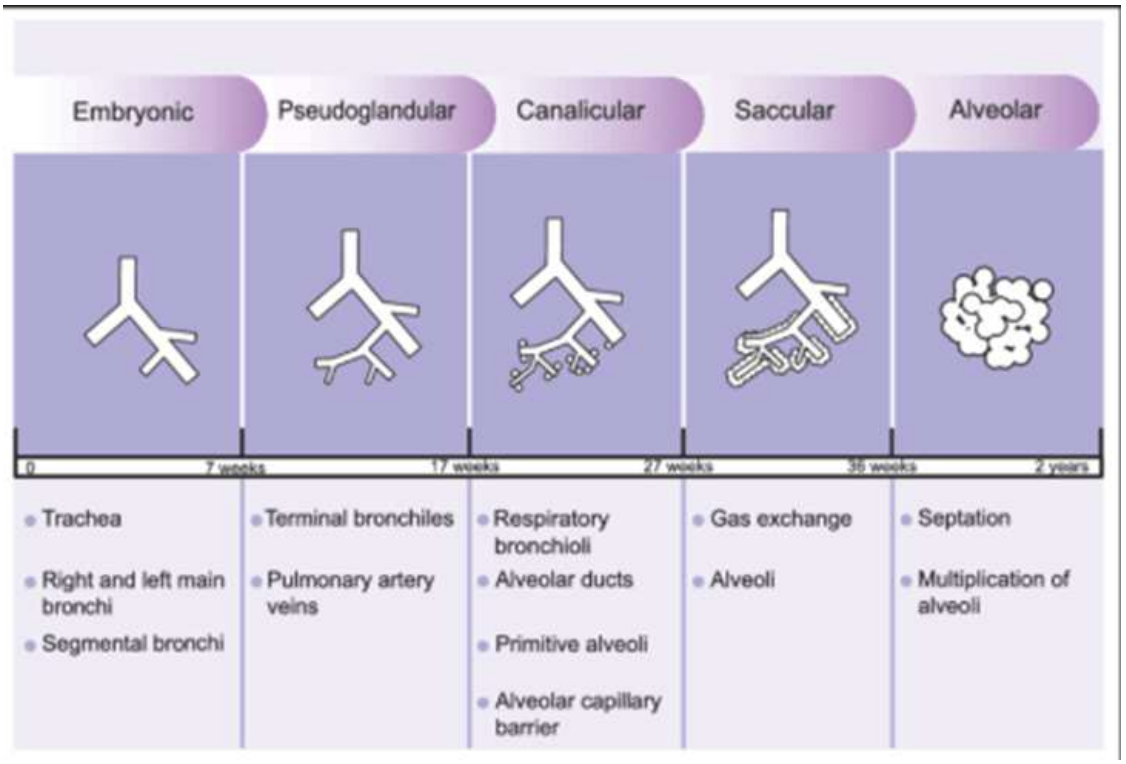
Ear and eye development
The ears and eyes develop from ectodermal thickenings on the surface of the embryo called placodes. The **otic placode** is visible from the 4th week and it disappears in the 5th week as the inner ear components form. The **optic placode** is visible from the end of the 4th week.

Limb development
Limb buds start to become visible from early in the 4th week with the **forelimb bud** being present before the **hindlimb bud**. The patterning of these buds is important for specifying the proximal, distal, dorsal and ventral axes in the development of the **digits**.

During weeks 7 and 8 the outgrowth of the buds progresses to form distinguishable hands and feet. There are condensations of cartilage which show precursors of digits and apoptosis occurs between the digits to separate them.

Heart development
The ventral surface of the heart is clearly visible from around day 22 and the development of the heart continues through to week 8. The heart is the first organ to function as the heartbeat begins at day 22 and circulation begins at day 27. The function of the heart is essential for the continued growth of the fetus for the required nutrients to reach developing cells.

Lung development
The lungs develop via a process called branching morphogenesis in five phases: embryonic, pseudoglandular, canalicular, saccular and alveolar. Different germ layers contribute to different parts. The endoderm and mesoderm supply most of the alveoli, the ectoderm contributes to the neural innervation and the mesoderm contributes to the musculoskeletal support.

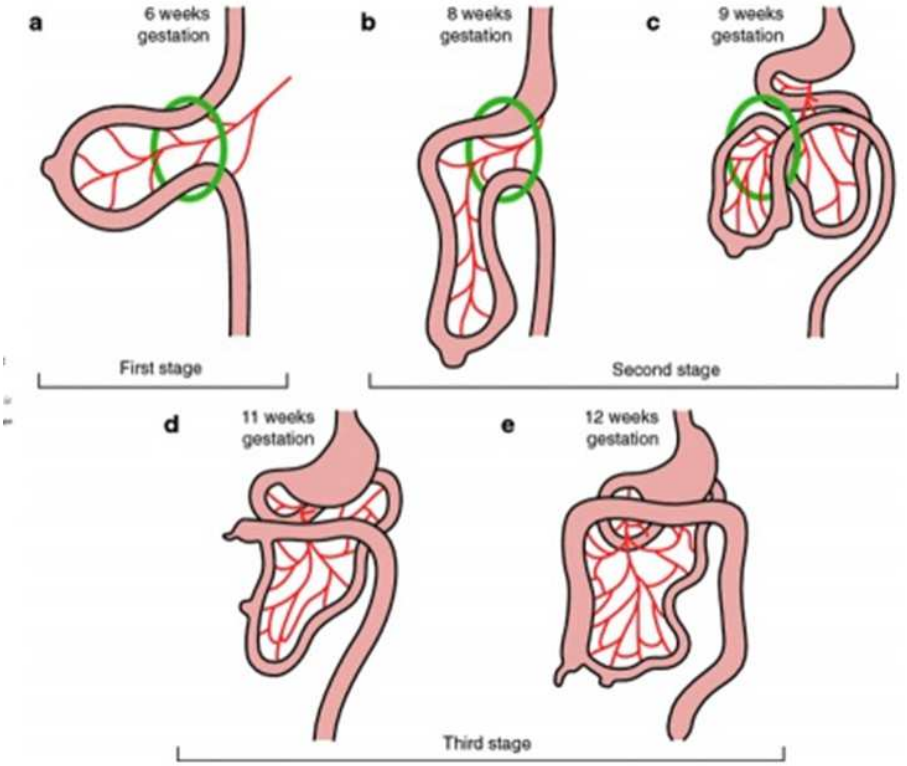


Stages of lung development. *Source: www.researchgate.net*

Kidney development
The kidneys also develop via branching morphogenesis in close association with the genitals from the **urogenital ridge**. There are three stages to the development: **pronephros** (day 18), **mesonephros** (day 24) and **metanephros** (day 35).

Gastrointestinal system development
The GI system originally arises from the **endoderm** in week 2 or 3. From week 4 onwards, different germ layers contribute to different parts: the **mesoderm** contributes to the mesentery, smooth muscle and blood vessels and the **ectoderm** contributes to the enteric nervous system.

There are three divisions which go on to form different structures. The **foregut** forms the oesophagus, oral cavity, trachea, stomach and pancreas. The **midgut** forms the small intestine and the ascending colon which is herniated during development. **Herniation** means the intestines develop outside the abdominal wall initially and then rotate to acquire the adult morphology. The **hindgut** then forms the remainder of the colon and rectum.



Development of the midgut. *Source:* www.researchgate.net

Slim Summary!

- During the first trimester (weeks 1–12), embryonic development advances rapidly. The process commences with the morula and blastocyst, progresses through gastrulation, and continues into organogenesis. By approximately week 9, the embryo has transitioned into a fetus, marking an important developmental milestone;
- Neural development begins as early as day 19, when the neural plate forms and subsequently folds into the neural tube. Timely closure of the neuropores is critical, as failure can result in congenital defects such as anencephaly or spina bifida. Alongside the neural tube, somites appear and will eventually differentiate into muscles, vertebrae, and ribs, establishing much of the musculoskeletal framework;
- Sensory organ development initiates early. The otic and optic placodes, which give rise to the ears and eyes, are evident by week 4. Limb buds also emerge during this period, and through processes such as apoptosis, digits are separated by week 8;
- The heart stands out as the first functional organ, beginning to beat around day 22. By day 27, it establishes circulation, ensuring the efficient delivery of nutrients necessary for ongoing embryonic growth.

Chapter 7 - Anatomy of the female reproductive system

The gross and microscopic anatomy of the female reproductive system will be covered in our separate anatomy booklet.

Slim Summary!

- The female reproductive system includes the ovaries, fallopian tubes, uterus, vagina, and external genitalia;
- Microscopically, the ovaries contain follicles at various stages of development, the uterus has three layers (endometrium, myometrium, perimetrium);
- The fallopian tubes are lined with ciliated epithelium that helps move the ovum toward the uterus.

Chapter 8 - Pregnancy in the physiology of the mother

Introduction
This chapter discusses the changes in the physiology of the mother during pregnancy.

Systems
Several physiological changes to different organ systems and tissues occur in the expectant mother due to the higher rate of metabolism. In the cardiovascular system, plasma volume, cardiac output, stroke volume and heart rate all increase whilst serum albumin concentration and serum colloid osmotic pressure decrease. There is also an increase in coagulation factors and fibrinogen in the blood. The uterus compresses the inferior vena cava. Renal blood flow increases in the kidneys and glomerular filtration rate increases progressively with a 50-60% overall increase at full-term. There are also changes in oxidative enzymes in the liver such as cytochrome P450. Tidal volume and minute ventilation increase in the lungs.

The pregnant person experiences nausea and vomiting as well as gastrointestinal reflux due to prolonged small bowel transit time and delayed gastric emptying. The gut microbiome changes and influences the developing microbiome of the fetus.

Maternal metabolic adaptation
A placenta specific hormone called **placental lactogen** is released which causes insulin resistance and reduces maternal glucose **uptake** so that more glucose can be absorbed by the fetus for growth. This may lead to a condition called **gestational diabetes** where there is excessive mobilisation of glucose and natural insulin resistance. Having gestational diabetes increases the lifetime risk of type 2 diabetes by 8-10 times.

Immunological transfer
Trophoblast-derived signals create a pro-inflammatory environment in early pregnancy. These signals cause maternal immune cell recruitment and most antibodies cannot cross the placenta. However, **IgG antibodies** are able to cross via the IgG receptors on syncytiotrophoblast cells. These maternal IgG antibodies can last up to 12 weeks of age. The fetus is protected from immune attack from the mother by the display of HLA-G proteins on trophoblast cells.

Whilst some immune responses in the mother are enhanced, there is suppression of other parts of the immune system to protect the fetus from immune attack, so this causes the pregnant person to be more susceptible to infection by pathogens.

Slim Summary!

- Systemic changes in pregnancy: increase in plasma volume, cardiac output, renal blood flow, and ventilation, while serum albumin levels drop and gastric motility slows down;
- Placental lactogen induces insulin resistance. This shift ensures the fetus gets a steady supply of glucose. Risks - some women may develop gestational diabetes which can increase their risk for type 2 diabetes later on;
- To tolerate the fetus, the maternal body allows IgG antibodies to cross the placenta, offering some protection. HLA-G expression helps prevent immune rejection of the fetus. Immune modulation increases risk of infection for the mother.

Chapter 9 - Hormone based contraception

Introduction
This chapter compares different methods of hormone-based contraception, in terms of efficacy, mechanisms and side-effects.

Combined Oral Contraceptive Pill (COCP)
The combined oral contraceptive pill contains both estrogen and progesterone. Its main function is to **prevent ovulation**. Estrogen acts by suppressing the secretion of follicle-stimulating hormone (FSH), which stops the development of a dominant follicle. Progesterone further suppresses luteinizing hormone (LH) surges and causes the cervical mucus to thicken, making it more difficult for sperm to penetrate. The endometrial lining also becomes less receptive to implantation. When taken as directed, COCPs are highly effective, with perfect-use failure rates below 1% and typical-use failure rates around 9%. Common side effects include nausea, breast tenderness, headaches, an increased risk of thromboembolic events, and possible mood changes. Daily adherence is required for effectiveness.

Progesterone-Only Pill (POP or Minipill)
The progesterone-only pill works primarily by **thickening the cervical mucus,** which prevents sperm from reaching the egg, and by altering the endometrium to reduce the likelihood of implantation. It can also inhibit ovulation by **suppressing gonadotropin-releasing hormone** (GnRH), which reduces LH and FSH secretion and prevents follicular development. The minipill is slightly less effective than the combined pill, with typical-use failure rates around 9% and perfect-use rates of about 0.3–0.5%. It is often recommended for women who cannot take estrogen, such as those who are breastfeeding or have a history of thromboembolism. Side effects can include irregular menstrual bleeding, spotting, headaches, and breast tenderness.

Emergency Contraception: Mifepristone
Mifepristone is a progesterone receptor antagonist used for **emergency contraception** or early termination of pregnancy. By blocking progesterone receptors, it prevents the **maintenance of the endometrial lining**, which makes implantation of a fertilized egg impossible. It can also induce uterine contractions and soften the cervix. Mifepristone is most effective when taken as soon as possible after unprotected intercourse, typically within 72 hours. Side effects may include nausea, vomiting, heavy bleeding, abdominal pain, and cramping. It is not intended for routine contraception but is an option following contraceptive failure or unprotected sex.

Slim Summary!

- COCP: Estrogen and progesterone suppress ovulation and alter cervical mucus and endometrium - highly effective but may cause nausea and thromboembolic risk;
- POP: Thickens cervical mucus and may inhibit ovulation - suitable for those avoiding estrogen, with possible irregular bleeding;
- Mifepristone: Blocks progesterone to prevent implantation - used within 72 hours as emergency contraception.

Chapter 10 - Labor

Introduction
This chapter covers the physiological events that initiate labour.

Uterine distension
Uterine distension is a significant contributor. As the fetus grows, the expanding uterus activates stretch receptors in the myometrial wall. These receptors signal both the maternal central nervous system and local uterine tissue, promoting the release of mediators that prime the myometrium for effective contractions. Concurrently, the cervix undergoes remodeling: it softens, becomes more distensible, and begins to efface. Rising levels of prostaglandins and estrogen drive this process by altering the cervical extracellular matrix and facilitating tissue relaxation in preparation for dilation.

Hormonal regulation is central throughout labor's initiation and progression. Progesterone maintains **uterine quiescence** during most of pregnancy by diminishing myometrial excitability and suppressing premature contractions. Near term, there is either a reduction in progesterone's functional influence or a blockade of its action, sometimes via increased enzymatic inactivation. This change permits the myometrium to respond more robustly to **contractile stimuli**. In contrast, estrogen concentrations gradually increase as term approaches, enhancing uterine readiness. Estrogen upregulates oxytocin receptor expression in the myometrium and stimulates prostaglandin synthesis, thereby facilitating cervical softening, uterine contractility, and coordinated contractions.

Oxytocin, released from the posterior pituitary, is a primary driver of uterine contractions during labor. Its secretion follows a **positive feedback mechanism**: cervical stretching during contractions stimulates further oxytocin release via the hypothalamus, which then enhances **myometrial contractility and intensifies cervical dilation** until delivery is achieved.

Prostaglandins, especially **prostaglandin E2**, work synergistically with oxytocin and estrogen. Produced by the uterus in response to estrogen, prostaglandins induce **cervical ripening** by breaking down collagen and modifying the extracellular matrix. Additionally, they increase myometrial sensitivity to oxytocin and mediate vascular and inflammatory changes required for labor progression.

Relaxin, which is secreted by both the corpus luteum and placenta, facilitates labor by increasing the laxity of the pelvic ligaments and pubic symphysis, thus permitting the pelvis to accommodate the fetus. It also contributes to cervical ripening, complementing prostaglandin effects during the preparatory phase.

Corticotropin-releasing hormone (CRH), synthesized by the placenta, helps regulate the timing of labor. As gestation advances, CRH levels rise, stimulating **cortisol production** in both mother and fetus, which in turn augments estrogen synthesis and enhances uterine contractility. CRH also modulates prostaglandin and oxytocin activity, supporting the orchestration of **effective myometrial contractions**.

The fetus plays an active role through its hypothalamic-pituitary-adrenal axis. Fetal cortisol not only promotes organ maturation but also influences placental hormone metabolism, driving increased estrogen production and enhancing uterine responsiveness to contractile signals.

Together, cortisol and CRH establish a signaling cascade that ensures labor commences only when the fetus is developmentally prepared for **extrauterine life**.

Cervical ripening is thus a critical preparatory process for labor, induced by a combination of hormonal and biochemical alterations. Prostaglandins are particularly significant, as they remodel the cervical connective tissue and facilitate the structural changes necessary for dilation and delivery.

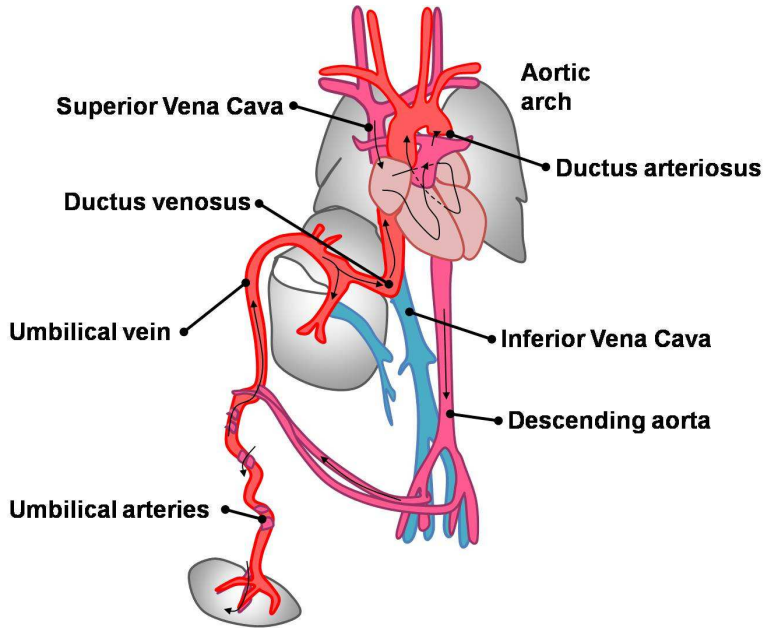
Slim Summary!

- Mechanical and hormonal triggers: Uterine stretch activates myometrial and cervical remodeling via prostaglandins and estrogen, preparing for contractions and dilation;
- Hormonal shifts: Decline in progesterone activity and rise in estrogen, oxytocin, and prostaglandins increase uterine contractility and cervical ripening;
- Fetal and placental role: Placental CRH and fetal cortisol enhance estrogen production and coordinate the onset and timing of labor.

Chapter 11 - Fetal circulation

Introduction

This chapter explains the fetal circulation and three adaptations it makes at birth: the closure of the foramen ovale, the ductus arteriosus and the ductus venosus.



Adaptations of Fetal Circulation. *Source: https://embryology.med.unsw.edu.au/*

Changes

At birth, the fetal circulatory system undergoes several critical adaptations to transition from placental to pulmonary respiration.

Foramen ovale

First, the foramen ovale, a passage between the right and left atria, permits blood to bypass the non-functioning fetal lungs. Upon the initiation of breathing, the newborn's lungs expand, decreasing pulmonary vascular resistance. This change increases left atrial pressure, which forces the flap of the foramen ovale to close, preventing further shunting of blood between the atria. Over time, this closure becomes permanent, forming the fossa ovalis.

Ductus arteriosus

Next, the ductus arteriosus connects the pulmonary artery to the aorta, allowing blood to avoid the pulmonary circulation in utero. Once the newborn begins breathing and blood oxygen levels rise, along with the withdrawal of placental prostaglandins, the ductus arteriosus constricts. Functional closure usually occurs within the first 12–24 hours, and anatomical closure follows over the subsequent weeks, resulting in the ligamentum arteriosum.

Ductus venosus

Finally, the ductus venosus provides a route for oxygenated blood from the umbilical vein to bypass the liver and enter the inferior vena cava. After birth, clamping of the umbilical cord ends placental blood flow, leading to the closure of the ductus venosus within a few days. It eventually becomes the ligamentum venosum.

A critical factor in these transitions is the onset of effective lung function. Surfactant, produced by type II alveolar cells and increasing substantially after 28 weeks' gestation, reduces alveolar surface tension. This facilitates lung expansion and efficient gas exchange, contributing to the rise in blood oxygen tension that drives the closure of the foramen ovale and ductus arteriosus.

Slim Summary!

- Foramen ovale closure: Expansion of the newborn's lungs reduces pulmonary resistance, increasing left atrial pressure and closing the foramen ovale, which later forms the fossa ovalis;
- Ductus arteriosus closure: Rising oxygen levels and decreased placental prostaglandins trigger constriction of the ductus arteriosus, forming the ligamentum arteriosum;
- Ductus venosus closure: Clamping of the umbilical cord halts placental blood flow, leading to closure of the ductus venosus within days, eventually becoming the ligamentum venosum.

Chapter 12 - Fetal lungs

Introduction
This chapter describes the changes to the fetal lungs at birth, as well as the role of surfactant in maintaining pressure in the lungs.

Fetal lungs
In a preterm fetus, the lungs are not actively being used so they are stiff and hard to inflate as they lack the substance **surfactant**. Surfactant is a substance produced by **type II alveolar cells** which reduces alveolar surface tension and allows the lungs to be inflated after birth.

As a fetus, the lungs are bypassed and the placenta is used for gas exchange. At birth **placental oxygenation** ceases and there is increased ventilation and perfusion of the lungs. The secretion of fluid which builds up in the lungs also ceases and the release of **adrenaline** causes the resorption of this fluid so that there is more volume available for air to be inspired.

Over time, pressure in the right atrium decreases and the foramen ovale closes as a result. The ductus arteriosus also closes as PaO_2 increases.

Slim Summary!

- Fetal lungs are initially stiff and non-functional due to the absence of surfactant, which is produced by type II alveolar cells;
- At birth, placental oxygenation stops, lung ventilation and perfusion increase, fluid secretion ceases, and adrenaline promotes fluid resorption to allow air entry;
- Circulatory changes follow: right atrial pressure decreases, closing the foramen ovale, and increased oxygen tension triggers ductus arteriosus closure.

Chapter 13 - Healthcare in the United Kingdom

Introduction
This chapter describes healthcare practices in the UK for normal pregnancy and birth.

Healthcare providers
UK pregnancy healthcare is directed by three groups of professionals: midwives (community/hospital), GPs (community) and obstetricians (hospital). Many people will book midwives who carry out most of the care duties during pregnancy. All pregnant people have at least two scan visits.

Visits
There are four phases of care:

- First trimester (0-12 weeks) – This is when **booking** happens which involves creating a risk assessment, dating of different milestones in the pregnancy and initial screening to check development. Investigations include testing for urine infections, HIV, hepatitis B, syphilis and red cell antibodies. An ultrasound is performed around the 10-12th week which is both transabdominal and transvaginal to check location, visibility and the number of fetuses;
- Second trimester (12-25 weeks) – A **fetal anomaly assessment** and ultrasound scan is performed at 20 weeks as the fetus should be fully formed with no further organogenesis. The scan can screen for syndromes such as Down's syndrome and other structural abnormalities;
- Third trimester (25-40 weeks) – This mainly involves monitoring with a **fetal growth assessment** and considering obstetric complications. Blood pressure and urine are measured to check for pre-eclampsia;
- Puerperium (delivery – 6 weeks after) – Breast feeding, recovery and neonatal care are monitored. The hand over to a health advisor begins after 4 weeks.

In someone's first pregnancy, there are ten visits and an anomaly scan at 20 weeks. From the second pregnancy onwards there are seven visits and still an anomaly scan at 20 weeks.

Week	Specifics
10	Booking and ultrasound
16	
20	Ultrasound
25*	
28	
31*	
34	
36	
38	
40*	
41	

Timing of visits/scans. *Source: SlimAcademy.* *Only for first-time pregnancy.

Terminology

- **Dating** – Pregnancy is clinically dated from the first day of the last menstrual period whereas embryologically it is dated by the number of days post-fertilisation. For ultrasounds the Crown-Rump length is used to indicate the time through the pregnancy;
- **EDD** – **Expected date of delivery**: This is usually calculated to be 40 weeks from the first day of the last menstrual period;
- **Embryo** – term used to describe the developing baby from conception to the end of the 9th week;
- **Fetus** – term used to describe the developing baby after the 9th week, but this term may end up being used throughout the whole pregnancy.

Slim Summary!

- UK pregnancy care is led by midwives, GPs, and obstetricians, with routine scans and check-ups;
- Four phases—first trimester (booking, 10–12 week scan), second (20-week anomaly scan), third (growth monitoring), puerperium (postpartum care);
- Pregnancy dated from last menstrual period; embryo until week 9, then fetus; EDD is 40 weeks.

Chapter 14 - Support

Introduction
This chapter discusses the different types of social support and it offers insight on the effects of these on health and wellbeing.

Support
Social support is essentially the network of assistance, care, and encouragement that people receive from those around them, family, friends, colleagues, and broader community ties. Social support actually occurs in several distinct forms.

Emotional support, for instance, takes the shape of empathy, reassurance, and attentive listening. This type of support is crucial for psychological well-being, as it fosters a sense of belonging and helps mitigate anxiety and depression. Individuals with strong emotional backing generally report higher self-esteem and are better equipped to cope with life's challenges.

Practical/ Instrumental support refers to tangible help, think financial assistance, help with transportation, or support with daily tasks during illness or recovery. Such hands-on aid eases the burden of everyday challenges, allowing individuals to focus on recovery or personal goals. Research consistently links practical support to faster recovery from illness and improved quality of life.

Informational support includes providing advice, guidance, or relevant knowledge to help with decision-making and problem-solving. Whether it's through health education, sharing personal experiences, or offering professional insight, this kind of support enhances health literacy and self-efficacy, both of which are associated with better overall health.

Appraisal or esteem support involves feedback that helps individuals evaluate themselves and their situations more accurately. This may include affirming someone's strengths or validating their feelings. Such support encourages adaptive coping strategies and boosts confidence, which in turn reduces vulnerability to stress-related issues.

Effects
Social support has wide-ranging effects on both mental and physical well-being. It acts as a buffer against stress, dampening the negative physiological impact of stress hormones on the body's systems. Strong social networks are linked to lower rates of depression, anxiety, and substance misuse, as well as improved recovery from medical conditions. Furthermore, social support often encourages healthier behaviors, such as regular exercise, adherence to medical guidance, and better nutrition. Conversely, social isolation and a lack of support correlate with higher risk of chronic disease, poorer psychological health, and increased morbidity and mortality.

Slim Summary!

- Types of social support: Includes emotional (empathy, reassurance), practical/instrumental (tangible help), informational (advice, guidance), and appraisal/esteem (feedback, validation);
- Benefits: Enhances psychological well-being, coping, self-esteem, recovery from illness, health literacy, and confidence.

Chapter 15 - Healthcare systems and cultural values

Introduction
This chapter shows how cultural values within healthcare systems affect the experience of people with pregnancy and childbirth.

Experiences in context
Pregnancy and childbirth experiences are deeply shaped by both healthcare systems and cultural contexts. Access to comprehensive antenatal care, qualified healthcare professionals, and reliable emergency services is strongly linked to positive outcomes for mothers and infants, lowering the risks of complications. In contrast, healthcare systems lacking resources often contribute to higher stress levels, increased risks, and generally poorer experiences for expectant mothers.

Cultural values play a significant role in these processes. Some communities maintain a preference for home births attended by traditional midwives, while others rely on institutional, hospital-based deliveries. Approaches to pain management, dietary practices, the choice of birth location, and the involvement of family members during childbirth are all subject to cultural interpretation.

Importantly, healthcare that is sensitive to these cultural differences, while still grounded in scientific evidence, has been shown to improve maternal satisfaction, adherence to medical guidance, and overall health outcomes. When healthcare providers disregard cultural norms and beliefs, it often results in mistrust, decreased engagement with services, and less favorable experiences. In short, culturally attuned, evidence-based care is essential for optimal maternal and neonatal health.

Slim Summary!

- Access to skilled care, antenatal services, and emergency support improves maternal and infant outcomes, while resource-poor systems increase stress and complications;
- Beliefs and practices shape preferences for birth setting, pain management, diet, and family involvement during childbirth;
- Integrating cultural values with evidence-based practices enhances maternal satisfaction, adherence, and health outcomes.

Chapter 16 - Evidence Based Medicine

Introduction
This chapter evaluates fundamentals of Evidence Based Medicine, EBM, in terms of clinical judgment, scientific evidence and patient autonomy in values and preferences.

Evidence Based Medicine
There is a **conscientious, explicit** and **judicious** use of current best evidence in making decisions about the care of individual patients. Evidence based medicine is the practise of medicine, fully applying scientific knowledge and committing to research based treatment. However, whilst practising medicine with scientific knowledge in mind, caregivers should collaborate with the patient.

Shared decision making is key in care during pregnancy and each individual patient's values and preferences are taken into account alongside the healthcare professionals' clinical judgement and scientific evidence. Patients have autonomy over their body, meaning that caregivers need to respect their patients wishes.

Slim Summary!

- Involves using the best current scientific evidence to guide clinical decisions for individual patients.

Chapter 17 - Clinical approach: Preventing neonatal death in pre-term delivery

Introduction
This chapter applies evidence for clinical approaches in the prevention of neonatal death in pre-term delivery.

Evidence based clinical approach
In pre-term delivery, several methods are used based on scientific evidence to reduce mortality. There is a clear structure for monitoring pregnancy in the UK with screening and ultrasounds so that abnormalities can be identified early.

There is easy access to a caesarean section in the UK and once the fetus is born healthcare professionals are prepared to perform neonatal resuscitation and provide respiratory and feeding support. Steroids and surfactant are usually administered to premature babies to help the lungs inflate as they can be very stiff.

Neonatal resuscitation – If the newborn is not breathing then they are wrapped and stimulated with inflation breaths. If there is no heart rate or it is less than 60bpm after 30 seconds then chest compressions and inflation breaths are performed in a 3:1 ratio.

Slim Summary!

- Monitoring and intervention: UK prenatal care uses screening, ultrasounds, and easy access to cesarean delivery to identify and manage risks in preterm births;
- Neonatal support: Premature infants receive steroids and surfactant to aid lung function, alongside respiratory and feeding support;
- Resuscitation protocol: If a newborn is not breathing, inflation breaths are given; if heart rate <60 bpm after 30 seconds, chest compressions with a 3:1 ratio are performed.

Afterword

Phew, you did it! You've finished reading your summary. 🎉
Want to boost your confidence for the exam? Don't worry — we've got you covered! With one of our convenient subscriptions, you'll always receive your summaries at a discount and get them before anyone else. Also, we offer tons of practise questions and flashcards to ultimately prepare for your exams. Curious? Check out our website!

Get in Touch with Slim Academy
Want to stay up to date with the latest developments at Slim Academy? Get in touch with us through:
🌐 www.slimacademy.nl
📧 s.dejong@slimacademy.nl
📱 @slimAcademy.nl
📞 010 214 32 45

We wish you lots of success with your studies and your exams!

Team Slim Academy