

# **The Reproductive System**

## **Foetal Development and Childbirth**

# The Reproductive System

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The ability to reproduce is fundamental to the continuing existence of all living beings.

The human species uses a process of sexual reproduction, relying on male fertilisation of a female egg.

This male / female fertilisation process combines the genetic information from both the father and mother, forming a unique 'genetic signature' and identity for the child.

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## Female Reproductive System

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The main purposes of the *female reproductive system* are the production of the eggs, or ova, and the protection of a fertilised ovum during its development into a baby.

[Figure 12 - 1]

In addition, the breasts provide milk for feeding the young infant during the early months of its life.

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## Uterus

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The *uterus* is a hollow muscular organ in which a foetus develops after fertilisation.

There are three main parts of the uterus:

**Body.** This is the main part.

**Fundus.** This is the area above the Fallopian tubes.

**Cervix.** This is the opening into the uterus from the vagina.

The uterus is composed from three layers of tissue:

**Perimetrium.** (outer layer) This is formed by folds of peritoneum, enclosing the uterus, except at the sides, where the Fallopian tubes enter.

**Myometrium.** (middle layer) This is formed from smooth muscle fibres and areolar tissue, together with blood vessels.

**Endometrium.** (inner layer) This is formed from columnar epithelium, containing many mucus secreting glands.

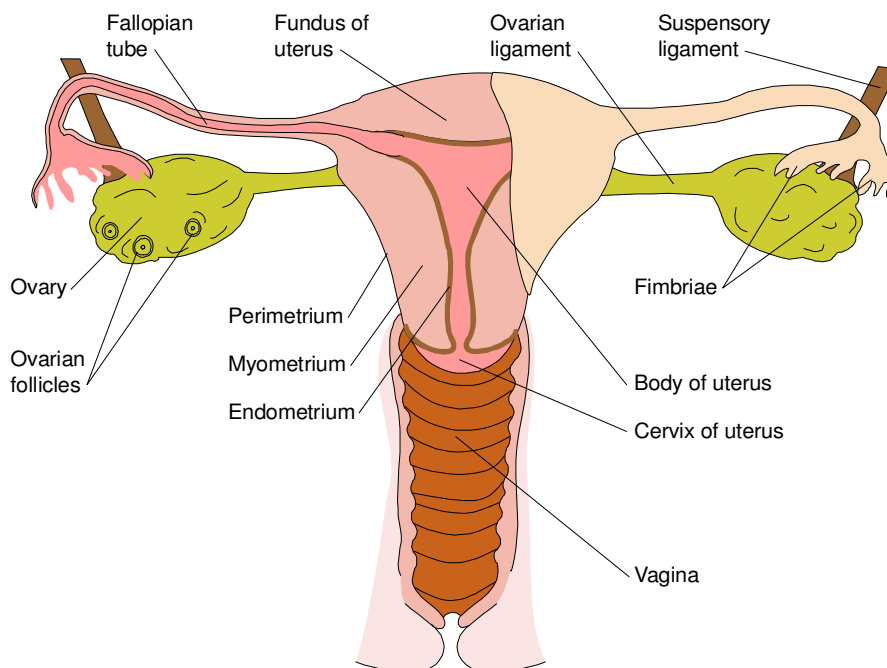
The uterus is supported in position, mainly by a system of ligaments, but with additional support from adjacent organs.

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**Figure 12 - 1** the female reproductive system

The main organs of the female reproductive system

The right side is shown in partial frontal section



## Vagina

The *vagina* is a tube, approximately 80mm long, which forms the external entry to the uterus.

It is composed of stratified epithelium, supported by a layer of smooth muscle, with an outer layer of areolar tissue.

The vagina does not contain secretory cells, but is kept moist by secretions from the uterus.

## Fallopian Tubes

The *Fallopian tubes* (also known as *uterine tubes*) provide pathways for the transport of ova from the ovaries to the uterus.

Being continuous with the uterus at their medial ends, they are composed from the same tissue layers, although the inner lining is ciliated.

The lateral ends of the tubes divide into a number of projections, or *fimbriae*.

The fimbriae 'reach out' towards the ovaries in order to catch ova as they are released during ovulation.

## Ovaries

The *ovaries* are the female reproductive glands.

Each ovary has a central medulla, composed of fibrous tissue, around which is a cortex made up from a framework of connective tissue containing ovarian follicles.

Each *ovarian follicle* contains one ovum.

## Ovulation

In response to hormonal stimulation from the pituitary gland, approximately every 28 days, one ovarian follicle matures and ruptures.

This releases the ovum into the peritoneal cavity, where it is 'caught' by one of the fimbriae of the nearby Fallopian tube.

The cilia in the Fallopian tube, together with peristalsis, propel the ovum towards the uterus.

Prior to ovulation, the maturing follicle cells produce the hormone *oestrogen*. This causes a thickening of the endometrium in preparation for a fertilised ovum.

After ovulation, the follicle lining cells develop into the *corpus luteum* through the action of luteinising hormone. They then secrete the hormone progesterone. This causes an increase in mucus secretion within the endometrium, in order to assist the movement of spermatozoa towards the ovum.

## Menstruation

When the ovum is not fertilised, progesterone secretions from the corpus luteum cease, through their own action in inhibiting the production of luteinising hormone.

About 14 days after ovulation, the internal lining of the uterus begins to break up, and is discharged, together with some blood and other secretions, via the vagina.

## External Female Sex Organs

The *external female sex organs* and tissue formations (known collectively as the *vulva*) [Figure 12 - 2] are found in the area around the opening to the vagina:

**Labia majora.** These are two folds of tissue forming the borders of the vulva.

They are composed of skin, fibrous tissue, and adipose tissue.

They contain a large number of sebaceous glands.

**Labia minora.** These are two smaller folds of tissue, similar in nature to the labia majora.

The area between the labia minora is known as the *vestibule*, into which the vagina and urethra open.

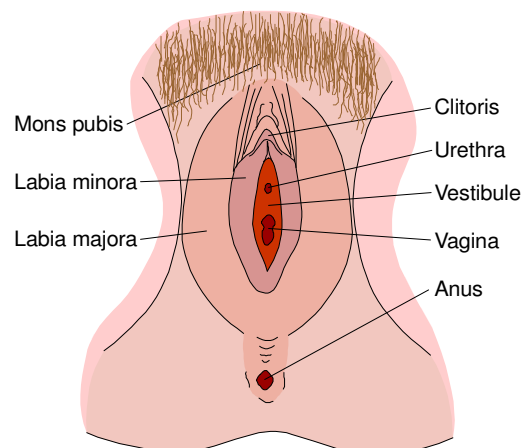
**Clitoris.** This corresponds to the male penis, and is an erectile organ. However, it has no reproductive function.

**Greater vestibular glands.** These secrete mucus, to moisten the vulva, through ducts near the opening of the vagina.

The area immediately anterior to the vulva, covering the symphysis pubis, is known as the *mons pubis*.

**Figure 12 - 2** external female sex organs

The arrangement of the external female sex organs



## Breasts

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The *breasts*, or *mammary glands*, [Figure 12 - 3] are considered as part of the female reproductive system as their purpose is to produce and secrete milk for the early feeding of an infant.

Each breast contains 15 to 20 clusters, or lobes, of glandular tissue. When stimulated by the hormone prolactin after childbirth, these lobes produce milk, which passes into *lactiferous ducts*. The milk is then stored in *lactiferous sinuses*, which link the ducts to the nipple.

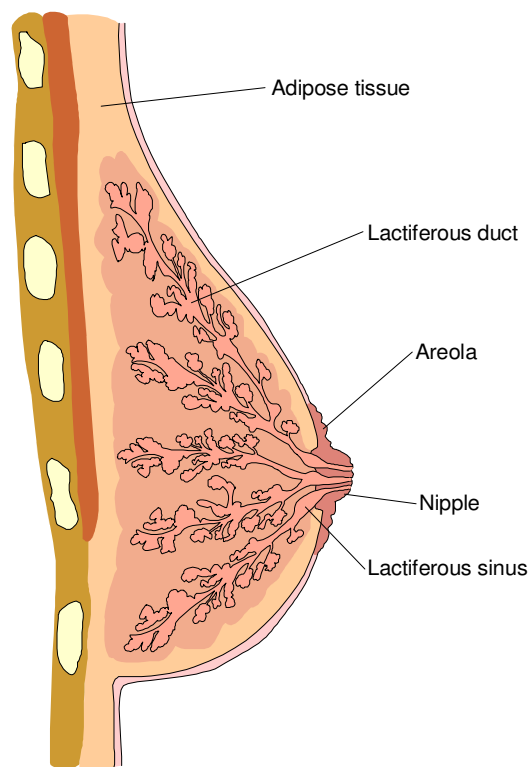
The milk is released via the nipple in response to a baby's sucking, through the action of the hormone oxytocin.

The remaining volume (and usually the majority) of the breasts is composed of adipose and fibrous tissue.

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**Figure 12 - 3** a breast

A simplified sagittal section through a breast



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## Male Reproductive System

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The purposes of the *male reproductive system* [Figure 12 - 4] are the production of spermatozoa, and the implantation of these into the female - towards fertilisation of an ovum.

### Testes

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The *testes* are the male reproductive glands. Within each testis are over 800 coiled *seminiferous tubules*, which produce several thousand spermatozoa each second. Between the tubules, groups of other cells secrete the hormone testosterone.

The ends of the tubules combine to form a single complex tubule, named the *epididymis*, which forms the exit duct from a testis.

The testes are contained in the *scrotum*, a pouch of skin, connective tissue, and smooth muscle. Each testis is supported by a *spermatic cord* of fibrous tissue, along which run blood and lymph vessels, nerves, and the *deferent duct (vas deferens)* which carries the spermatozoa from the epididymis.

The scrotum supports the testes external to the main parts of the body, maintaining a temperature of approximately 34°C, which is required for successful production of spermatozoa.

### Seminal Vesicles

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The *seminal vesicles* are two pouches of fibrous muscular tissue, lined with columnar epithelium, lying behind the bladder. They join the deferent ducts, forming ejaculatory ducts.

The seminal vesicles secrete a viscous fluid which provides an energy source for spermatozoa.

### Ejaculatory Ducts

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The *ejaculatory ducts* connect the separate deferent ducts and the seminal vesicles together, and link through the prostate gland into the urethra.

### Prostate Gland

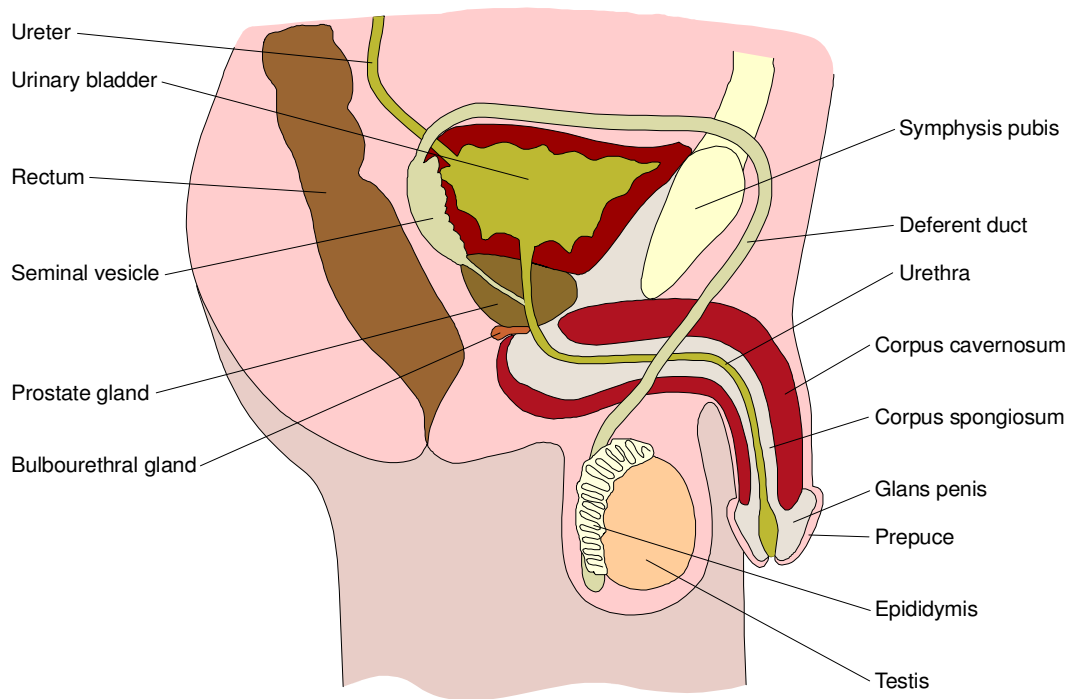
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The *prostate gland* surrounds the urethra immediately below the bladder. It has an outer layer of fibrous tissue and smooth muscle, and a central core of glandular material.

It secretes a thin lubricating fluid via numerous ducts into the urethra.

**Figure 12 - 4** the male reproductive system

A sagittal section through the male reproductive organs



### Urethra

The *urethra* in the male serves the dual purpose of carrying urine, and semen.

The urethra originates at the bladder, passes through the prostate gland (where it is joined by the ejaculatory ducts), and along the length of the penis, to end at the external urethral orifice.

The flow of fluid along the urethra is controlled by two sphincters, as described for the urinary system.

### Penis

The *penis* is formed from three columns of erectile tissue and smooth muscle, supported by fibrous tissue.

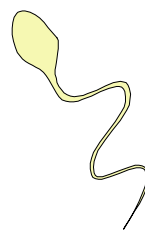
The urethra runs through the central *corpus spongiosum*, with lateral columns, the *corpora cavernosa*, on either side.

The corpus spongiosum expands into the tip of the penis, or *glans penis*, which is normally covered by the *prepuce* or *foreskin*. (The prepuce is often surgically removed on health or religious grounds).

The penis has a relatively large blood supply. In response to parasympathetic nervous stimulation, this increases, causing erection.

### Semen

*Semen* is the fluid passed out of the urethra (into the female vagina) during ejaculation. It consists of: an energy giving fluid from the seminal vesicles, a lubricating fluid from the prostate gland, mucus, and spermatozoa.



*Spermatozoa* resemble minuscule tadpoles in form, having an elongated round 'head', and a 'tail' with which they are able to propel themselves. They are amongst the smallest of structures in the body, being around 0.05mm in total length.

1ml of semen contains approximately 100 million spermatozoa.

### *Dysmenorrhoea*

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*Dysmenorrhoea* is a general term referring to pain and cramps in the lower abdominal and pelvic regions during menstruation.

It has a variety of causes, including: stress, endometriosis, infection, excessive sexual activity, fibroids, ovarian cysts, and straightforward use of inter-uterine contraceptive devices and tampons.

### *Endometriosis*

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*Endometriosis* is the growth of endometrium-like tissue in areas of the body external to the uterus. This usually occurs in the pelvic region, but may occur elsewhere in the body.

These areas of tissue then react as inter-uterine tissue, following the standard monthly cycle. This leads to pain - often intense - during menstruation.

### *Fibroids*

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*Fibroids* are non-malignant growths of connective tissue and muscle fibre in the uterus - usually within the myometrium.

The cause of fibroids is not known, although use of oral contraceptives may be a contributory factor.

If the fibroids remain small in size, they tend to be asymptomatic, but if they continue to grow, they may cause pain and discomfort, excessive menstrual bleeding, and urinary frequency.

### *Mastitis*

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*Mastitis* is an inflammation of breast tissue, usually as a result of infection by staphylococcus aureus bacteria.

These bacteria live on the skin, and the infection usually enters through breaks or cracks in the skin at the point of the nipple. The infection then causes oedema around the lactiferous ducts with associated pain, swelling, and tenderness.

The affected breast may enlarge and there may be a 'lump'. The infection may spread to include nearby lymph nodes.

### *Ovarian Cyst*

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An *ovarian cyst* is a sac of fluid, which develops - either singly, or in multiples, in an ovary.

Generally ovarian cysts are benign, although they may grow to such a size as to cause swelling in the abdomen and pressure onto adjacent organs.

If the cyst rotates on its supporting stalk, it may cut off its own blood supply, with resulting abdominal pain and vomiting.

### *Prostate Problems*

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#### *Prostatitis*

*Prostatitis* is a bacterial inflammation of the prostate gland. It may follow other infections, or be brought on by conditions such as stress. It leads to symptoms of discomfort in the lower abdominal regions and urinary system.

#### *Enlarged prostate*

*Enlargement of the prostate* is very common in males above the age of 40, although the cause is mainly unknown. In 50% of cases, no symptoms result and the condition is benign. In other cases pressure on the urethra leads to difficulty in urinating, urinary frequency, and incomplete bladder emptying. This, in turn, may cause distension of the bladder. In an extreme case, urination becomes impossible - the very painful condition of *urinary retention*.

### *Sexually Transmitted Diseases*

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The term *sexually transmitted disease* refers to an infection where the common mechanism for transmission is by sexual contact.

#### *Chlamydia*

The name *chlamydia* strictly refers to a series of bacteria. However, the term is commonly associated with a sexually transmitted infection by chlamydia trachomatis bacteria.

This infection is often asymptomatic, but may lead to non-specific urethritis in males, and to pelvis inflammatory disease in females. This affects the Fallopian tubes and ovaries, causing lower abdominal pain. If not treated, it may lead to infertility, or become a factor in ectopic pregnancy.

#### *Genital herpes*

*Genital herpes* is a sexually transmitted infection by the herpes simplex virus. It causes small blisters on the penis or around the vagina. If not treated, these then develop into painful ulcers.

## **Gonorrhoea**

Gonorrhoea is a sexually transmitted infection by *Neisseria gonorrhoea* bacteria.

The infection may produce no symptoms, or it may settle in the throat, producing the condition *gonococcal pharyngitis*.

Alternatively, the infection may infect the reproductive organs, producing pelvic inflammatory disease in females, infection of the epididymis or prostatitis in males. A common symptom is a discharge of pus from the urethra together with urinary pain and discomfort.

Untreated gonorrhoea may spread and lead to urinary tract infections, peritonitis, or arthritis.

### ***Non-specific urethritis***

*Non-specific urethritis (NSU)*, also known as *non-gonococcal urethritis*, is an inflammation of the urethra from a sexually transmitted infection.

In females, a discharge from the vagina is the main sign.

In males, a discharge from the penis and painful urination are the main indications. The condition may spread to the epididymis, causing a painful inflammation inside the scrotum.

## **Syphilis**

Syphilis is a sexually transmitted infection by *treponema pallidum* bacteria.

The disease, if not treated, has three main stages:

**Primary syphilis.** This may be asymptomatic, or may involve painless sores, called chancres, in the genital area, rectum, or mouth, with enlarged lymph nodes in the vicinity.

**Secondary syphilis.** The chancres will tend to ulcerate. A generalised skin rash will accompany extensive enlargement of lymph nodes. There may be skin lesions in areas such as the groin, armpits, and under the breasts, together with general symptoms of unwell.

**Tertiary syphilis.** Skin lesions will become destructive and may spread to the skeleton and liver. In some cases, the aorta may inflame and encourage development of an aneurysm. As a final stage, damage to the central nervous system may lead to multiple problems including sensory loss. Long term health problems are then likely.

# Foetal Development and Childbirth

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Following sexual intercourse between a male and a female, the female ovum may be fertilised by a male sperm. (The chances of successful fertilisation depend on many unpredictable factors, and may be reduced to almost zero by the use of contraceptive devices).

Under normal circumstances, the fertilised ovum will develop into an infant over the next 40 weeks, protected in the uterus of the female.

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## Fertilisation and Implantation

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### Fertilisation

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During sexual intercourse, the male ejaculates hundreds of millions of sperms into the female vagina. These sperms begin to move through the uterus into the Fallopian tubes.

If intercourse has taken place whilst a live ovum is present in a Fallopian tube, the sperm which reaches this ovum first will join with it and cause fertilisation.

During *fertilisation*, the head of the sperm enters the ovum, passing on genetic information. After fertilisation further sperms are prevented from entering the ovum.

The fertilised ovum is then known as a *zygote*.

### Implantation

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A few hours after fertilisation, cells inside the zygote begin to split and multiply, and the zygote becomes an *embryo*. It also begins to move towards, and into, the uterus.

After about six or seven days, the embryo has reached the uterus. It then attaches to the endometrium, becoming completely covered by endometrial cells.

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## Development

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After implantation in the uterus, the embryo begins development.

(Note that references to “month” infer periods of four weeks).

### Embryonic Development

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During the first eight weeks of pregnancy, all the major systems of the body begin to form, albeit in miniature.

During week 5, the head grows significantly as the brain begins to develop.

The beginnings of the limbs appear during week 6.

At the end of week 8, the embryo has taken on the basic human form, with a beating heart, although it is only approximately 25mm long.

It is now known as a *foetus*.

The development of the embryo is aided by a series of membranes:

**Chorion.** This is a protective sac enclosing the embryo. The chorion connects into the endometrium at the site of implantation through a multitude of minute villi.

**Yolk sac.** This provides a site for early generation of blood cells. It also initiates the development of reproductive cells.

After serving its functions, the yolk sac reduces in size, becoming a thin stalk by week 6.

**Amnion.** This is a thin, tough, membrane which surrounds the embryo, inside the chorion. The space between the amnion and the embryo is filled with *amniotic fluid*.

### Placenta

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The *placenta* provides a source and transport mechanism for essential nutrients and hormones to the embryo, and later the foetus. It forms out of the chorion, around the area of implantation. It develops along with the embryo and foetus, reaching its full thickness of approximately 25mm by month 5.

There is no direct link between placenta and endometrium; substance exchange takes place between capillaries in the chorionic villi, and the circulation in the endometrium.

### Umbilical Cord

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The *umbilical cord* forms a physical link between the placenta and the developing foetus, carrying nutrients and waste materials.

It comprises two arteries and one vein, together with connective tissue.

### Foetal Development

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By the end of month 3, the foetus contains the beginnings of all the organ forms required for normal life, including blood, and is approximately 50 to 60mm in length.

The remainder of the pregnancy is concerned with an increase in size and the maturation of the organ systems:

**Month 4.** Bone marrow begins to generate blood cells. The brain and other vital organs reach the end of their basic development.

**Month 5.** The face has formed. The digestive system begins to mature. Muscle and bone formations become detectable, and the foetus begins spontaneous movements.

**Month 6.** The internal organs take up their final positions. Brain development is largely complete.

**Month 7.** The nervous system develops sufficiently for the foetus to carry out 'practice' reflex movements.

**Month 8.** The number of fat cells increases. The foetus has now reached a stage where chances of survival outside the uterus are significant.

**Month 9.** Fat accumulation continues, and the nails form.

**Month 10.** Foetal development completes, and the foetus normally turns to a head-down position ready for birth. It is now 300 to 350mm in length.

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## **Childbirth**

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Childbirth normally occurs during week 39 to week 41 of a pregnancy.

There are three main stages to childbirth:

**Stage 1.** This occurs between the time the mother first experiences regular contractions of the uterus, through to the cervix of the uterus being fully dilated for birth. During stage 1, the amniotic sac may rupture with the discharge of the amniotic fluid. This is commonly known as the *breaking of the waters*.

**Stage 2.** This covers the period during which the baby is delivered. Muscular contractions expel the infant from the womb. Immediately after birth, the infant's lungs (which have been inactive until now) begin to function.

**Stage 3.** This covers the period during which the placenta, and any remaining fluid from within the uterus, are delivered.

### Delivery Presentations

The term *delivery presentation* describes the orientation of an infant as it descends through the birth canal.

**Cephalic presentation.** (head first). This is considered as the norm.

**Breech presentation.** This is considered abnormal.

A *complete breech* presentation occurs when the hips and the knees are both flexed and the buttocks present first.

A *frank breech* presentation occurs when the hips are flexed with the legs straight and drawn across the chest.

Other breech presentations may involve either knees or feet presenting first.

**Shoulder presentation.** This is considered abnormal. It occurs when the shoulder, arm, or torso present first.

A shoulder presentation is more likely in a premature birth or multiple birth, and occurs if the foetus is lying sideways - in a *transverse lie*.

### Eclampsia

*Eclampsia* is a condition, of unknown cause, where seizures and unconsciousness - not related to some other cause - occur during pregnancy. Serious danger to both mother and child may result.

*Pre-eclampsia* - if not treated - is a precursor to full eclampsia. It is characterised by oedema to the hands and face, rapid weight gain, headaches and visual disturbances, accompanied by a rising blood pressure.

### Ectopic Pregnancy

An *ectopic pregnancy* occurs when a fertilised egg implants in tissue other than in the uterus - most commonly in a Fallopian tube.

The cause of this is often a previous infection or surgery, which has led to the movement of the zygote being impeded. Use of the 'morning after pill' may also cause an ectopic pregnancy.

An ectopic pregnancy is not viable, and if not surgically removed, will almost certainly lead to death of the mother and the foetus.

Initially, an ectopic pregnancy will show no symptoms, but as the foetus grows, it will distend the point of implantation, which will eventually rupture. This will cause severe abdominal pain and probably vaginal bleeding.

### Meconium Aspiration

*Meconium* is the first faeces of the newborn child. It is a sticky thick dark green substance. Meconium is often present in the amniotic fluid beyond the 34<sup>th</sup> week of pregnancy.

If the foetus is stressed during delivery and hypoxia results, this may increase peristalsis and cause passing of meconium. If first respirations then occur before complete delivery, or whilst the infant is still covered in meconium stained amniotic fluid, this may be drawn into the lungs.

Aspiration of meconium is a serious problem, and may be fatal. Meconium can block the airway, impede gas exchange in the lungs and cause inflammation of the airway tissue.

### Miscarriage

A *miscarriage* is defined as an expulsion of a foetus at any point up to 24 weeks into a pregnancy.

The cause of miscarriage is generally unknown, but abnormalities of the foetus - either genetic or developmental - are potential contributory factors.

Injury or illness of the mother may also trigger a miscarriage.

A foetus expelled before the 24<sup>th</sup> week of pregnancy is very unlikely to have developed sufficiently to survive.

### Premature Birth

A *premature birth* or *preterm birth* occurs at any point between 24 weeks and 37 weeks into a pregnancy.

In many cases, no cause is identifiable for a premature delivery, but pre-eclampsia, multiple pregnancies, injury or illness of the mother, or a spontaneous early dilation of the cervix may initiate a premature birth.

Depending on the point at which a premature birth occurs in the full term cycle, the infant may not be fully developed and will be weak.

The respiratory centre and muscles of respiration may not be fully developed, giving rise to breathing problems. The heat regulating centre may not be fully functioning, which together with insufficient heat production and insufficient adipose tissue as insulation, may require external heat for survival. Poor reflexes may affect feeding by inhibiting the swallowing and sucking actions. An under-developed immune system may leave the infant susceptible to respiratory and gastro-intestinal infections.