CHAPTER 10

The Reproductive System & Development: What It Took To Make You

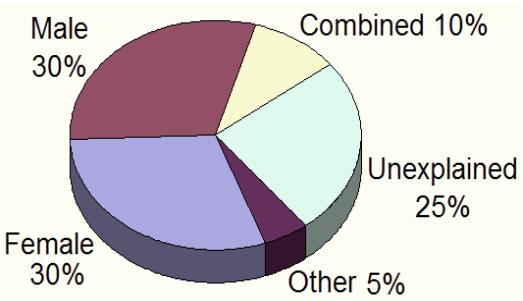
LEARNING OBJECTIVES

By the end of this class you should be able to:

- Understand infertility and the options and treatment available to remedy it.
- List the parts of the human male reproductive system and their functions.
- Describe the structure of the testis and the process of spermatogenesis.
- List the parts of the human female reproductive system and their functions.
- Summarize the events of the ovarian and uterine cycles, and explain how these two cycles are regulated.
- Identify the early embryonic stages
- Describe the development of the neural tube.
- Distinguish between embryo and fetus

Introduction

Infertility means not being able to get pregnant after one year of trying (or six months if a woman is 35 or older). Lots of couples have infertility problems. About one-third of the time, it is a female problem. In another one-third of cases, it is the man with the fertility problem. For the remaining one-third, both partners have fertility challenges or no cause is found. Some common reasons for infertility in women include: i) age – as a woman ages, normal changes that occur in her ovaries and eggs make it harder to become pregnant. Also, as a woman and her eggs age, she is more likely to miscarry, as well as have a baby with genetic problems, such as Down syndrome; ii) health problems – some women have diseases or conditions that affect their hormone levels, which can cause infertility. Common problems with a woman's reproductive organs, like uterine fibroids, endometriosis, and pelvic inflammatory disease can worsen with age and also affect fertility; iii) lifestyle factors – certain lifestyle factors also can have a negative effect on a woman's fertility. Examples include smoking, alcohol use, weighing much more or much less than an ideal body weight, a lot of strenuous exercise, and having an eating disorder. Stress also can affect fertility. Unlike women, some men remain fertile into their 60's and 70's. But as men age, they might begin to have problems with the shape and movement of their sperm. They also have a slightly higher risk of sperm gene defects. Or they might produce no sperm, or too few sperm. Lifestyle choices also can affect the number and quality of a man's sperm. Alcohol and drugs can temporarily reduce sperm quality. And researchers are looking at whether environmental toxins, such as pesticides and lead, also may be to blame for some cases of infertility. Men also can have health problems that affect their sexual and reproductive function. These can include sexually transmitted infections (STIs), diabetes, surgery on the prostate gland, or a severe testicle injury or problem.

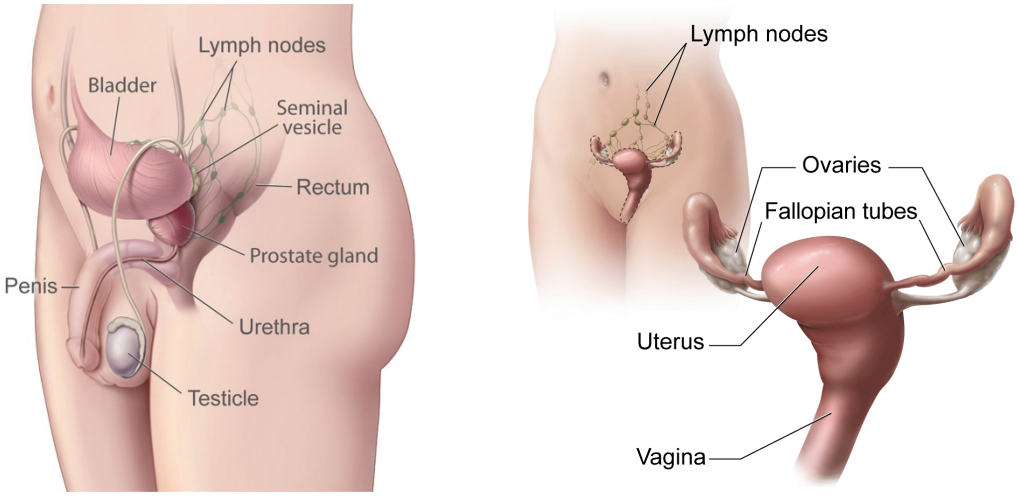


Infertility Causes. Causes of infertility, data compiled in the United Kingdom 2009 from the Department of Health UK. (Credits: Mikael Haggstrom, Public Domain) .

About 9 in 10 cases of infertility are treated with fertility drugs or corrective surgery that will damages or anatomical abnormalities. Specialized procedures are also available: i) **intrauterine insemination** (IUI), also called artificial insemination – male sperm is injected into part of the woman's reproductive tract. IUI often is used along with drugs that cause a woman to ovulate; ii) **assisted reproductive technology** (ART) – ART involves stimulating a woman's ovaries; removing eggs from her body; mixing them with sperm in the laboratory; and putting the embryos back into a woman's body; iii) third party assistance – options include donor eggs (eggs from another woman are used), donor sperm (sperm from another man are used), or surrogacy (when another woman carries a baby for you). For some couples, adoption or foster care offers a way to share their love with a child and to build a family.

Human Reproductive Anatomy

Females are considered the "fundamental" sex—that is, without much chemical prompting, all fertilized eggs would develop into females. The reproductive tissues of male and female humans develop similarly in utero until about the seventh week of gestation when a low level of the hormone **testosterone** is released from the gonads of the developing male. Testosterone causes the primitive gonads to differentiate into male sexual organs. When testosterone is absent, the primitive gonads develop into ovaries. Tissues that produce a penis in males produce a clitoris in females. The tissue that will become the scrotum in a male becomes the labia in a female. Thus, the male and female anatomies arise from a divergence in the development of what were once common embryonic structures.

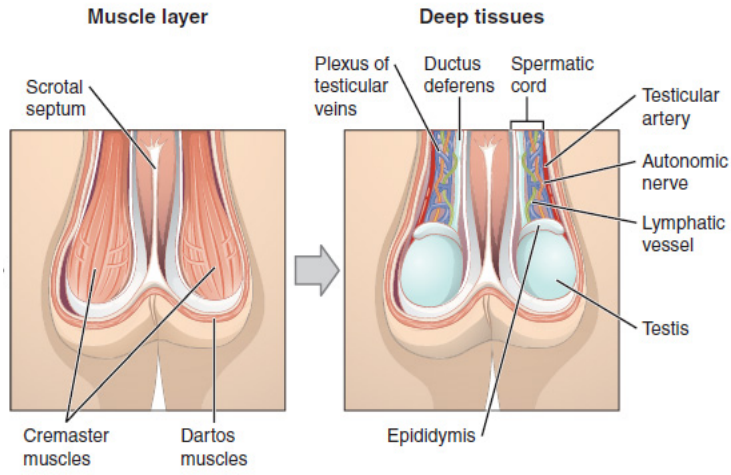


Human Male and Female Reproductive Systems. (Credits: National Cancer Institute. Left: NIH Medical Arts, Public Domain; right: Alan Hoofring/Don Bliss, Public Domain).

The Male Reproductive System and Sperm Cells

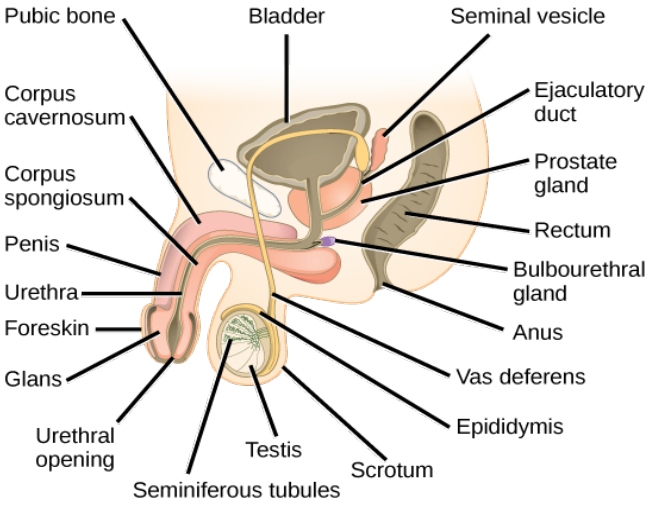
Unique for its role in human reproduction, a gamete is a specialized sex cell carrying 23 chromosomes—one half the number in body cells. At fertilization, the chromosomes in one male gamete, called a sperm (or spermatozoon), combine with the chromosomes in one female gamete, called an oocyte. The function of the male reproductive system is to produce sperm and transfer them to the female reproductive tract. The male reproductive anatomy is composed of:

- **Two testes** that develop within the body cavity posterior to the kidney and descend into the **scrotum**, an external pouch. Since Sperm are immobile at body temperature the testes are external to the body so that a correct temperature is maintained for motility. Thus, the pair of testes must be suspended outside the body so the environment of the sperm is about 2 °C lower than body temperature to produce viable sperm. If the testes do not descend through the abdominal cavity during fetal development, the individual has reduced fertility. Each testis is approximately 2.5 by 3.8 cm (1.5 by 1 inch) in size.
- **Two epididymides** (sing. epididymis) coiffing each testis and extending laterally to become the **vasa deferentia** (sing. vas deferens) or **sperm ducts**. On each side, the vasa deferentia loop over the ureters and enter the **urethra.**



Human Male Reproductive Anatomy. Top: lateral view. Bottom: anterior view of the scrotum and testes structures (Credits: CNX OpenStax, CC BY 4.0)

- The **penis** drains urine from the urinary bladder, via the urethra which opens at its end, and is a **copulatory organ** during intercourse. The penis contains three tubes of **erectile tissue** that become engorged with blood, making the penis erect, in preparation for intercourse. The organ is inserted into the vagina culminating with an ejaculation. During orgasm, the accessory organs and glands connected to the testes contract and empty the semen (containing sperm) into the urethra and the fluid is expelled from the body by muscular contractions causing ejaculation. After intercourse, the blood drains from the erectile tissue and the penis becomes flaccid. **Erectile dysfunction** (ED) is a condition in which a man has difficulty either initiating or maintaining an erection. The combined prevalence of minimal, moderate, and complete ED is approximately 40 percent in men at age 40, and reaches nearly 70 percent by 70 years of age. In addition to aging, ED is associated with diabetes, vascular disease, psychiatric disorders, prostate disorders, the use of some drugs such as certain antidepressants, and problems with the testes resulting in low testosterone concentrations. These physical and emotional conditions can lead to interruptions in the vasodilation pathway needed for the erectile tissue to become engorged, and result in an inability to achieve an erection

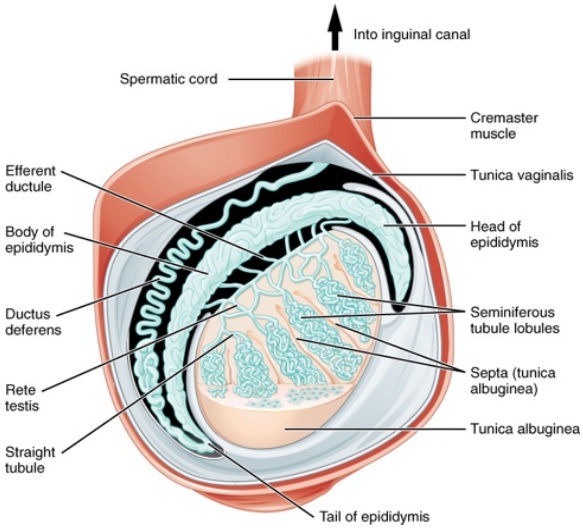


Human Male Reproductive Anatomy. lateral view. (Credits: CNX OpenStax, CC BY 4.0)

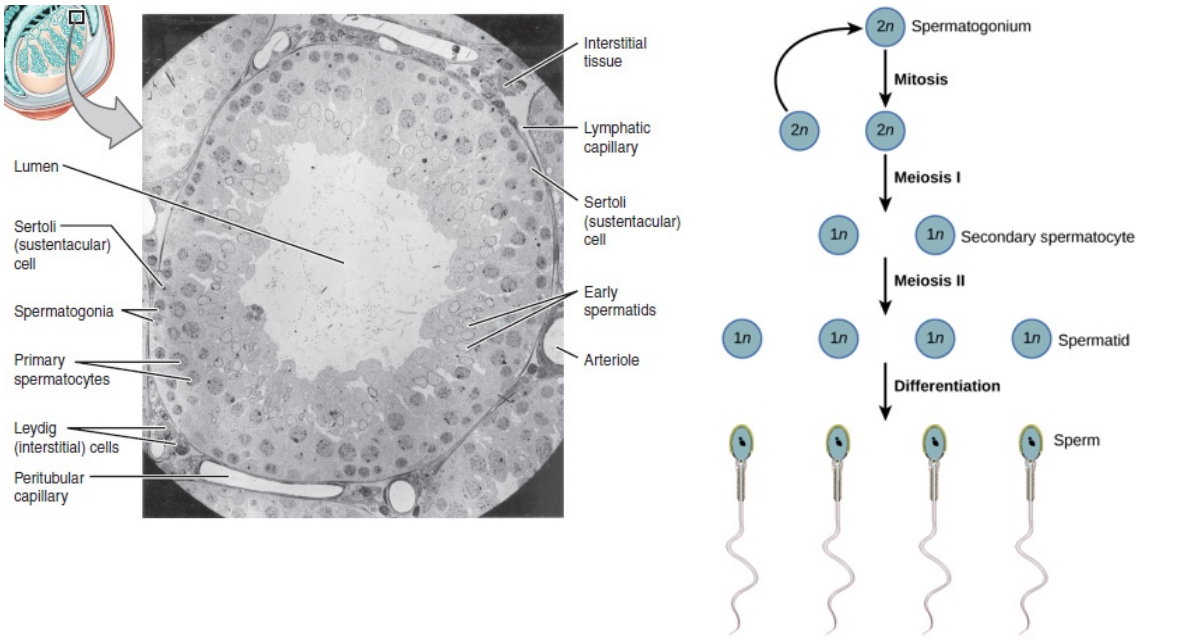
- **Two seminal vesicles** which are glands located where the vasa deferentia meet the urethra.
- A small **prostate gland** about the size of a walnut, formed of both muscular and glandular tissues. The prostate normally doubles in size during puberty. At approximately age 25, it gradually begins to enlarge again. This enlargement does not usually cause problems; however, abnormal growth of the prostate, or **benign prostatic hyperplasia** (BPH), can cause constriction of the urethra as it passes through the middle of the prostate gland, leading to a number of lower urinary tract symptoms, such as a frequent and intense urge to urinate, a weak stream, and a sensation that the bladder has not emptied completely. Another common disorder involving the prostate is **prostate cancer**. According to the Centers for Disease Control and Prevention (CDC), prostate cancer is the second most common cancer in men.
- A pair of **bulbourethral glands** (or Cowper's glands) lie laterally and dorsally where the urethra enters the penis.

The testes produce sperm and make and secrete hormones such as **testosterone** the main sex hormone in males. A series of ducts convey sperm from the testis to the body surface: epididymis, vas deferens, urethra. The seminal, prostate and bulbourethral glands produce and release fructose-rich secretions, alkaline fluid and lubricating mucus in the ducts where they mix with sperm cells to form **semen**. Only 5% of the semen consists of spermatozoa.

The formation of sperm cells is called **spermatogenesis** and starts at **puberty** when sexual organs mature and increased testosterone leads to the appearance of **secondary sexual traits** (coarse hair, deepening of the voice). Spermatogenesis occurs in the **seminiferous tubules**. These tubules which stretched out would extend to about the length of a football field, are coiled in the testes. Diploid **spermatogonia**, germ cells located by the outer edges of the tubules, divide repeatedly by mitosis and the resulting cells, the **spermatocytes** undergo meiosis. Four haploid **spermatids**, mature *i.e.* loose most of their cytoplasm and grow a flagellum, to become spermatozoa in the lumen of the tubules. The cells are then carried along the seminiferous tubules by cilia to the **epididymis** in about 10 days. Secretions of the epididymides complete sperm maturation and the cells become motile. Production of viable sperm is achieved at a temperature of 94-95°F, thus, early in the embryonic development, the testes descend from their initial position in the abdomen into the scrotum.



Anatomy of the Testis. Credit: OpenStax Anatomy and Physiology CC BY 4.0).

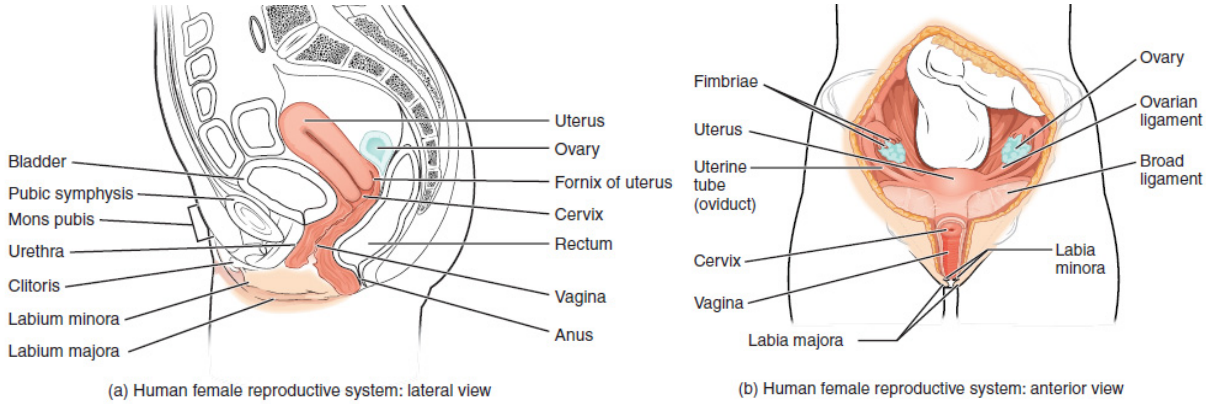


Testes and Spermatogenesis. Left: Photomicrograph of a seminiferous tubule cross-section. Right: Spermatogenesis (credit: OpenStax Anatomy and Physiology CC BY 4.0).

The sperm cells are associated with **Sertoli cells** that nourish and promote the development of the sperm. Other cells present between the walls of the tubules are the interstitial **cells of Leydig**, which produce testosterone once the male reaches adolescence. When the sperm have developed flagella they leave the seminiferous tubules and enter the epididymis. This structure lies along the top and posterior of the testes and is the site of sperm maturation. The sperm leave the epididymis and enter the vas deferens, which carries the sperm behind the bladder, and forms the ejaculatory duct with the duct from the seminal vesicles. During a **vasectomy**, a section of the vas deferens is removed, preventing sperm (but not the secretions of the accessory glands) from being passed out of the body during ejaculation and preventing fertilization.

The Female Reproductive System, Egg Cells and Menstruation

A number of female reproductive structures are exterior to the body. These include the breasts and the vulva, which consists of the mons pubis, clitoris, labia majora, labia minora, and the vestibular glands. The breasts consist of mammary glands and fat. Each gland consists of 15 to 25 lobes that have ducts that empty at the nipple and that supply the nursing child with nutrient- and antibody-rich milk to aid development and protect the child.



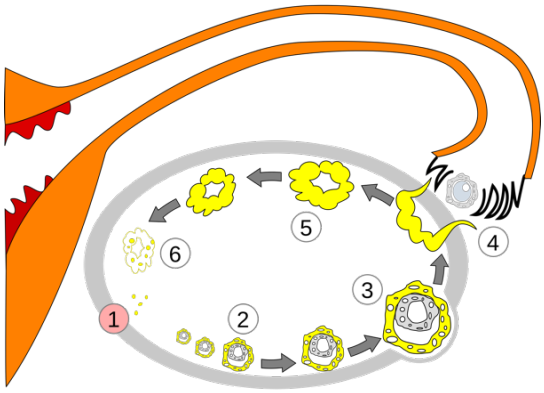
The Female Reproductive System. The major organs of the female reproductive system are located inside the pelvic cavity (credit: OpenStax Anatomy and Physiology CC BY 4.0).

Internal female reproductive structures include:

- **A pair of ovaries** is held in place in the abdominal cavity by a system of ligaments. The outermost layer of the ovary is made up of follicles, each consisting of one or more follicular cells that surround, nourish, and protect a single egg. The ovaries also produce hormones, such as **estrogen**.
- **Two fallopian tubes** or oviducts that join the body of the uterus at the midline. Fallopian tubes, extend from the uterus in the lower abdominal cavity to the ovaries, but they are not in contact with the ovaries. The lateral ends of the oviducts flare out into a trumpet-like structure and have a fringe of finger-like projections called fimbrae. When an egg is released at ovulation, the fimbrae help the nonmotile egg enter into the tube. The walls of the oviducts have a ciliated epithelium over smooth muscle. The cilia beat, and the smooth muscle contracts, moving the egg toward the uterus. Fertilization usually takes place within the oviduct and the developing embryo is moved toward the uterus. It usually takes the egg or embryo a week to travel through the oviduct. Sterilization in women is called a **tubal ligation**; it is analogous to a vasectomy in males in that the oviducts are severed and sealed, preventing sperm from reaching the egg
- The **uterus** which is located dorsal to the urinary bladder. The uterus is about the size of a woman's fist. The uterus has a thick muscular wall and is lined with an **endometrium** rich in blood vessels and mucus glands that develop and thicken during the female cycle. Thickening of the endometrium prepares the uterus to receive the fertilized egg or zygote, which will then implant itself in the endometrium. The uterus supports the developing embryo and fetus during gestation. Contractions of the smooth muscle in the uterus aid in forcing the baby through the vagina during labor. If fertilization does not occur, a portion of the lining of the uterus sloughs off during each menstrual period. The endometrium builds up again in preparation for implantation. Part of the uterus, called the **cervix**, protrudes into the top of the vagina. Research over many years has confirmed that **cervical cancer** is most often caused by a sexually transmitted infection with human papillomavirus (HPV). Risk factors for cervical cancer include having unprotected sex; having multiple sexual partners; a first sexual experience at a younger age, when the cells of the cervix are not fully mature; failure to receive the HPV vaccine; a compromised immune system; and smoking. The risk of developing cervical cancer is doubled with cigarette smoking.
- The **vagina** or birth canal, extends posteriorly from the uterus and opens near and behind the urethra.
  Ovaries produce the female gametes, eggs, and secrete hormones. When an egg is release by an ovary, it enters the oviduct. If fertilization occurs, the resulting embryo completes its development in the uterus. The vagina serves as both the female organ for copulation or intercourse and birth canal.

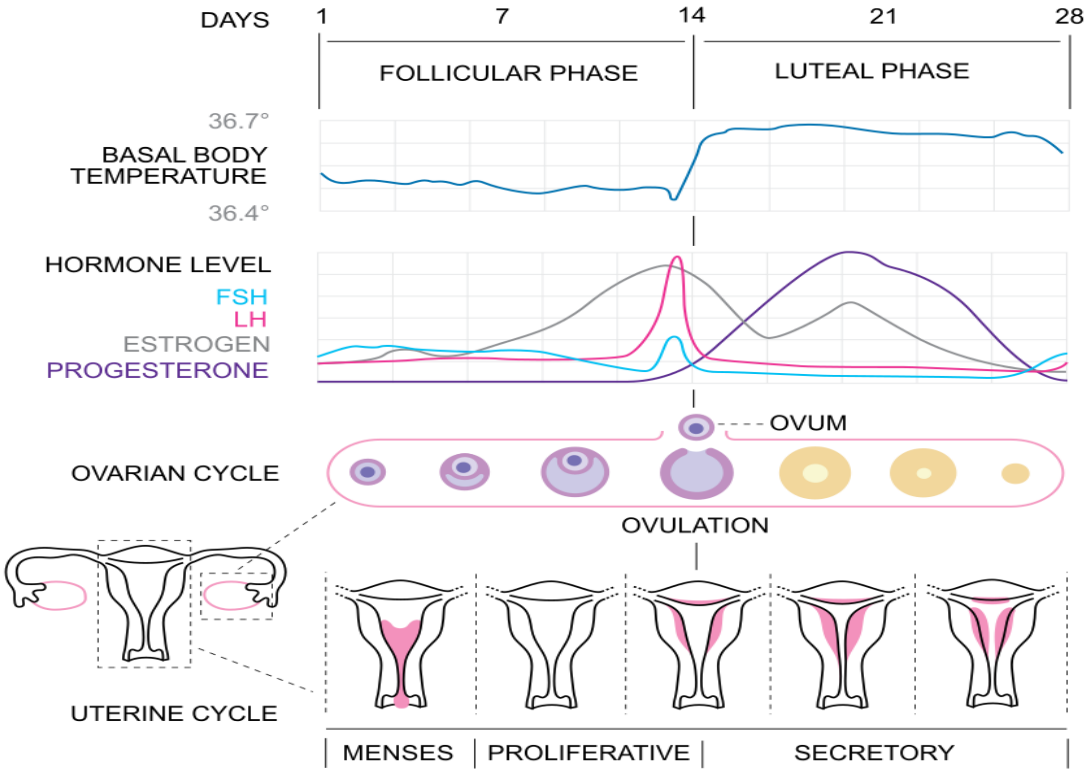
The functions of the female reproductive system are i) production of eggs and sex hormones (ovaries), ii) receive semen during **copulation** or intercourse (vagina), iii) transport of eggs from the ovaries to the uterus (oviducts**)**, iv) sustain the development of an embryo (endometrium: lining of the uterus) and, v) birthing (uterus and vagina).

Oogenesis, the formation of egg cells**,** starts before birth. By the fourth month after conception, **oogonia,** diploid female germ cells, enlarge and become primary oocytes which enter the first meiotic division. These primary oocytes are immature eggs, that remain inactive until puberty. A baby girl is born with about 2-3 million primary oocytes in her ovaries. At puberty, hormonal changes will prompt the primary oocytes to mature, one at a time in about 28 days; this is the **ovarian cycle**. Only about 400 primary oocytes will undergo this cycle as they complete their first meiotic division and become mature ovarian follicles (a secondary oocyte halted in meiosis II in a fluid-filled cavity and cells around it). During ovulation, the walls of the mature follicle rupture and the secondary oocyte, or ovum, is ejected in the nearby oviduct. The oocyte, still in the oviduct, must be penetrated by a sperm cell (**fertilization**) to complete its second meiotic division and subsequently fuse its nucleus with that of the sperm cell and form a diploid **zygote**. The remains of the follicle left in the ovary will transform into the **corpus luteum** ("yellow body") which produces hormones. If pregnancy does not occur, the corpus luteum breaks down (luteal phase) and a new ovarian follicle will start to mature.



The Ovarian Cycle. 1: Primary oocytes; 2: Secondary follicles maturing; 3: Mature follicle; 4: Ovulation; 5: Corpus luteum; 6: Corpus luteum deterioration (credit: Shazz CC BY-SA 3.0).

Events in the ovaries coordinate with changes in the uterus which cyclically undergoes thickening in preparation for a possible pregnancy. The **uterine cycle or menstrual cycle** starts with the onset of **menstruation**, the flow of bits of endometrium (uterine lining) and blood (known as menses) through the cervix and out of the vagina. The uterine cycle and ovarian cycles are under hormonal control. A woman enters **menopause** when all her ovarian follicles have been released or have aged and disintegrated resulting in lower hormonal levels and cessation of the menstrual cycle. The **oral contraception pill** consists of synthetic estrogens and progesterones that inhibit the development of ovarian follicle and therefore ovulation.



The Ovarian and Uterine Cycles. FSH: Follicle Stimulating Hormone. LH: Luteinizing Hormone. FSH and LH are secreted by the anterior pituitary gland. Estrogen and progesterone are secreted by the ovaries. (credit: Isometrik CC BY-SA 3.0).

Activity 1. Gametogenesis and Reproductive Organs

1.1 -List the structures sperm cells go through from the seminiferous tubules to the urethra.

1.2 -Write the word that matches the definition:

Produces eggs: _____ *Site of embryo development:* _____ *Release of the ovum in the oviduct:* _____

Male copulatory organ: _____ *Female copulatory organ:* _____ *Produces spermatozoa:* _____

Empty follicle after ovulation: _____ _____ *Shedding of the endometrium:* _____ *Fertilized egg:* _____

Main female reproductive hormones: _____ _____ *Time when spermatogenesis starts:* _____

1.3 -Looking at the illustration with the ovarian and uterine cycle, determine when is a woman's fertile period. Provide two ways a woman could determine when she has ovulated.

1.4 -Explain why abstention from sexual intercourse during a woman's fertile period (called rhythm method) is not very effective.

1.5 -Will a man having a vasectomy, or a woman having had a tubal ligation, experience any symptoms/changes in their body or during sexual intercourse? Explain.

Fertilization and Embryonic Development

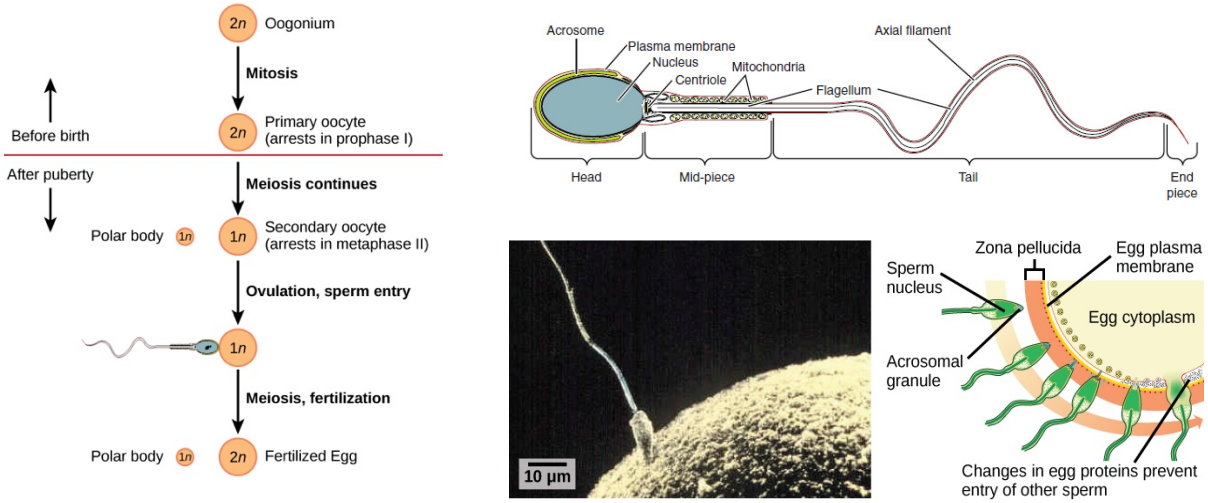
In approximately nine months, a single cell—a fertilized egg—develops into a fully formed infant consisting of trillions of cells with myriad specialized functions. The dramatic changes of fertilization, embryonic development, and fetal development are followed by remarkable adaptations of the newborn to life outside the womb. An offspring's normal development depends upon the appropriate synthesis of structural and functional proteins. This, in turn, is governed by the genetic material inherited from the parental egg and sperm, as well as environmental factors.

Newborns. (credit: Public Domain)

Fertilization

Fertilization is the process in which gametes (an egg and sperm) fuse to form a **zygote**. During sexual intercourse, about 300 million sperm are deposited in the vagina where they can live for 3 days. They swim towards the ovaries and fertilization usually takes place in the oviduct. In mammals, the egg is protected by a layer of extracellular matrix consisting mainly of glycoproteins called the **zona pellucida**. When a sperm binds to the zona pellucida, a series of biochemical events, called the **acrosome reactions**, take place. In placental mammals, the **acrosome** contains digestive enzymes that initiate the degradation of the glycoprotein matrix protecting the egg and allowing the sperm plasma membrane to fuse with the egg plasma membrane. The sperm enters the ovum where its tail and organelles degenerate. After the nuclear membranes of both cells break down, the two haploid genomes condense to form a diploid genome.

Only one sperm cell penetrates the egg but it takes the release of enzyme by many to clear the way to the egg plasma membrane. The entry of the sperm cell triggers the release of proteins by the egg in other locations to prevent other sperm from fusing with the egg. This mechanism prevents **polyspermy** that would result in a genetically abnormal embryo.

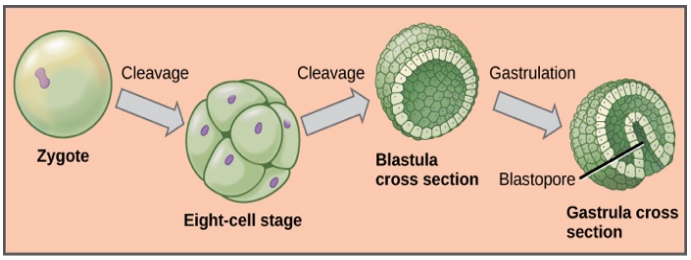


Sperm, Egg and Fertilization. Left: Fertilization triggers the completion of meiosis II by the oocyte (credit: OpenStax Rice University CC BY 4.0). Top right: Structure of a sperm cell (credit: OpenStax College CC BY 3.0). Bottom right: Fertilization and acrosomal reactions (credit: OpenStax Rice University CC BY 4.0).

Embryonic Development

Cleavage and Gastrulation

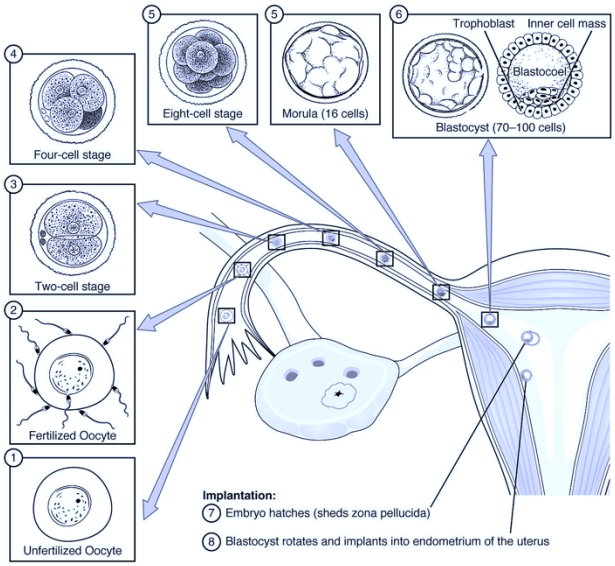
Right after fertilization, the zygote begins to divide successively by mitosis. These divisions are called **cleavage** and result in a cluster of 16-32 cells called the **morula**. As the divisions continue, the cells become smaller and are arranged in a ball that surrounds a cavity, the **blastocoele**, filled with fluid. This stage is called the **blastula or blastocyst**. The cells continue to divide and move about and start forming layers and a **blastopore**. This step is called **gastrulation.** In humans, the blastopore becomes the anus. The late **gastrula** displays 3 primary tissue layers of **germ layers:**



Early Embryonic Development in Animals. From zygote to early gastrula (credit: CNX OpenStax CC BY 4.0). Bottom: Location of early development in the human female reproductive tract (credit: OpenStax College CC BY 3.0)

- the **endoderm** that forms the embryonic gut, and will be the state for the respiratory, urinary and digestive tracts,
- the **mesoderm** which is the source of all muscles, connective tissues and the circulatory system,
- the **ectoderm** which gives rise to the nervous system and body covering such as skin.

In humans, **implantation**, attachment of the blastula to the lining of the uterus, happens about 8 days after fertilization. This allows for development of extraembryonic membranes and nourishment of the embryo from the mother's bloodstream (placental mammals). Lack of migration of the embryo in the uterus and its development in the oviduct results in an **ectopic pregnancy.**

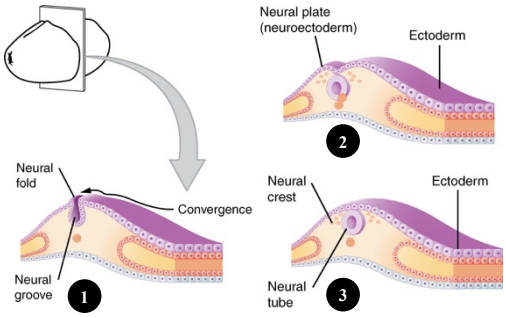


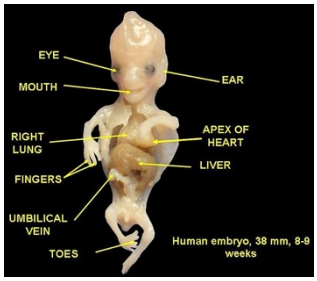
Early Embryonic Development in Animals. Location of early development in the human female reproductive tract (credit: OpenStax College CC BY 3.0)

Organogenesis

Organs formation, from the germ layers, starts after gastrulation, through the process of **differentiation**. Differentiation is based on the selective expression of genes in different cells. Differentiation results in cells lineages with unique structures and functions. To form organs, tissues interact, cells move and change shape. Some cells will undergo apoptosis. Organs will grow in size, take a mature form and start performing their specialized functions. In vertebrates, one of the primary steps during organogenesis is **neurulation**, the formation of the neural system. The ectoderm forms epithelial cells and tissues, and neuronal tissues. The neural tube and notochord form first. This happens about 18 days after fertilization in humans.

In humans, the first 8 weeks are known as **embryonic development** and the remainder of pregnancy is known as the **fetal period**. The fetus at 8 weeks is recognizable as human, is about 3 cm (a little more than an inch) in size and has all its organ systems and identifiable limbs.





Neurulation and Embryonic Development. Left: stages of neurulation in the gastrula (credit: modified from OpenStax CC BY 4.0). Center: 5-week old human embryo (credit Ed Uthman, Public Domain). Right: 8-week old human embryo (credit: Anatomist90 CC BY-SA 3.0).

Activity 2. Fertilization and Embryogenesis – Critical Thinking
2.1 - How would you explain the difference in the size and shape of sperm and egg cells?
2.2 - Why are so many sperm cells need to be released for fertilization of one egg?
2.3 - What would polyspermy lead to an abnormal embryo?
2.4 - Explain why an ectopic pregnancy is bound to profound issues for the embryo and mother and is unlikely to be successful (one in 3 million)

Activity 3. Rat – Organs of the Abdominopelvic Cavity: Digestive System Review

3.1 - Place your rat on your dissection tray, and tie it down ventral side up. Continuing from last time, you will make 2 new cuts, to expose a viewing window into the abdomen.

3.2 - Identify the **liver** then lift the right lobes to observe the **gallbladder.** State functions of these organs.

3.3 - Observe the **stomach** on the left, under the liver. Describe its appearance and what it is connected to on both of its ends.

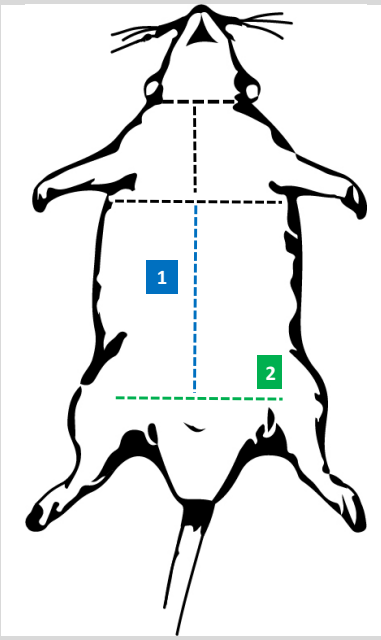
3.4 - Locate the **small intestine** and determine its different parts, the short **duodenum**, and the **jejunum-ileum** portion.

3.5 - Observe the **large intestine/colon**. Why is it called "large" intestine? How does it differ in appearance with the human colon? Find the **cecum**, a side pouch at the juncture between small and large intestines. The cecum tends to be larger in herbivores. Based on this, what kind of diet is a rat most suited to eat?

3.6 - The **rectum** is the terminal portion with the external opening, the **anus**. If the rectum is not easily visible, go hunting for it during Activity 5, when you are looking more closely at the pelvic region.

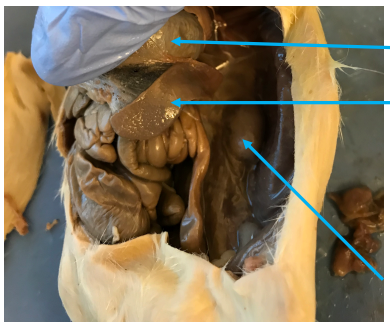
3.7 - Identify the **spleen**, an elongated, flat and dark organ, which curves along the stomach.

3.8 - Lift the stomach and find the white/gray, granular and membranous **pancreas** situated beneath the stomach. What kind of gland is the pancreas?



Note: In this picture, the extra flaps of abdominal skin were cut away.

Sometimes, the **pancreas** is easily visible. However, you may also have to lift up the stomach to see this delicate organ.



To get a better view of the spleen, you may move around the stomach. Notice the **kidney** peeking up at us from the dorsal wall.

The coils of intestines are held together by thin membranes called mesenteries. Gently pull the the loops apart to find the cecum at the juncture between the small and large intestines.

Activity 4. Rat – Organs of the Abdominopelvic Cavity: Urogenital System

4.1 - Expose the urinary organs by moving the intestines upward in the abdominal cavity. Gently cut throught the peritoneum with a probe to better see the **kidneys** and **ureters**. You may remove some digestive organs (as long as your are definitely done with them) to more easily view the dorsal wall of the rat. The kidneys are large, firm bean shaped structures embedded in the dorsal wall. Notice that each kidney has a renal artery and vein, which allow for renal circulation. What happens to the blood after it enters the kidney?

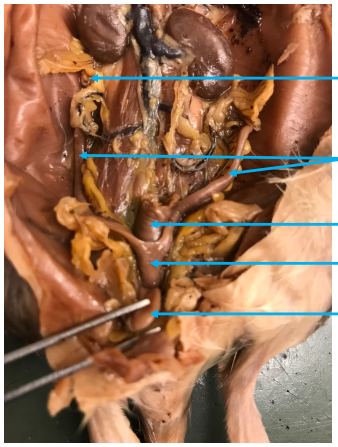
4.2 - Locate the **adrenal glands** which are the small yellow glands on top of the kidneys. They secrete adrenaline into the blood during stress and regulate a number of aspects of homeostasis.

4.3 - Try to follow one of the ureters to see where it connects with the **urinary bladder**.

4.4 - If you have a female rat:

- Locate the paired **ovaries** below the kidneys. **These are the major reproductive organs of the female rat which produce eggs.** Next, locate the **uterine horns.** The uterine horns allow the female rat to give birth to multiple offspring (ie. a litter of rat pups).

- Locate the **body of the uterus** where the uterine horns meet medially. Notice that the bladder lies on top of the uterine body, while the colon lies below it. From the uterine body extends the vagina.

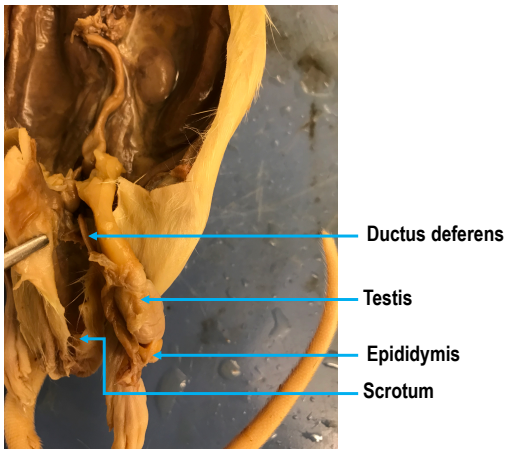


Note: notice the strands of yellow adipose tissue throughout the abdominal and pelvic cavity.

4.5 - If you have a male rat:

- Carefully open the different layers of the scrotal sac on one side to expose a **testis (pl. testes). These are the major reproductive organs of the male rat which produce the sperm.**

- On the of the testis is a coiled tube called the **epididymis** which collects and stores sperm cells. The tubular **vas/ductus deferens** moves sperm from the epididymis to the urethra, which carries sperm through the penis and out the body. Locate the **epididymis** which becomes the **vas deferens.**



Review Questions

1. What is infertility? How can it be remedied?
2. Describe where the testes are located in humans. How is their location helping their main function?
3. How are spermatogenesis and oogenesis similar? How are they different?
4. Explain menstruations. Provide reasons why a female cannot be pregnant before puberty or after menopause.
5. With your knowledge of human reproductive anatomy and physiology discuss possible ways of contraception.
6. Where does fertilization take place in humans?
7. What is the role of the uterus?
8. Describe the first weeks of embryo development.
9. Practice identifying organs on dissected rat specimens with more pictures here: https://www.biologycorner.com/myimages/rat-anatomy/

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