



BIO 004 · HUMAN ANATOMY · SOLANO COMMUNITY COLLEGE

Week 6 Course Notes.

Urinary · Reproductive · Endocrine

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The Urinary System

The Urinary System

A reference for the urinary system video and lab. This page covers the gross anatomy of the kidney, the nephron, the juxtaglomerular apparatus and filtration membrane, the blood supply, and the ureters, bladder, and urethra. The focus is on the structures and the job each one does.

- BY THE END**
1. Describe the gross anatomy of the kidney and its tissue layers.
 2. Identify the parts of a nephron and the layers of the filtration membrane.
 3. Trace the blood supply of the kidney and the path of urine.

The Urinary System, an Overview

The urinary system filters the blood and makes urine. The kidneys do the work; the rest of the system carries and stores the urine.

Urinary system	the kidneys, ureters, urinary bladder, and urethra	Urinary bladder	the muscular sac that stores urine
Kidneys	the paired organs that filter the blood and form urine	Urethra	the tube that carries urine from the bladder to the outside
Ureters	the paired tubes that carry urine from the kidneys to the bladder	Roles of the kidney	filtering wastes from the blood, balancing water, ions, and pH, and helping regulate blood pressure

The Kidneys, Gross Anatomy

The kidneys are bean-shaped organs against the back wall of the abdomen. Three tissue layers cushion and anchor each one, and the interior sorts into a cortex and a medulla.

Location	retroperitoneal, between T12 and L3; the right kidney sits slightly lower because of the liver	Renal cortex	the outer region of kidney tissue, just beneath the capsule
Renal hilum	the notch on the medial border where the ureter, vessels, and nerves enter and leave	Renal columns	extensions of the cortex that dip down between the renal pyramids
Renal capsule	the smooth, fibrous inner layer that maintains the kidney's shape	Renal medulla	the inner region of kidney tissue
Adipose capsule	the layer of fat around the capsule that cushions the kidney and holds it in place	Renal pyramids	the cone-shaped masses of the medulla, with their bases toward the cortex
Renal fascia	the outer layer of connective tissue that anchors the kidney to the abdominal wall	Renal papilla	the tip of a renal pyramid, which drains urine into a minor calyx
		Parenchyma	the functional tissue of the kidney, the cortex and pyramids together, which holds the nephrons

The Nephron

The nephron is the functional unit of the kidney, the structure that actually makes urine. It has two main parts: the renal corpuscle and the renal tubule.

Nephron	the microscopic functional unit of the kidney; each kidney holds about one million	Podocytes	the cells of the inner, visceral layer of the capsule, whose foot-like processes form filtration slits
Renal corpuscle	the filtering head of the nephron; the glomerulus inside the glomerular capsule	Capsular space	the space inside the capsule where the filtrate collects before entering the tubule
Glomerulus	the tuft of leaky, fenestrated capillaries where the blood is filtered	Proximal convoluted tubule	the first, coiled segment of the renal tubule, lined with a brush border of microvilli
Glomerular capsule	Bowman's capsule; the cup that surrounds the glomerulus and collects the filtrate	Nephron loop	the loop of Henle; the U-shaped segment with a descending limb and an ascending limb

Distal convoluted tubule	the second coiled segment of the renal tubule	Collecting duct	the duct that gathers fluid from many nephrons and carries it toward the renal papilla
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Nephrons come in two types, sorted by how deep their loop reaches. Compare them.

TYPE	FEATURES
Cortical nephrons	about 85 percent of nephrons; short loops that barely enter the medulla, wrapped by peritubular capillaries
Juxtamedullary nephrons	about 15 percent of nephrons; long loops that reach deep into the medulla, served by the vasa recta; they concentrate the urine

The Juxtaglomerular Apparatus and Filtration Membrane

Where the distal tubule touches its own glomerulus, a small structure monitors and adjusts filtration. The filtration membrane itself is a three-layer sieve.

Juxtaglomerular apparatus	the structure where the distal convoluted tubule contacts the arterioles of its own renal corpuscle	Macula densa	the cells of the distal tubule that sense the sodium and chloride concentration of the fluid
		Juxtaglomerular cells	modified smooth muscle cells in the afferent arteriole that release renin when blood pressure is low

Blood is filtered across a three-layer membrane. Compare what each layer holds back.

LAYER	WHAT IT HOLDS BACK
Fenestrated endothelium	the pored wall of the glomerular capillary; it lets plasma pass but blocks blood cells
Basement membrane	the layer between the capillary and the podocytes; it blocks large plasma proteins
Slit membranes	the filtration slits between the podocyte processes; they block medium-sized proteins

The Blood Supply of the Kidney

Blood reaches the nephrons through a branching chain of arteries and leaves through a matching set of veins. Trace the arterial path.

- 1 Renal artery** branches from the abdominal aorta and enters at the hilum
- 2 Segmental and interlobar arteries** carry blood between the renal pyramids
- 3 Arcuate arteries** arch along the bases of the pyramids, between the cortex and medulla
- 4 Interlobular arteries** branch up into the cortex
- 5 Afferent arteriole** delivers blood into the glomerulus
- 6 Glomerulus** the capillary tuft where filtration occurs
- 7 Efferent arteriole** carries blood out of the glomerulus
- 8 Peritubular capillaries and vasa recta** wrap the renal tubules, then drain into veins that lead to the renal vein

The Ureters, Bladder, and Urethra

Once urine leaves the nephrons it is collected, carried, stored, and finally released by the rest of the system.

Minor and major calyces	the cup-shaped chambers that collect urine from the renal papillae and channel it into the renal pelvis	Wall layers	the ureter and bladder share three layers: a mucosa lined with transitional epithelium that lets the bladder stretch, a smooth muscle muscularis, and an outer adventitia
Renal pelvis	the funnel-shaped cavity that collects urine and passes it into the ureter	Trigone	the smooth triangular area at the base of the bladder, marked by the two ureter openings and the urethral opening
Ureters	the muscular tubes that carry urine from the kidneys to the bladder by peristalsis		

Detrusor muscle	the smooth muscle layer of the bladder wall that contracts to empty it	Male urethra	longer; it passes through the prostate as the prostatic urethra, through the perineum as the membranous urethra, and through the penis as the spongy urethra
Internal urethral sphincter	the involuntary smooth muscle ring at the bladder outlet	Female urethra	shorter; it opens between the clitoris and the vaginal opening
External urethral sphincter	the voluntary skeletal muscle ring that gives conscious control over urination		

The Path of Urine

Urine leaves the nephron and flows through a fixed series of structures to the outside.

- ① **Collecting duct** gathers the fluid from many nephrons
- ② **Minor and major calyces** collect the urine draining from the renal papillae
- ③ **Renal pelvis** funnels the urine toward the ureter
- ④ **Ureter** carries the urine down to the bladder
- ⑤ **Urinary bladder** stores the urine
- ⑥ **Urethra** carries the urine out of the body

Common Disorders of the Urinary System

Compare the common disorders of the urinary system by the structure each one affects.

DISORDER	WHAT IT IS
Urinary tract infection	an infection of the urethra, bladder, or kidneys, usually by bacteria
Kidney stones	hardened mineral deposits that form in the kidney and can lodge in the ureter
Glomerulonephritis	inflammation of the glomeruli that impairs filtration
Renal failure	loss of the kidney's ability to filter the blood, acute or chronic
Nephroptosis	a floating kidney; the kidney drops from its normal position when its fat support is lost
Urinary incontinence	loss of voluntary control over urination, as stress, urge, overflow, or functional incontinence
Polycystic kidney disease	an inherited disorder in which many fluid-filled cysts enlarge the kidneys

Position and pathway predict the problem

The kidney depends on its **adipose capsule** to stay in place. When that fat is lost, the kidney can drop, kinking the ureter and blocking the flow of urine. The anatomy of the support explains the symptom.

Urine travels one narrow path. A **kidney stone** that forms in the renal pelvis causes no pain until it enters the **ureter**, where it scrapes and blocks a tube only millimeters wide. The location along that path predicts where the pain is felt.

The two urethras differ, and so does the risk. The **female urethra** is short, which gives bacteria a shorter climb to the bladder and is one reason urinary tract infections are more common in women.

Study questions

Work on answering these in writing, in your own words. They are the questions to bring to class, and good practice for the reasoning the exams ask for.

1. Trace a drop of filtrate through the nephron, from the glomerulus to the collecting duct.
2. Name the structures of the kidney from the cortex inward, and what each region contains.
3. Trace urine from the collecting duct to outside the body, naming each structure.
4. Compare the cortex and the medulla of the kidney by which parts of the nephron sit in each.

The Male Reproductive System

The Reproductive System, Male

A reference for the male reproductive system video and lab. This page covers the scrotum and testes, the duct system and the path of sperm, the structure of a sperm cell, the accessory glands, and the penis. The focus is on the structures and the job each one does.

- BY THE END**
1. Identify the structures of the scrotum and the testes.
 2. Trace the path of sperm through the duct system.
 3. Name the accessory glands and the parts of a sperm cell and the penis.

The Male Reproductive System, an Overview

The male reproductive system produces sperm and delivers it. Its parts sort into the gonads, a duct system, the accessory glands, and the supporting structures.

Testes	the male gonads; they produce sperm and secrete hormones	Accessory glands	the seminal vesicles, prostate, and bulbourethral glands, which add fluid to form semen
Duct system	the epididymis, ductus deferens, ejaculatory ducts, and urethra, which store, mature, and transport sperm	Supporting structures	the scrotum and the penis, which help deliver sperm into the female tract

The Scrotum and Testes

The testes hang outside the body in the scrotum, which keeps them a few degrees cooler than the core. Inside each testis, coiled tubules produce the sperm.

Scrotum	the pouch of skin and subcutaneous tissue that supports the testes; a raphe marks its surface and a scrotal septum divides it within	Seminiferous tubules	the tightly coiled tubes within the lobules where sperm are produced
Dartos muscle	the smooth muscle of the scrotum that wrinkles the skin to reduce heat loss	Sustentacular cells	the Sertoli cells lining the seminiferous tubules; they nourish developing sperm and form the blood-testis barrier
Cremaster muscle	the skeletal muscle that raises and lowers the testes to regulate their temperature	Interstitial cells	the Leydig cells between the tubules; they produce testosterone
Tunica vaginalis	the serous membrane, derived from the peritoneum, that partly covers each testis	Rete testis	the network of channels that the seminiferous tubules drain into at the back of the testis
Tunica albuginea	the white fibrous capsule that divides each testis into 200 to 300 lobules	Efferent ductules	the small ducts that carry sperm from the rete testis to the epididymis

The Duct System and the Path of Sperm

After they form, sperm travel a fixed series of ducts that store them, mature them, and carry them out.

Epididymis	the comma-shaped, coiled duct on the testis where sperm are stored and gain motility	Urethra	the shared final duct; it passes through the prostate, the perineum, and the penis
Ductus deferens	the vas deferens; the duct that carries sperm from the epididymis up toward the urethra	Spermatic cord	the bundle that contains the ductus deferens, blood vessels, nerves, and the cremaster muscle
Ejaculatory duct	the short duct formed where the ductus deferens meets the seminal vesicle duct; it empties into the prostatic urethra	Pampiniform plexus	the network of testicular veins in the spermatic cord that cools incoming arterial blood by counter-current exchange

Sperm follow one route from the testis to the outside.

- ① **Seminiferous tubules** sperm are produced inside the testis
- ② **Epididymis** sperm are stored and gain the ability to move
- ③ **Ductus deferens** sperm are carried up out of the scrotum
- ④ **Ejaculatory duct** the ductus deferens joins the seminal vesicle duct
- ⑤ **Urethra** sperm pass through the prostatic, membranous, and spongy urethra to the outside

The Structure of a Sperm Cell

A mature sperm cell is built for one job, reaching and entering an oocyte. It has a head and a tail.

Head	the part of the sperm that holds the nucleus with its 23 chromosomes	Neck	the part of the tail just behind the head, containing the centrioles
Acrosome	the enzyme-filled cap over the head that helps the sperm penetrate the oocyte	Middle piece	the part of the tail packed with mitochondria, which power movement
		Principal piece	the longest part of the tail
		End piece	the tapering terminal part of the tail

The Accessory Glands and Semen

Three sets of accessory glands add fluid to the sperm. The mixture of sperm and these fluids is semen. Compare the glands.

GLAND	WHAT IT ADDS
Seminal vesicles	an alkaline fluid rich in fructose that nourishes the sperm; the largest share of semen
Prostate	a milky, slightly acidic fluid that helps the sperm stay active
Bulbourethral glands	the Cowper's glands; an alkaline mucus that neutralizes urine in the urethra and lubricates
Semen	the mixture of sperm and the fluids of the three accessory glands

The Penis

The penis delivers semen and carries the urethra. It is built around three columns of erectile tissue.

Root	the attached portion of the penis, containing the bulb and the crura	Corpora cavernosa	the two dorsal columns of erectile tissue
Body	the free, movable portion of the penis	Corpus spongiosum	the single ventral column of erectile tissue that surrounds the spongy urethra
Glans penis	the enlarged, acorn-shaped tip, an extension of the corpus spongiosum	Erectile tissue	the spongy tissue of the columns that fills with blood during an erection
Prepuce	the foreskin; the loose fold of skin over the glans		

Common Disorders of the Male Reproductive System

Compare the common disorders of the male reproductive system by the structure each one affects.

DISORDER	WHAT IT IS
Cryptorchidism	one or both testes fail to descend into the scrotum
Hydrocele	a collection of serous fluid in the tunica vaginalis around a testis
Varicocele	an abnormal swelling of the veins that drain the testis
Benign prostatic hyperplasia	a non-cancerous enlargement of the prostate that can squeeze the urethra
Prostate cancer	a malignant tumor of the prostate gland

DISORDER	WHAT IT IS
Testicular cancer	a malignant tumor of the testis
Inguinal hernia	a loop of intestine pushes through a weak point in the abdominal wall at the inguinal canal

Why the testes hang outside

Sperm production needs a temperature a few degrees below the body core, which is why the **testes** sit in the scrotum and the **cremaster** and **dartos** muscles adjust their position. In **cryptorchidism**, an undescended testis stays at body temperature, and if it is not corrected the warmth can destroy the sperm-forming cells.

The duct system shares its final stretch with the urinary tract. Because the **urethra** passes straight through the **prostate**, an enlarged prostate squeezes the urethra and makes urination difficult, which is how a reproductive organ produces a urinary symptom.

Study questions

Work on answering these in writing, in your own words. They are the questions to bring to class, and good practice for the reasoning the exams ask for.

1. Trace the path of a sperm cell from where it is made to where it leaves the body, naming each duct.
2. Name the accessory glands of the male reproductive system and what each one adds to semen.
3. Explain, anatomically, why the testes sit outside the main body cavity.
4. Compare the structures that produce sperm with the structures that store and carry them.

The Female Reproductive System

The Reproductive System, Female

A reference for the female reproductive system video and lab. This page covers the ovaries, the uterine tubes and the path of the ovum, the uterus, the vagina and external genitalia, and the mammary glands. The focus is on the structures and the job each one does.

- BY THE END**
1. Identify the structures of the ovary and the uterine tubes.
 2. Name the regions, ligaments, and wall layers of the uterus.
 3. Identify the external genitalia and the structures of the mammary gland.

The Female Reproductive System, an Overview

The female reproductive system produces oocytes, receives sperm, and supports a developing fetus. Its organs sort into the gonads, the genital tract, the external genitalia, and the mammary glands.

Ovaries	the female gonads; they produce oocytes and secrete hormones	Vagina	the canal that receives the penis and serves as the birth canal
Uterine tubes	the fallopian tubes; they carry the oocyte toward the uterus	Vulva	the external genitalia, collectively called the vulva or pudendum
Uterus	the muscular organ where a fertilized ovum implants and a fetus develops	Mammary glands	the milk-producing glands of the breasts

The Ovaries

The ovaries are paired, almond-shaped organs held beside the uterus by ligaments. Inside, the developing oocytes sit in structures called follicles.

Ovaries	the paired, almond-shaped female gonads, one on each side of the uterus	Ovarian medulla	the deeper region of looser connective tissue holding blood vessels and nerves
Broad ligament	the fold of peritoneum that drapes over the uterus and tubes; it attaches to the ovary by the mesovarium	Ovarian follicles	the structures in the cortex, each holding an oocyte at a stage of development
Ovarian ligament	the cord that anchors the ovary to the uterus	Follicle stages	primordial, then primary, then secondary, then the vesicular (Graafian) follicle; each stage has a larger oocyte and more granulosa cells, with a fluid-filled antrum in the later stages
Suspensory ligament	the fold that attaches the ovary to the pelvic wall	Mature follicle	the large, fluid-filled follicle ready to release its oocyte at ovulation
Germinal epithelium	the surface layer of low cuboidal epithelium covering the ovary	Corpus luteum	the yellow body; the structure left after ovulation, which later degenerates into a scar called the corpus albicans
Tunica albuginea	the whitish capsule of dense connective tissue just beneath the germinal epithelium		
Ovarian cortex	the region beneath the tunica albuginea that contains the ovarian follicles		

The Uterine Tubes and the Path of the Ovum

The uterine tubes catch the released oocyte and carry it toward the uterus. Fertilization, when it happens, usually happens here.

Infundibulum	the funnel-shaped end of the tube, open to the pelvic cavity near the ovary	Ampulla	the widest and longest portion of the tube, where fertilization usually occurs
Fimbriae	the fringe of finger-like projections at the infundibulum that sweep the oocyte into the tube	Isthmus	the narrow, thick-walled portion that joins the tube to the uterus

Lining of the tube	ciliated and secretory cells whose cilia and fluid move the oocyte toward the uterus
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The ovum follows one route from the ovary to the uterus.

- 1 **Ovary** the mature follicle releases the secondary oocyte at ovulation
- 2 **Fimbriae and infundibulum** the fimbriae sweep the oocyte into the funnel of the tube
- 3 **Ampulla** the oocyte travels through the widest part of the tube, where sperm may fertilize it
- 4 **Isthmus** the oocyte or early embryo passes through the narrow part of the tube
- 5 **Uterus** the oocyte or embryo reaches the uterine cavity

The Uterus

The uterus is a thick-walled, pear-shaped organ between the bladder and the rectum. Ligaments hold it in place and three layers build its wall.

Fundus	the dome-shaped superior portion of the uterus, above the entry of the tubes	Broad ligaments	the paired folds of peritoneum attaching the uterus to the pelvic walls
Body	the tapered central portion of the uterus	Uterosacral ligaments	the paired folds connecting the uterus to the sacrum
Cervix	the narrow inferior portion that opens into the vagina	Cardinal ligaments	the paired ligaments extending from the pelvic wall to the cervix and vagina
Uterine cavity	the interior space of the body of the uterus	Round ligaments	the paired fibrous cords running from the uterus to the labia majora
Cervical canal	the interior of the cervix, opening to the uterine cavity at the internal os and to the vagina at the external os		

The wall of the uterus has three layers. Compare them.

LAYER	WHAT IT IS
Perimetrium	the outer serous layer, part of the visceral peritoneum
Myometrium	the thick middle layer of smooth muscle that contracts during childbirth
Endometrium	the inner vascular lining; its stratum functionalis sheds in menstruation and its stratum basalis rebuilds it

The Vagina and External Genitalia

The vagina connects the cervix to the outside. The external genitalia, the vulva, surround its opening.

Vagina	the fibromuscular canal from the cervix to the exterior; the birth canal	Clitoris	the small mass of erectile tissue at the anterior junction of the labia minora, built from two corpora cavernosa and capped by a glans; homologous to the penis
Fornix	the recess of the vagina that surrounds the cervix	Vestibule	the region between the labia minora, holding the vaginal and urethral openings
Hymen	the thin fold of mucous membrane that partly closes the vaginal opening	Greater vestibular glands	the Bartholin's glands beside the vaginal opening, which secrete lubricating mucus
Mons pubis	the cushion of fatty tissue over the pubic symphysis	Perineum	the diamond-shaped region holding the external genitalia and anus, split into a urogenital triangle and an anal triangle
Labia majora	the two larger, hair-covered folds of skin; homologous to the scrotum		
Labia minora	the two smaller, hairless folds within the labia majora		

The Mammary Glands

The mammary glands lie in the breasts, over the chest muscles. They are modified sweat glands that produce milk.

Mammary glands	the modified sweat glands of the breast that produce milk	Lactiferous ducts	the ducts that carry milk from the lobes toward the nipple
Lobes	the 15 to 20 or more compartments of the mammary gland, each divided into lobules	Nipple	the pigmented projection where the lactiferous ducts open
Lobules	the subdivisions of a lobe, containing the milk-secreting alveoli	Areola	the circular pigmented area of skin around the nipple
Alveoli	the small sacs of glandular tissue that secrete milk	Suspensory ligaments	the Cooper's ligaments that support the breast

Common Disorders of the Female Reproductive System

Compare the common disorders of the female reproductive system by the structure each one affects.

DISORDER	WHAT IT IS
Endometriosis	endometrial tissue grows outside the uterus, on the ovaries or pelvic lining
Ovarian cysts	fluid-filled sacs that form on or in an ovary
Uterine fibroids	non-cancerous tumors of the smooth muscle of the myometrium
Pelvic inflammatory disease	an infection that spreads through the uterus, tubes, and ovaries
Cervical cancer	a malignant tumor of the cervix
Ectopic pregnancy	an embryo implants outside the uterus, most often in a uterine tube
Breast cancer	a malignant tumor of the mammary gland tissue

Open pathways and shed linings

The female tract has an open route to the abdomen. The **infundibulum** opens into the pelvic cavity rather than sealing onto the ovary, which is how an oocyte is caught, but also how infection can climb from the vagina through the uterus and tubes to cause **pelvic inflammatory disease**.

The same open route explains **ectopic pregnancy**. If a fertilized ovum is delayed in the **uterine tube**, it can implant there instead of in the uterus, in a narrow tube never built to hold it.

The **endometrium** is built in two layers for a reason. The stratum functionalis is shed and rebuilt each cycle from the permanent stratum basalis, so the lining can renew itself month after month.

Study questions

Work on answering these in writing, in your own words. They are the questions to bring to class, and good practice for the reasoning the exams ask for.

1. Trace the path of an oocyte from the ovary to the uterus, naming each structure.
2. Name the layers of the uterine wall and what each one contributes.
3. Compare the ovarian and the uterine cycles, and describe how they line up in time.
4. Explain how the structure of the ovary changes across one cycle.

Pregnancy and Birth

Pregnancy and Birth

A reference for the pregnancy and birth video and lab. This page covers fertilization and implantation, the stages of prenatal development, the placenta and fetal membranes, the gravid uterus, and the stages of labor.

- BY THE END**
1. Describe fertilization and implantation.
 2. Order the stages of prenatal development from zygote to fetus.
 3. Name the placenta and the fetal membranes and what each does.
 4. Describe the gravid uterus and the three stages of labor.

Pregnancy and Birth, an Overview

Pregnancy begins at fertilization and ends at birth. Over those months a single cell becomes a fetus, supported by a temporary set of structures built just for the pregnancy.

Pregnancy	the period from fertilization to birth, during which a fetus develops in the uterus	Embryo	the developing offspring during the first 8 weeks after fertilization
Gestation	the length of a pregnancy, about 38 weeks from fertilization, or 40 weeks counted from the last menstrual period	Fetus	the developing offspring from the 9th week until birth
		Trimesters	the three roughly three-month periods that pregnancy is divided into

Fertilization and Implantation

Pregnancy begins when a sperm and an egg unite. The new cell divides as it travels, and about a week later it embeds itself in the wall of the uterus.

Fertilization	the union of a sperm and an egg, normally in the ampulla of the uterine tube	Blastocyst	the hollow ball of cells that reaches the uterus, with an inner cell mass and an outer layer
Zygote	the single cell formed at fertilization	Inner cell mass	the cluster of cells of the blastocyst that becomes the embryo
Cleavage	the series of rapid cell divisions the zygote undergoes as it travels toward the uterus	Trophoblast	the outer layer of the blastocyst that becomes the fetal part of the placenta
Morula	the solid ball of cells produced by cleavage	Implantation	the embedding of the blastocyst into the endometrium, about a week after fertilization

Stages of Prenatal Development

From one cell to a newborn, development passes through a fixed set of stages. Follow them in order.

- 1 **Zygote** the single cell formed when a sperm and an egg unite
- 2 **Cleavage** rapid cell divisions produce a solid ball of cells, the morula
- 3 **Blastocyst** a hollow ball of cells that reaches the uterus and implants in the endometrium
- 4 **Embryo** from implantation through week 8; the organs and body systems form
- 5 **Fetus** from week 9 until birth; the body grows and the systems mature
- 6 **Birth** the fetus is delivered, ending the gestation

The Placenta and Fetal Membranes

A pregnancy builds temporary structures that support the fetus and are discarded at birth. Compare the placenta and the fetal membranes.

STRUCTURE	WHAT IT IS	ROLE
Placenta	the disc-shaped organ that forms during pregnancy	exchanges oxygen, nutrients, and wastes between the mother's blood and the fetus's blood
Umbilical cord	the cord linking the fetus to the placenta	carries the two umbilical arteries and the umbilical vein
Amnion	the innermost fetal membrane	forms the fluid-filled sac that surrounds the fetus
Amniotic fluid	the fluid within the amnion	cushions the fetus, lets it move, and allows even growth
Chorion	the outermost fetal membrane	contributes the fetal portion of the placenta
Yolk sac	an early fetal membrane	forms the earliest blood cells and the germ cells

The Gravid Uterus and Fetal Position

The uterus changes more than any other organ during pregnancy, and the fetus settles into position for birth.

Gravid uterus	the uterus during pregnancy, which enlarges enormously to hold the growing fetus	Vertex position	the head-down position most fetuses settle into by late pregnancy, ready for birth
The expanding uterus	by full term it reaches up to the rib cage, pushing the abdominal organs aside	Breech position	a position in which the buttocks or feet, rather than the head, are nearest the cervix
Cervical changes	the cervix stays firm and closed through pregnancy, then softens and thins as birth approaches	Lightening	the descent of the fetus lower into the pelvis as birth nears

Labor and Birth

Labor is the process of birth. It is divided into three stages, which follow in a fixed order.

- ① **Dilation stage** regular contractions thin and open the cervix until it is fully dilated; the longest stage
- ② **Expulsion stage** strong contractions push the fetus through the cervix and vagina; it ends with the birth of the baby
- ③ **Placental stage** contractions continue and expel the placenta, now called the afterbirth

Labor	the process by which the fetus and placenta are expelled from the uterus	Cesarean section	surgical delivery of the fetus through an incision in the abdominal and uterine walls
Afterbirth	the placenta and attached membranes, expelled in the placental stage		

Disorders of Pregnancy

Compare the common conditions of pregnancy by the structure or stage each one affects.

CONDITION	AFFECTED STRUCTURE OR STAGE	WHAT IT IS
Ectopic pregnancy	the implantation site	the embryo implants outside the uterus, most often in a uterine tube; a structural emergency
Miscarriage	the pregnancy	the loss of a pregnancy before the fetus can survive on its own
Placenta previa	the placenta	the placenta lies over the cervical opening and can block the birth canal
Preeclampsia	the mother's blood pressure	a serious condition of later pregnancy marked by high blood pressure
Gestational diabetes	blood sugar control	high blood sugar that first develops during pregnancy

CONDITION	AFFECTED STRUCTURE OR STAGE	WHAT IT IS
Breech presentation	fetal position	the fetus is positioned buttocks or feet first, which can complicate a vaginal delivery

Temporary structures, lasting clues

The **placenta** is the exchange organ of pregnancy, and where it sits matters. In placenta previa it lies over the cervix, blocking the path the baby would take, which is why position is checked on ultrasound and may call for a cesarean section.

The **amniotic sac** normally stays sealed until labor. Its rupture, felt as the "water breaking," releases the amniotic fluid and signals that birth is near. A sample of that fluid can also be drawn, in amniocentesis, to study the fetus.

The **fetal membranes** and placenta are built for one pregnancy and discarded at birth as the afterbirth. Examining the delivered placenta afterward gives clues to how the pregnancy went, a temporary organ read like a record.

Study questions

Work on answering these in writing, in your own words. They are the questions to bring to class, and good practice for the reasoning the exams ask for.

1. Trace the events from fertilization to implantation, naming where each one occurs.
2. Name the structures of the placenta and explain what passes between mother and fetus.
3. Compare the fetal circulatory shortcuts with the circulation after birth.
4. Name the three stages of labor and what happens in each.

Endocrine Anatomy

Endocrine Anatomy

A reference for the endocrine anatomy video and lab. This page covers the endocrine glands, where each one sits in the body, and the gross anatomy of the pituitary, thyroid, parathyroid, adrenal, and pancreatic glands. Hormone action belongs to physiology and is not covered here.

- BY THE END**
1. Name the major endocrine glands and locate each one in the body.
 2. Describe the gross anatomy of the pituitary gland and its connection to the hypothalamus.
 3. Identify the parts of the thyroid, parathyroid, adrenal, and pancreatic glands.
 4. Name organs that are not endocrine glands but still contain endocrine tissue.

The Endocrine System, an Overview

The endocrine system is a scattered set of glands and tissues that signal the body by releasing hormones into the blood. This page covers where those glands sit and how each one is built.

Endocrine system	the glands and tissues that release hormones into the blood to signal distant cells	Exocrine gland	by contrast, a gland that secretes through a duct onto a surface; not part of the endocrine system
Hormone	a chemical messenger released by an endocrine cell that travels in the blood to act on target cells	Target cell	a cell that carries the receptor for a given hormone and therefore responds to it
Endocrine gland	a ductless gland that secretes its product directly into the surrounding fluid and blood		

The Major Endocrine Glands

The pure endocrine glands do nothing but make hormones. They are spread from the brain to the pelvis. Compare them by where each one sits.

GLAND	LOCATION	NOTE	MAIN SECRETIONS
Hypothalamus	the floor and walls of the third ventricle, in the diencephalon of the brain	links the nervous and endocrine systems and directs the pituitary	releasing and inhibiting hormones; makes ADH and oxytocin
Pituitary gland	in the sella turcica of the sphenoid bone, hanging below the hypothalamus	the small gland the hypothalamus controls	anterior: GH, TSH, ACTH, FSH, LH, prolactin; posterior: releases ADH and oxytocin
Pineal gland	the posterior roof of the third ventricle, in the brain	a small, cone-shaped gland of pinealocytes, often with calcified corpora arenacea (brain sand)	melatonin
Thyroid gland	the anterior neck, just below the larynx, wrapped around the trachea	the largest purely endocrine gland	thyroid hormone (T3, T4); calcitonin
Parathyroid glands	the posterior surface of the thyroid gland, usually four small glands	tiny glands embedded behind the thyroid	parathyroid hormone (PTH)
Thymus	the mediastinum, behind the sternum	large in childhood, shrinks after puberty	thymosins
Adrenal glands	one capping the superior pole of each kidney	also called the suprarenal glands	cortex: aldosterone, cortisol, androgens; medulla: epinephrine, norepinephrine
Pancreatic islets	scattered through the pancreas, behind the stomach	the endocrine portion of the pancreas	insulin, glucagon, somatostatin
Ovaries	the female pelvis, one on each side of the uterus	the female gonads	estrogen, progesterone
Testes	the scrotum	the male gonads	testosterone

The Pituitary Gland

The pituitary gland, or hypophysis, is about the size of a pea. It sits in the sella turcica and hangs from the hypothalamus by a stalk. Its two lobes come from two different tissues.

Hypophysis	another name for the pituitary gland	Hypophyseal portal system	the set of blood vessels that carries hypothalamic signals directly to the anterior lobe
Sella turcica	the saddle-shaped pocket of the sphenoid bone that cradles and protects the pituitary	Adenohypophysis (anterior lobe, pars distalis)	the glandular anterior lobe; on a slide its cells sort into acidophils (pink/red), basophils (blue/purple), and pale chromophobes
Infundibulum	the slender stalk that connects the pituitary to the hypothalamus above it	Neurohypophysis (posterior lobe, pars nervosa)	the neural posterior lobe, made of nerve fibers and supporting pituicytes

Compare the two lobes by the tissue they are made of and how each connects to the hypothalamus.

LOBE	OTHER NAME	TISSUE	LINK TO THE HYPOTHALAMUS
Anterior lobe	adenohypophysis	glandular epithelial tissue	the hypophyseal portal system, a set of blood vessels
Posterior lobe	neurohypophysis	nervous tissue, an extension of the hypothalamus itself	a tract of nerve fibers running down through the infundibulum

The Thyroid and Parathyroid Glands

The thyroid gland sits across the front of the trachea, and the four small parathyroid glands are embedded in its back surface.

The thyroid gland			
Thyroid gland	the largest purely endocrine gland, two lateral lobes lying against the trachea below the larynx	Thyroid follicles	the microscopic hollow spheres that make up the gland
Isthmus	the bridge of thyroid tissue, crossing the front of the trachea, that connects the two lobes	Colloid	the protein-rich fluid stored in the center of each follicle
		Follicular cells	the cells forming the wall of a follicle
		Parafollicular cells	also called C cells, scattered between the follicles

The parathyroid glands			
Parathyroid glands	usually four small, round glands on the posterior surface of the thyroid lobes	Oxyphil cells	the larger, pink-staining cells scattered among the chief cells; their function is uncertain
Chief cells	the main hormone-producing cell of the parathyroid glands		

The Adrenal Glands

An adrenal, or suprarenal, gland caps the top of each kidney. Each gland is really two glands in one: an outer cortex and an inner medulla, formed from different tissues.

Adrenal cortex	the outer region and the bulk of the gland, glandular tissue arranged in three layered zones	Chromaffin cells	the modified sympathetic neurons of the medulla that secrete epinephrine and norepinephrine
Adrenal medulla	the inner core, modified nervous tissue that belongs to the sympathetic nervous system		

The cortex is built in three zones. Follow them in order, from the surface inward.

- Zona glomerulosa** the thin outer zone, just beneath the connective tissue capsule

- 2 **Zona fasciculata** the thick middle zone, the widest of the three, its cells in straight columns
- 3 **Zona reticularis** the inner zone, a branching network of cells against the medulla

The Pancreas and the Gonads

The pancreas and the gonads are mixed organs. Each does an endocrine job alongside another role, so only part of the organ is endocrine tissue.

Pancreas	a soft gland behind the stomach, both an exocrine and an endocrine organ	Acini	by contrast, the exocrine clusters of the pancreas that make digestive enzymes; not endocrine tissue
Pancreatic islets	also called the islets of Langerhans, the small clusters of endocrine cells scattered through the pancreas	Ovaries	the paired female gonads in the pelvis, endocrine glands as well as reproductive organs
		Testes	the paired male gonads in the scrotum, endocrine glands as well as reproductive organs

Organs with Endocrine Tissue

Beyond the pure endocrine glands, many organs whose main job is something else still carry pockets of endocrine cells. Compare them.

ORGAN	ENDOCRINE TISSUE IT CONTAINS
Hypothalamus	neurosecretory cells; a neuroendocrine organ that controls the pituitary gland
Heart	hormone-producing cells in the wall of the atria
Kidneys	cells that release a hormone driving red blood cell production, plus an enzyme acting on blood pressure
Stomach and small intestine	scattered endocrine cells in the lining of the digestive tract
Liver	cells that contribute to a growth-related hormone and to blood pressure control
Skin	cells that begin the production of vitamin D, which acts as a hormone
Adipose tissue	fat cells that release a hormone signaling the body's energy stores
Placenta	a temporary organ of pregnancy that releases hormones supporting the pregnancy

Where a gland sits shapes its disease

The **pituitary gland** is boxed inside the bony **sella turcica**, so a pituitary tumor has nowhere to expand but upward, where it presses on the optic chiasm. A loss of peripheral vision can be the first sign that a gland the size of a pea has enlarged.

The **thyroid gland** lies just under the skin of the anterior neck, so an enlarged thyroid, a **goiter**, is visible and can be felt. The same superficial position lets a clinician palpate the gland and makes thyroid surgery accessible, though the tiny **parathyroid glands** on its back surface must be carefully spared.

Each **adrenal gland** rests on the superior pole of a kidney, which is why imaging ordered for the kidney also captures the adrenal, and why an adrenal mass is sometimes found by accident.

Study questions

Work on answering these in writing, in your own words. They are the questions to bring to class, and good practice for the reasoning the exams ask for.

1. Compare an endocrine and an exocrine gland by how each delivers its product.
2. Name the major endocrine glands and one hormone associated with each.
3. Explain the hypothalamus-to-pituitary relationship and why the pituitary is called the master gland.
4. Compare the anterior and posterior pituitary by how each releases its hormones.