

Chapter 35

Animal Reproduction and Development



Animals Reproduce Asexually or Sexually

Animals may reproduce asexually or sexually.



Section 35.1

Aphids: © The McGraw-Hill Companies, Inc., Steven P. Lynch; beetles: © Corbis RF

Animals Reproduce Asexually or Sexually

Asexual reproduction does not require a partner and produces identical or nearly identical offspring. Many of these black aphids, for example, are clones.



Animals Reproduce Asexually or Sexually

In **sexual reproduction**, both parents contribute genes to the offspring, which are genetically unique. These beetles, for example, reproduce sexually.



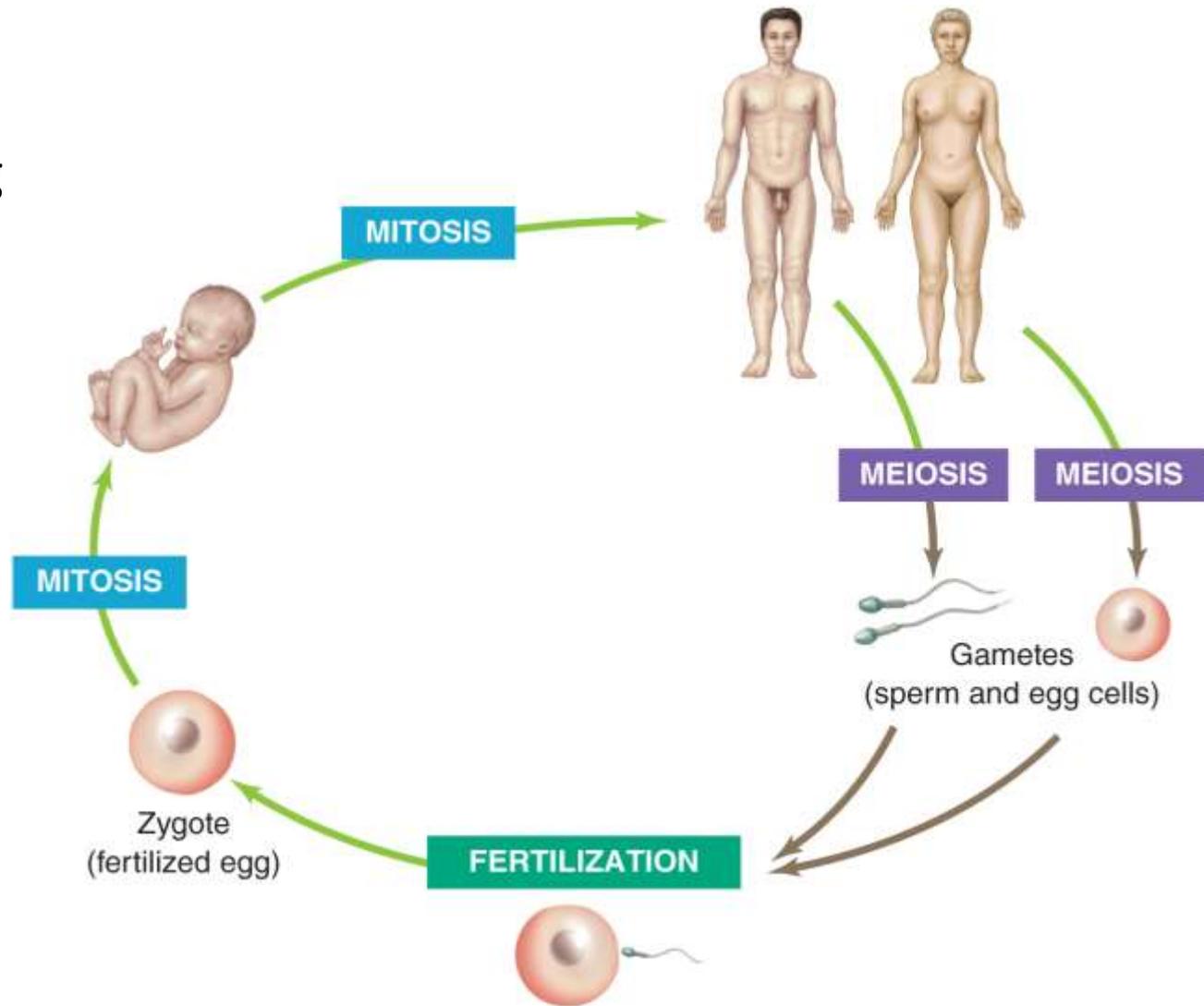
Animals Reproduce Asexually or Sexually

Although sexually reproducing individuals use energy finding and courting mates, variation among offspring is adaptive in changing environments.



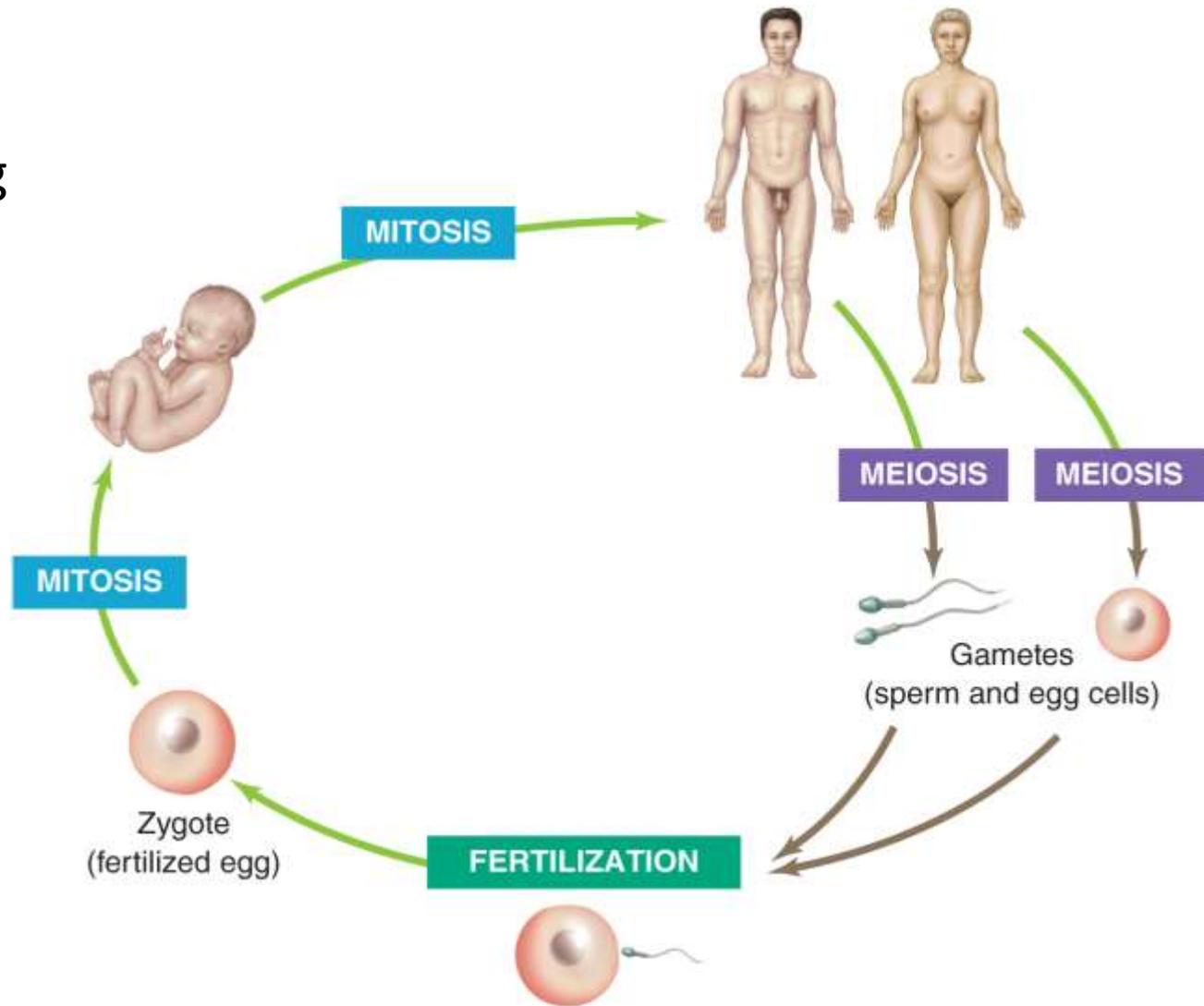
Animals Reproduce Asexually or Sexually

The gonads of sexually reproducing individuals produce haploid **gametes** by meiosis.



Animals Reproduce Asexually or Sexually

Gametes unite at **fertilization**, forming a diploid **zygote**.



Animals Reproduce Asexually or Sexually

Among sexually reproducing species, fertilization might be internal or external.

a.

b.

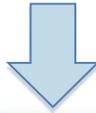
External fertilization: © Andrew J. Martinez/Science Source; stilits: © Tim Fitzharris/Minden Pictures

Figure 35.1



Animals Reproduce Asexually or Sexually

This male sea urchin is releasing sperm into the water.
If a sperm cell unites with an egg cell released from a female,
then fertilization occurs **externally**.



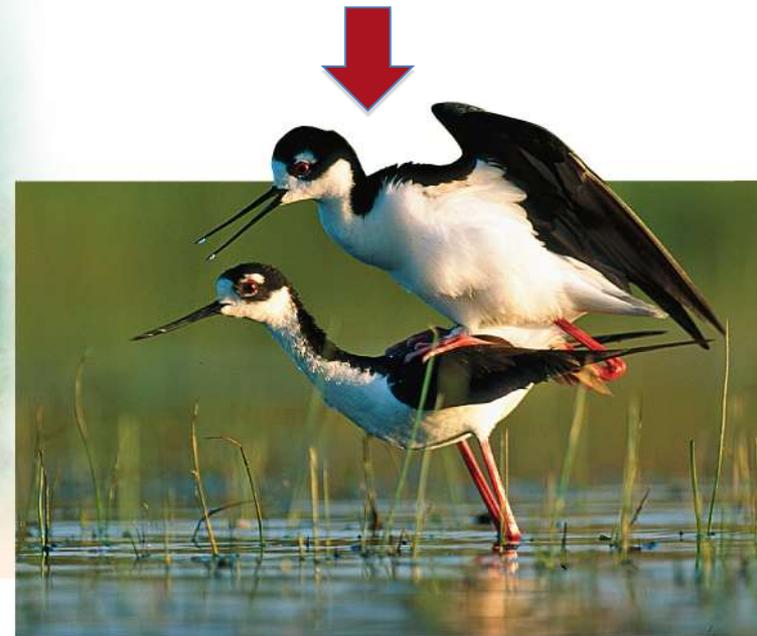
a.



b.

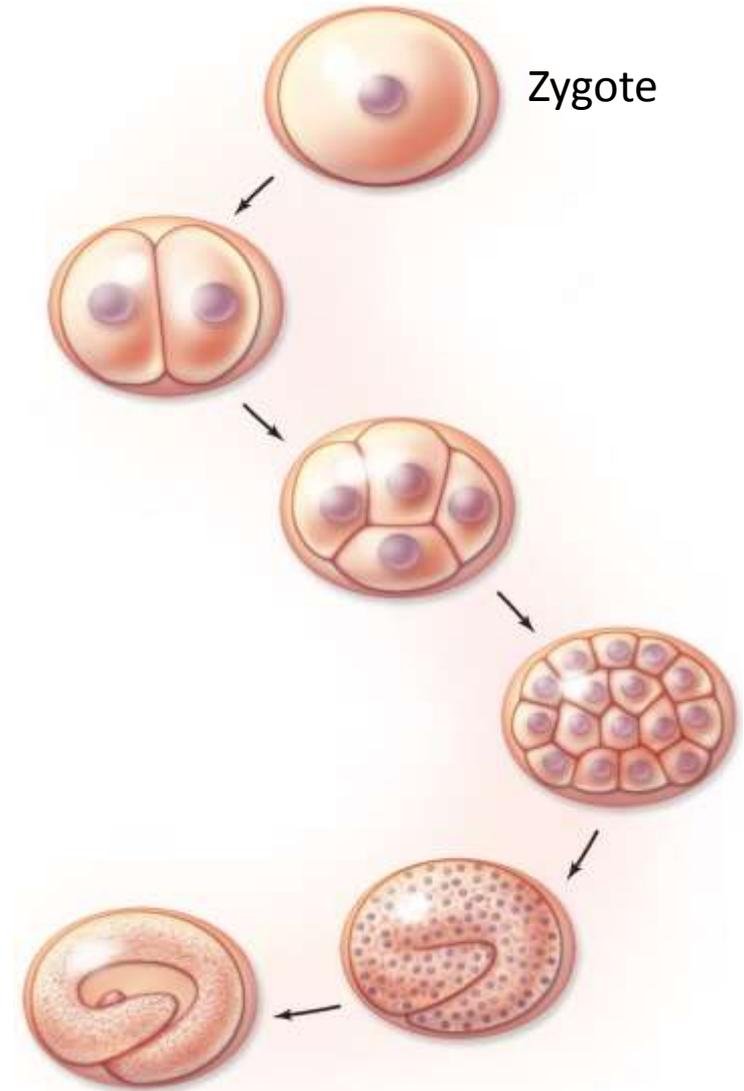
Animals Reproduce Asexually or Sexually

Internal fertilization occurs when gametes unite inside the body of one of the parents (usually the female, as in these birds).



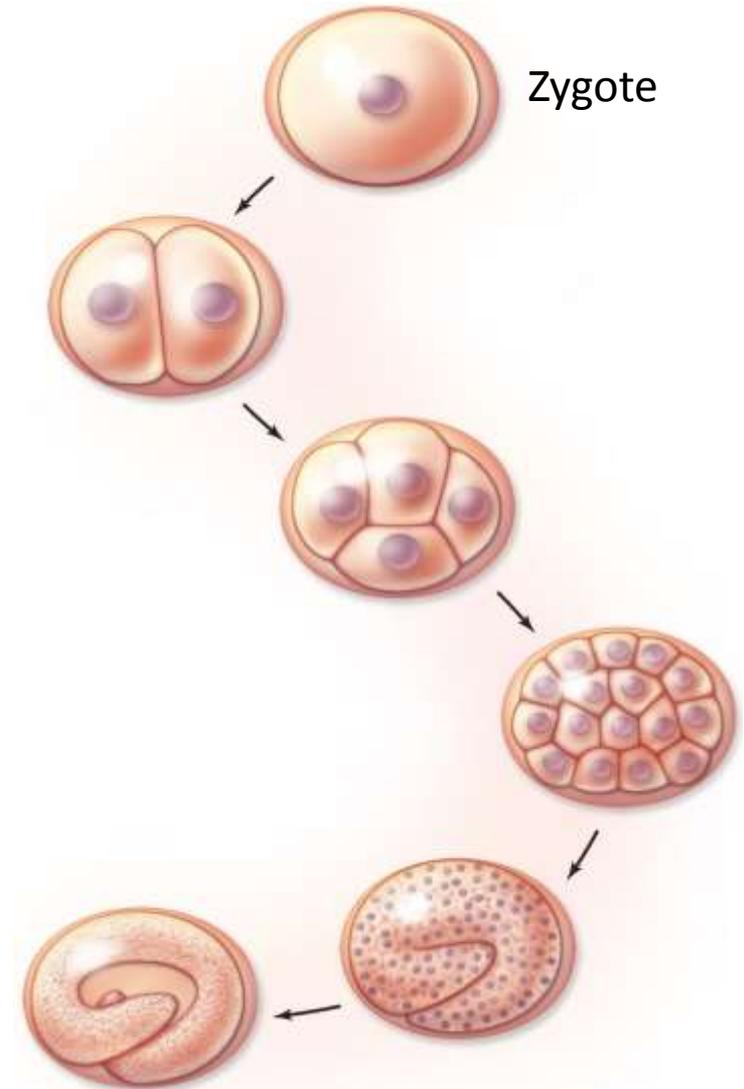
Development Begins with the Zygote

The zygote begins to divide soon after fertilization is complete.



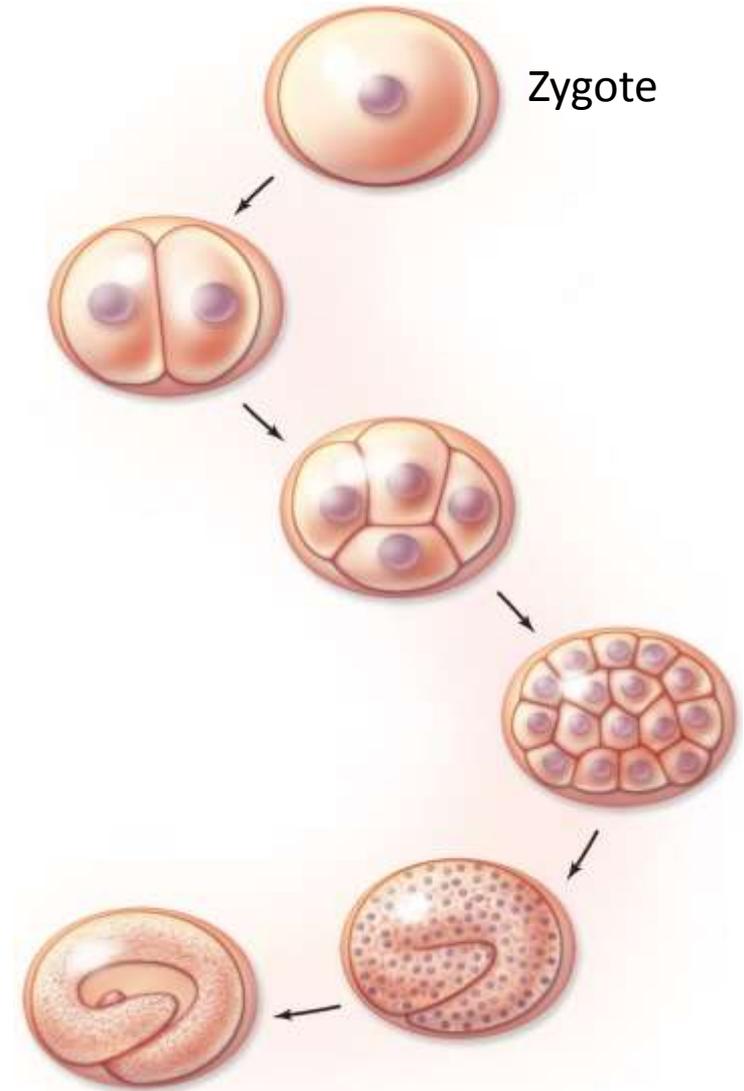
Development Begins with the Zygote

Soon, cells begin to **differentiate**, or acquire specialized functions.



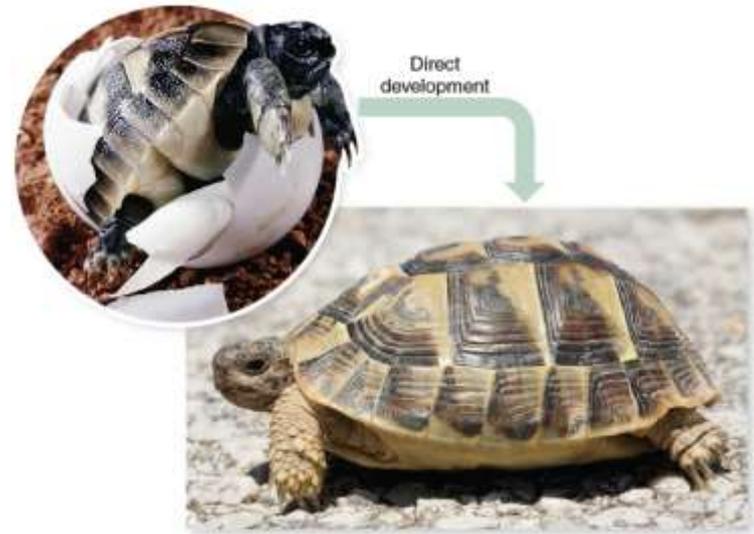
Development Begins with the Zygote

Genes then determine the overall shape and structure of the animal's body in a process called **pattern formation**.



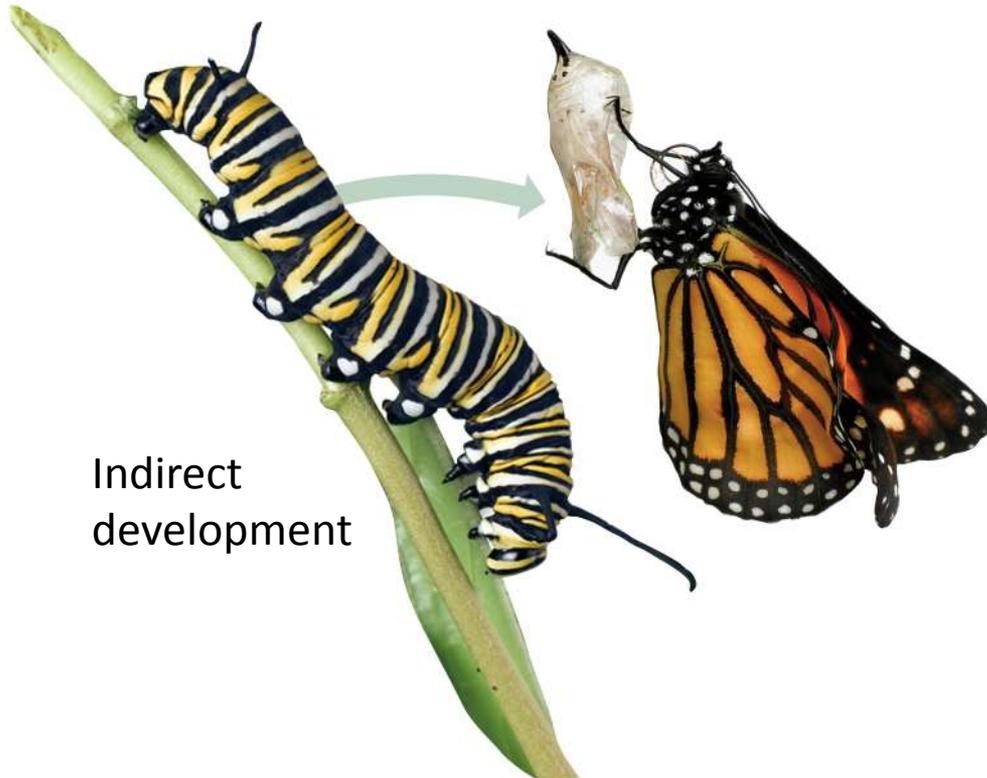
Development Begins with the Zygote

Development might be indirect or direct.

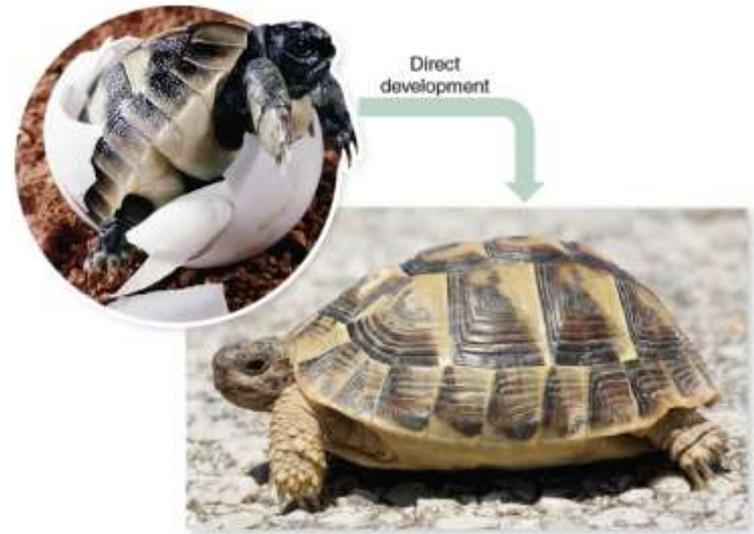


Development Begins with the Zygote

An animal that undergoes **indirect development** has an immature stage that looks different from the adult.

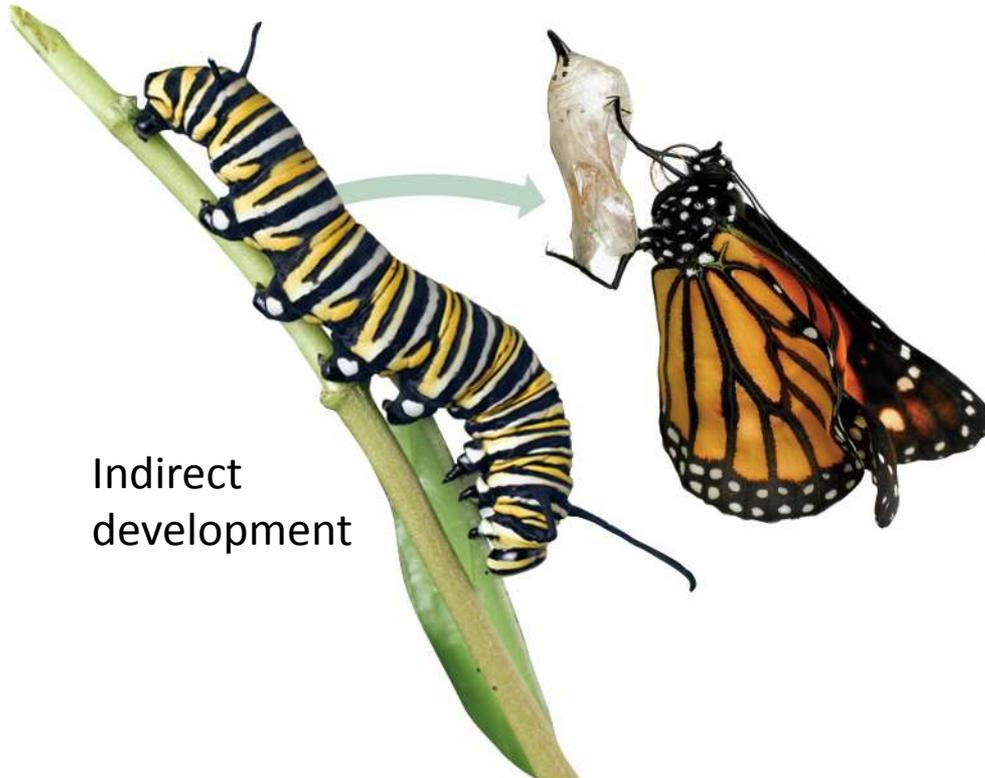


Indirect development

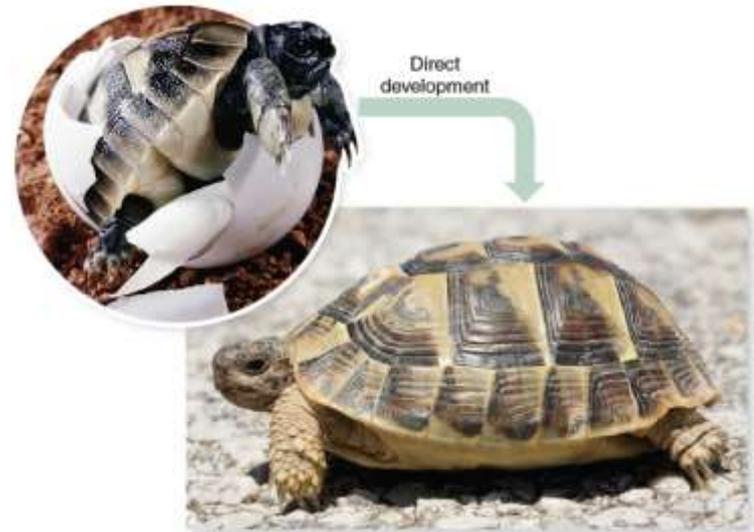


Development Begins with the Zygote

Animals undergoing **direct development** have an immature stage that looks like a small adult.



Indirect development



Direct development



Clicker Question #1

What is the role of the zygote in the sexual life cycle?

- A. It produces the male gametes.
- B. It produces the female gametes.
- C. It is the first cell of a new offspring.
- D. It is the first differentiated cell of a new offspring.
- E. It represents the last stage in reproduction before fertilization.



Clicker Question #1

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35.1 Mastering Concepts



How is internal fertilization different from external fertilization?

The Reproductive System

A Practical Guide



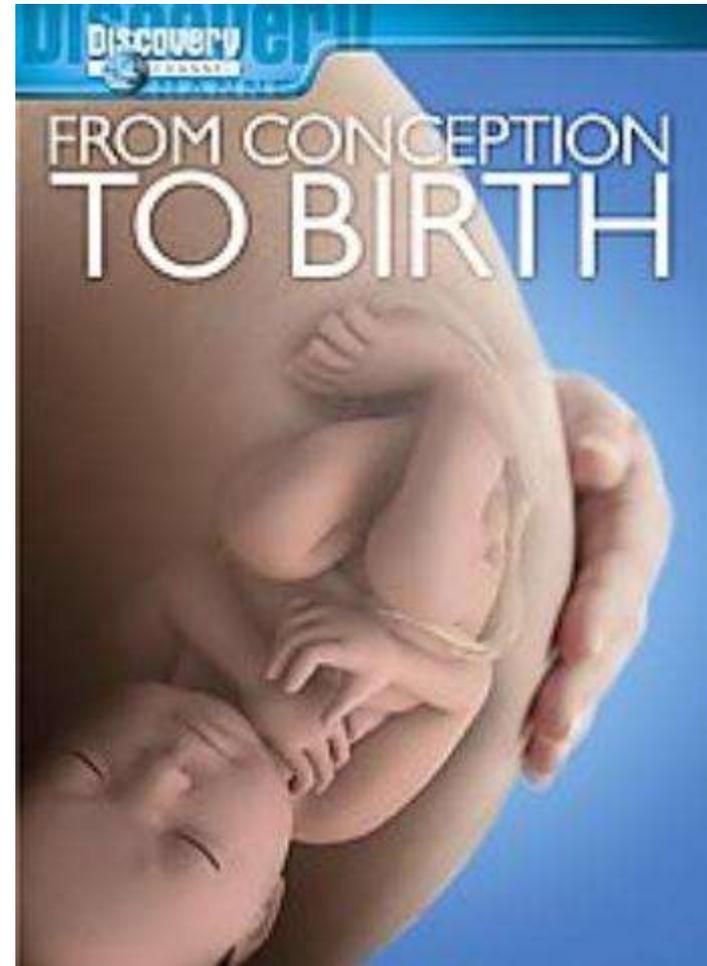
Unlike other animals, humans can **CHOOSE** when they want to reproduce.

In this chapter, we will only focus on the more practical aspects of human reproduction.

Your book may be a resource, but we will not be following it closely.

Here, you will get an overview of both the male and female reproductive system as well as a general idea of how the process of pregnancy and birth occur.

We will also be watching the video – “From Conception to Birth”



Male Reproductive System

Major Structures:

Testes

Vas Deferens

Prostate

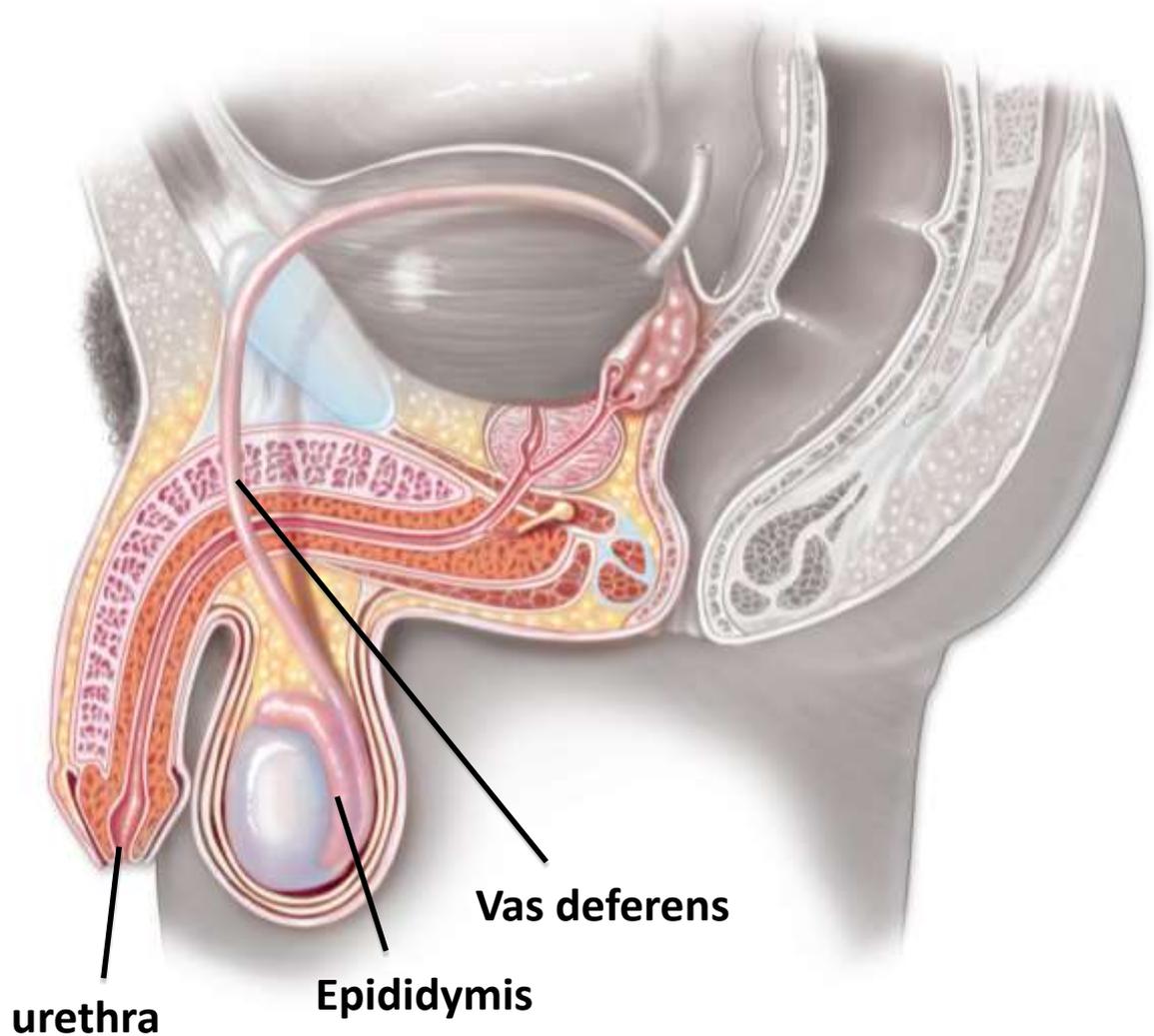
Penis



Human Reproduction: Males Anatomy

Epididymis -
collects mature sperm which is eventually propelled through the vas deferens

Vas deferens -
sperm travel through this tube, joins with urethra

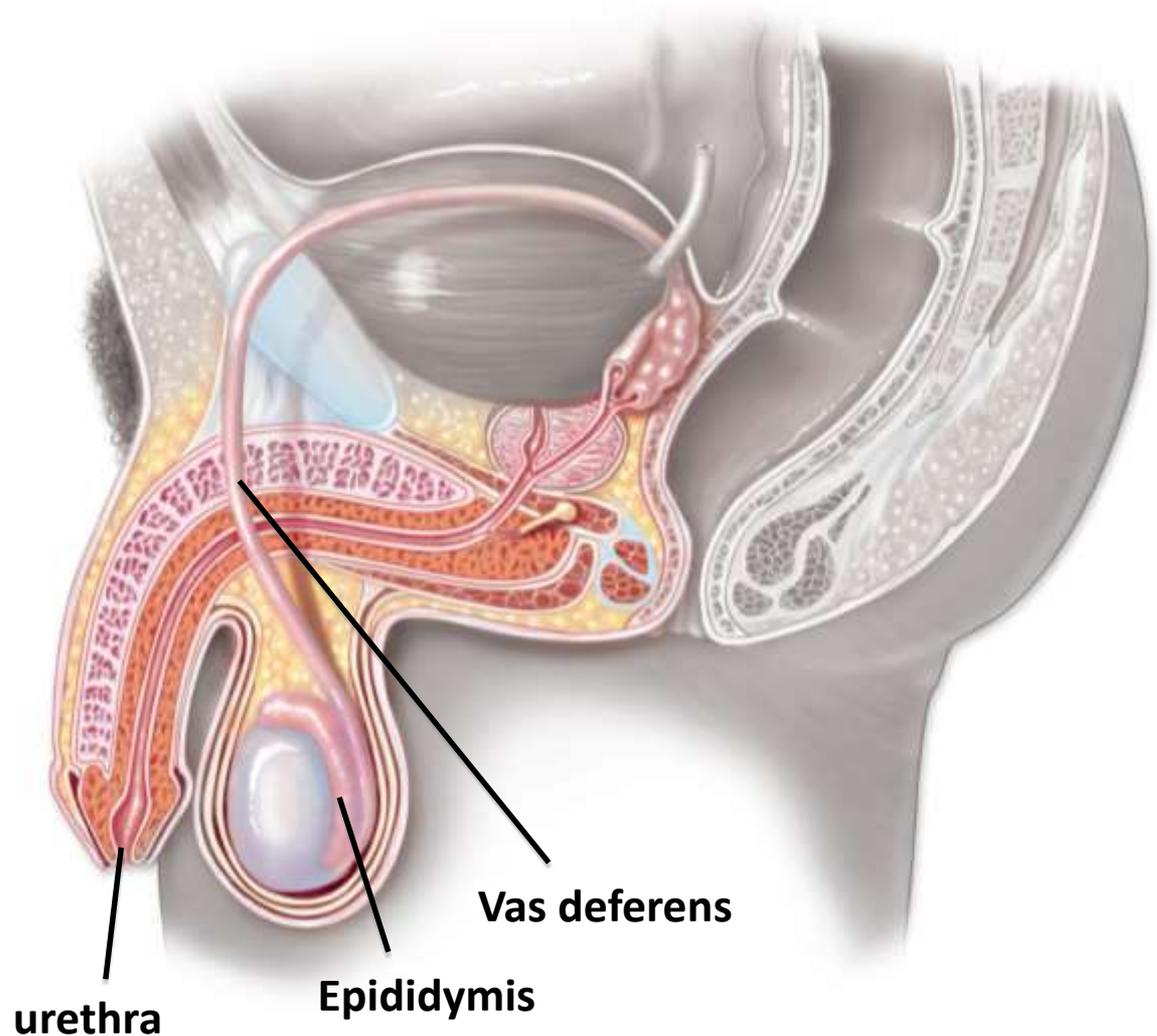


Human Reproduction: Males Anatomy

Urethra-

Tube that carries both urine and seminal fluid in the male and is usually about 15 inches in length.

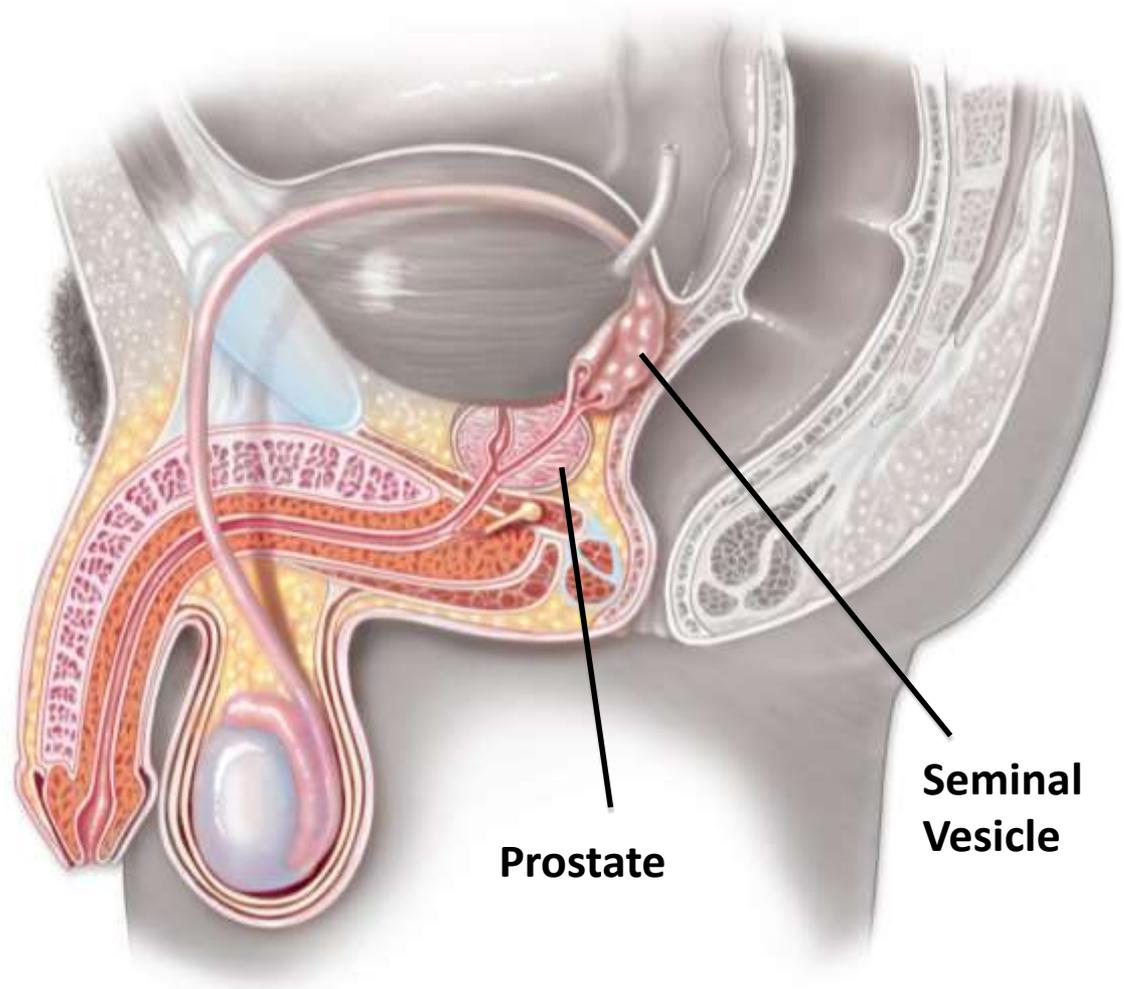
Note males cannot urinate and ejaculate at the same time.



Human Reproduction: Males Anatomy

Seminal Vesicle – holds the liquid that will mix with sperm to form semen. It is a thick fluid that contains citric acid, proteins, and sugars

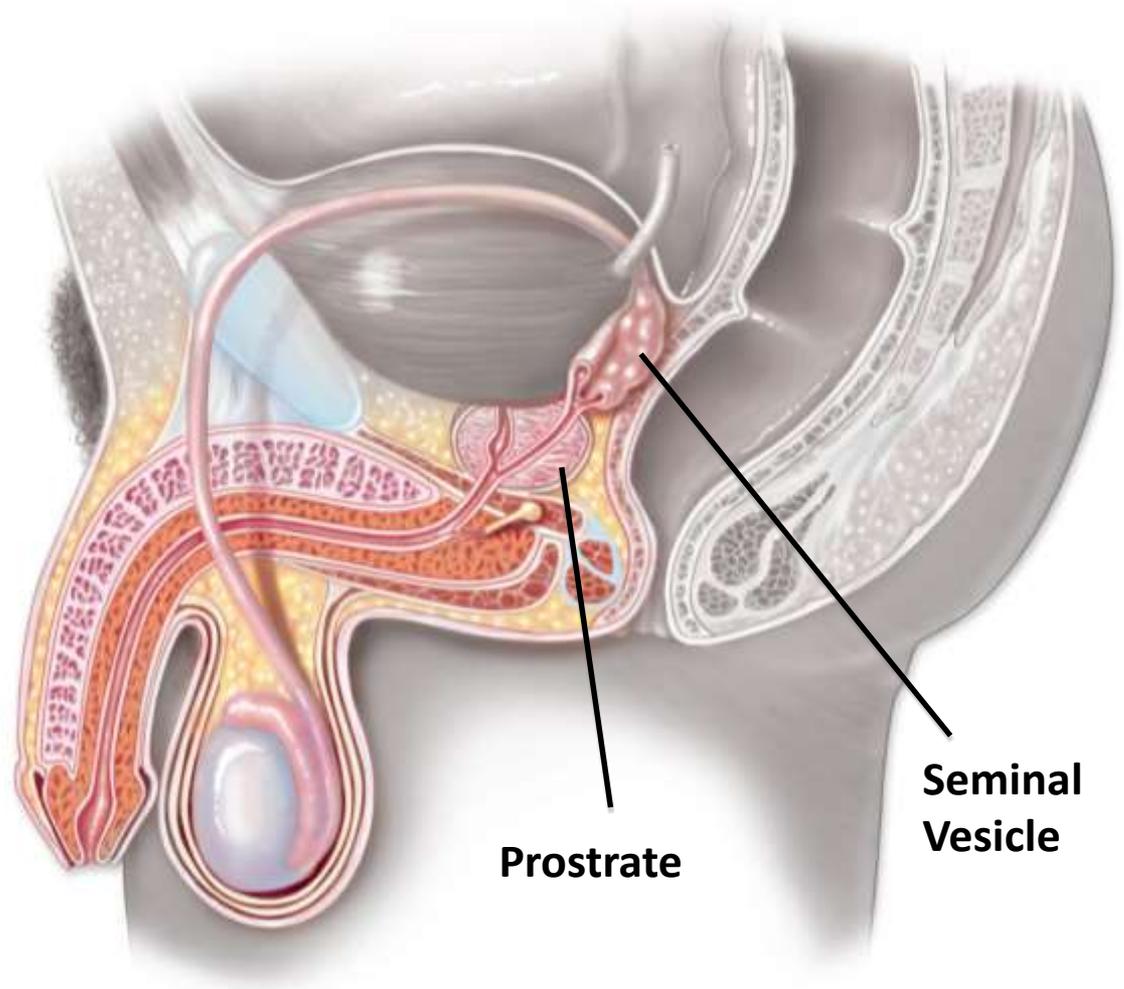
Prostate gland- sperm travel through this tube, joins with urethra



Human Reproduction: Males Anatomy

Prostate gland-

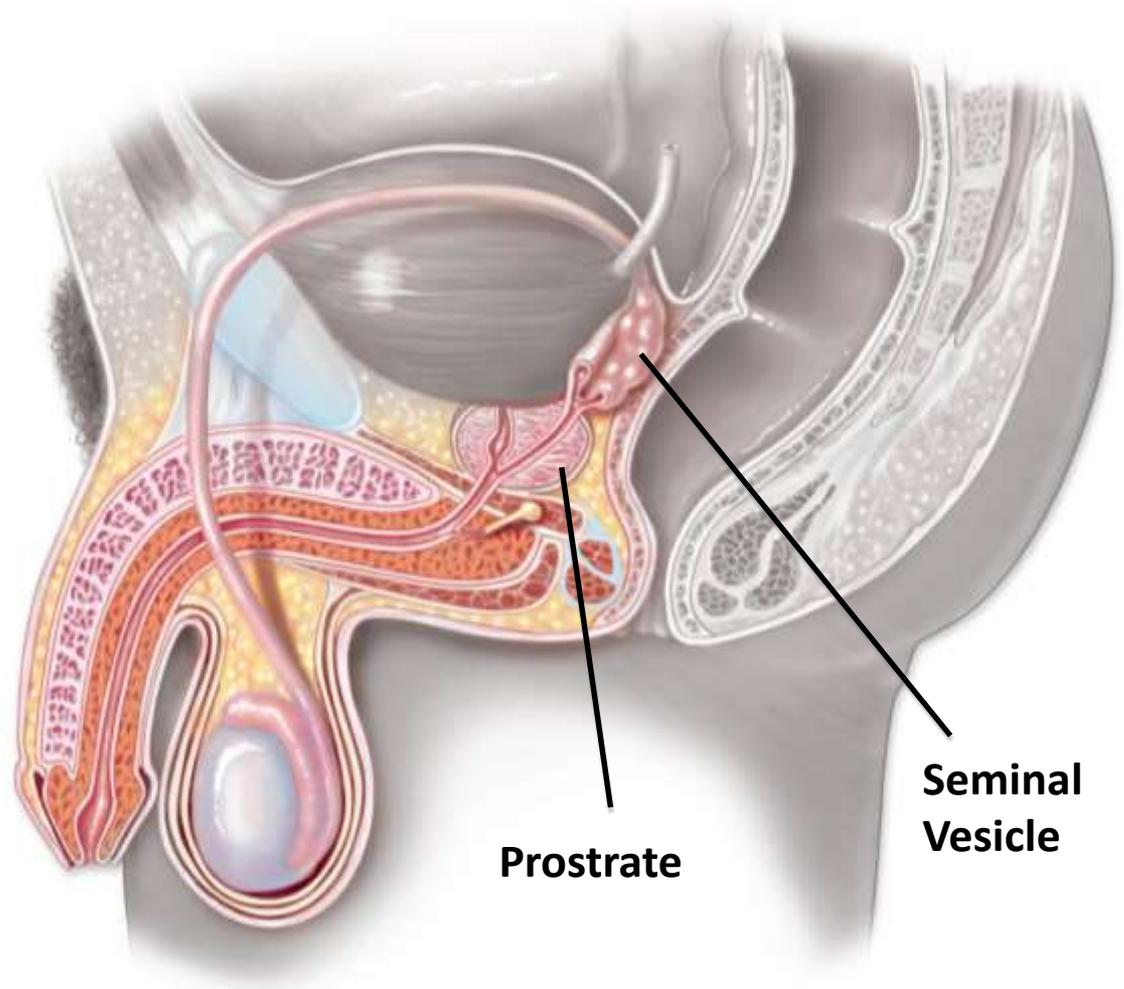
Secrets prostate fluid which is one of the components of semen and the prostate muscles help propel seminal fluid into urethra during ejaculation



Human Reproduction: Males Anatomy

Bulbourethral gland-

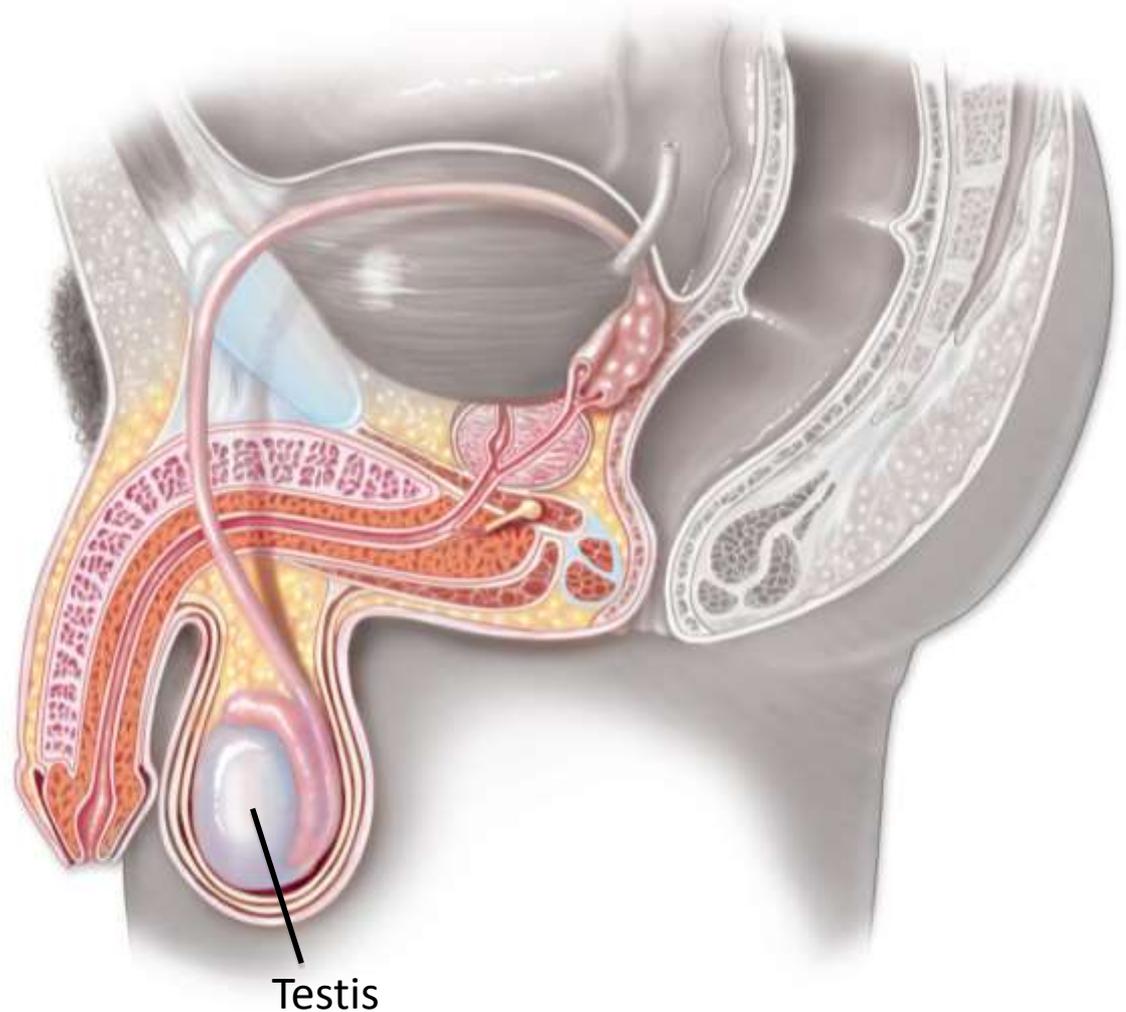
Secrets pre-ejaculate fluid that is clear and is a basic in nature to help neutralize some of the acidity of the female vagina.



Human Reproduction: Males Produce Sperm

Testosterone is responsible for many of the **secondary male characteristics** such as:

- More muscle tone
- facial hair
- auxiliary hair
- Deeper voice



Other Male Secondary Characteristics



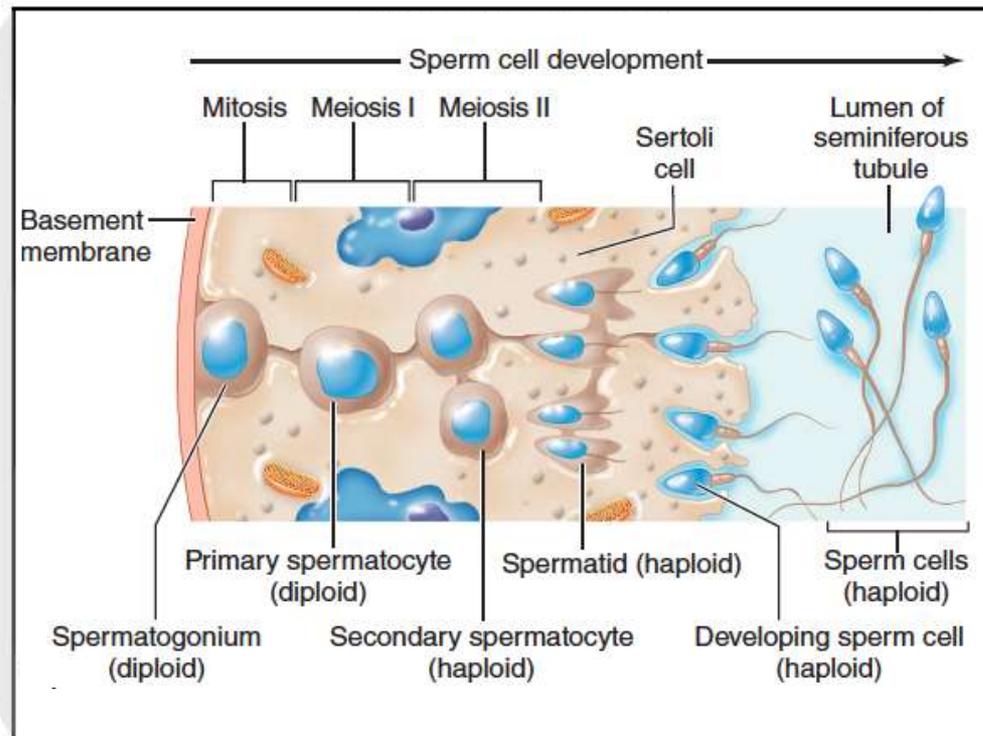
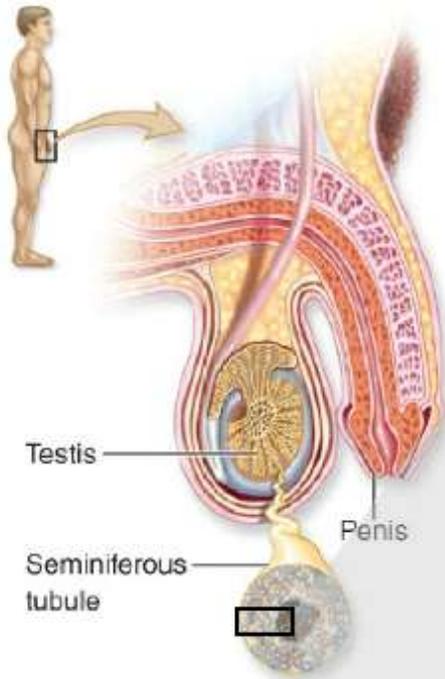
Wider shoulder to hip ratio
More muscle mass



Greater muscle mass
in front of femur bone

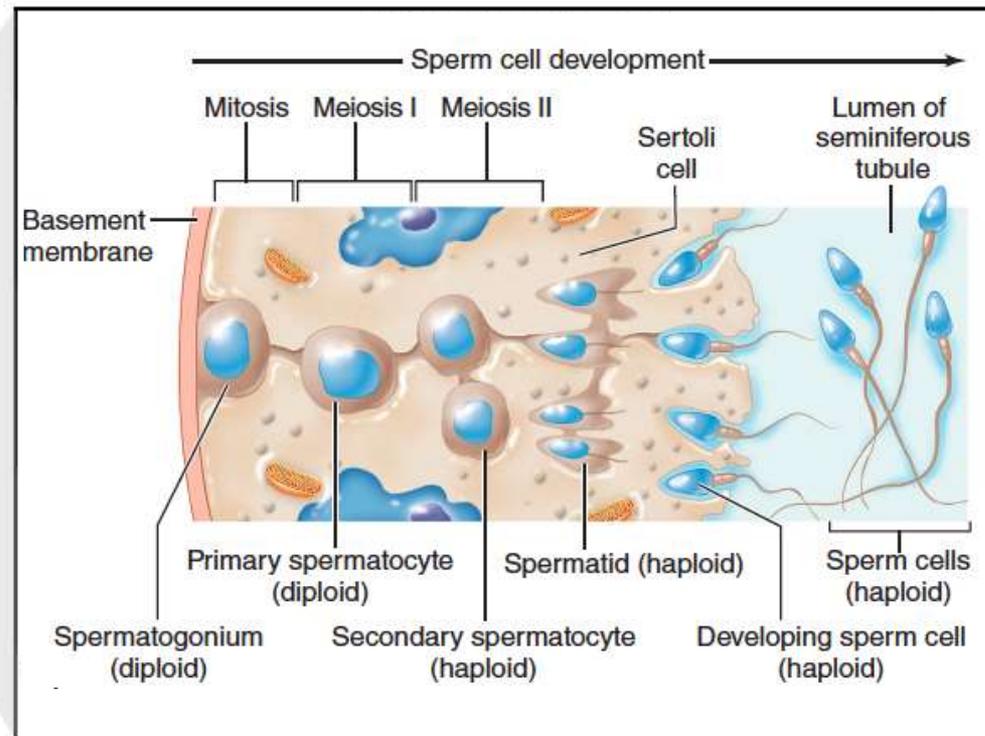
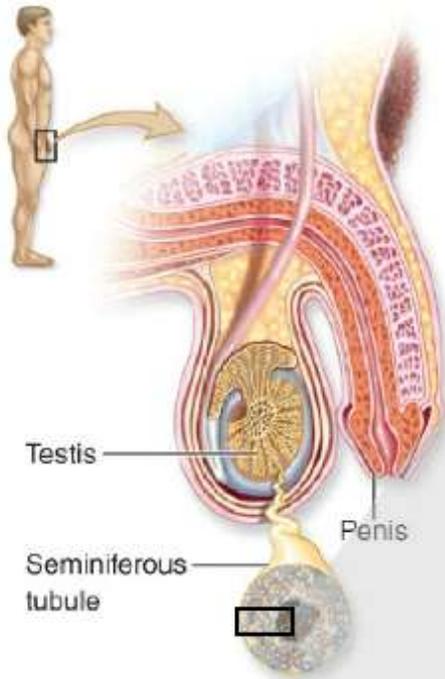
Human Reproduction: How Males Produce Sperm

Within each testis are tightly coiled **seminiferous tubules**. Sperm production occurs in the walls of these tubules.



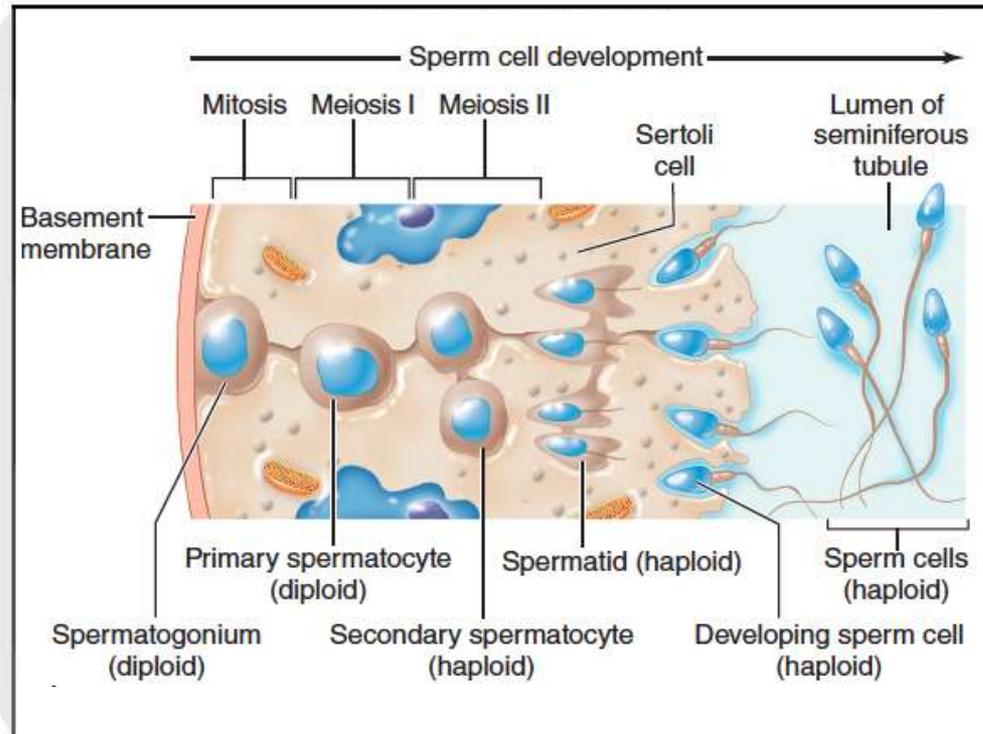
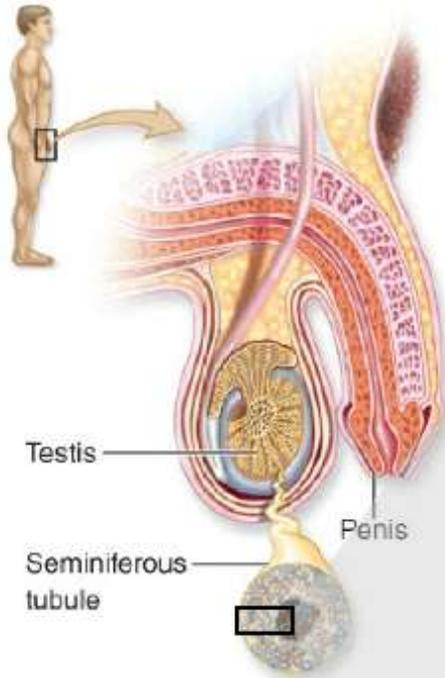
Human Reproduction: Males Produce Sperm

Sertoli cells surround, support, and nourish developing sperm cells.



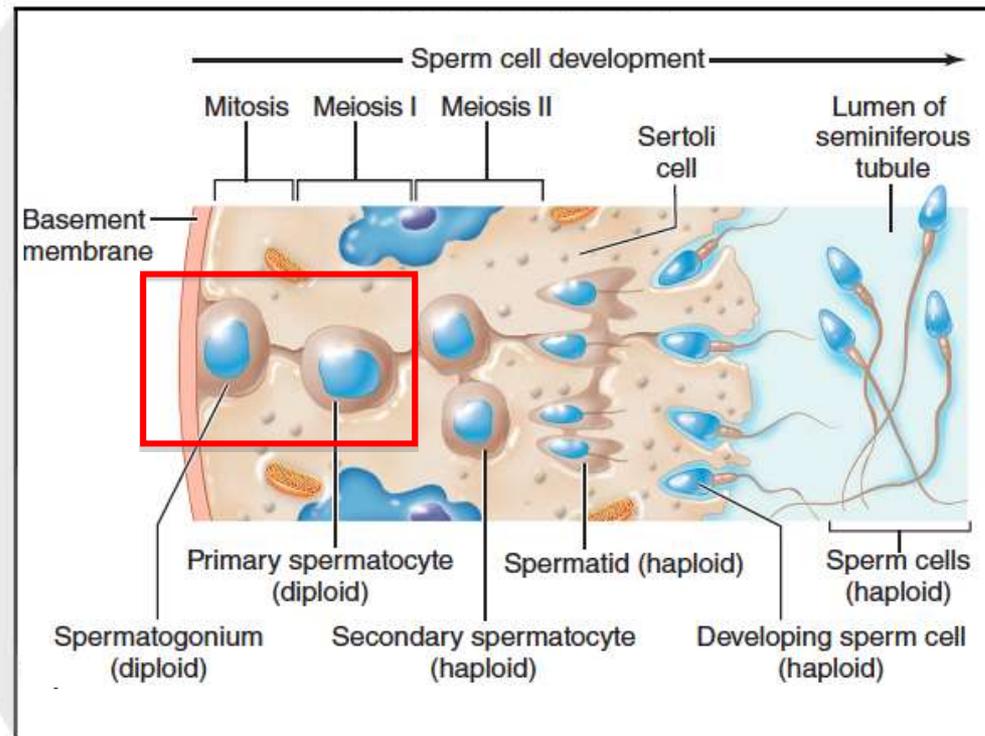
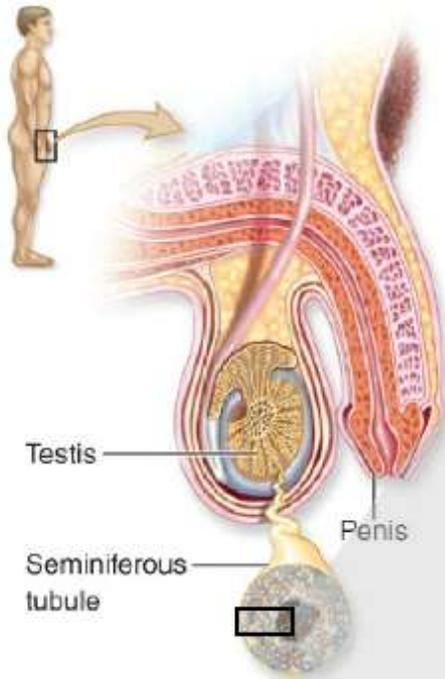
Human Reproduction: Males Produce Sperm

Leydig cells fill the spaces between tubules and secrete male sex hormones.



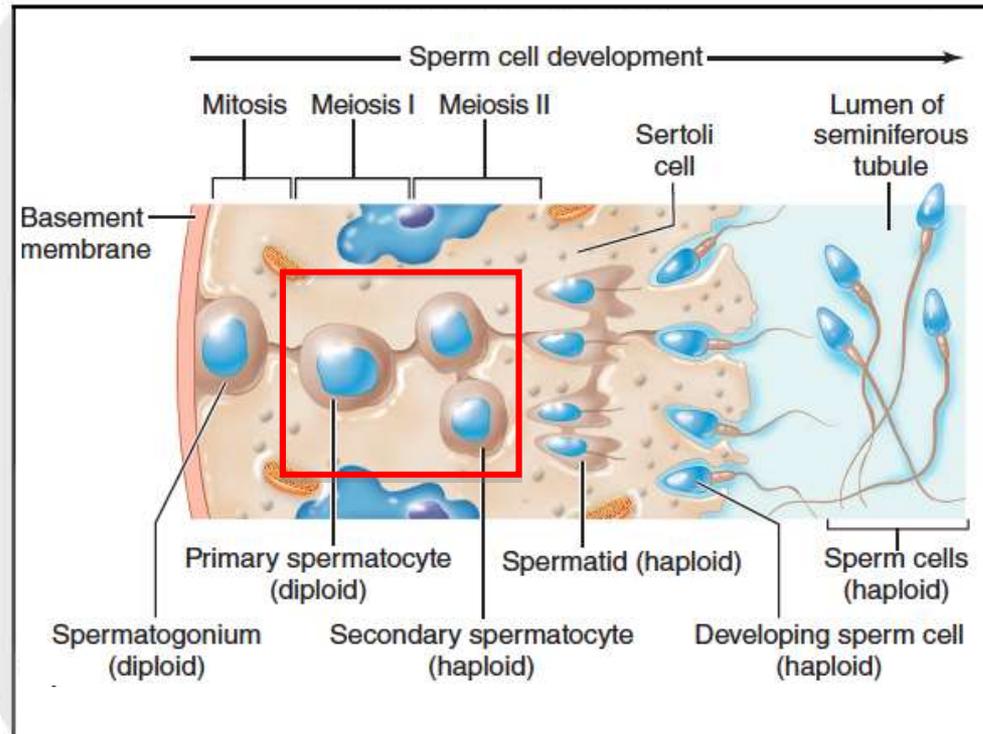
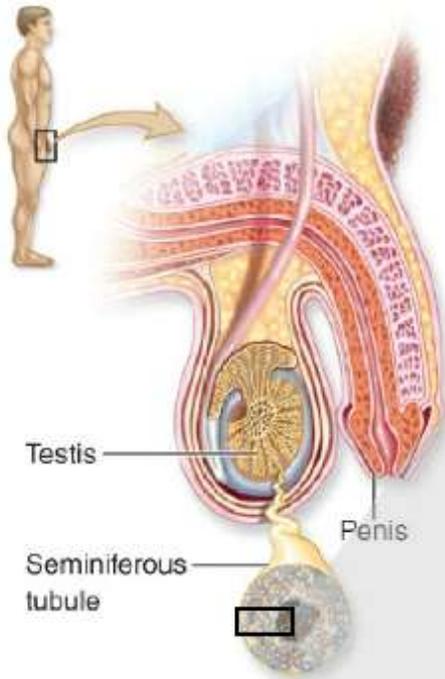
Human Reproduction: Males Produce Sperm

Diploid germ cells called **spermatogonia** divide by mitosis into **primary spermatocytes**.



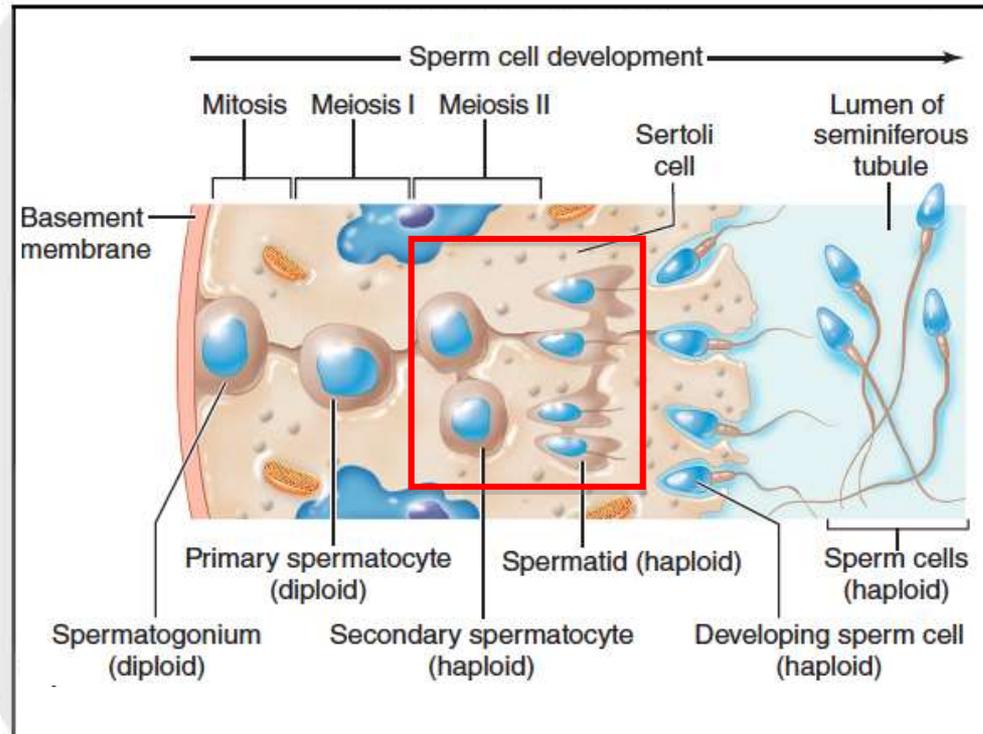
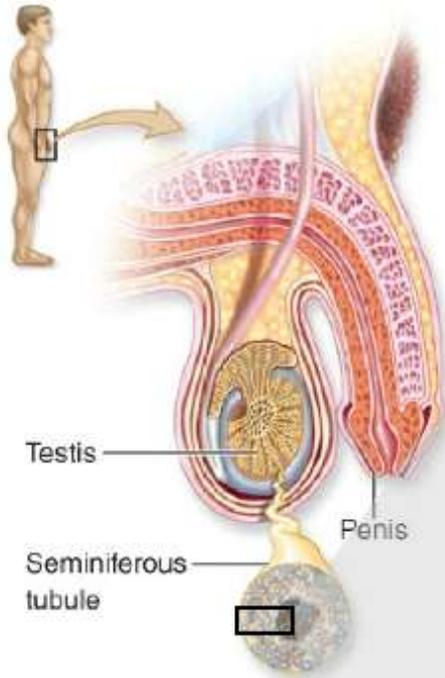
Human Reproduction: Males Produce Sperm

Each primary spermatocyte divides meiotically. Meiosis I yields two **secondary spermatocytes**.



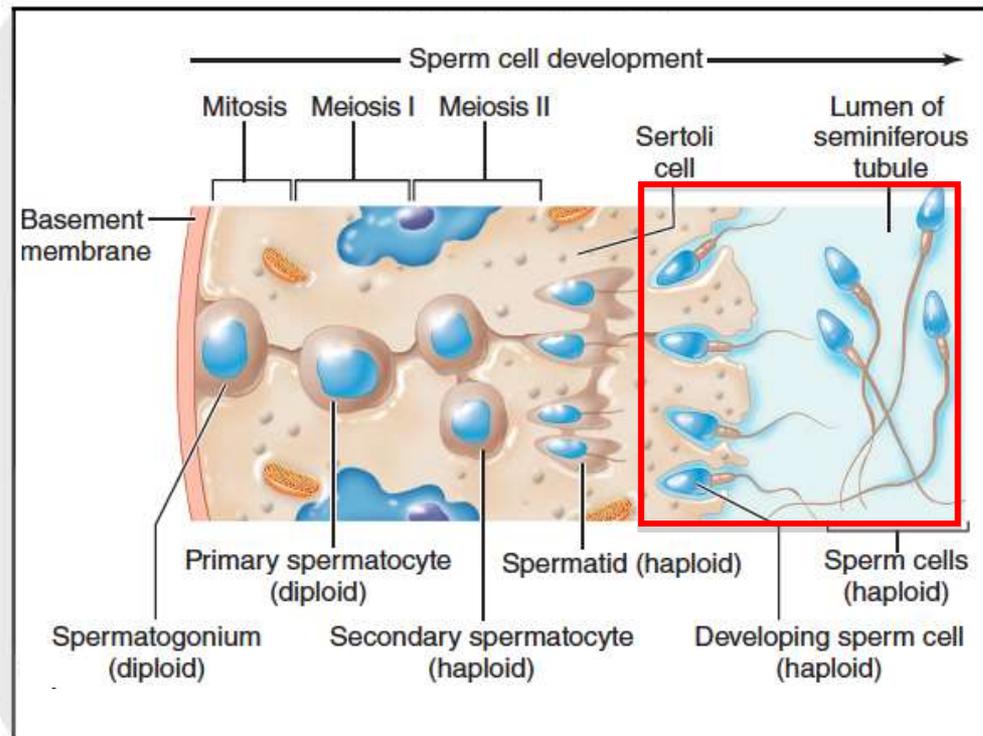
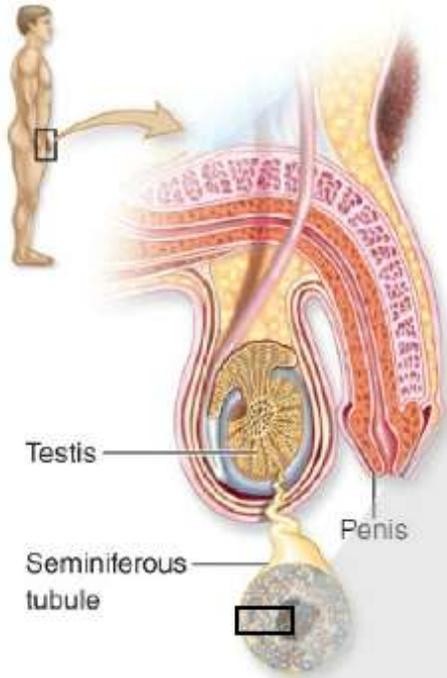
Human Reproduction: Males Produce Sperm

Secondary spermatocytes undergo meiosis II, yielding four **spermatids**.



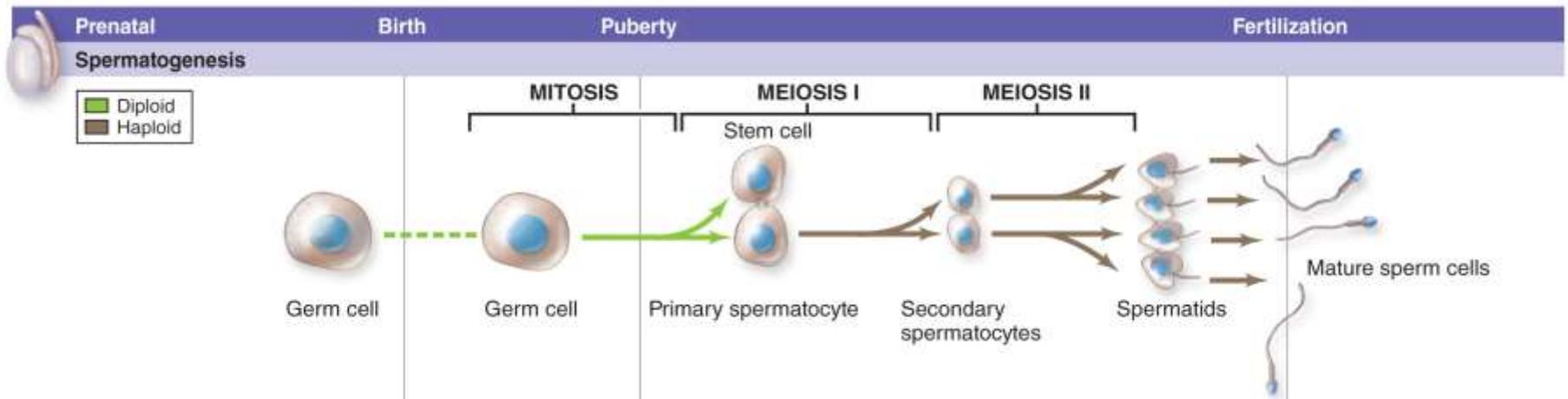
Human Reproduction: Males Produce Sperm

About 74 days after the germ cell divided, mature sperm cells are released into the lumen of the seminiferous tubule.



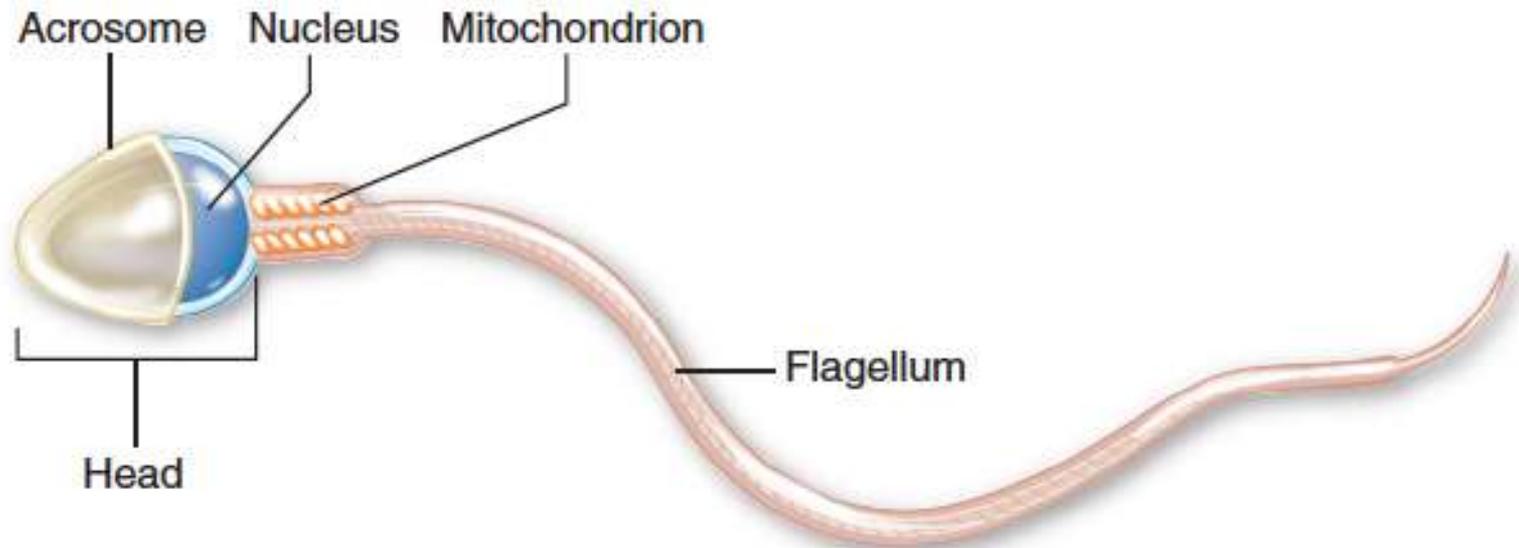
Human Reproduction: Males Produce Sperm

This diagram summarizes sperm cell development.



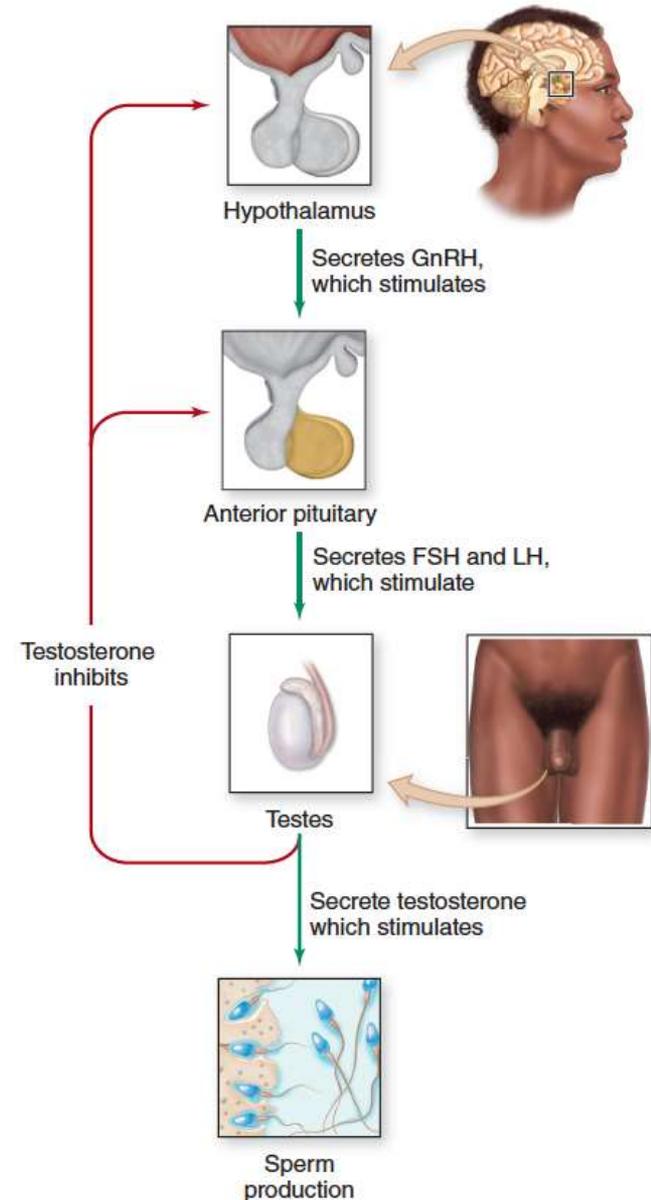
Human Reproduction: Males Produce Sperm

Each mature sperm cell has a haploid nucleus, a long flagellum, mitochondria, and a caplike **acrosome** that helps it penetrate the egg cell.



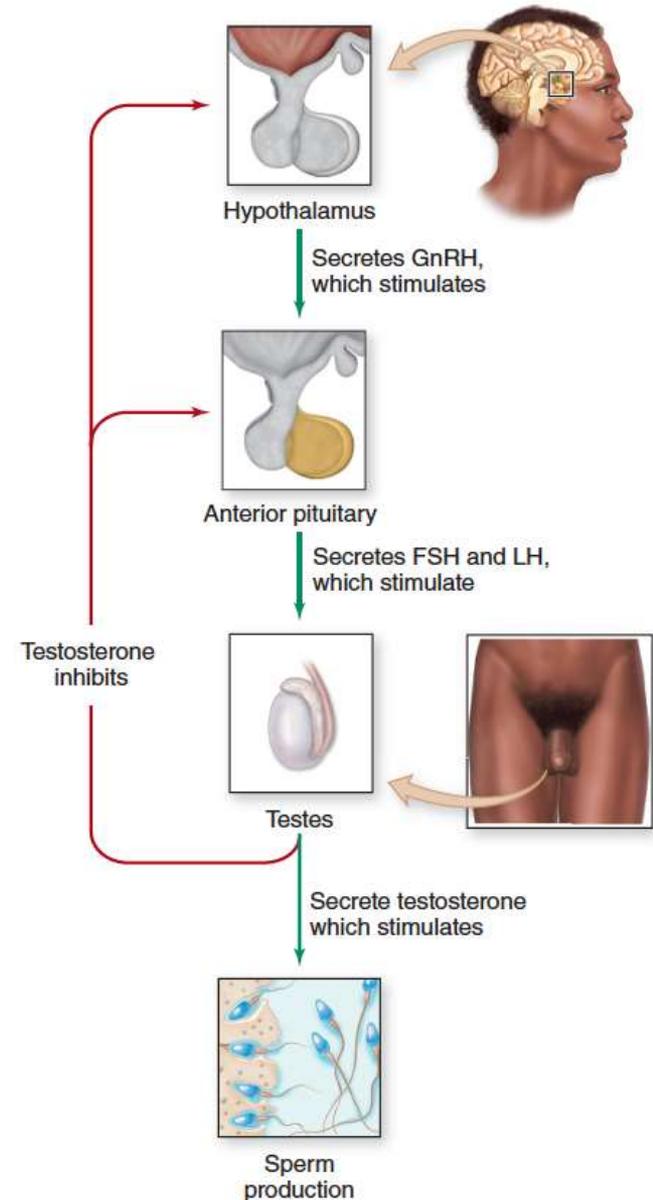
Human Reproduction: Males Produce Sperm

Hormones influence male reproductive function. The hypothalamus produces GnRH, which stimulates the anterior pituitary to release FSH and LH.



Human Reproduction: Males Produce Sperm

FSH and LH, in turn, stimulate the testes to produce testosterone, cueing sperm production.



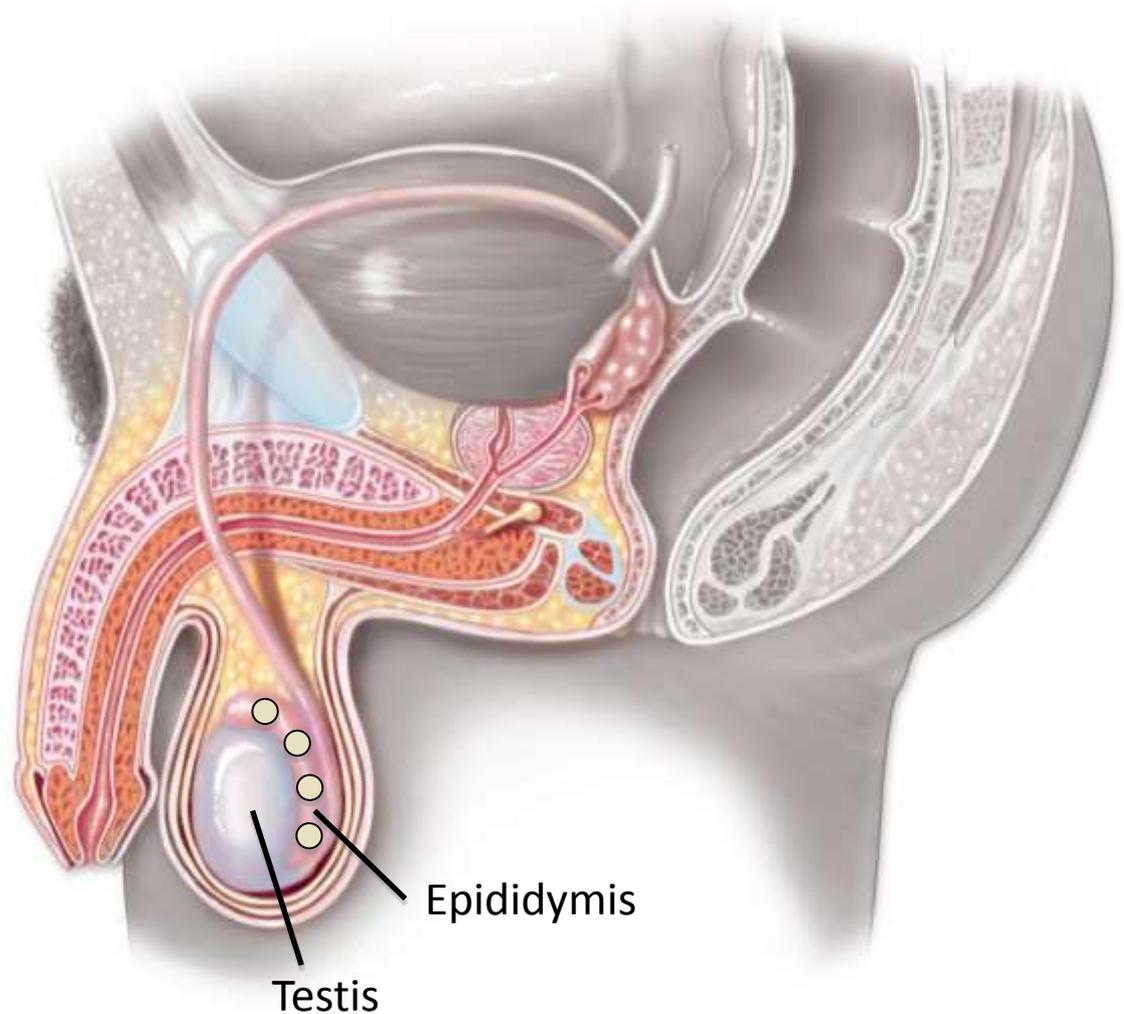
35.2 Mastering Concepts



Describe the path of sperm from the testes to the penis.

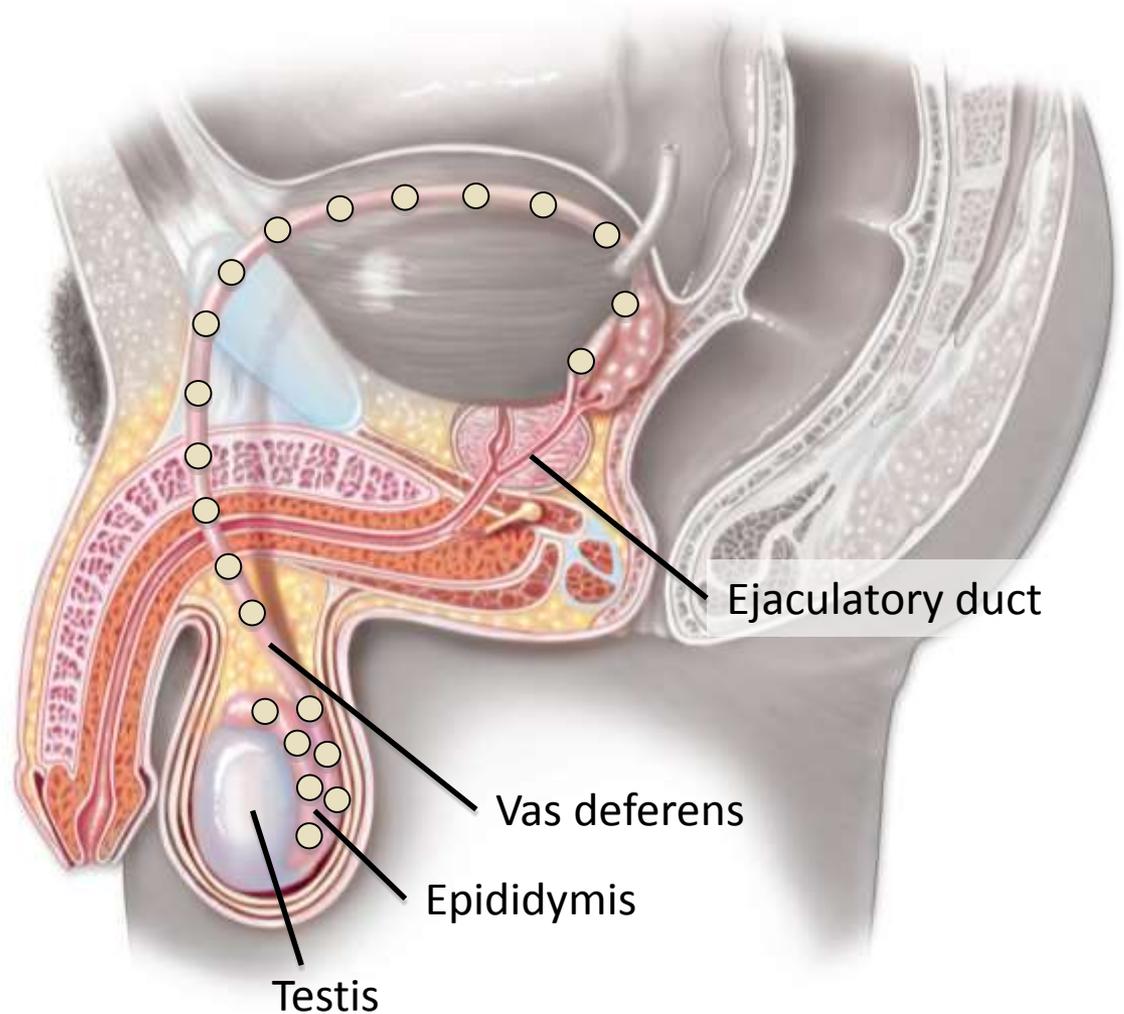
Human Reproduction: Males Produce Sperm

Sperm are made in the **testis** and are stored in the coiled tubules of the **epididymis**.



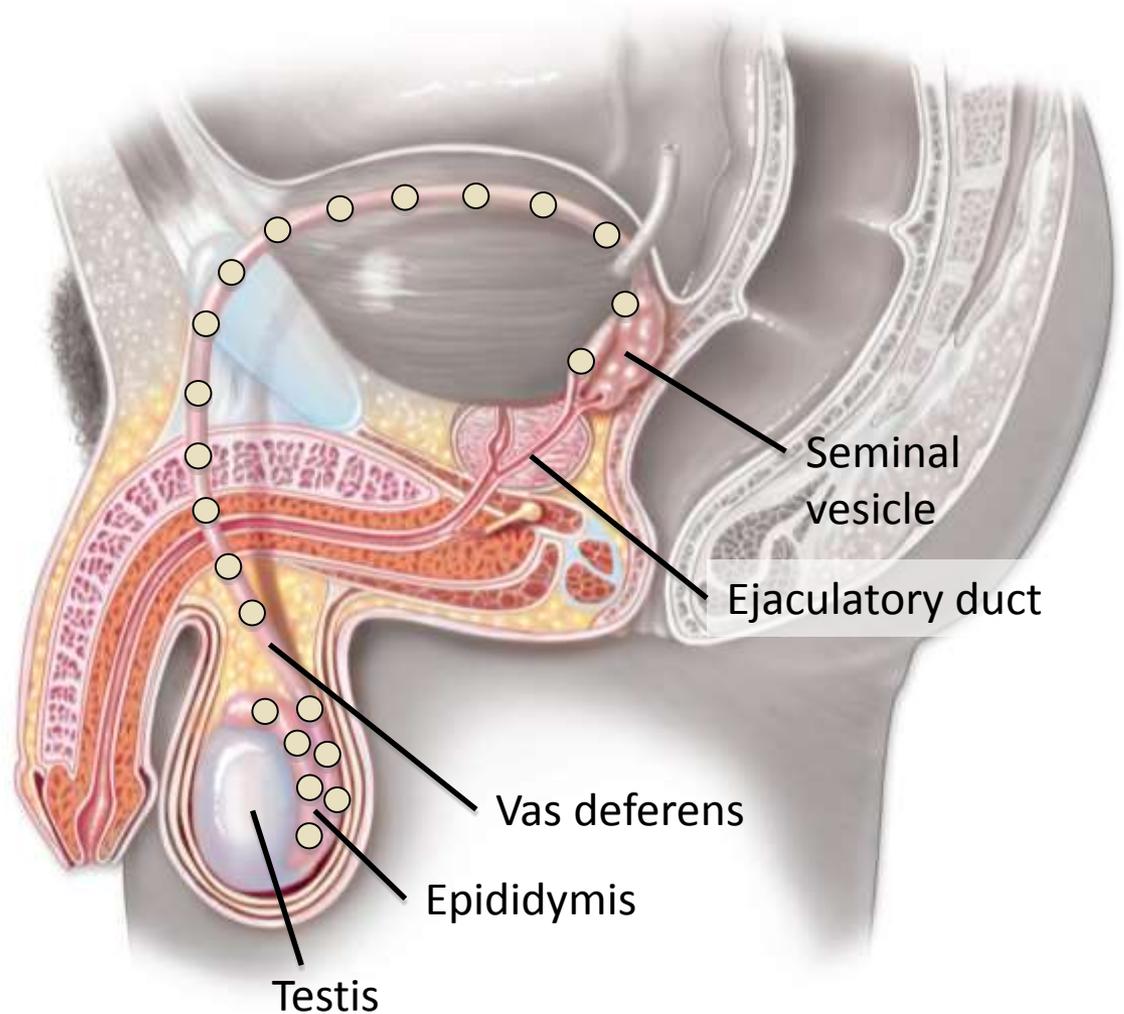
Human Reproduction: Males Produce Sperm

Sperm travel from the epididymis to a **vas deferens**, a duct that passes above the urinary bladder and connects with an **ejaculatory duct**.



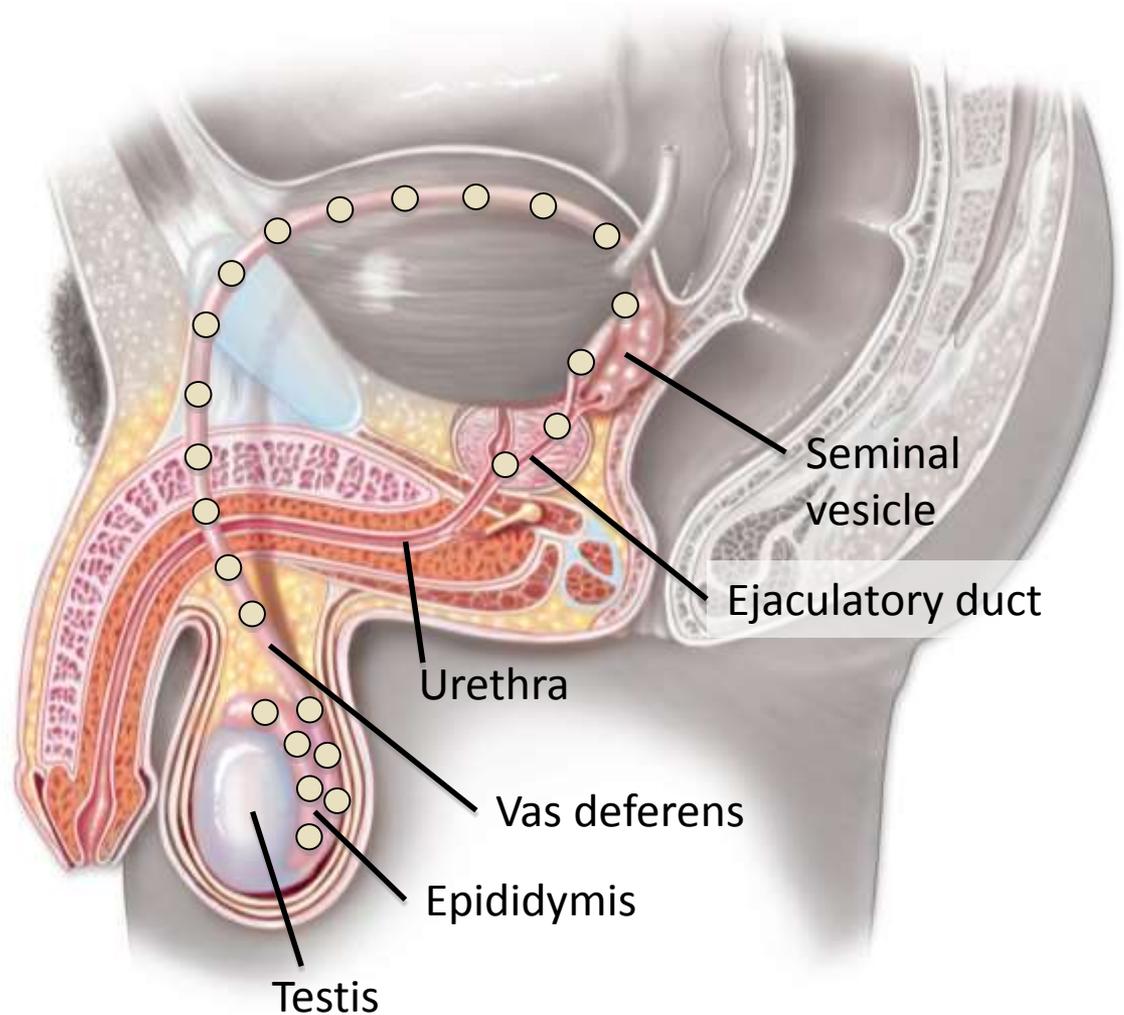
Human Reproduction: Males Produce Sperm

Near the end of each vas deferens is a **seminal vesicle**, which secretes most of the fluid in semen.



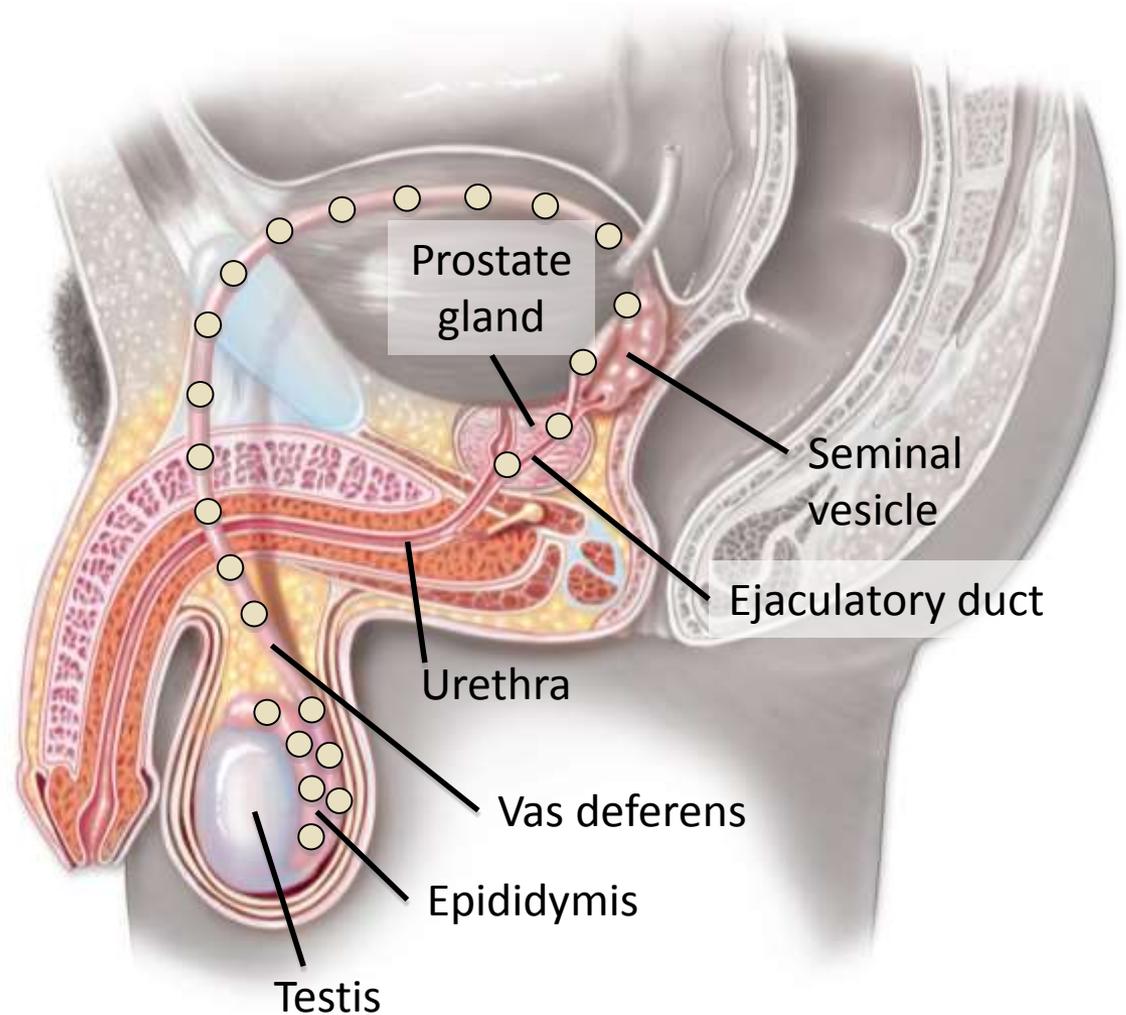
Human Reproduction: Males Produce Sperm

Sperm travel through the ejaculatory duct to the **urethra**.



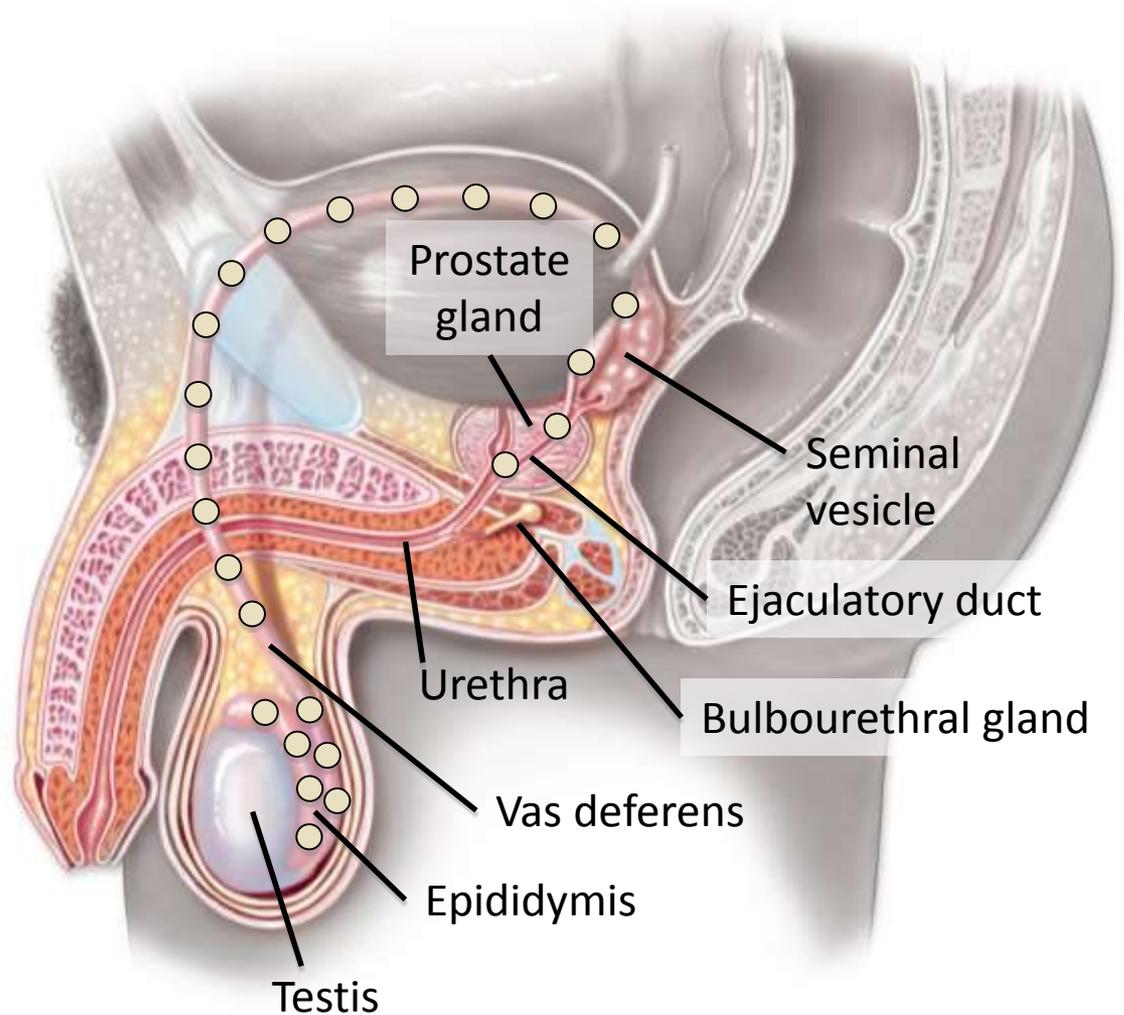
Human Reproduction: Males Produce Sperm

The **prostate gland** surrounds part of the urethra and secretes an alkaline fluid that activates sperm to swim.



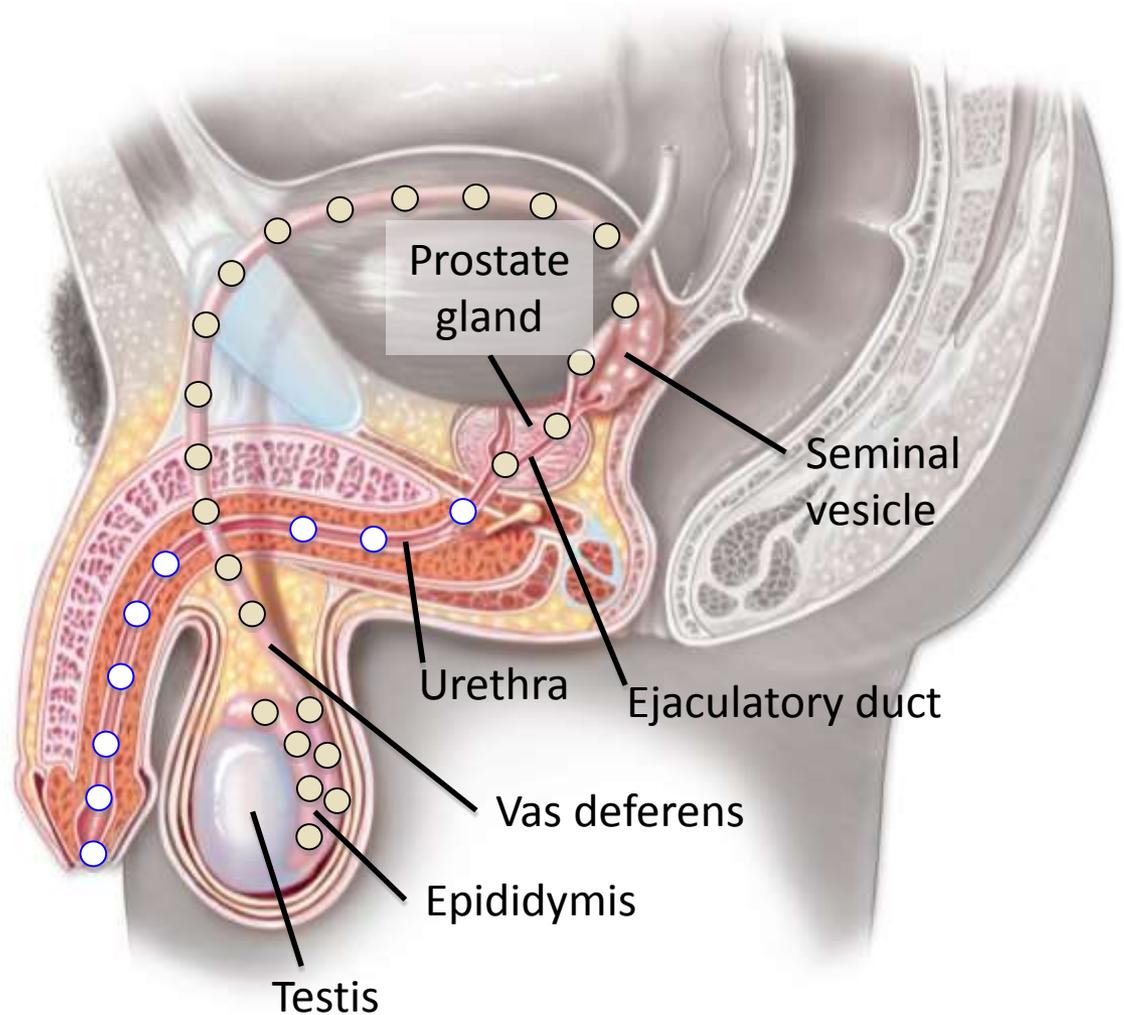
Human Reproduction: Males Produce Sperm

Two **bulbourethral glands** also attach to the urethra. They secrete an alkaline mucus that prepares the urethra for sperm.



Human Reproduction: Males Produce Sperm

Sperm travel through the urethra. During **ejaculation**, the penis discharges semen from the body.





Clicker Question #2

A sperm cell passes through multiple tubes along its journey in the male reproductive system. Which of the following comes *last* in the sequence?

- A. testis
- B. urethra
- C. epididymis
- D. vas deferens
- E. seminiferous tubule

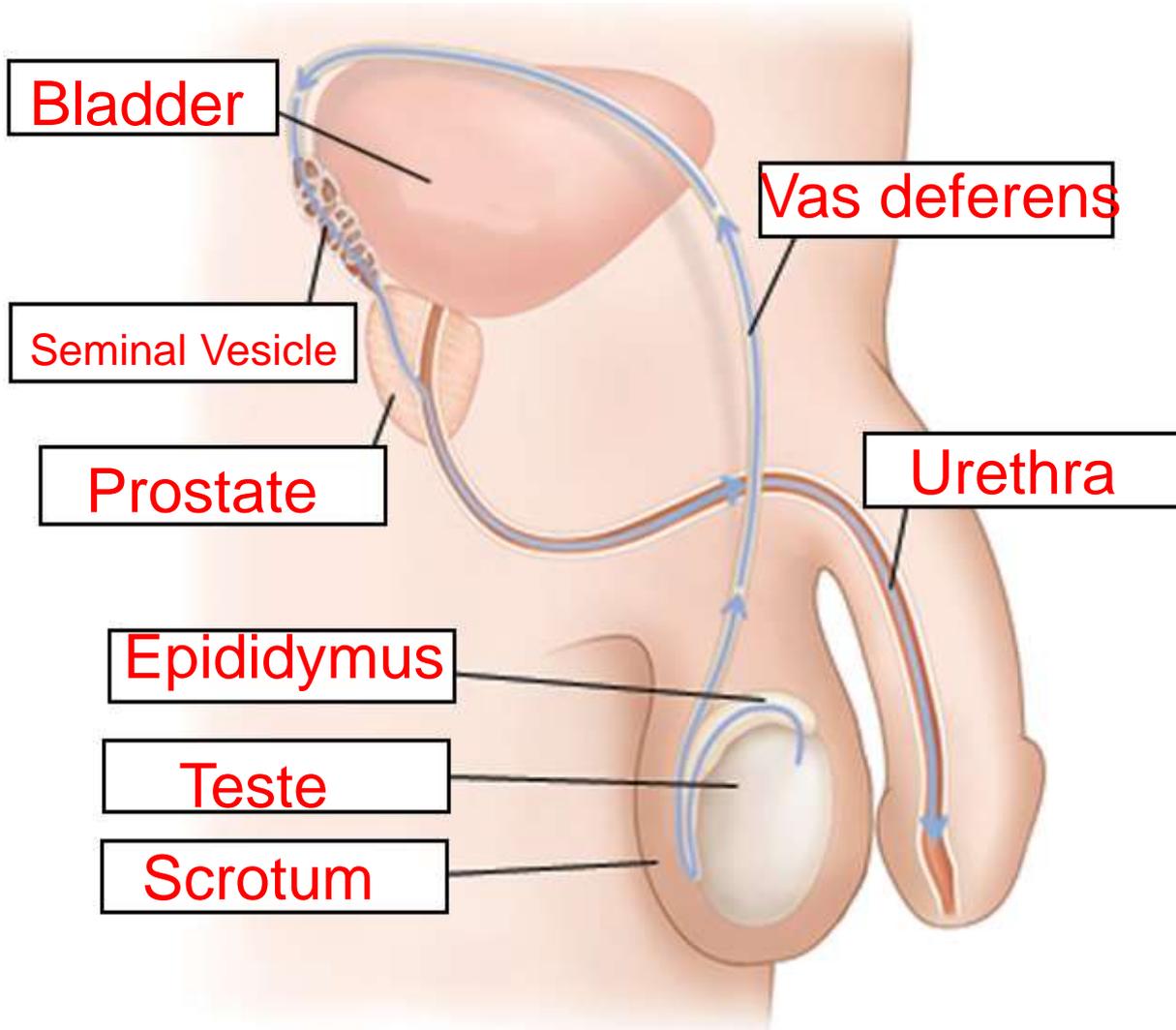


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WORD BANK



Vas deferens

Scrotum

Urethra

Prostate

Epididymus

Bladder

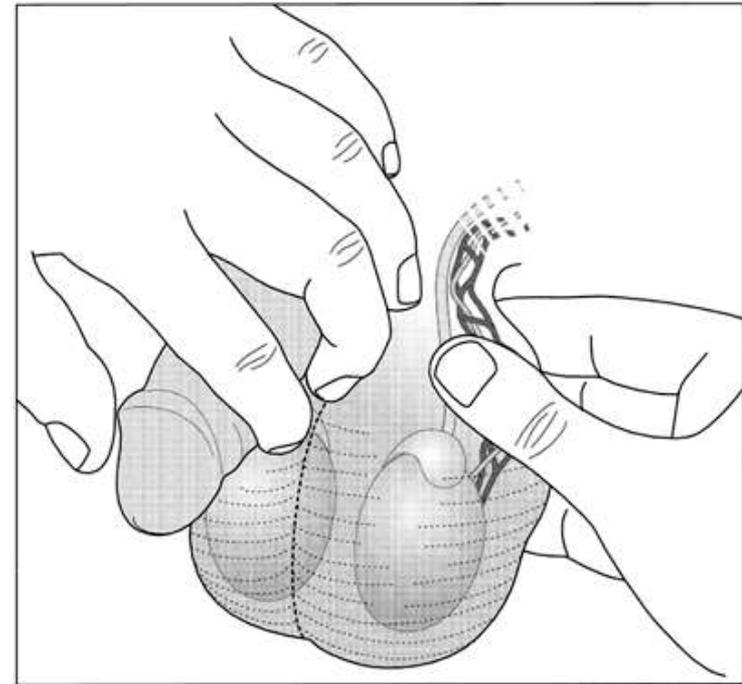
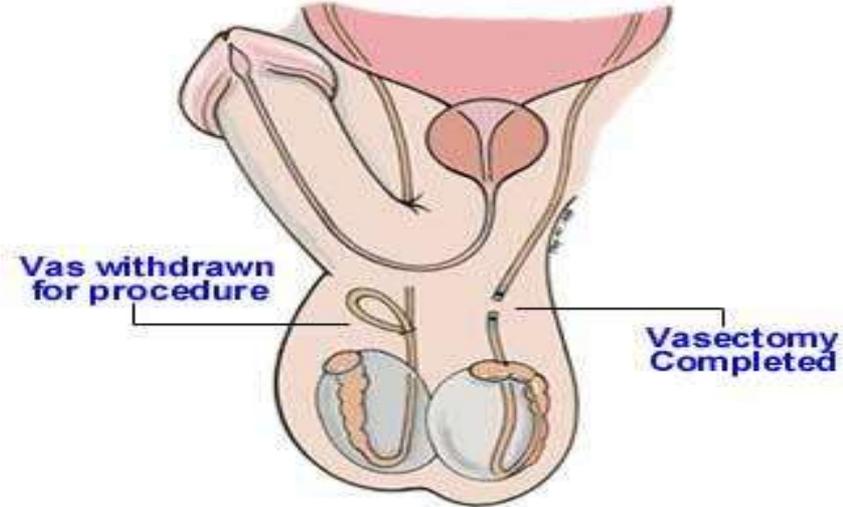
Teste

Seminal Vesicle

Male Contraception

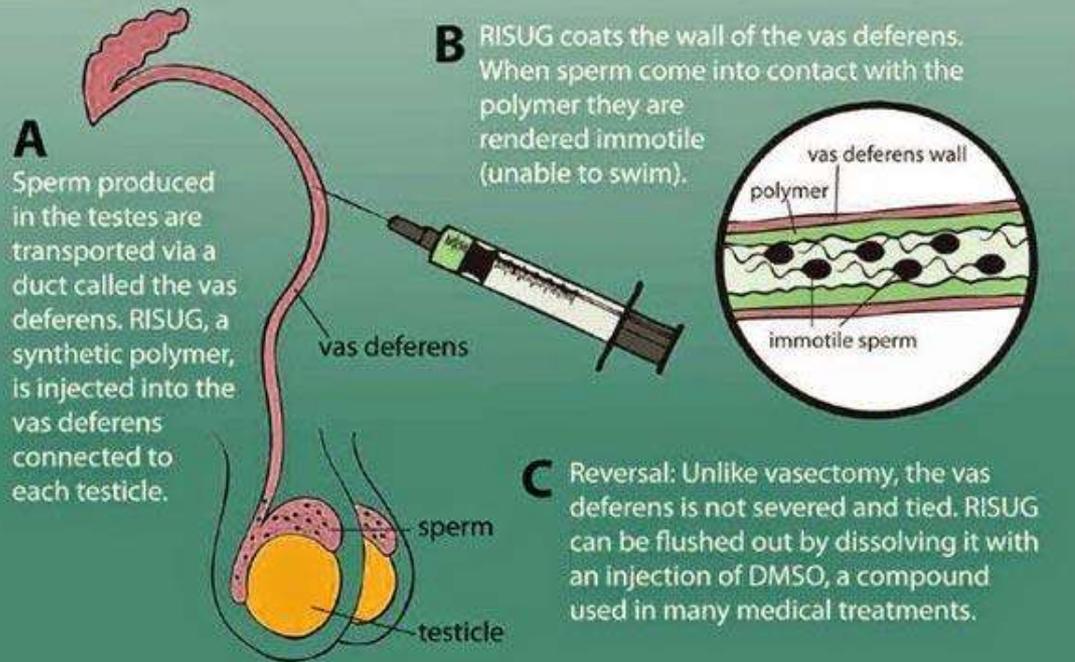
Vasectomy - the vas deferens tube is cut to prevent sperm leaving (and fertilizing an egg)

This procedure can be done right in the doctor's office



Male Contraception - not yet approved

One-Shot Male Birth Control: How the "Reversible Vasectomy" Works



Vasalgel is a long-acting, nonhormonal contraceptive with a significant advantage over vasectomy: it is likely to be more reversible. The procedure is similar to a vasectomy, except a gel is injected into the vas deferens, rather than cutting the vas.

Another injection can remove the polymer and restore fertility (maybe).

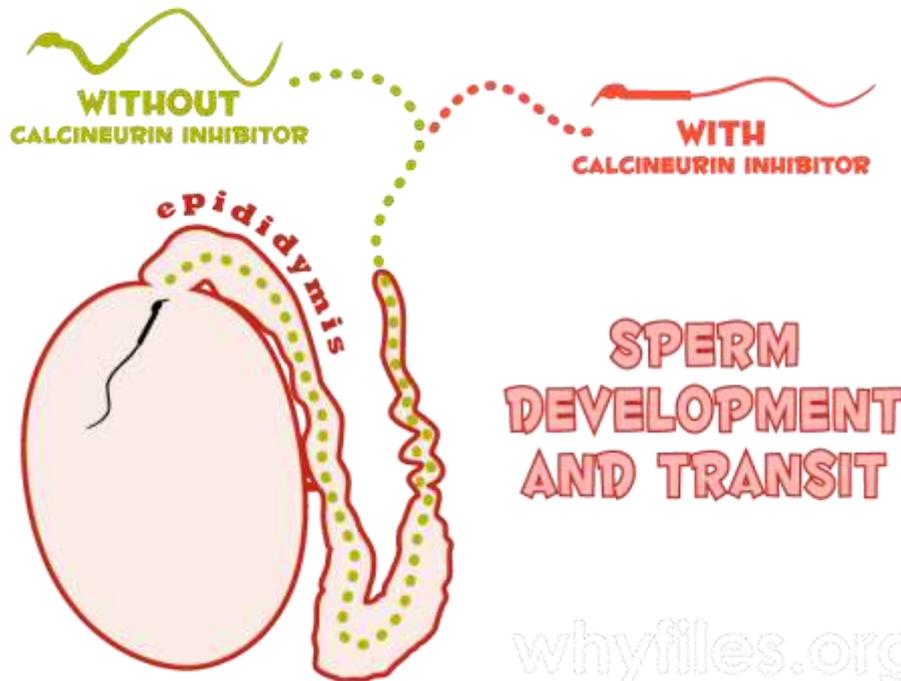
This technique is still being studied and has not been approved for use.

RISUG (Reversible Inhibition of Sperm Under Guidance)

Also See http://www.wired.com/magazine/2011/04/ff_vasectomy/ for full story and VIDEO!

[In a study in mice published in October 2015](#), a protein called Calcineurin was found to be crucial in helping sperm swim and break through the membrane of a female egg.

When the genes behind this protein were blocked, the mice became infertile. Effects were seen in the mice within four to five days after treatment. The effects were also reversible as fertility was restored one week after treatments were stopped.

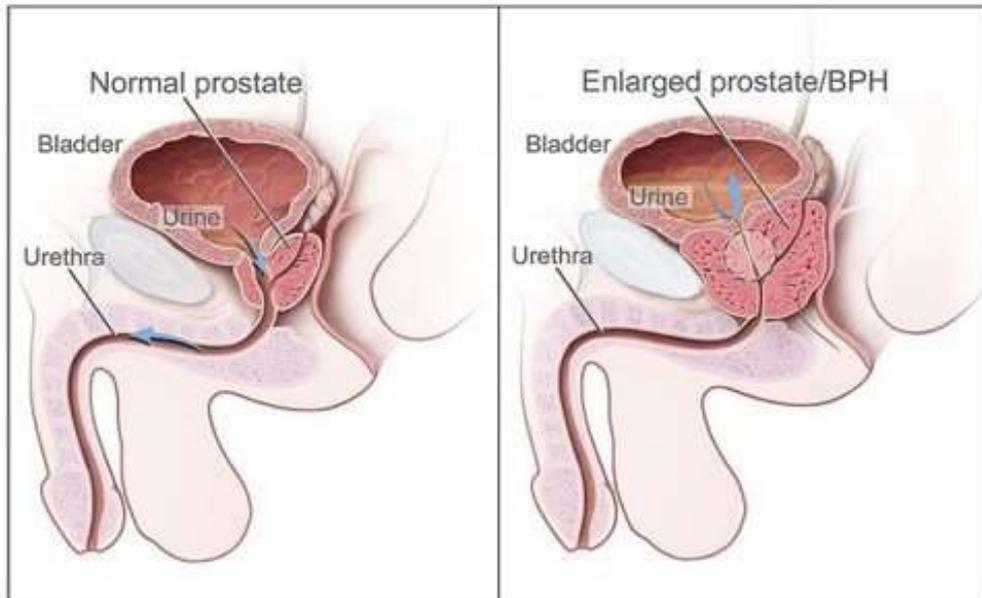
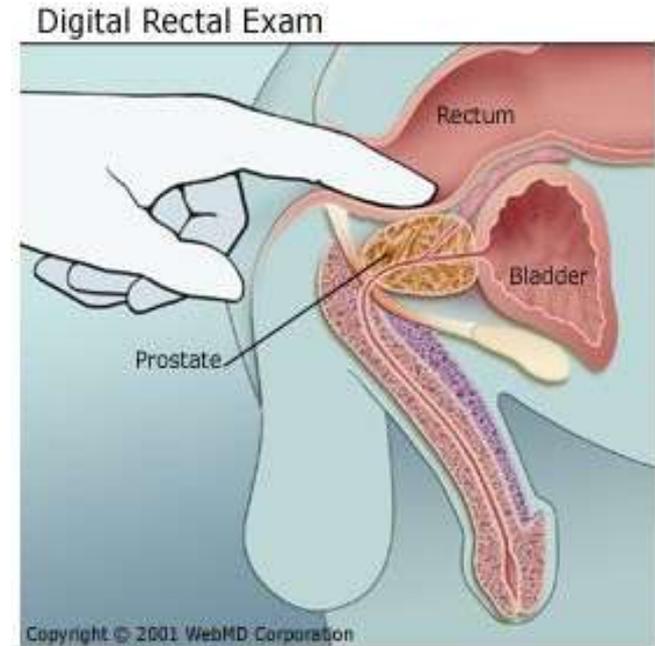


The midpiece of the sperm tail (flagella) contains the sperm's mitochondria and operates the movement of the tail. When sperm are deprived of the chemical calcineurin, the midpiece becomes more rigid and adopts a hook-like shape that constricts the tail's range of motion.

It's great getting older...April Fools

Recommended after age 50 -
prostate exam

Doctors use the digital rectal exam
(DRE) as a relatively simple test
to check the prostate



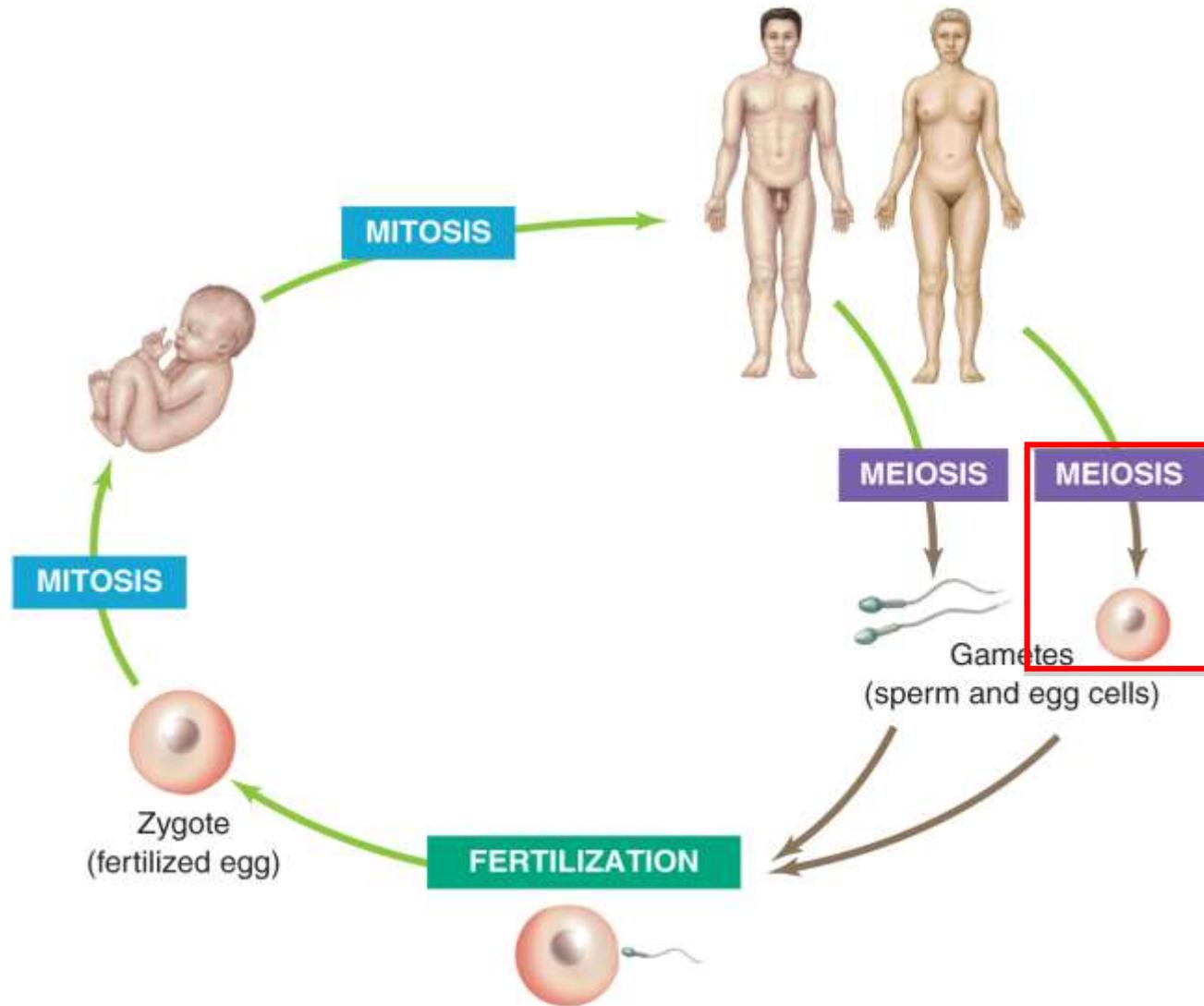
BPH = benign
prostate
hypertrophy

A robotic butt and virtual patient software allows medical students to receive feedback on the prostate exams they administer.



Human Reproduction: Females Produce Eggs

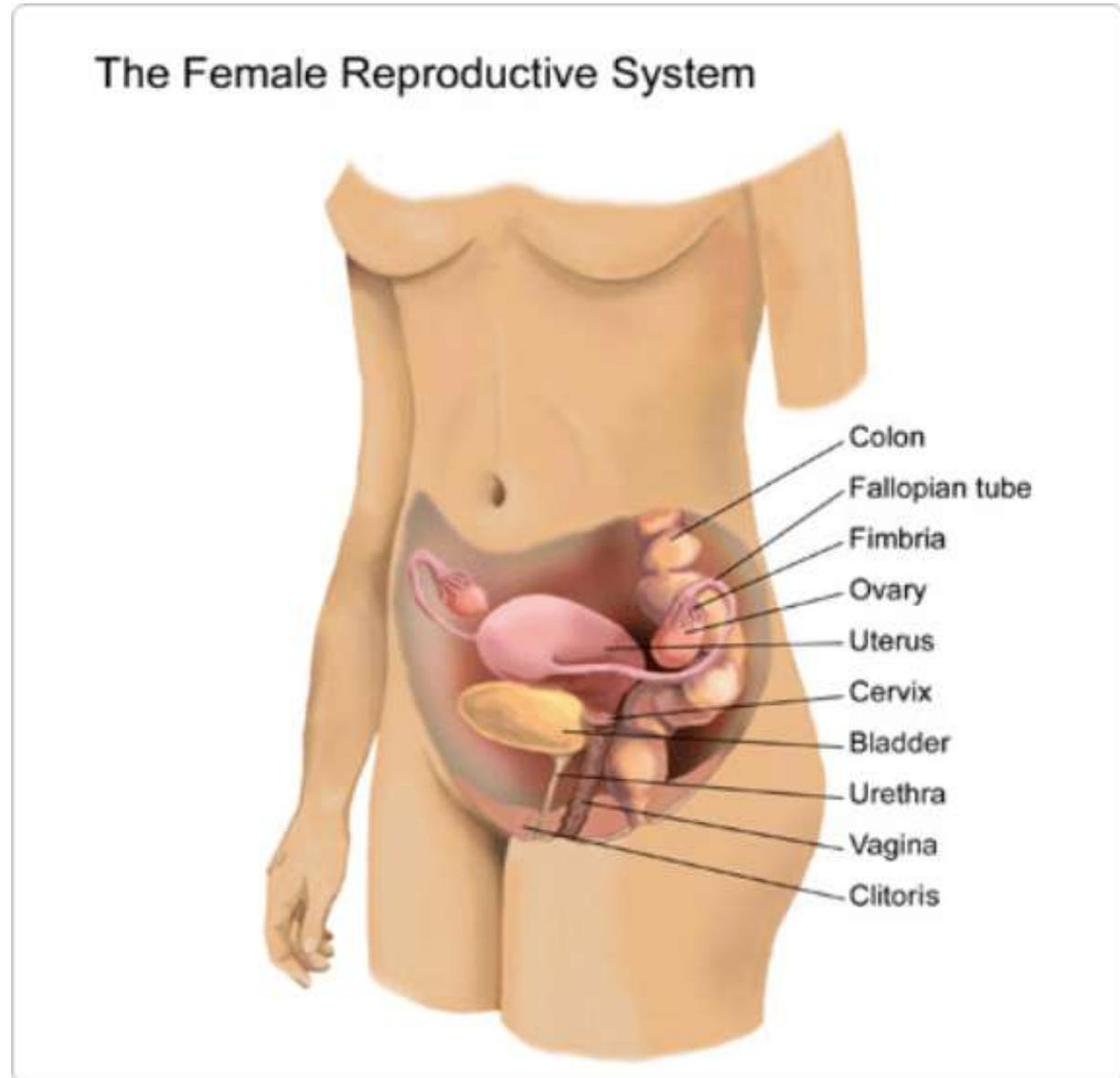
Now let's look at female reproductive anatomy and egg production.



FEMALE REPRODUCTION

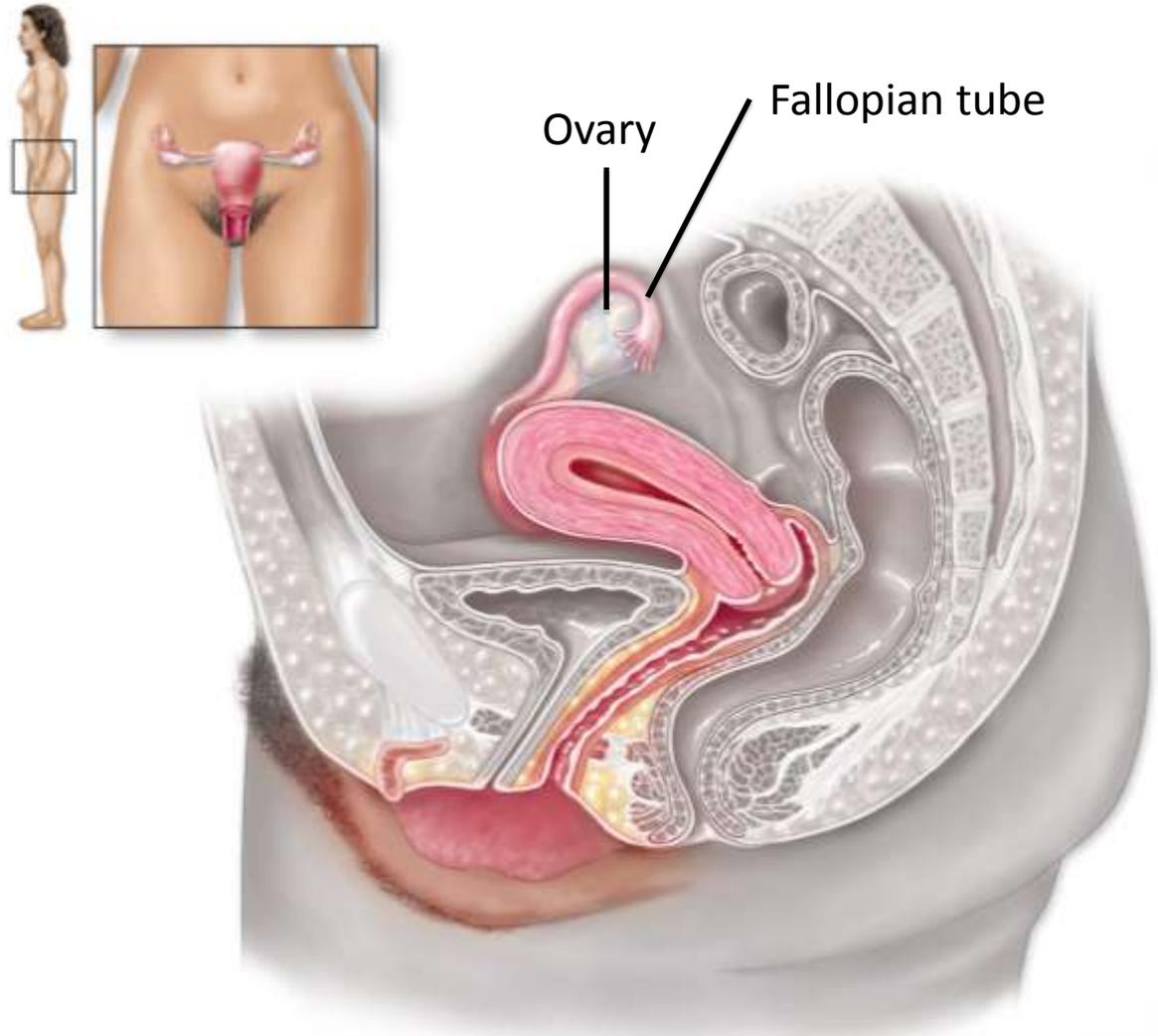
Main Structures

- Ovary
- Uterus
- Fallopian Tubes
- Vagina
- Cervix



Human Reproduction: Females Anatomy

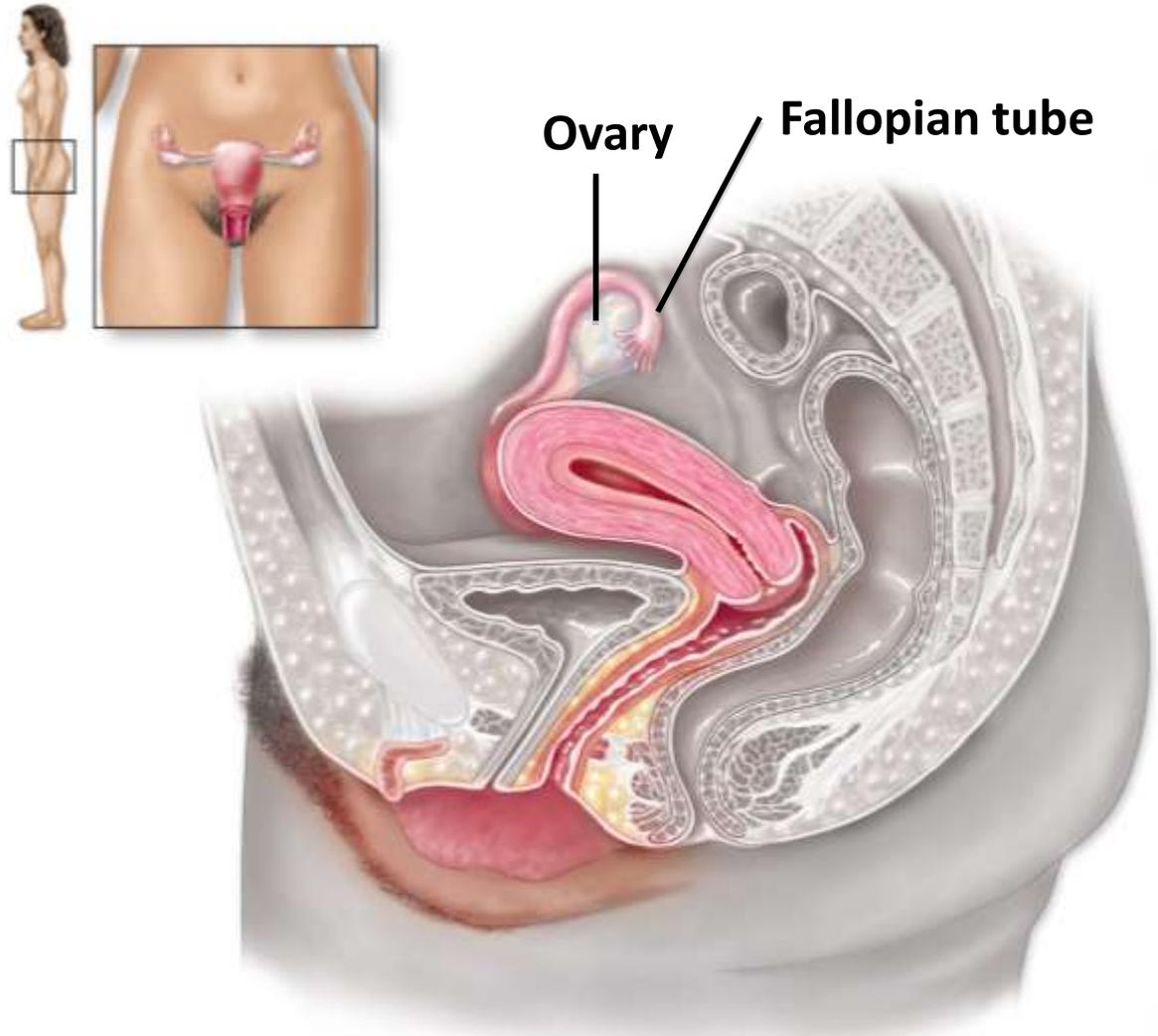
The female reproductive system includes two **ovaries**, each surrounded by the fingerlike extensions of one **Fallopian /uterine tube**.



Human Reproduction: Females Anatomy

Fallopian/uterine tube – transport the ova from the ovary to the uterus each month in pre-menopausal women

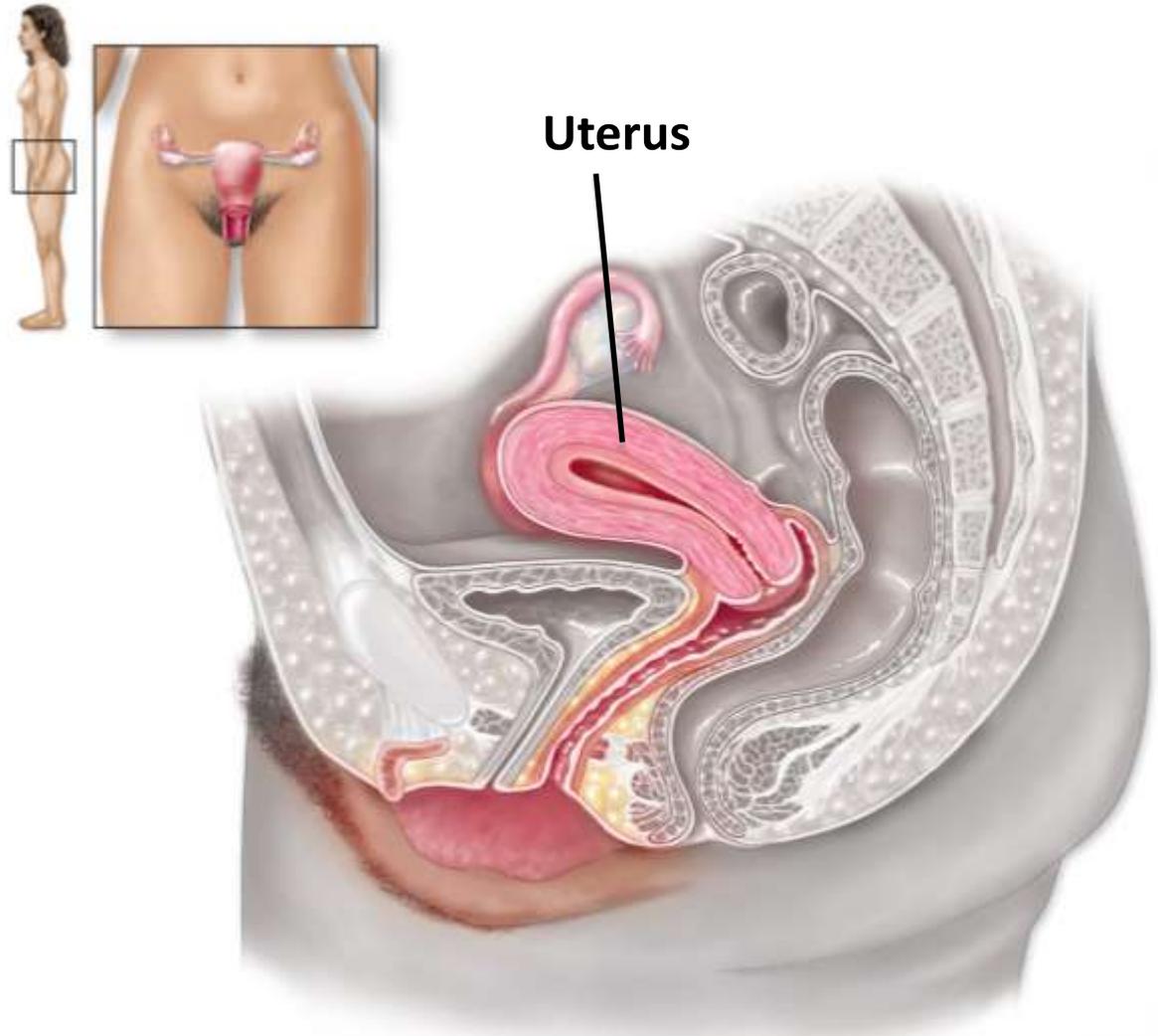
Ovary- produces oocytes (eggs) and produce estrogen and progesterone.



Human Reproduction: Females Anatomy

The main job of the **uterus** is to become an hospitable environment for a potential zygote by making a thick layer of tissue (**endometrium**) rich with capillaries

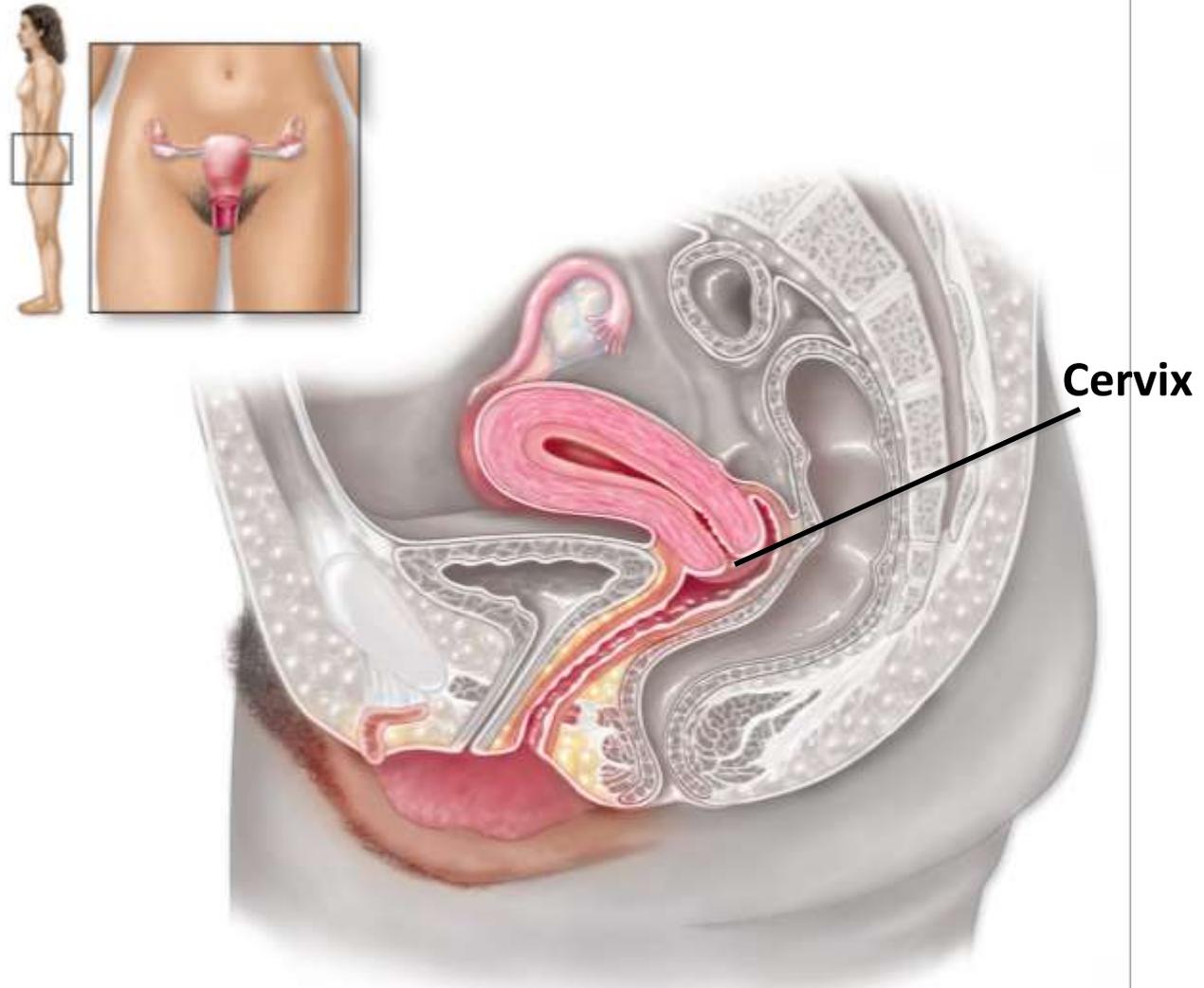
Secondarily, it is to contract to **help sperm pass** to fallopian tubes, contract during **childbirth**, and necessary for **achieving orgasms**



Human Reproduction: Females Anatomy

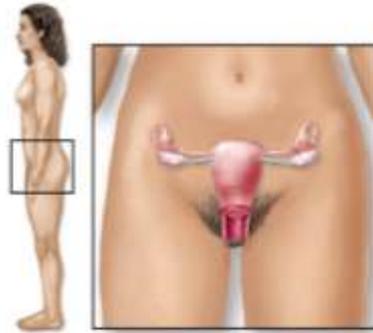
Cervix- allows flow of menses from uterus into vagina and directs the uterus during intercourse.

During pregnancy forms a mucus plug to prevent “water” from bursting



Human Reproduction: Females Anatomy

Vagina- receives the penis during intercourse and serves as the conduit for menses from the uterus.



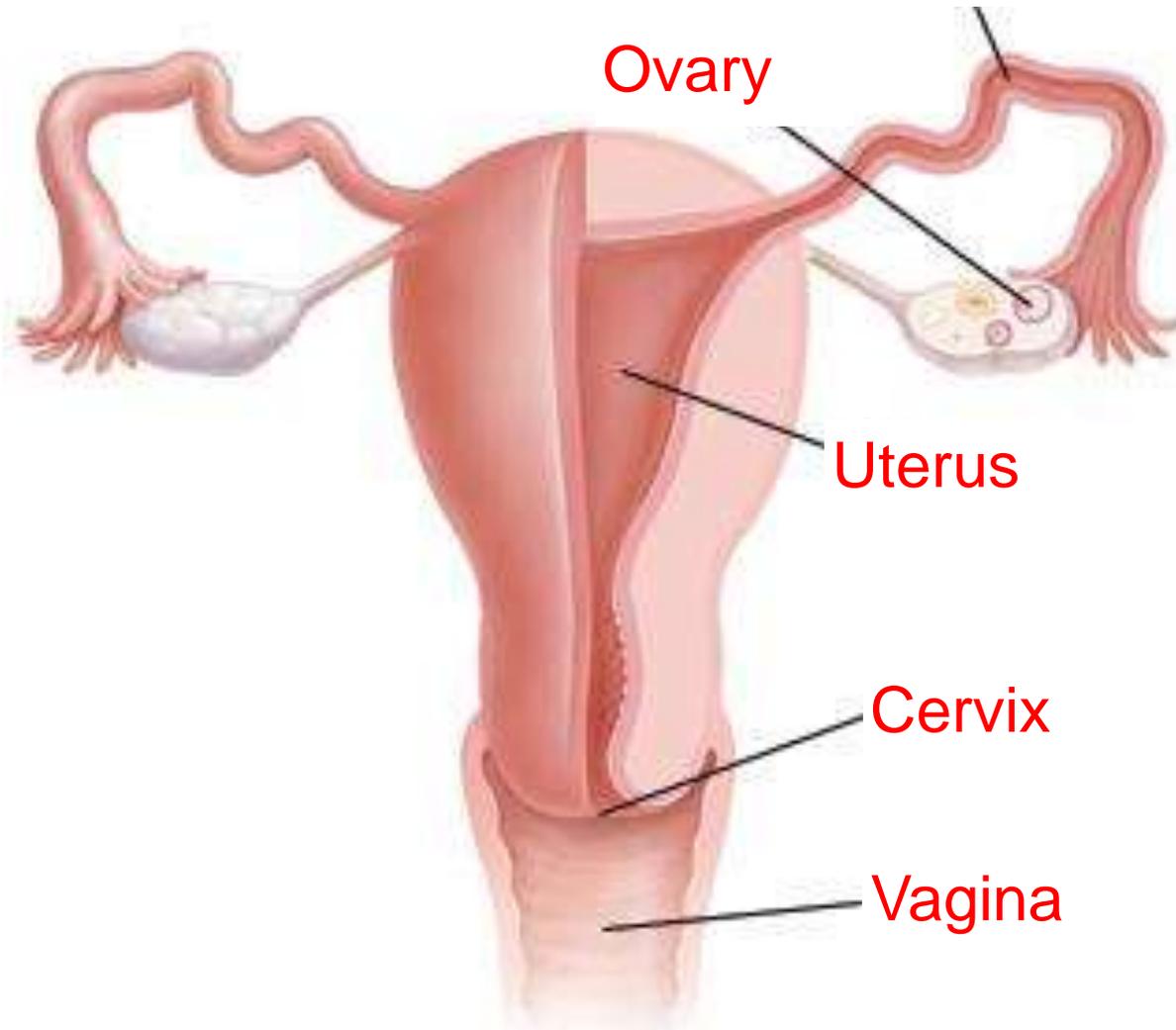
Also where a baby will pass aka the birth canal

Vagina



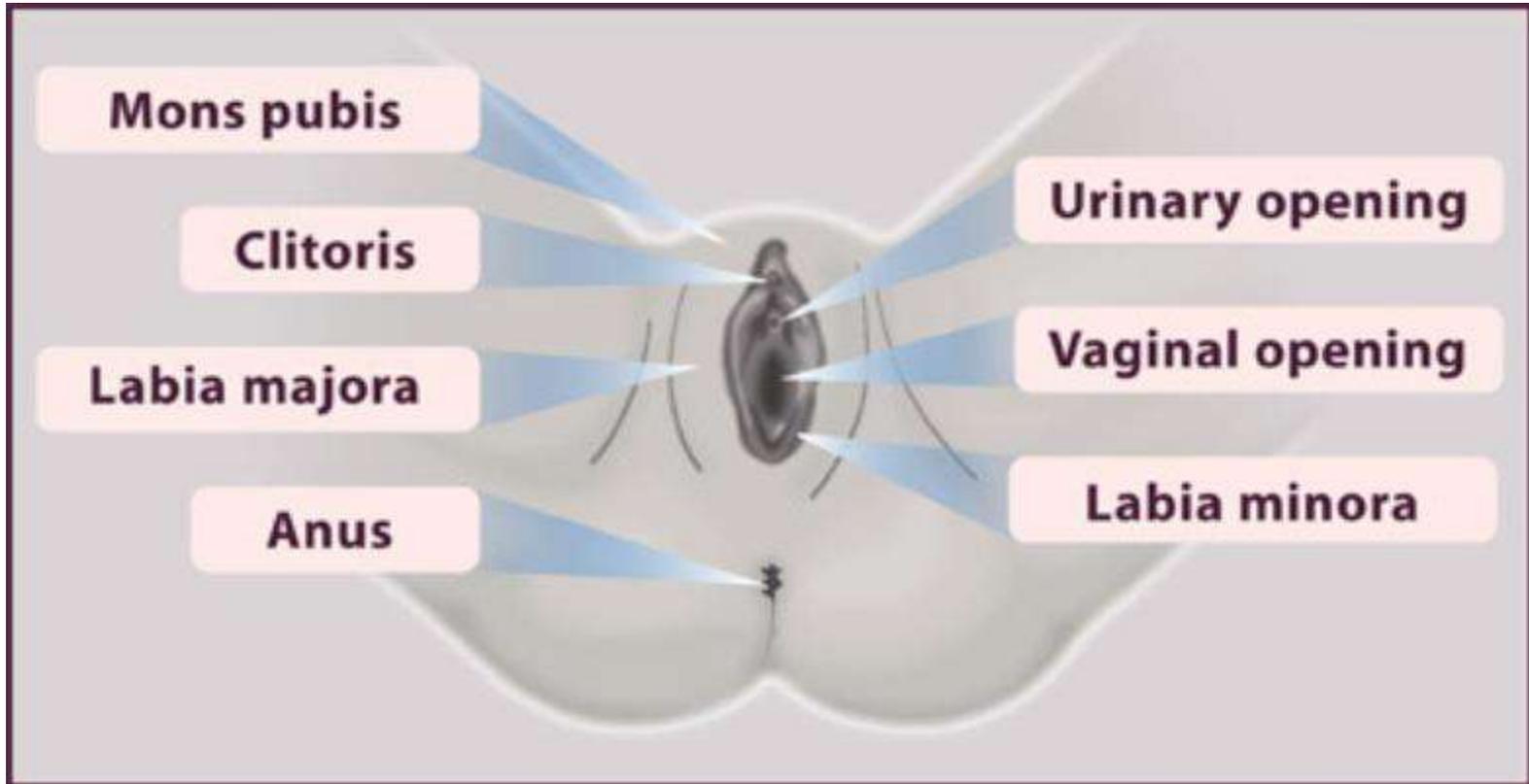
Fallopian Tubes

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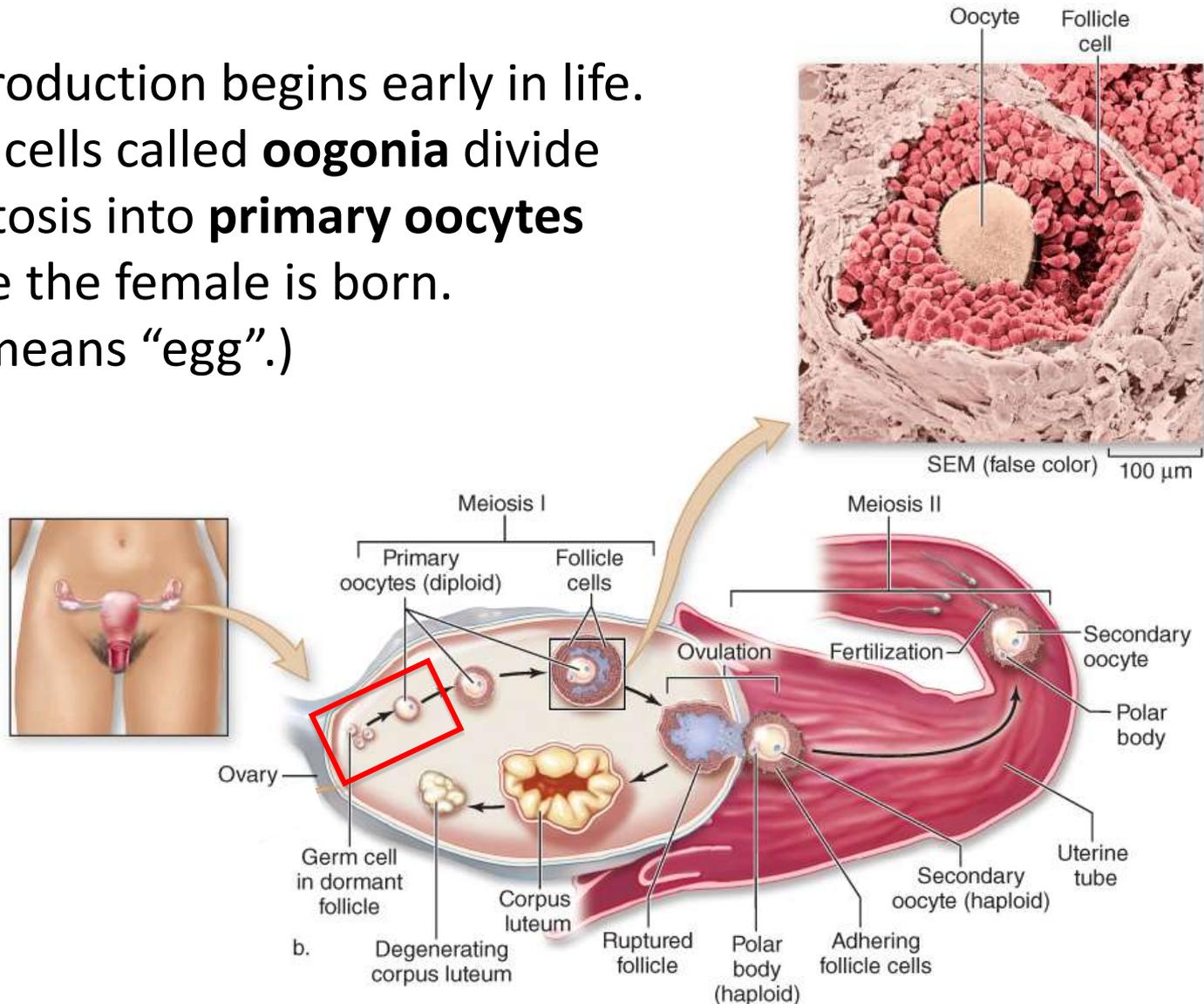
- Cervix
- Fallopian Tubes
- Vagina
- Ovary
- Uterus

Female External



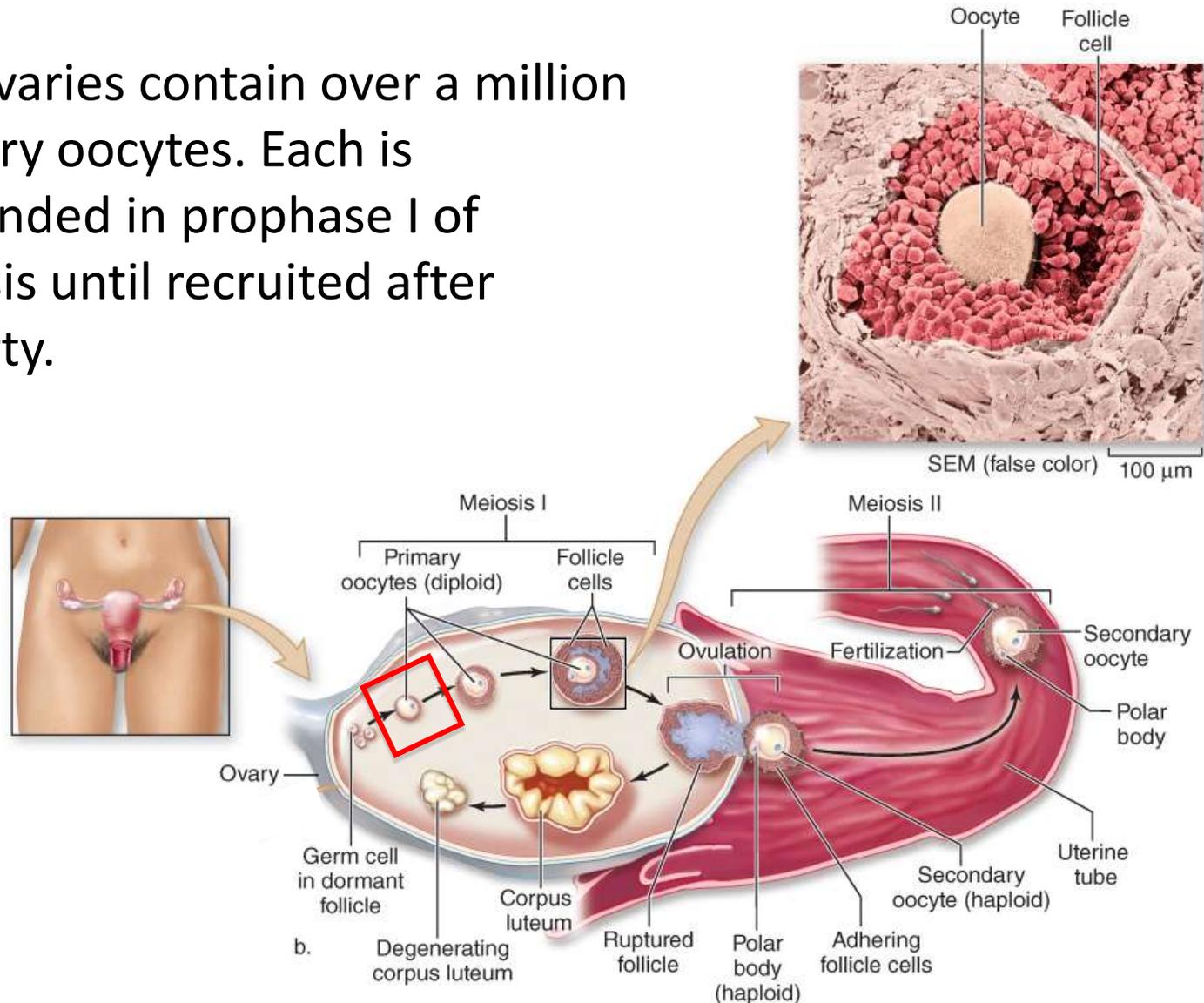
Human Reproduction: Females Produce Eggs

Egg production begins early in life. Germ cells called **oogonia** divide by mitosis into **primary oocytes** before the female is born. (*Oo-* means “egg”.)



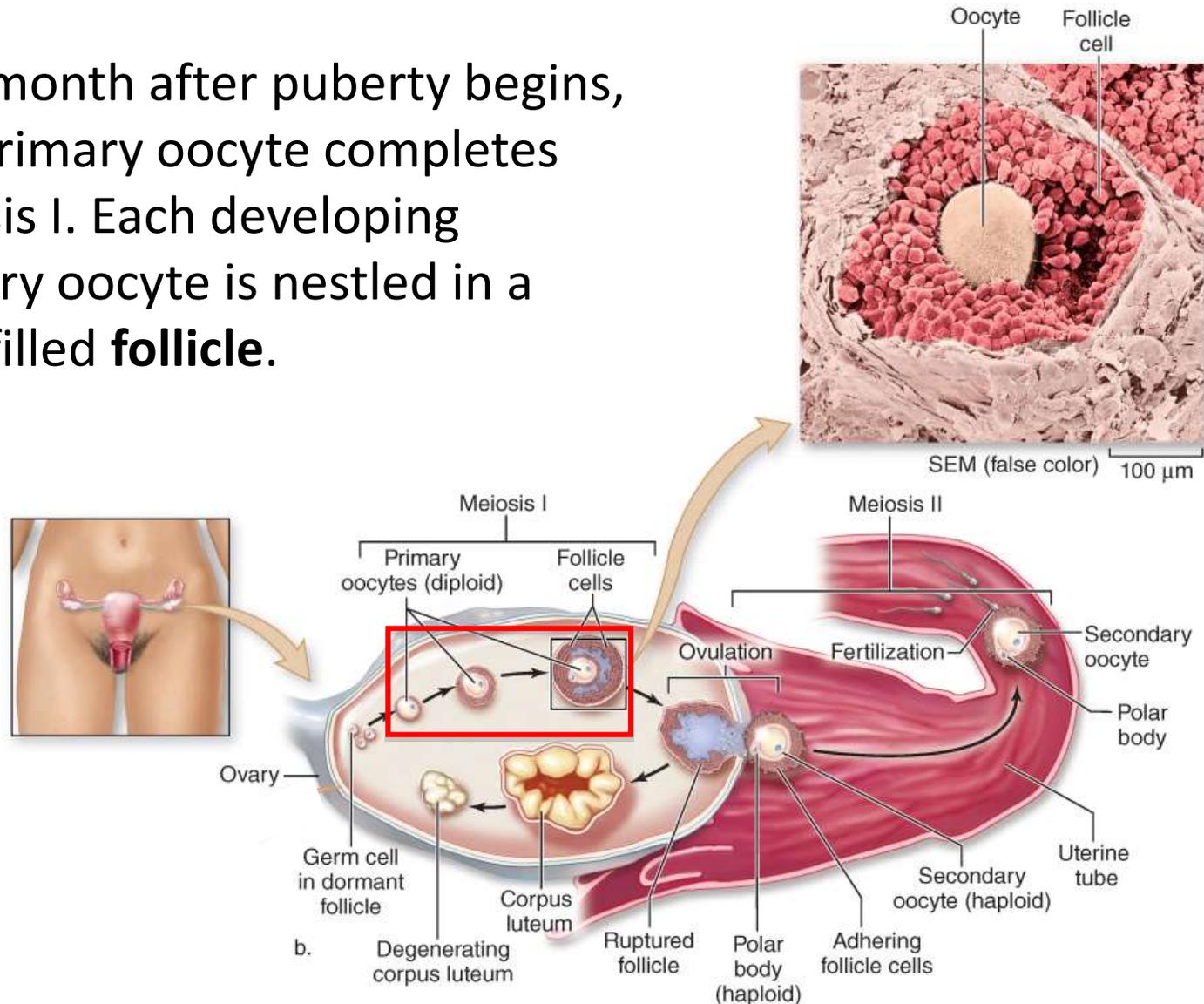
Human Reproduction: Females Produce Eggs

The ovaries contain over a million primary oocytes. Each is suspended in prophase I of meiosis until recruited after puberty.



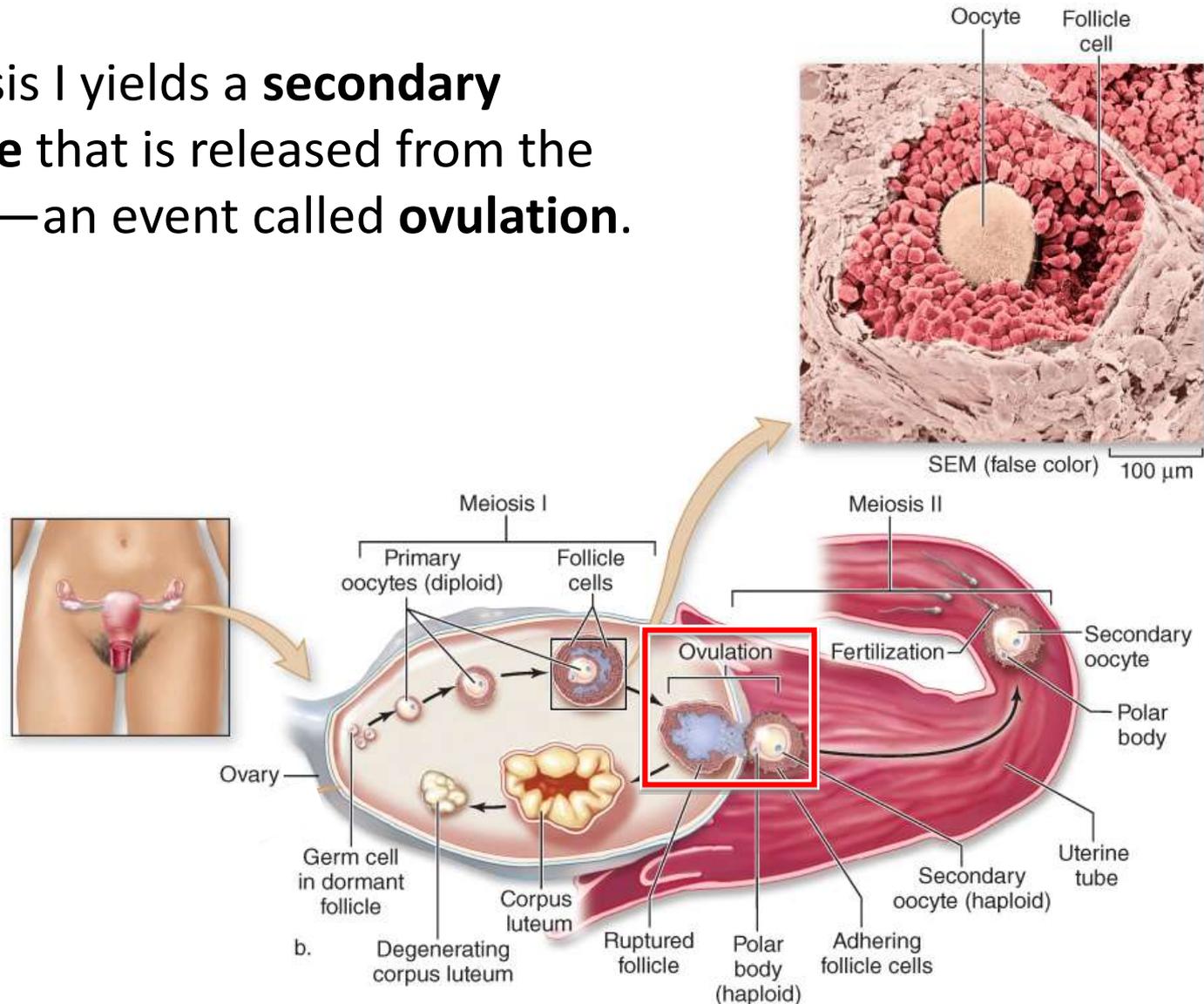
Human Reproduction: Females Produce Eggs

Each month after puberty begins, one primary oocyte completes meiosis I. Each developing primary oocyte is nestled in a fluid-filled **follicle**.



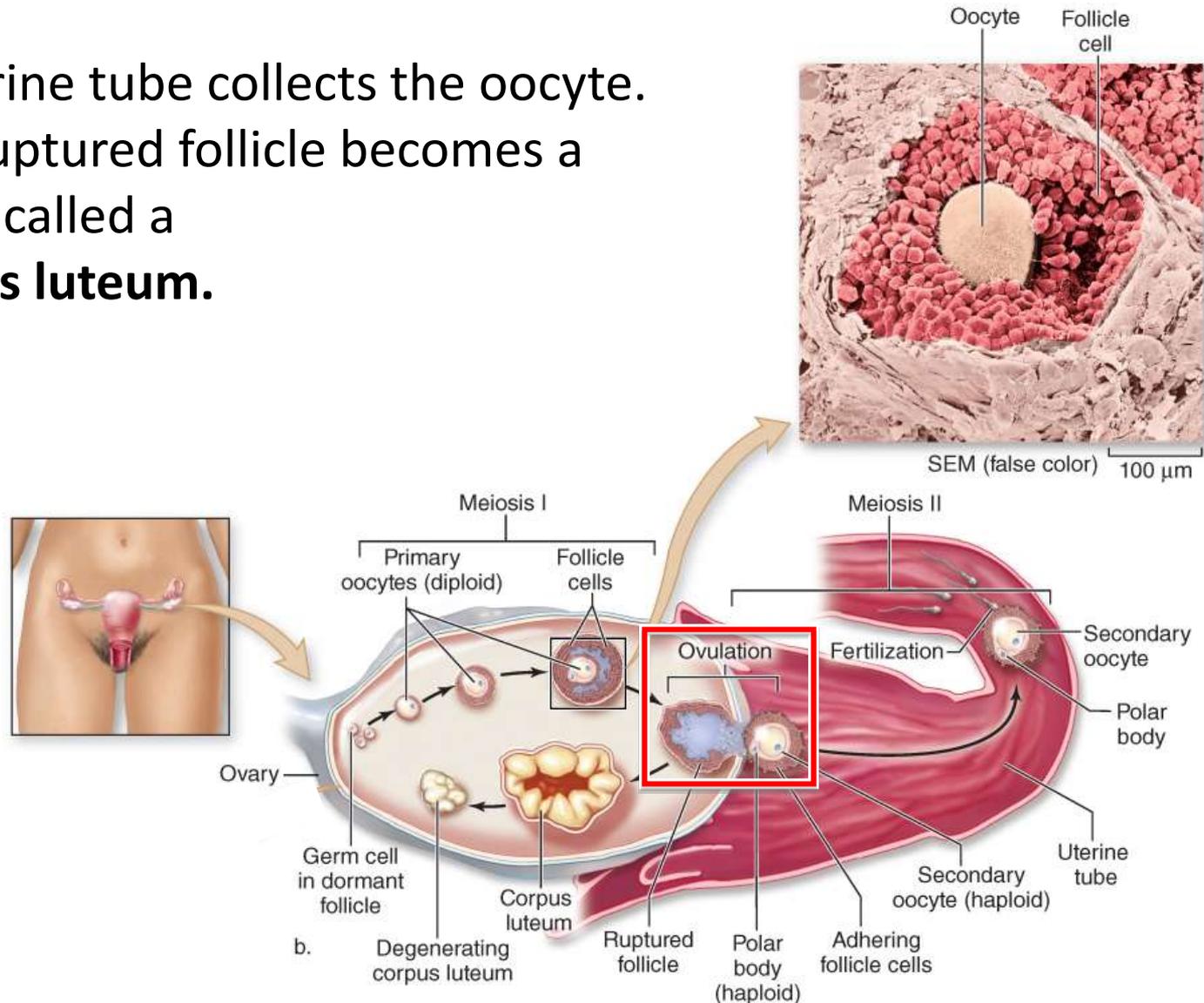
Human Reproduction: Females Produce Eggs

Meiosis I yields a **secondary oocyte** that is released from the ovary—an event called **ovulation**.



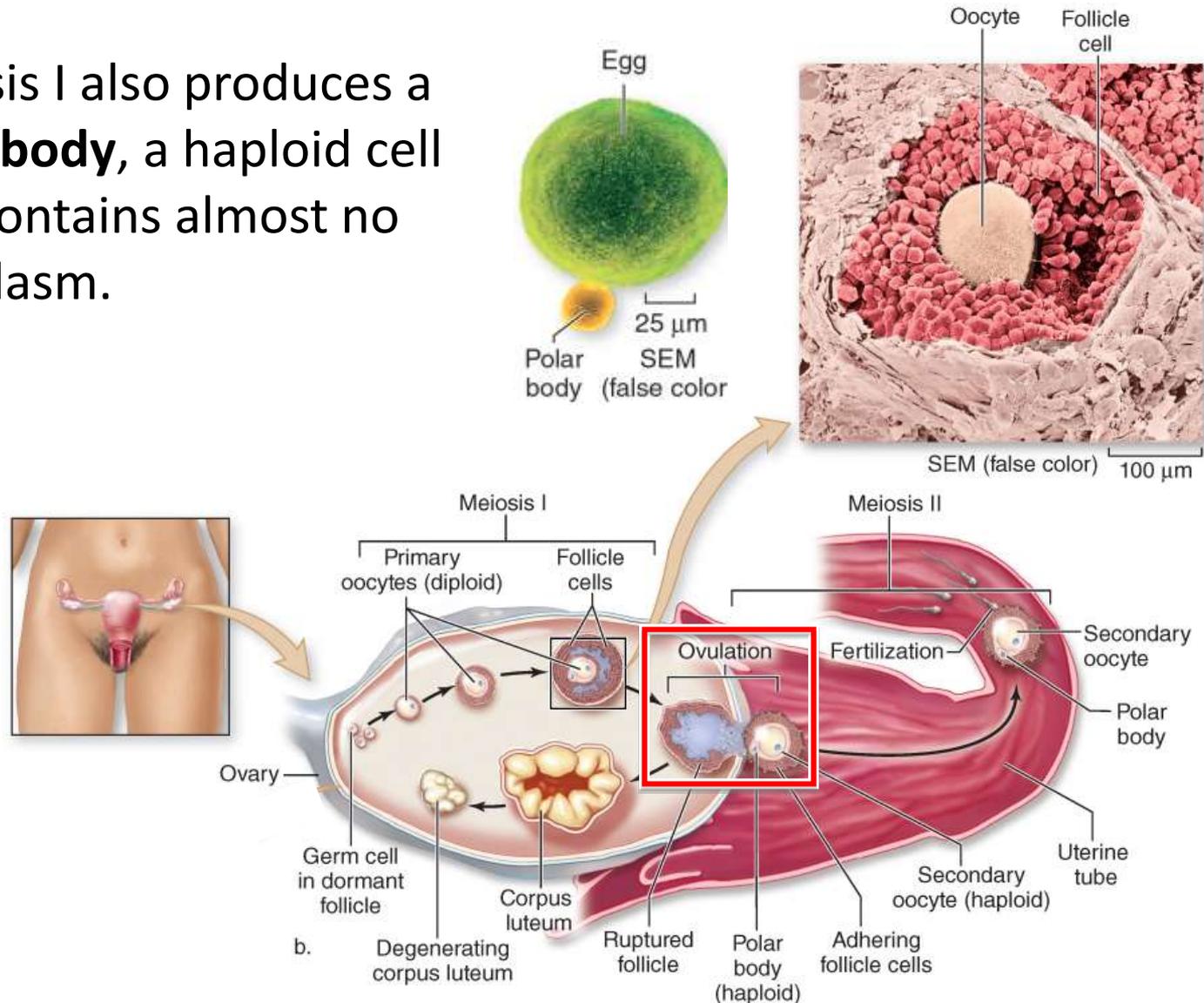
Human Reproduction: Females Produce Eggs

A uterine tube collects the oocyte.
The ruptured follicle becomes a gland called a **corpus luteum**.



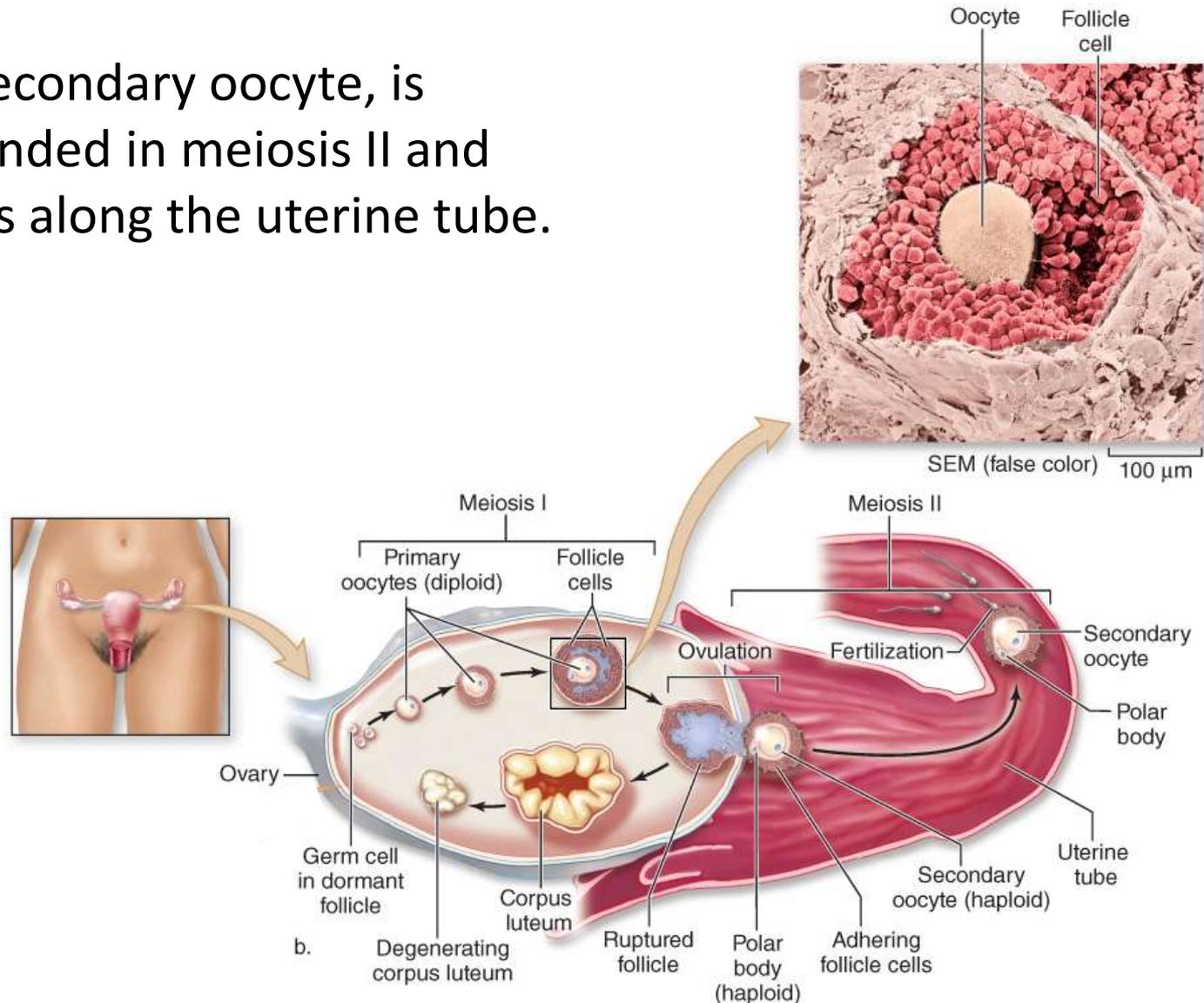
Human Reproduction: Females Produce Eggs

Meiosis I also produces a **polar body**, a haploid cell that contains almost no cytoplasm.



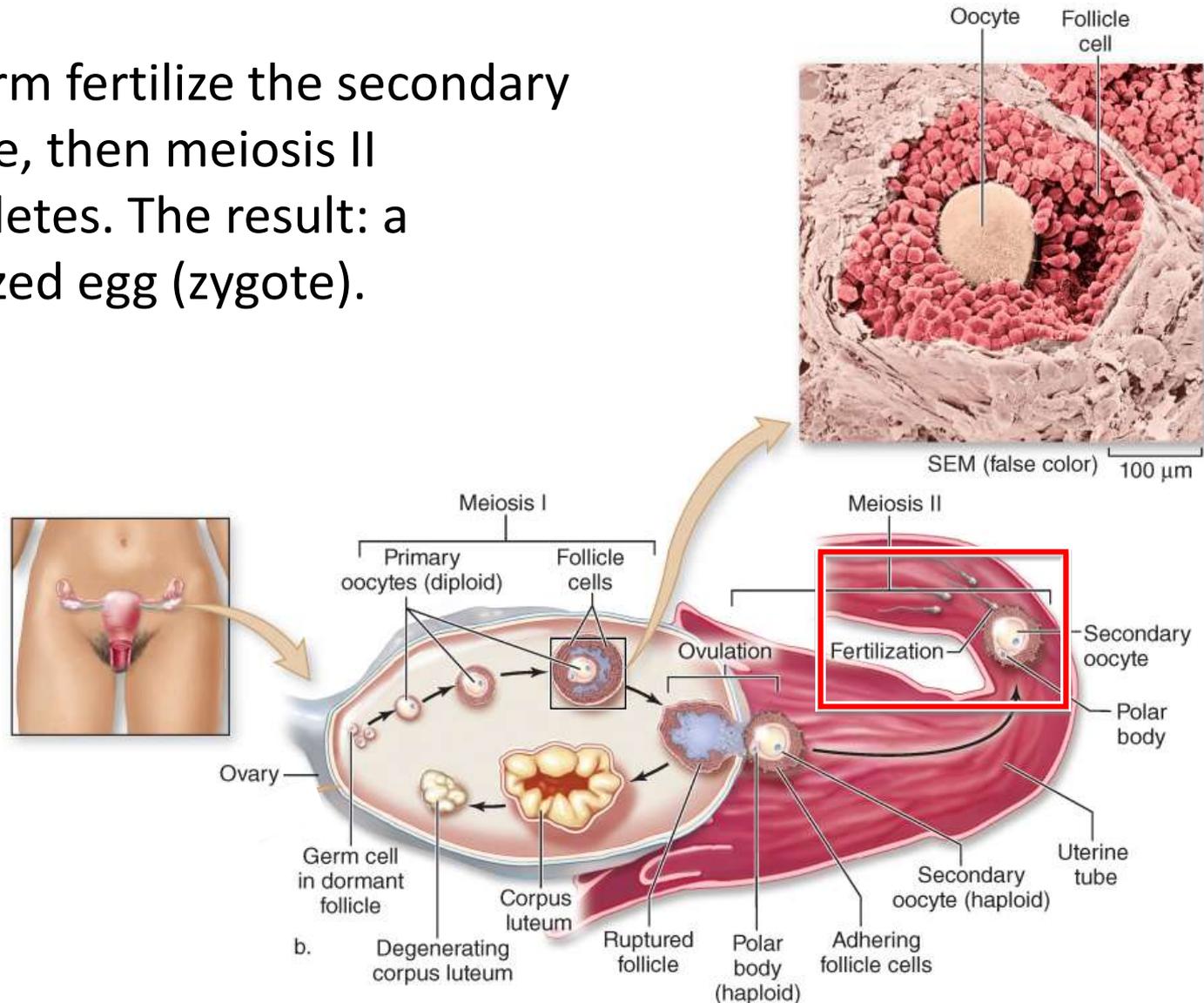
Human Reproduction: Females Produce Eggs

The secondary oocyte, is suspended in meiosis II and travels along the uterine tube.



Human Reproduction: Females Produce Eggs

If sperm fertilize the secondary oocyte, then meiosis II completes. The result: a fertilized egg (zygote).



Human Reproduction: Females Produce Eggs

This diagram summarizes the events of egg development.

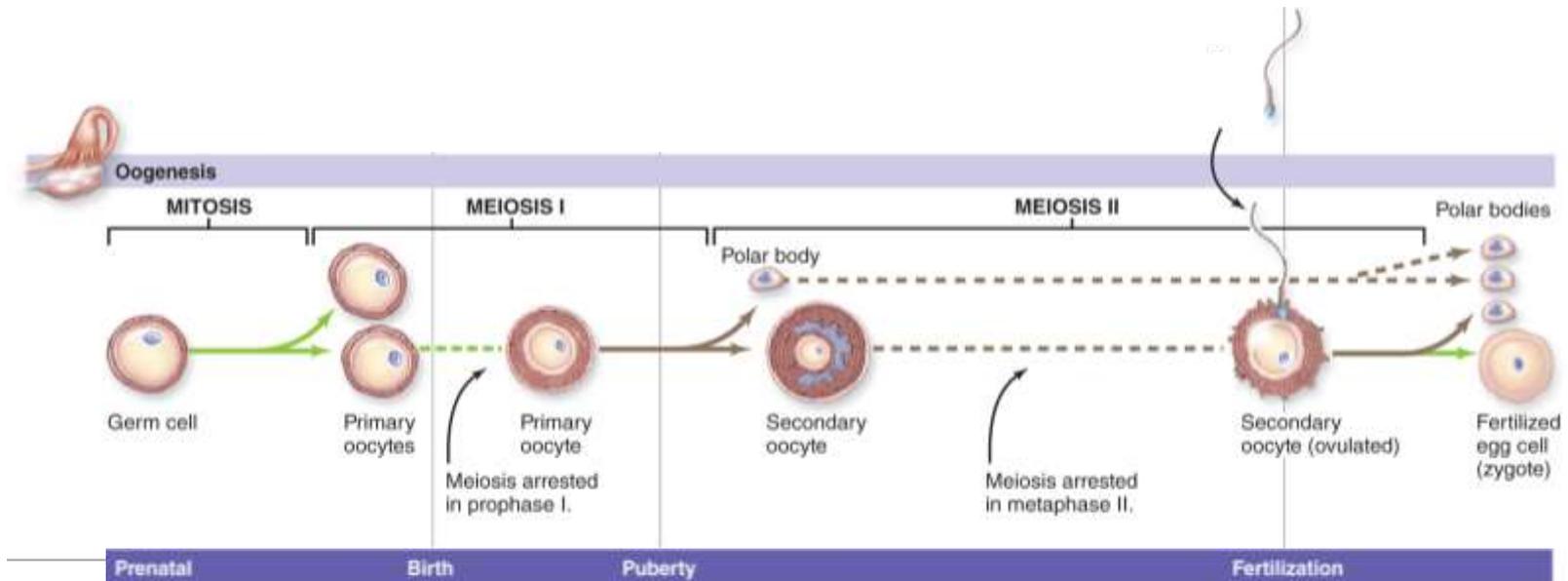


Figure 46.12b

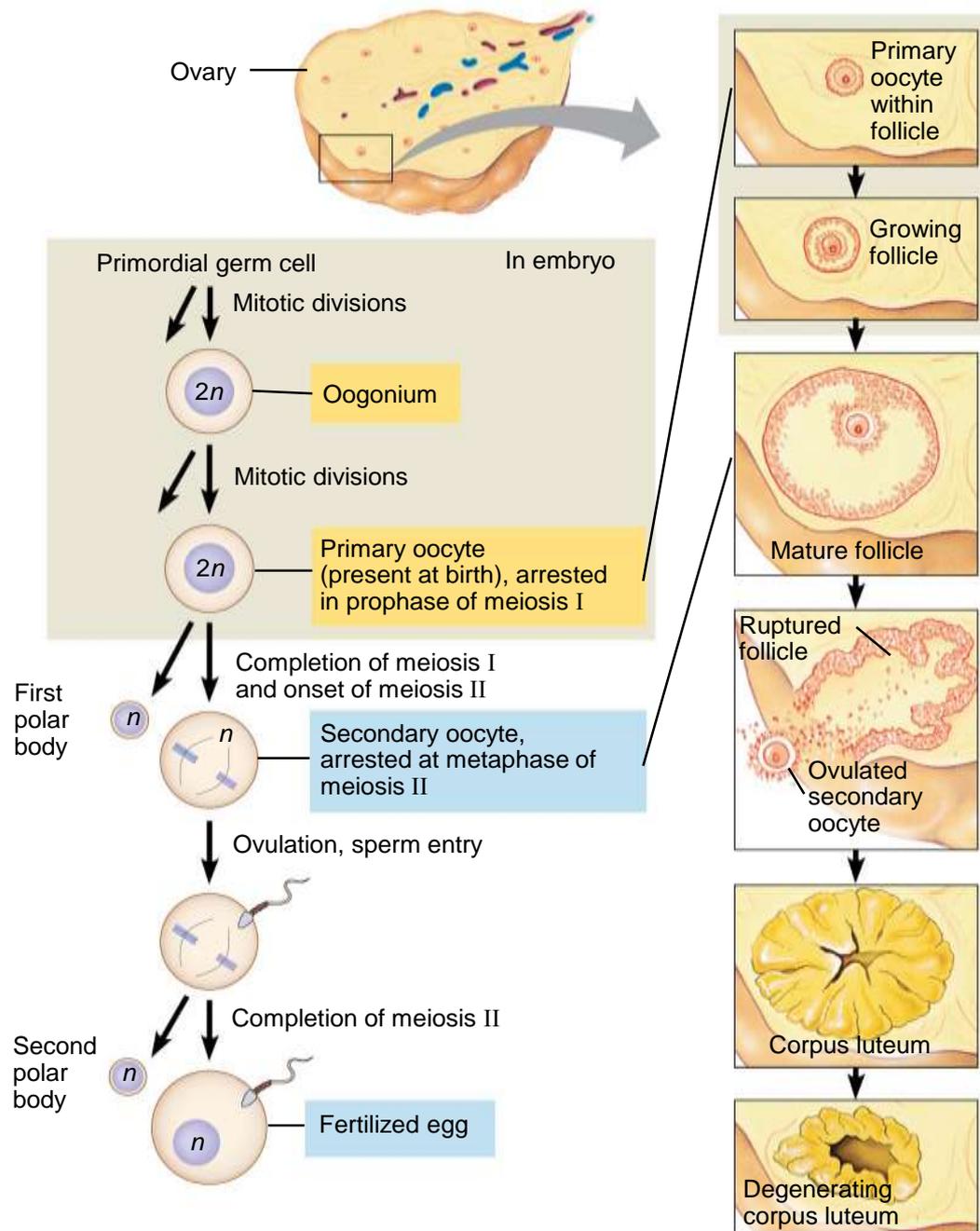
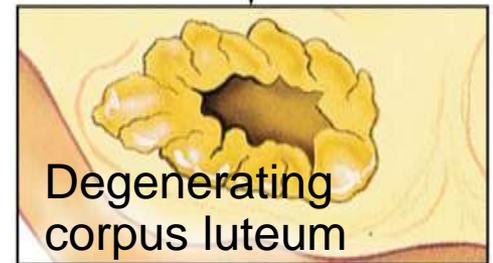
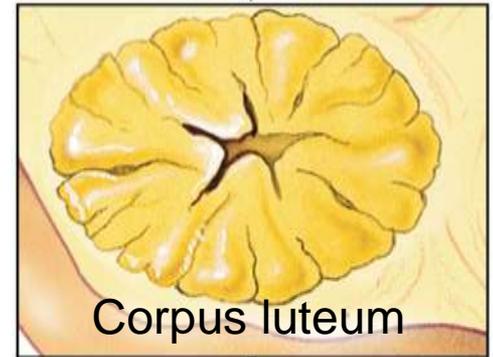
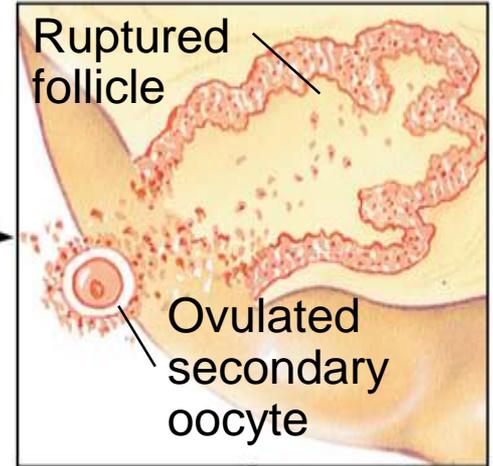
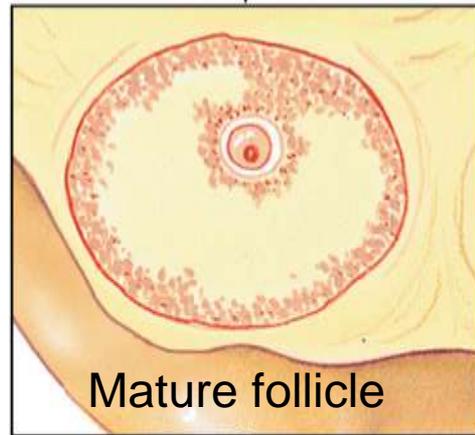
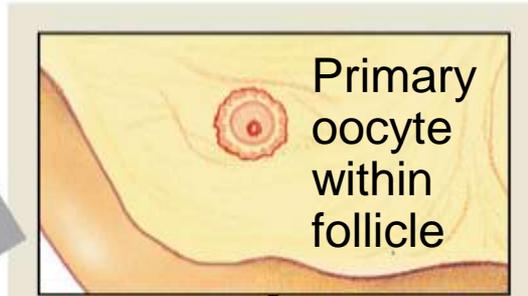
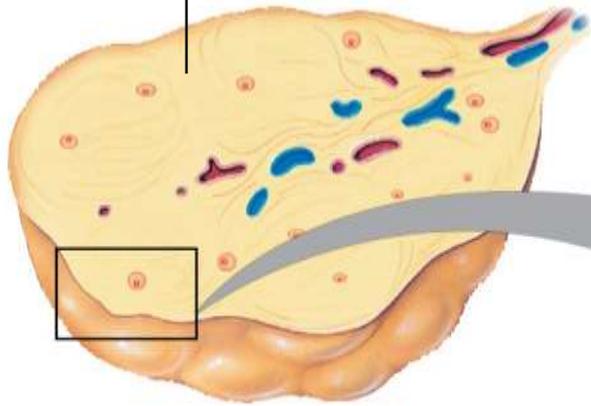


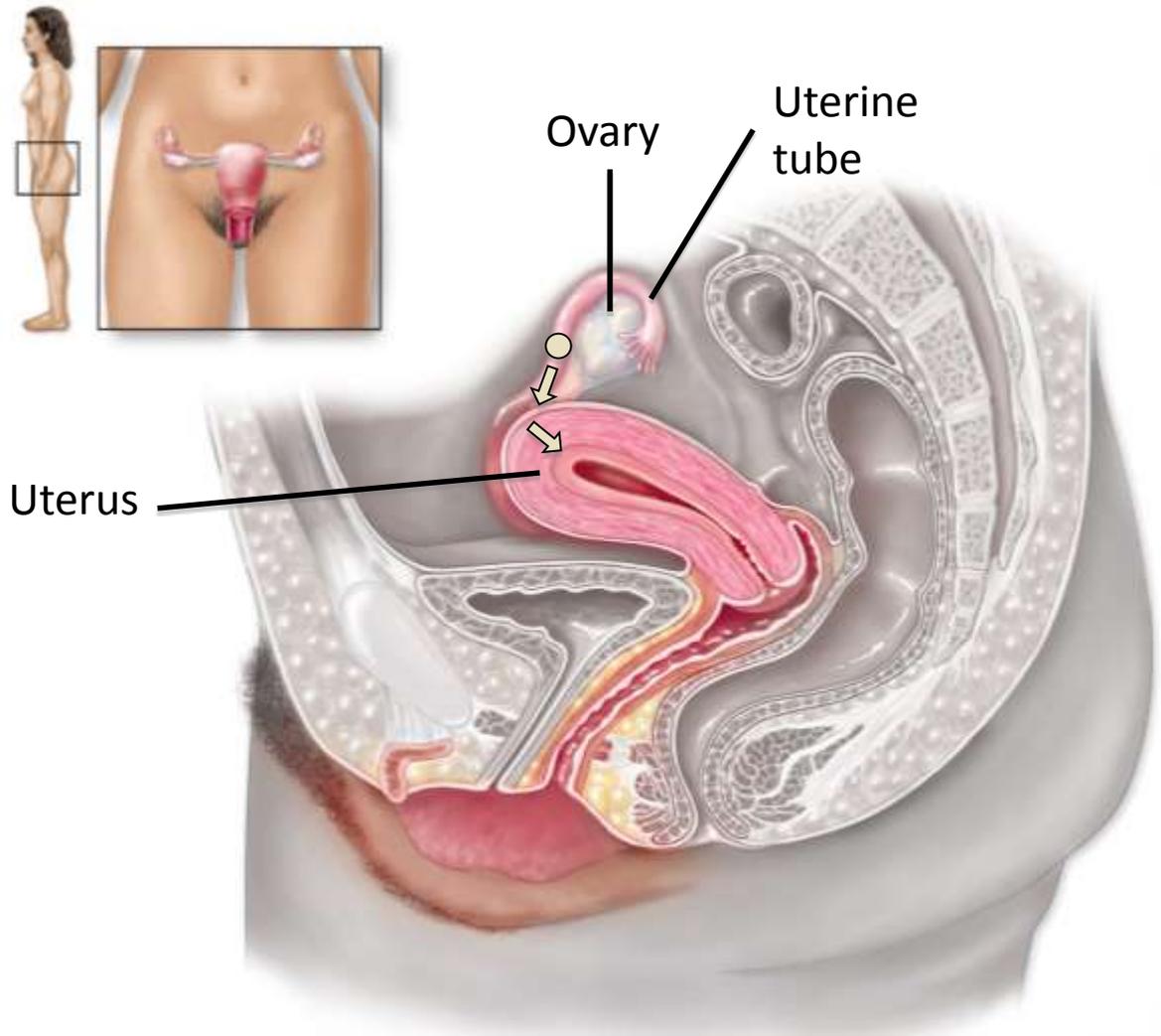
Figure 46.12ba

Ovary



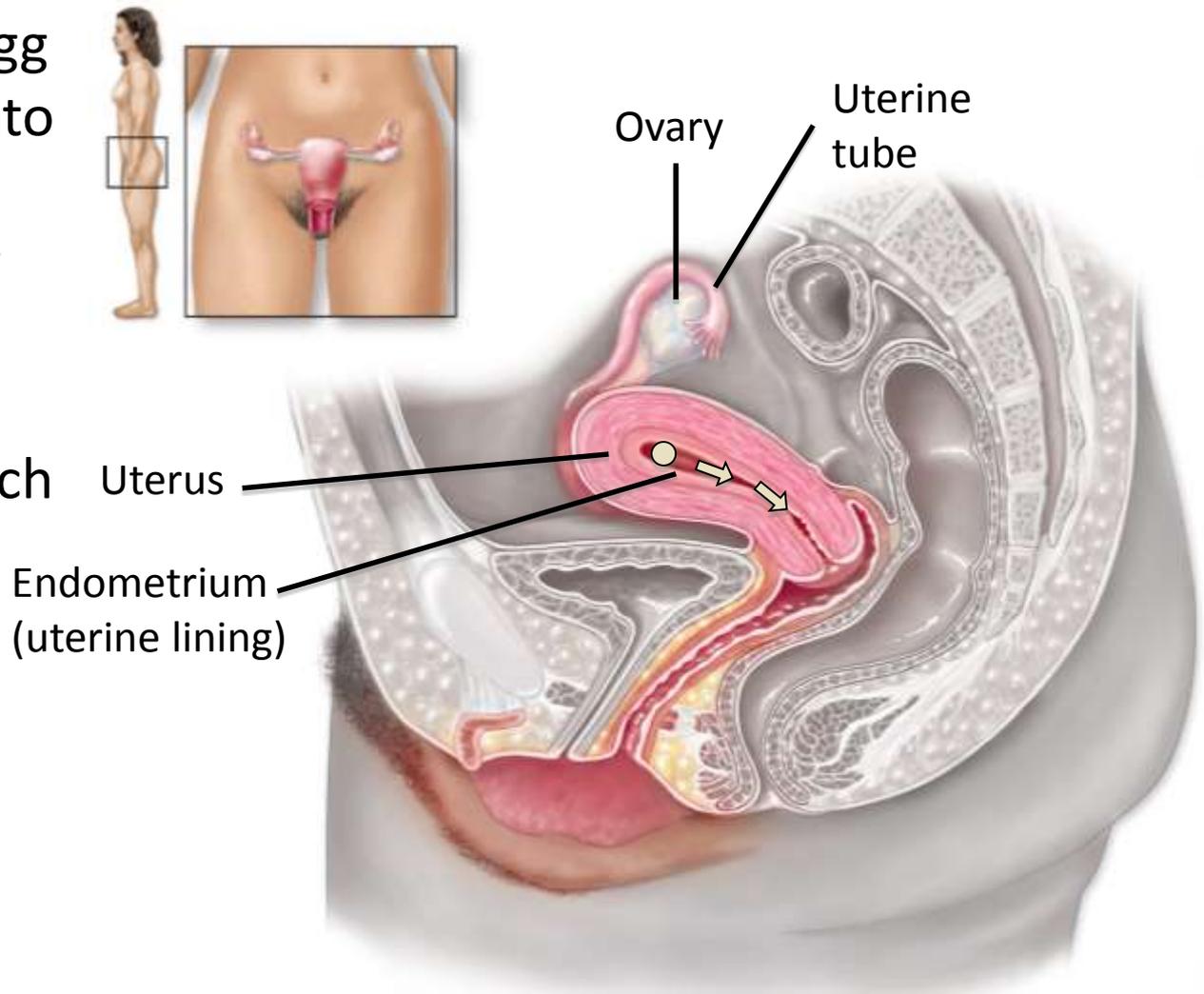
Human Reproduction: Females Produce Eggs

Whether or not an egg cell is fertilized, it travels from the uterine tube into the uterus.



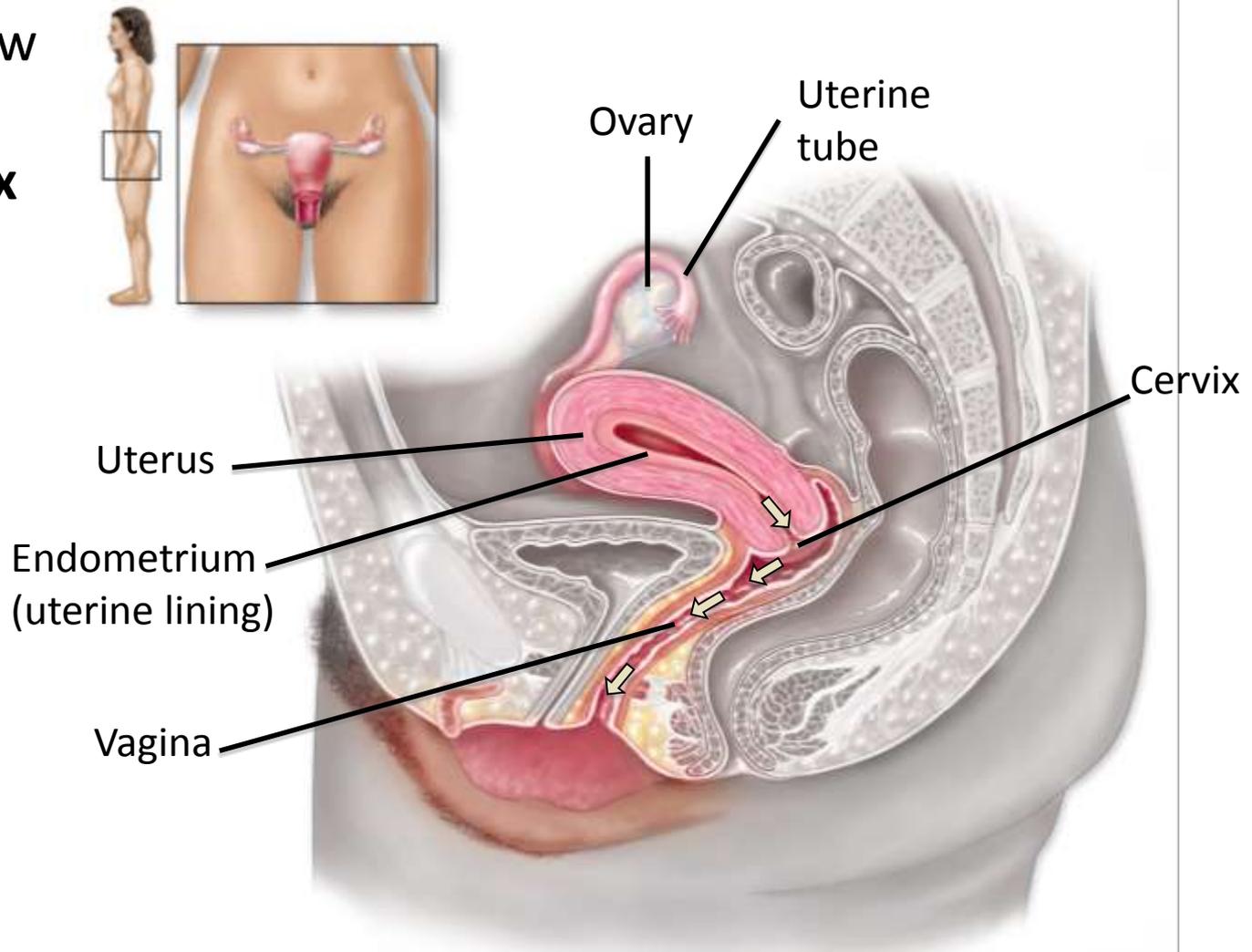
Human Reproduction: Females Produce Eggs

The unfertilized egg it is reabsorbed into the body or is discharged during **menstruation**—when the uterus sheds its lining each month.



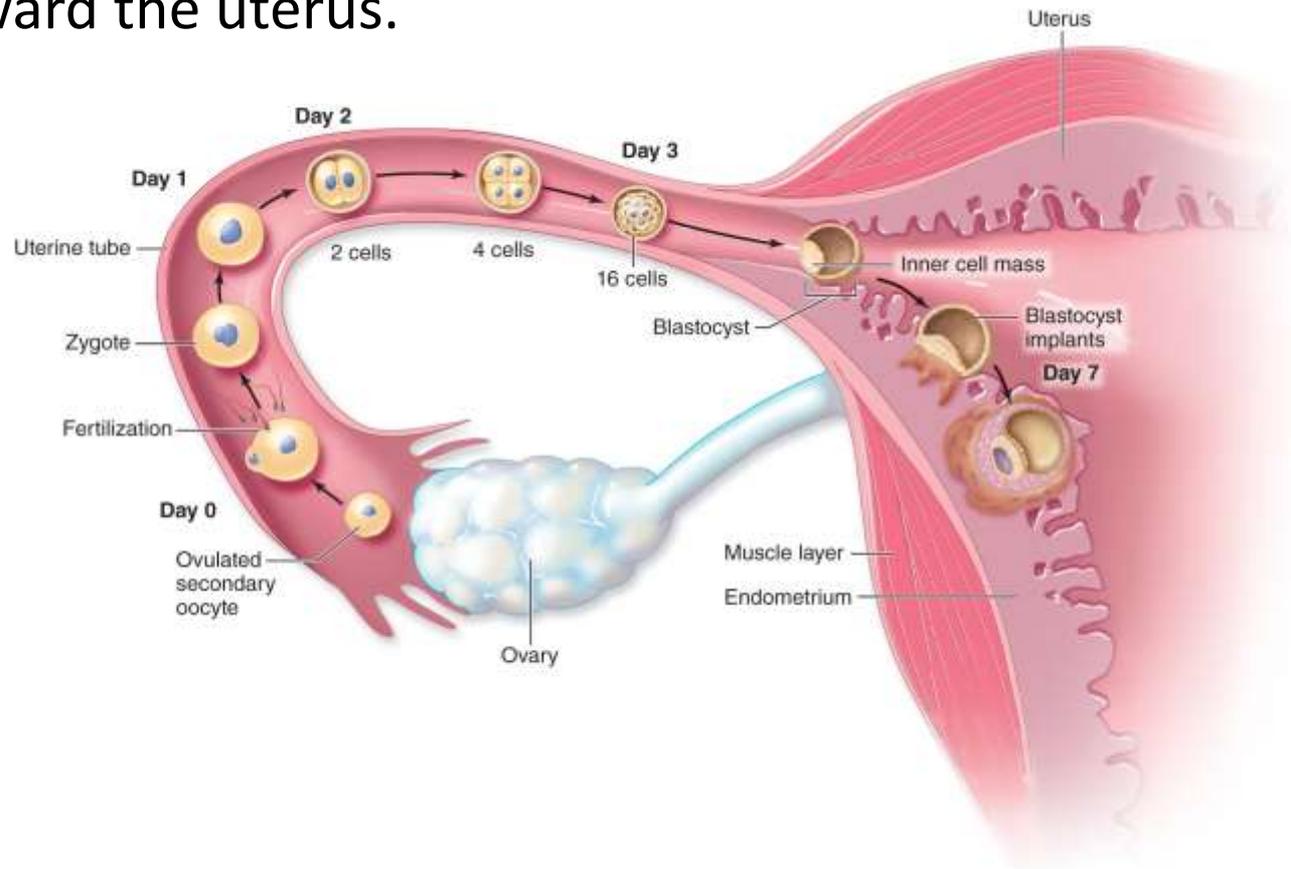
Human Reproduction: Females Produce Eggs

The menstrual flow exits the body through the **cervix** and **vagina**.



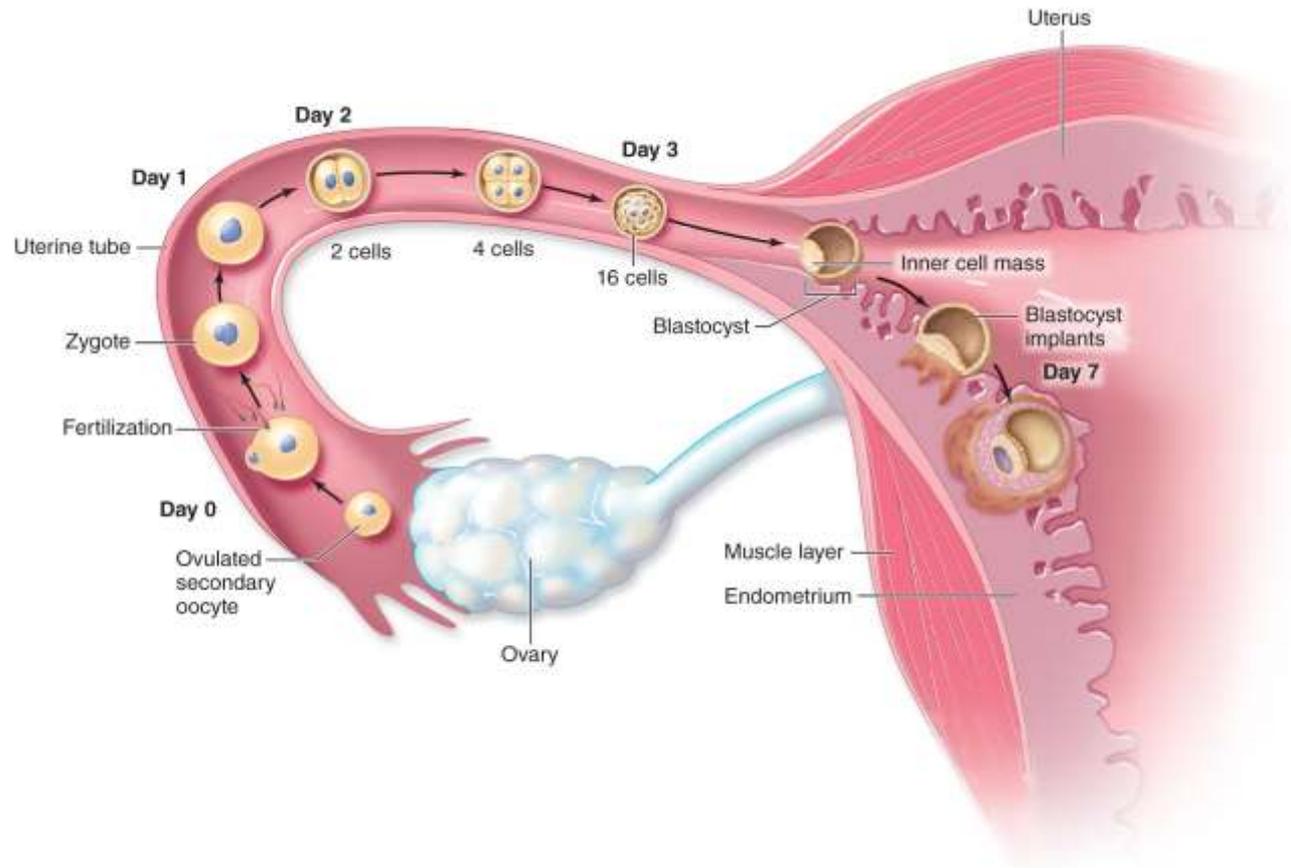
Human Reproduction: Females Produce Eggs

A fertilized egg has a different fate. It begins dividing as it travels along the uterine tube toward the uterus.



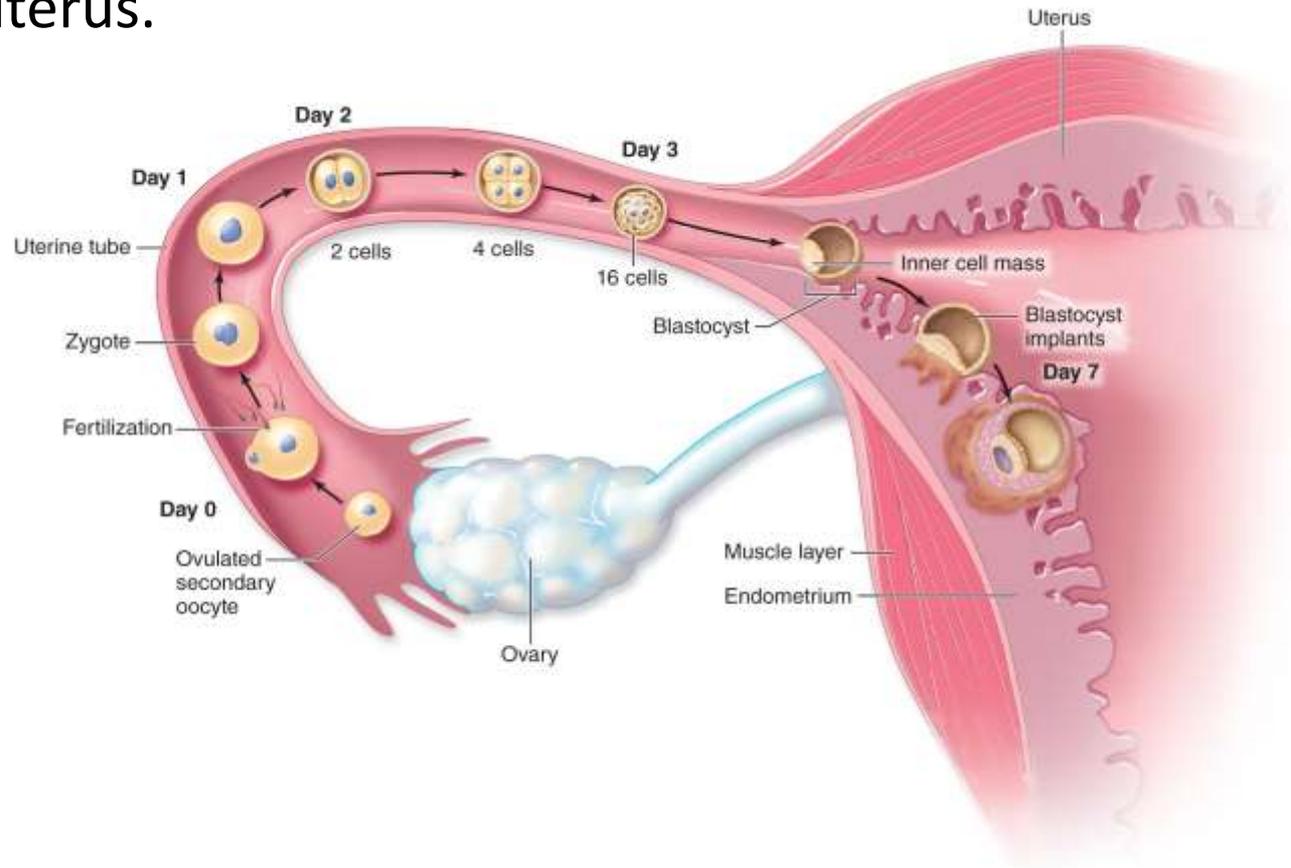
Human Reproduction: Females Produce Eggs

When it reaches the uterus, the preembryo implants in the uterine lining.



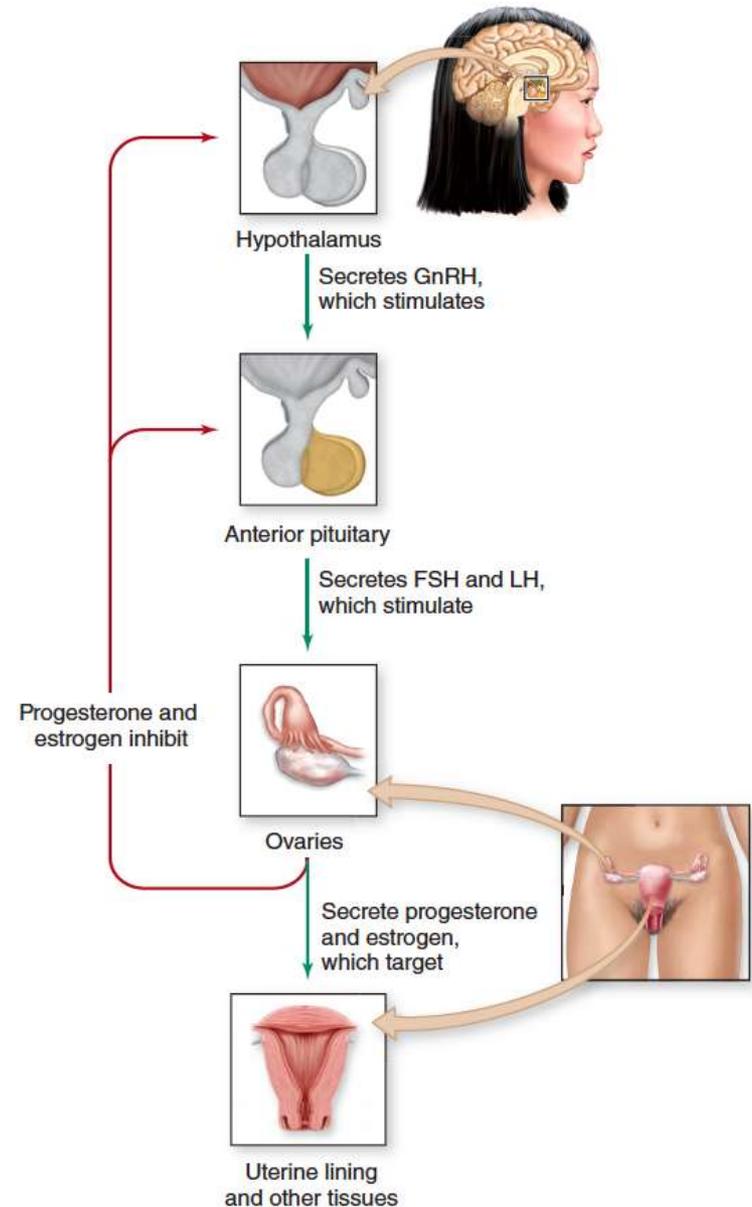
Human Reproduction: Females Produce Eggs

Hormonal changes prevent menstruation, so the preembryo is retained in the uterus.



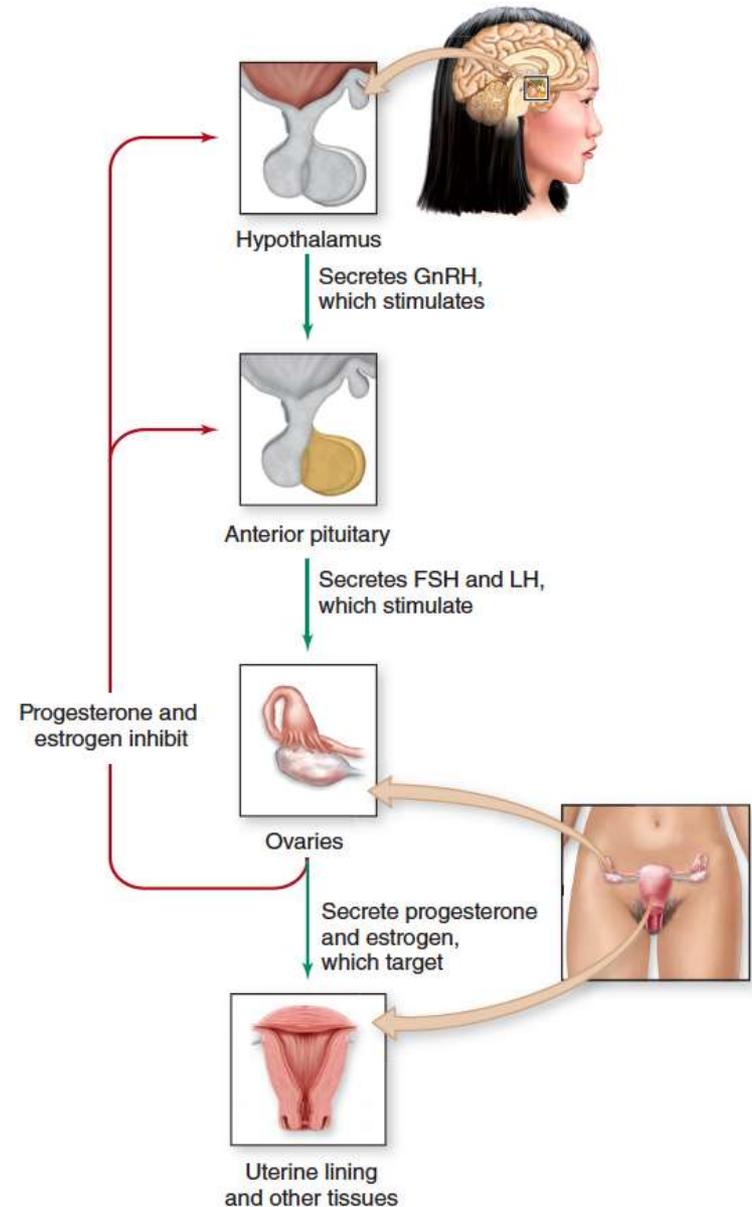
Human Reproduction: Females Produce Eggs

Many hormones that influence male reproductive function also occur in females.



Human Reproduction: Females Produce Eggs

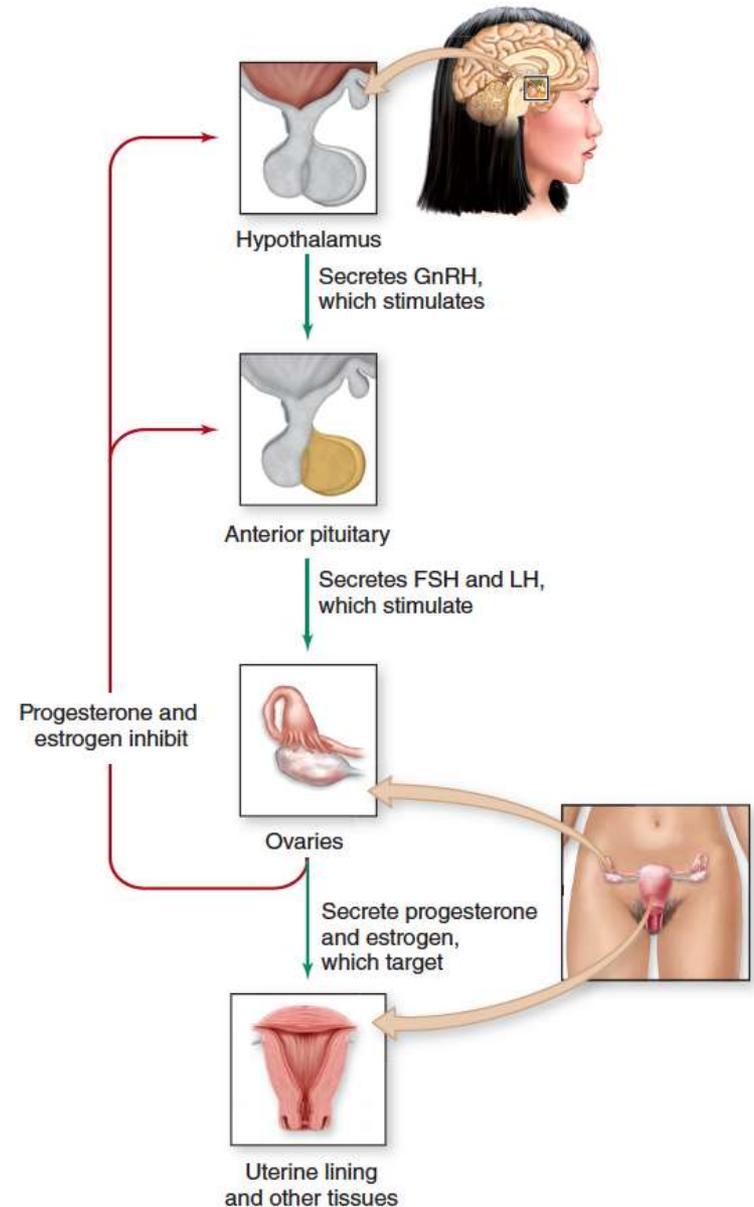
The hypothalamus produces GnRH, which stimulates the anterior pituitary to release FSH and LH.



Human Reproduction: Females Produce Eggs

FSH and LH, in turn, stimulate the ovaries to secrete progesterone and estrogen, which target the uterine lining.

How do these hormones influence ovulation and menstruation?



Human Reproduction: Females Produce Eggs

The **ovarian cycle** controls oocyte maturation in the ovaries.

Ovarian cycle →

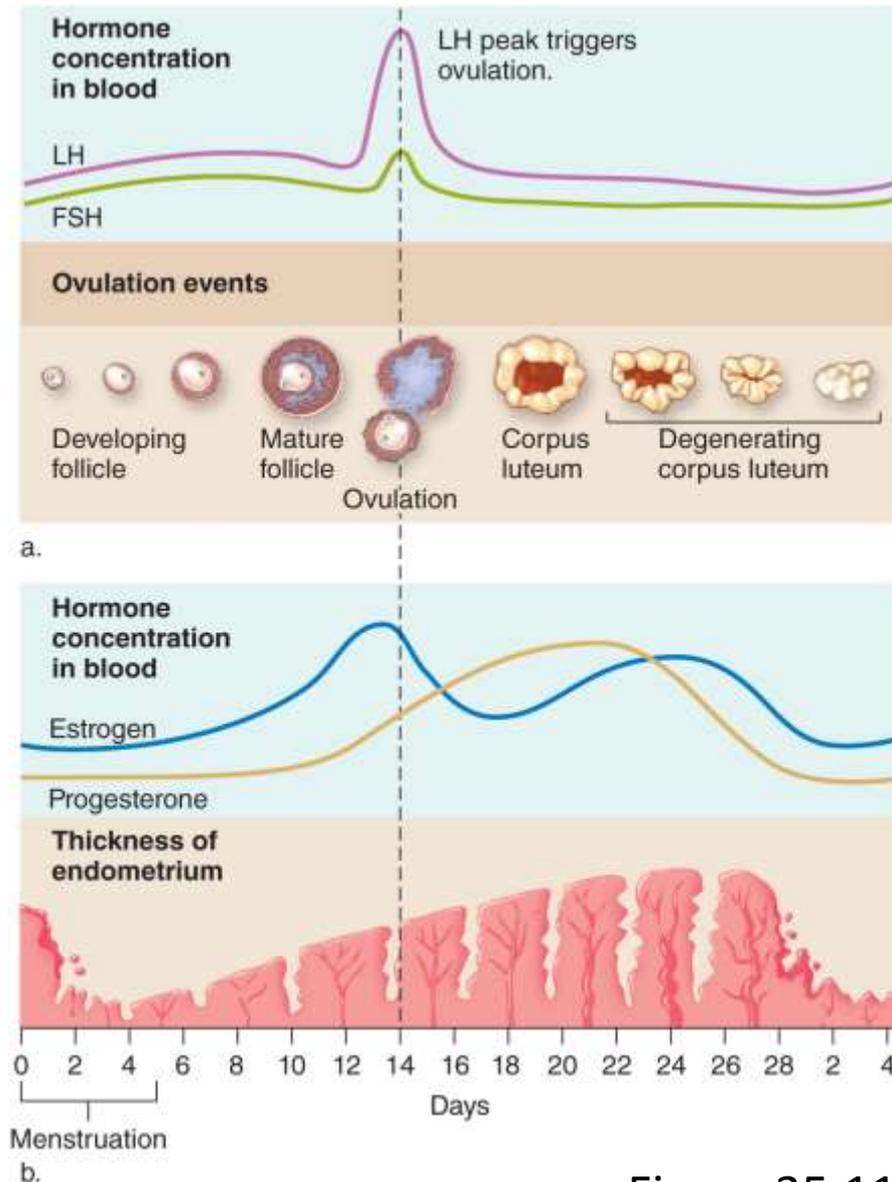


Figure 35.11

Human Reproduction: Females Produce Eggs

Ovarian cycle →

LH and FSH primarily regulate the ovarian cycle.

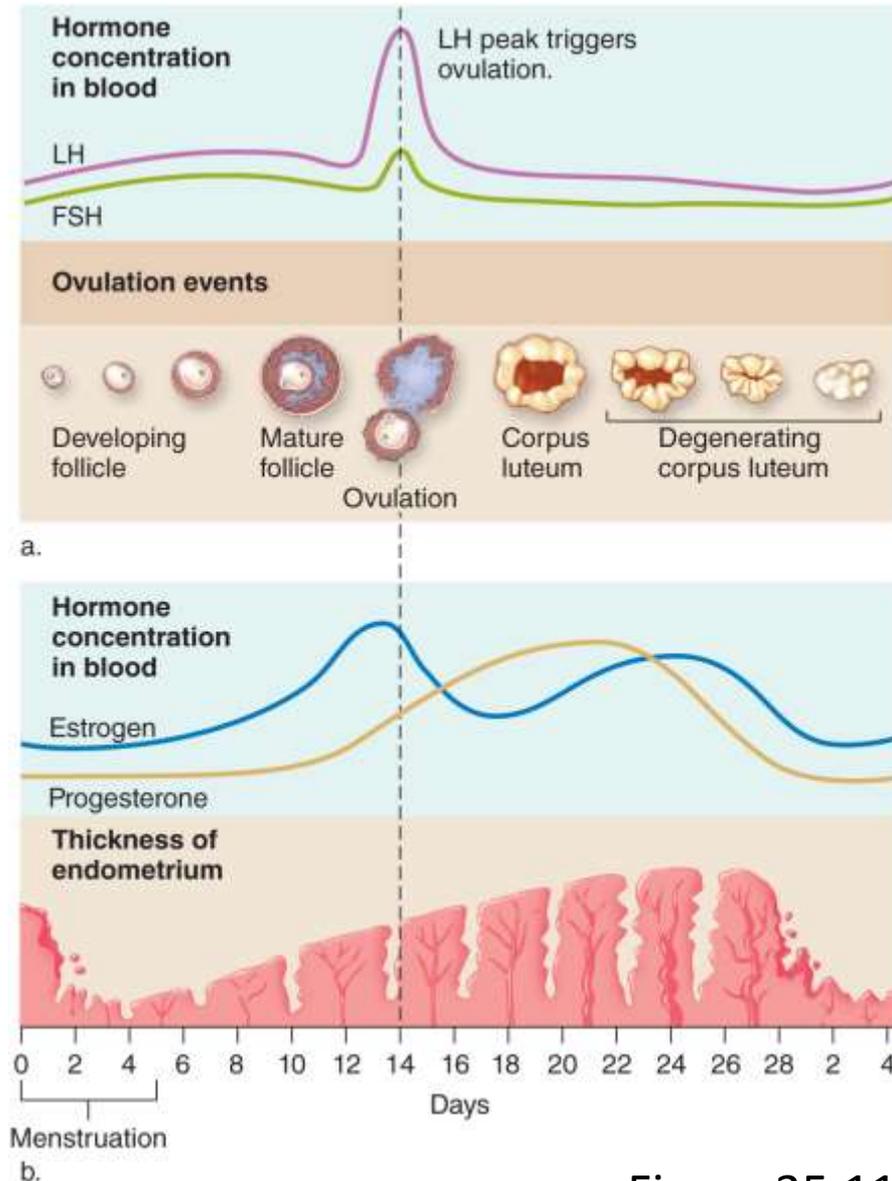


Figure 35.11

Human Reproduction: Females Produce Eggs

The **menstrual cycle** prepares the uterus for pregnancy.

Menstrual cycle →

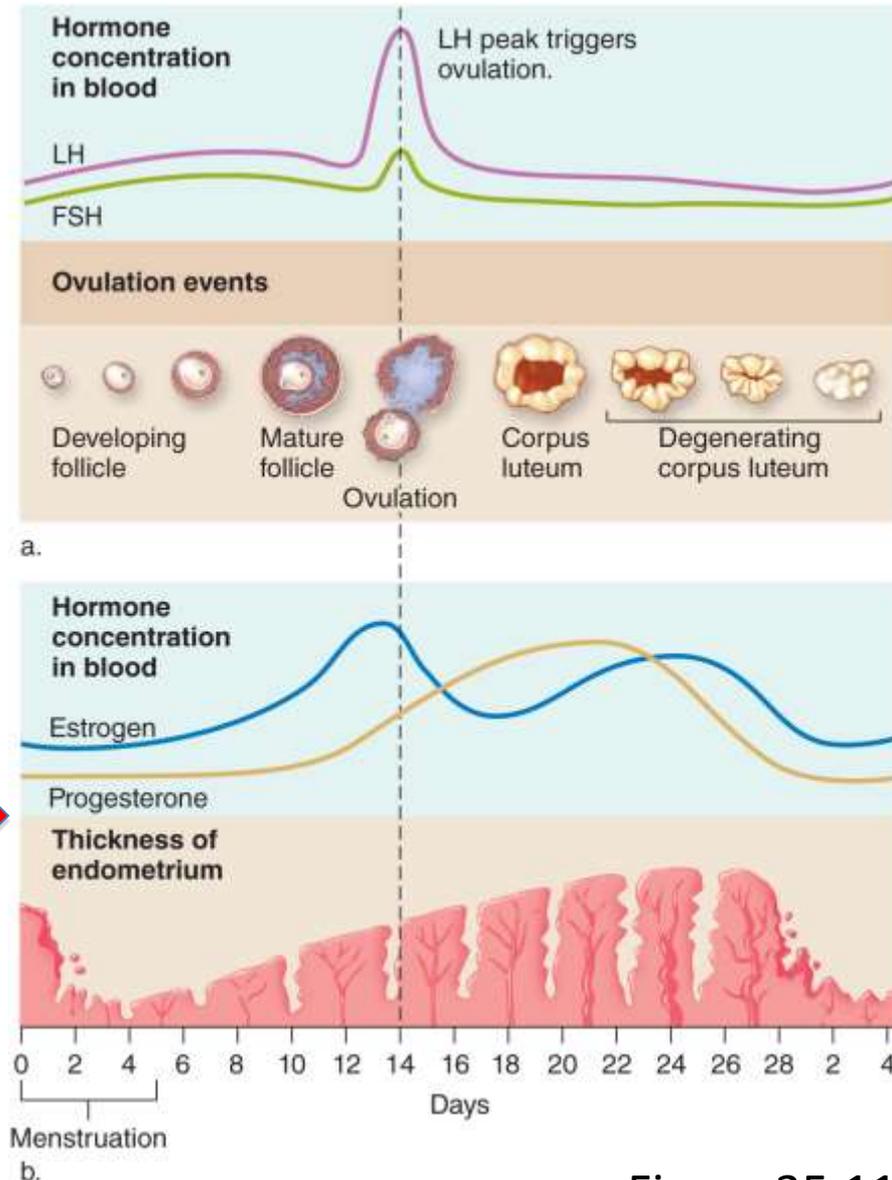


Figure 35.11

Human Reproduction: Females Produce Eggs

Estrogen and **progesterone** primarily regulate the menstrual cycle.

Menstrual cycle →

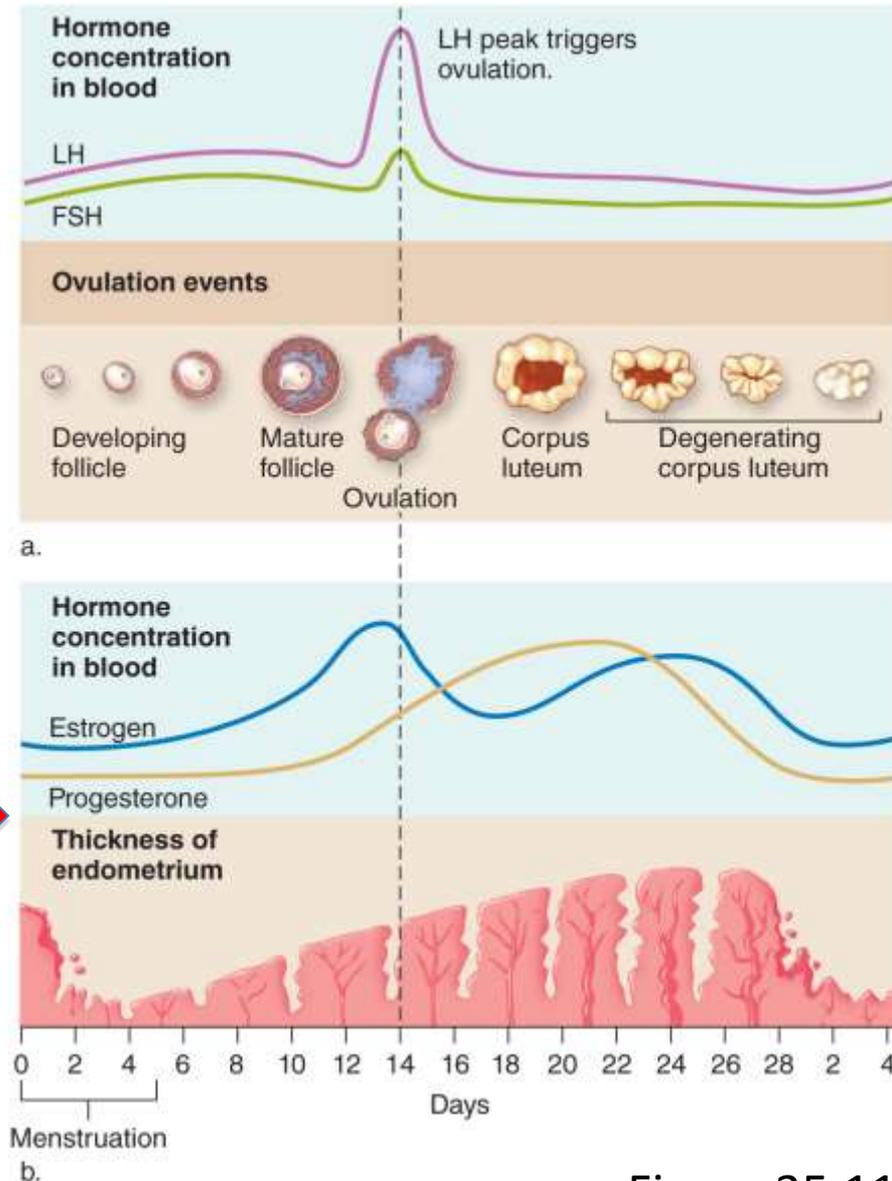
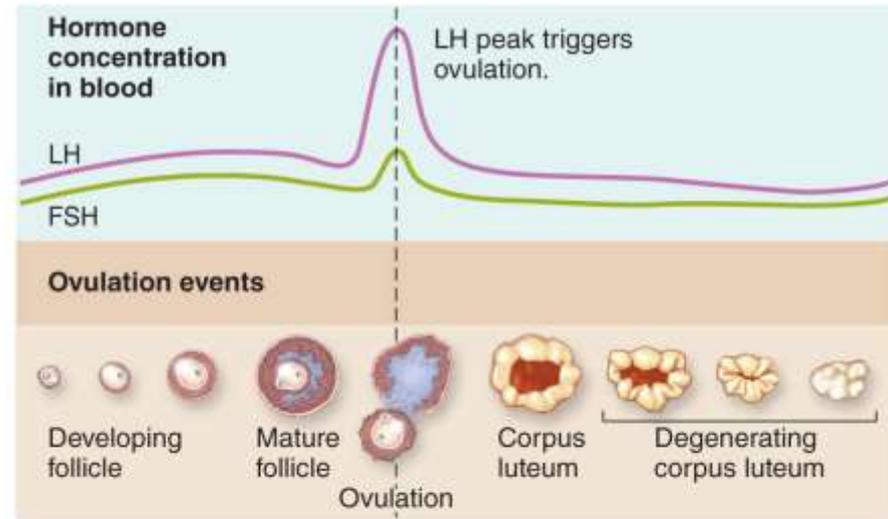


Figure 35.11

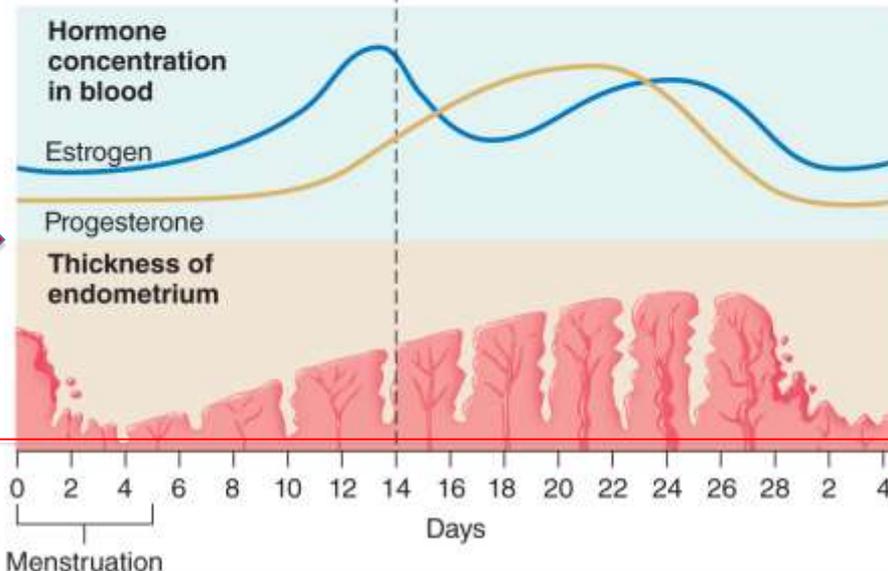
Human Reproduction: Females Produce Eggs

The concentrations of all four hormones fluctuate on about a 28-day cycle.

Ovarian cycle →



Menstrual cycle →



Human Reproduction: Females Produce Eggs

Ovarian cycle →

The rising FSH concentration early in the cycle stimulates follicles to develop, preparing an oocyte for ovulation.

*FSH = Follicle stimulating hormone

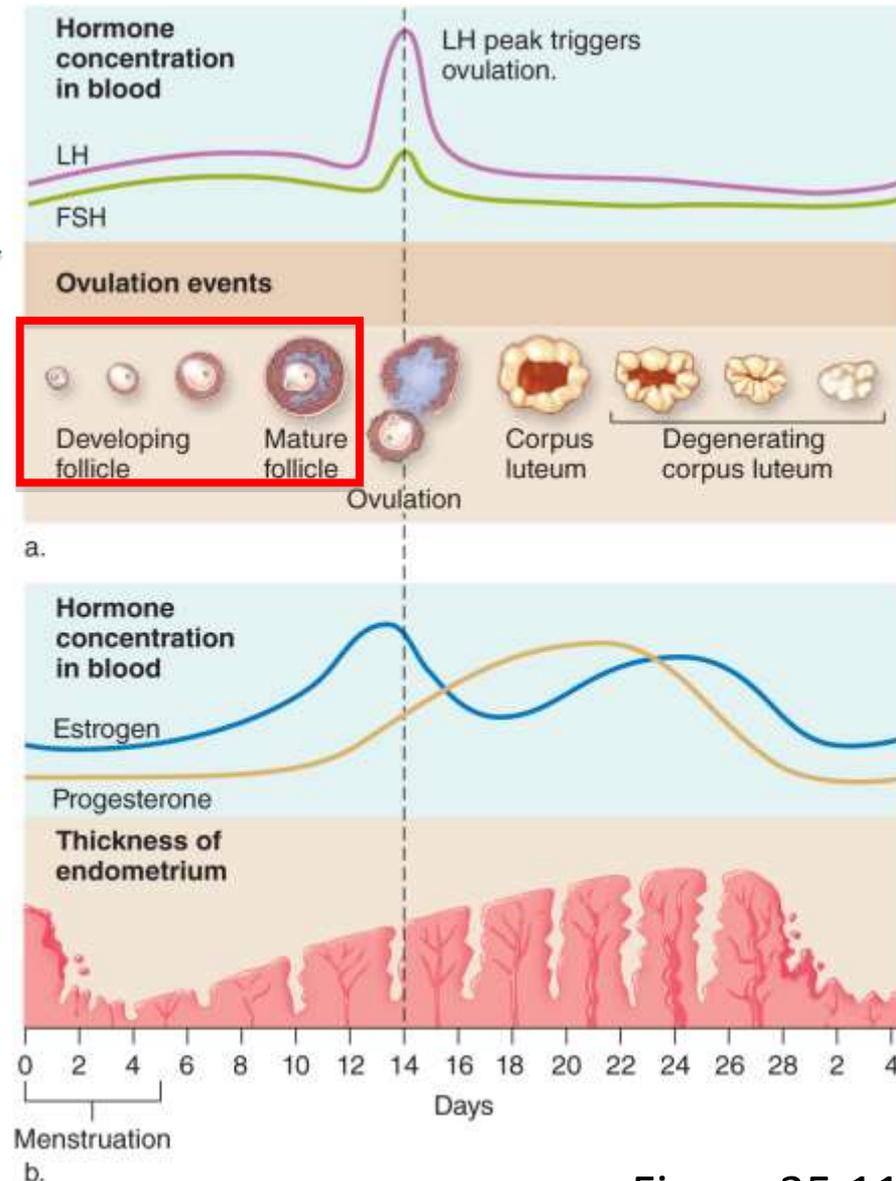


Figure 35.11

Human Reproduction: Females Produce Eggs

Ovarian cycle →

In the middle of the cycle, a spike in estrogen triggers a spike in LH, which cues ovulation.

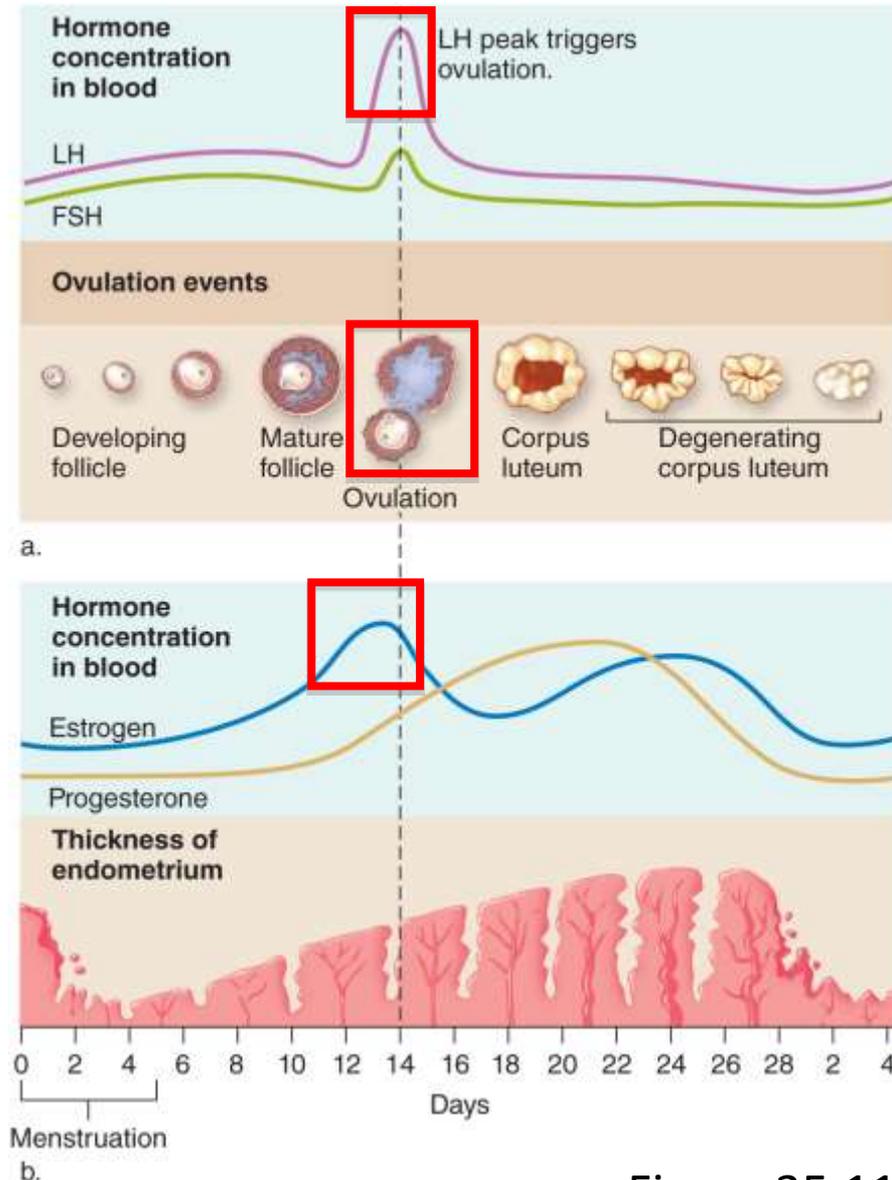


Figure 35.11

Human Reproduction: Females Produce Eggs

Ovarian cycle →

Under the influence of LH, the ruptured follicle transforms into a corpus luteum.

*LH = Luteinizing hormone

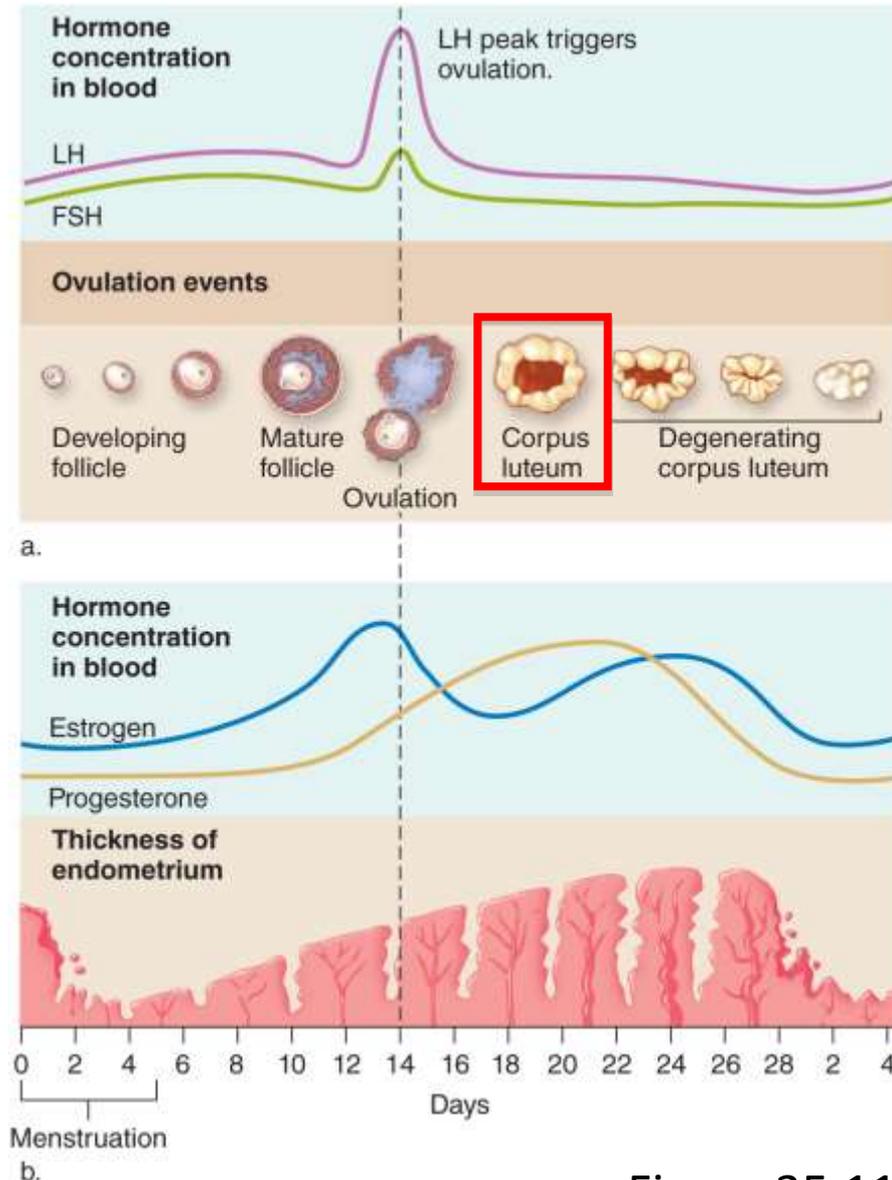


Figure 35.11

Human Reproduction: Females Produce Eggs

The corpus luteum produces large amounts of progesterone, which cues the uterine lining to thicken further.

Menstrual cycle →

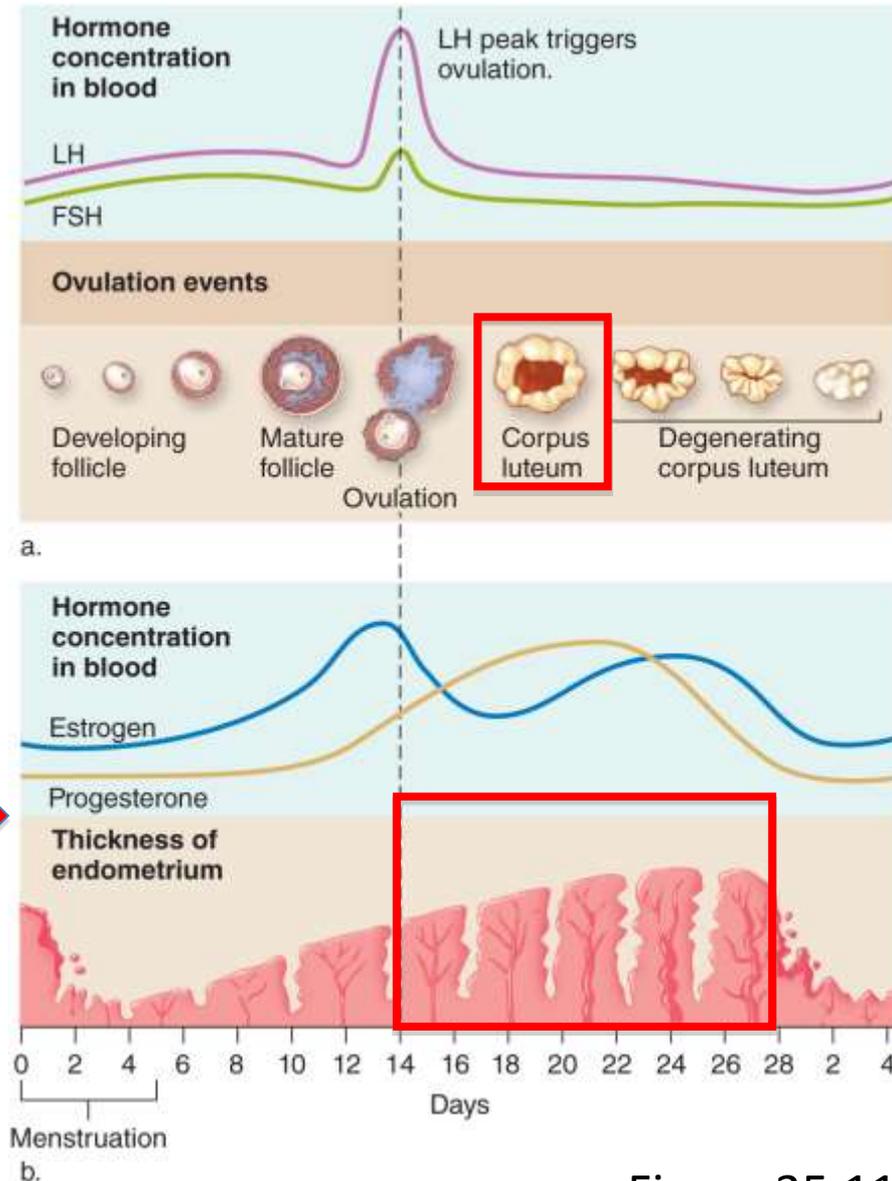


Figure 35.11

Human Reproduction: Females Produce Eggs

The thickening uterine lining prepares the uterus for possible pregnancy.

Menstrual cycle →

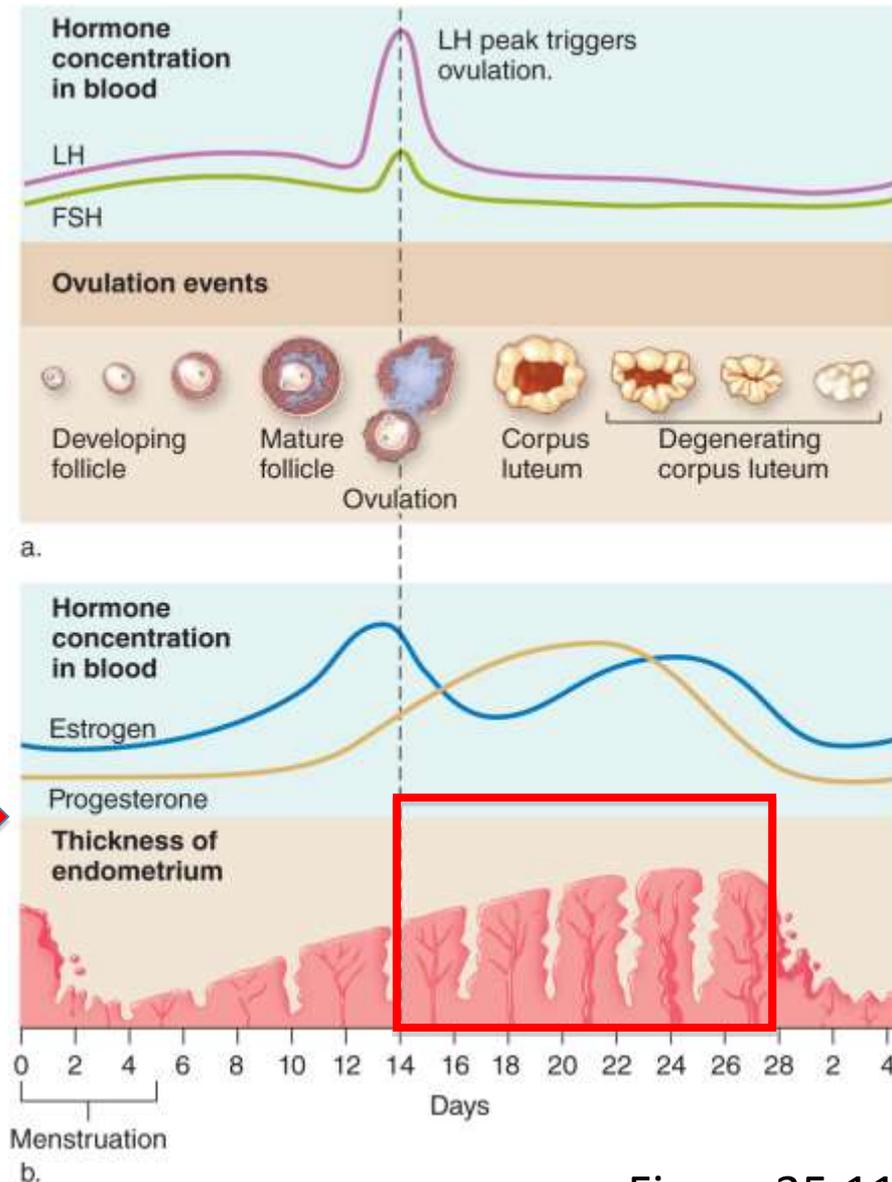
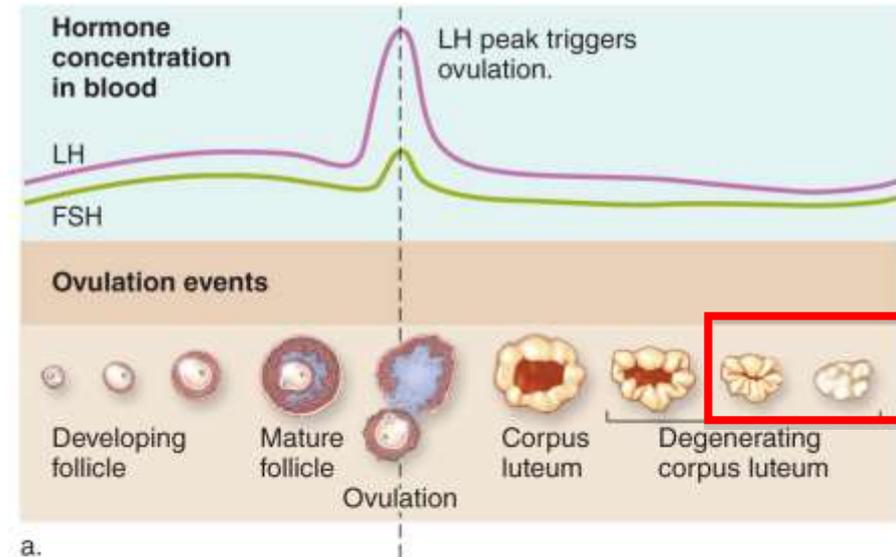


Figure 35.11

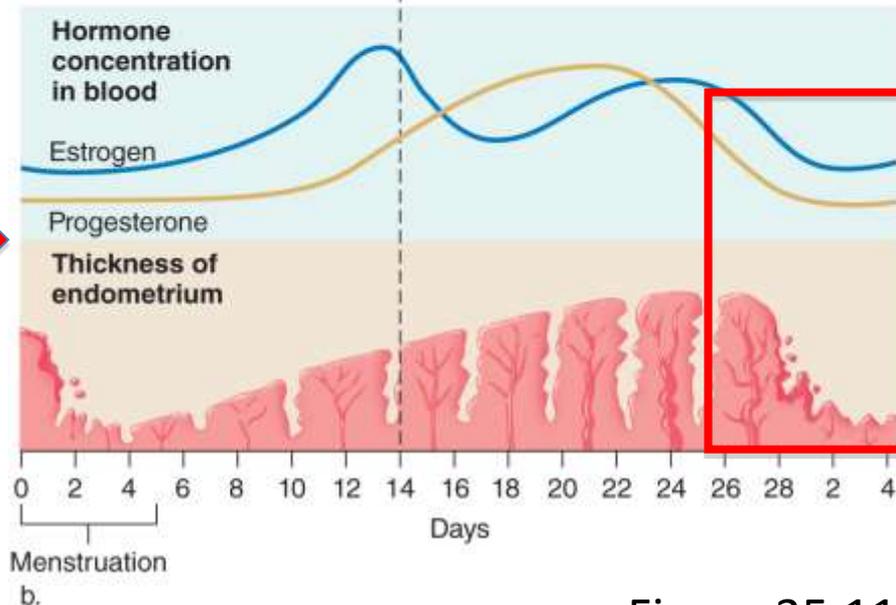
Human Reproduction: Females Produce Eggs

If no pregnancy occurs, then the corpus luteum degrades after about 14 days. Progesterone levels drop and menstruation occurs.

Ovarian cycle →

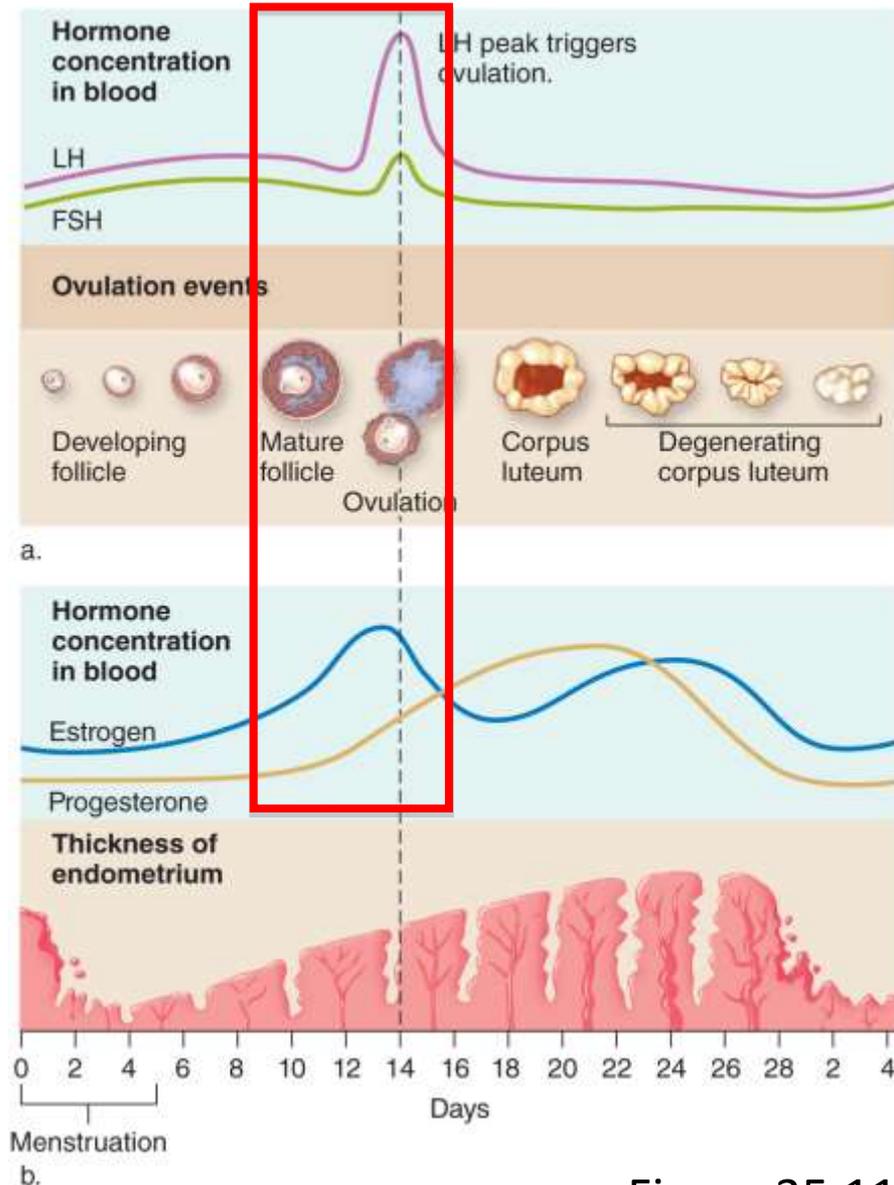


Menstrual cycle →



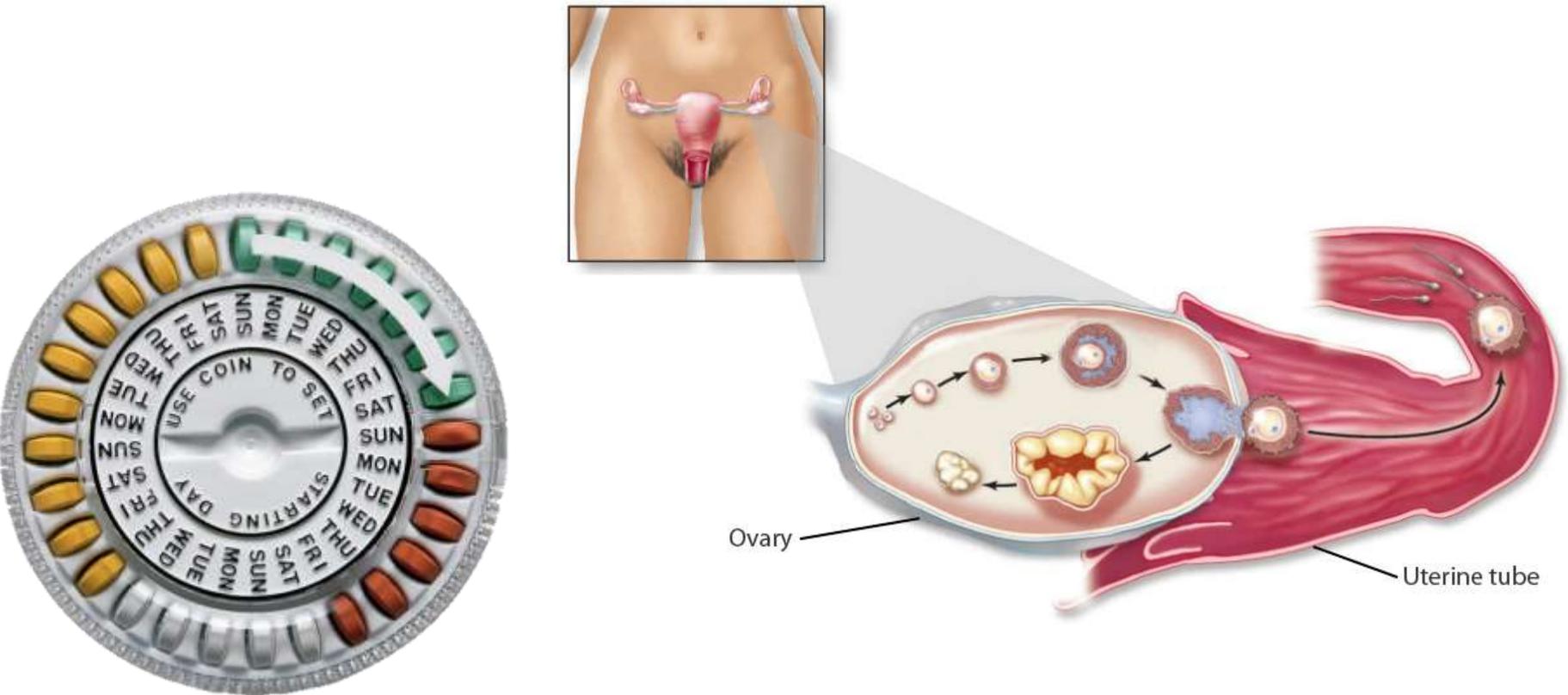
Human Reproduction: Birth Control

Birth control pills contain synthetic forms of estrogen and progesterone. They disrupt the normal hormonal changes that trigger ovulation.



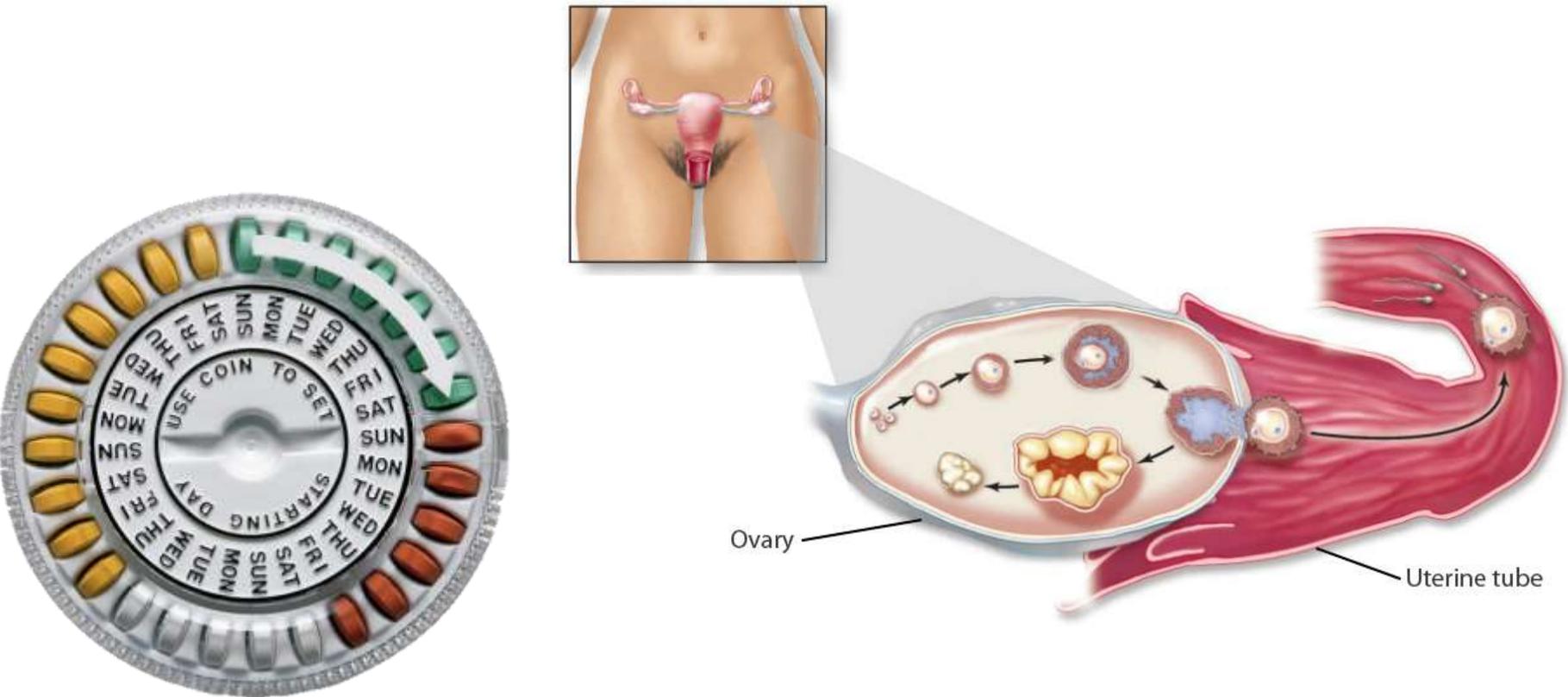
Human Reproduction: Birth Control

If no egg is released, fertilization cannot occur.

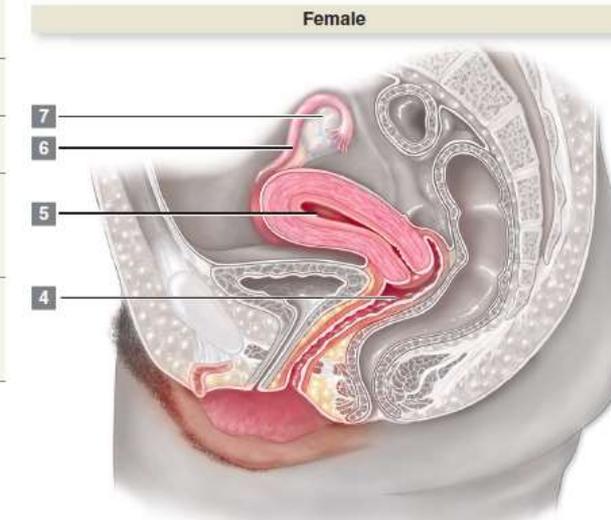
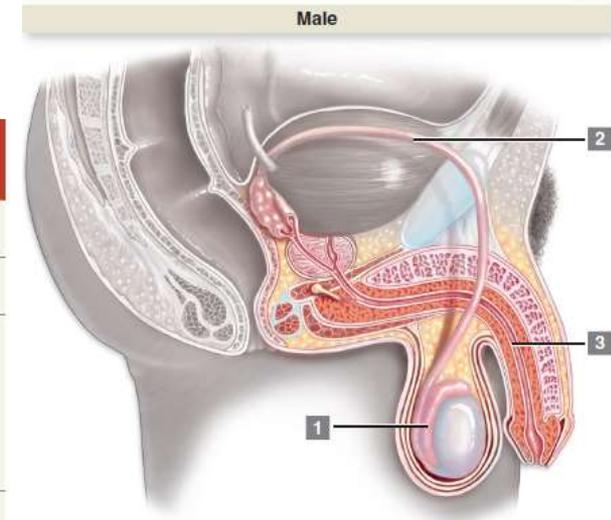


Human Reproduction: Birth Control

Most other forms of birth control also prevent fertilization, although some types prevent a preembryo from implanting in the uterine lining (see next slide).



Human Reproduction: Birth Control



Method	Area(s) Targeted	Mechanism	Advantages	Disadvantages	Pregnancies per 100 women per year
Abstinence	1	No intercourse; sperm remain inside male	No cost	Difficult to do	0
Vasectomy*	2	Cuts vas deferentia, so sperm cells never reach urethra	Permanent; does not interrupt spontaneity	Requires minor surgery; difficult to reverse	< 1
Withdrawal*	3	Removal of penis from vagina before ejaculation	No cost	Not recommended for sexually inexperienced men; requires great self-control; sperm may leak from penis before withdrawal; sperm spilled on vulva may cause pregnancy	18
Latex condom	3	Worn over penis or inserted into vagina; keeps sperm out of vagina	Protects against sexually transmitted diseases	Disrupts spontaneity; reduces sensation	15
Cervical cap used with spermicide*	4	Kills sperm and blocks cervix	Inexpensive; can be kept in for 24 hours	May slip out of place; must be fitted	20
Intrauterine device (IUD) *	5	Prevents implantation of preembryo	Does not interrupt spontaneity	Severe menstrual cramps; risk of infection	< 1
Tubal ligation*	6	Cuts uterine tubes, so oocytes never reach uterus	Permanent; does not interrupt spontaneity	Requires surgery; risk of infection; difficult to reverse	< 1
Fertility awareness method*	6, 7	No intercourse during fertile times, as inferred from body temperature and other clues (see this section's Burning Question)	No cost	Requires careful record-keeping	20
Hormone supplements (estrogen and/or progesterone)*	5, 7	Prevents ovulation and implantation	Does not interrupt spontaneity; easy to use	Menstrual changes; weight gain; headaches	2-9

*Does not protect against sexually transmitted diseases (STDs).



Clicker Question #3

Tubal ligation is a surgical birth control method in which both uterine tubes are severed and sealed. This procedure prevents

- A. estrogen production.
- B. menstruation.
- C. ovulation.
- D. sperm from encountering an egg.
- E. All of the choices are correct.



Clicker Question #3

Tubal ligation is a surgical birth control method in which both uterine tubes are severed and sealed. This procedure prevents

- A. estrogen production.
- B. menstruation.
- C. ovulation.
- D. sperm from encountering an egg.
- E. All of the choices are correct.

35.3 Mastering Concepts



How do hormones regulate ovulation?

Human Reproduction: STDs

Some disease-causing microbes move from host to host during sexual encounters, causing **sexually transmitted diseases (STDs)**.

TABLE 35.4 Examples of Sexually Transmitted Diseases

Disease	Agent	Treatment
Viruses		
HIV/AIDS	Human immunodeficiency virus (HIV)	Combination of drugs that reduce viral replication
Genital warts	Human papillomavirus (HPV)	Removal of warts
Cervical cancer	Human papillomavirus (HPV)	Surgery, radiation, chemotherapy
Genital herpes	Herpes simplex virus	Medications that reduce outbreak frequency and duration
Hepatitis B	Hepatitis B virus	None
Bacteria		
Chlamydia	<i>Chlamydia trachomatis</i>	Antibiotics
Gonorrhea	<i>Neisseria gonorrhoeae</i>	Antibiotics
Syphilis	<i>Treponema pallidum</i>	Antibiotics
Protists		
Trichomoniasis	<i>Trichomonas vaginalis</i>	Antiprotozoan drugs
Fungi		
Yeast infection	<i>Candida albicans</i>	Antifungal drugs

Human Reproduction: STDs

The spread of STDs can be prevented in many ways:

- Abstaining from sex
- Having only one sexual partner
- Using a latex condom
- Being vaccinated (only protects against some STDs)

TABLE 35.4 Examples of Sexually Transmitted Diseases

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Viruses		
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Chlamydia	<i>Chlamydia trachomatis</i>	Antibiotics
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Syphilis	<i>Treponema pallidum</i>	Antibiotics
Protists		
Trichomoniasis	<i>Trichomonas vaginalis</i>	Antiprotozoan drugs
Fungi		
Yeast infection	<i>Candida albicans</i>	Antifungal drugs

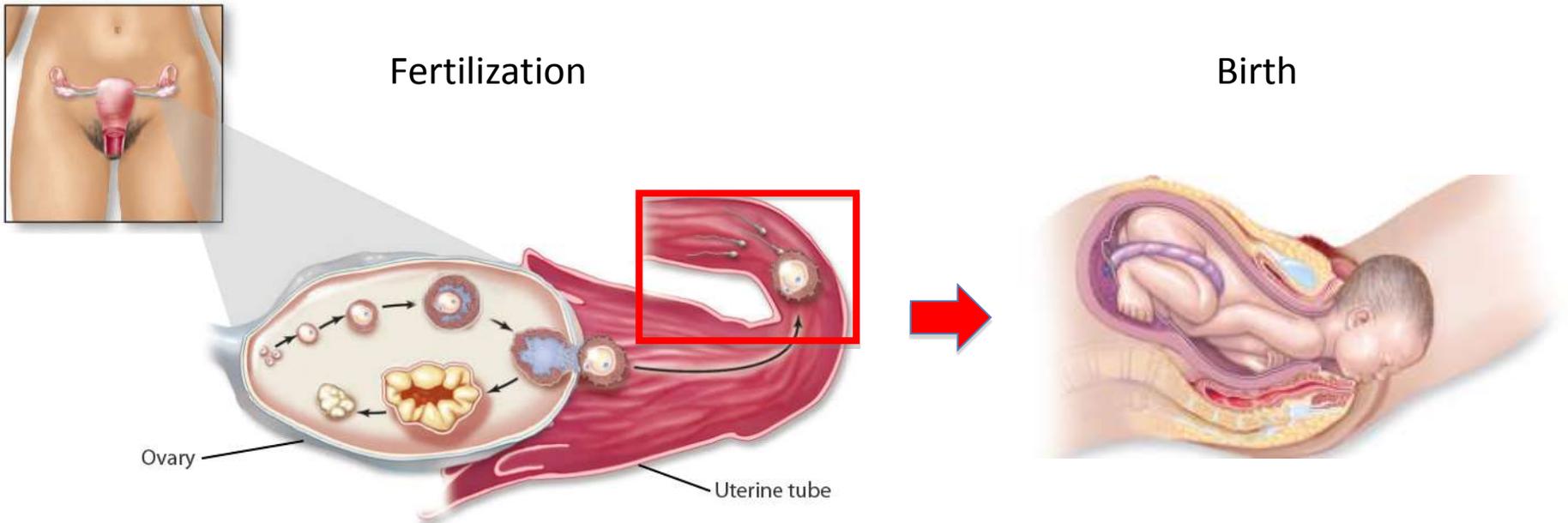
35.4 Mastering Concepts



List and describe three common STDs.

Human Reproduction: Fertilization to Birth

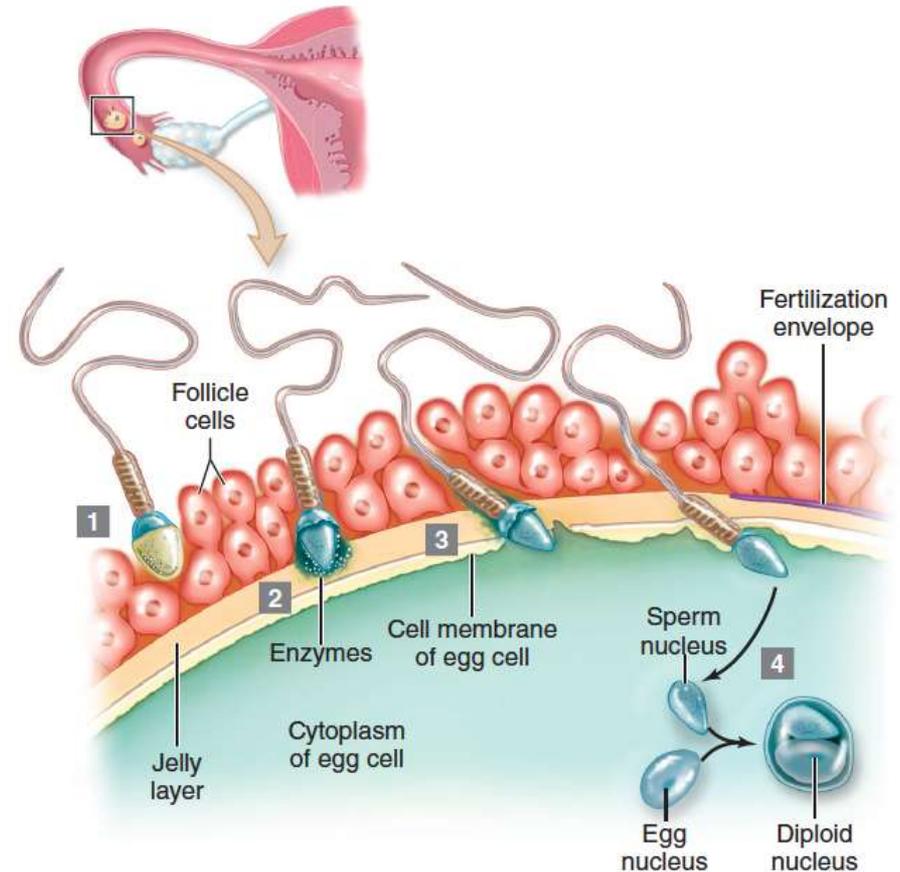
Many events occur between fertilization and birth.



Human Reproduction: Fertilization to Birth

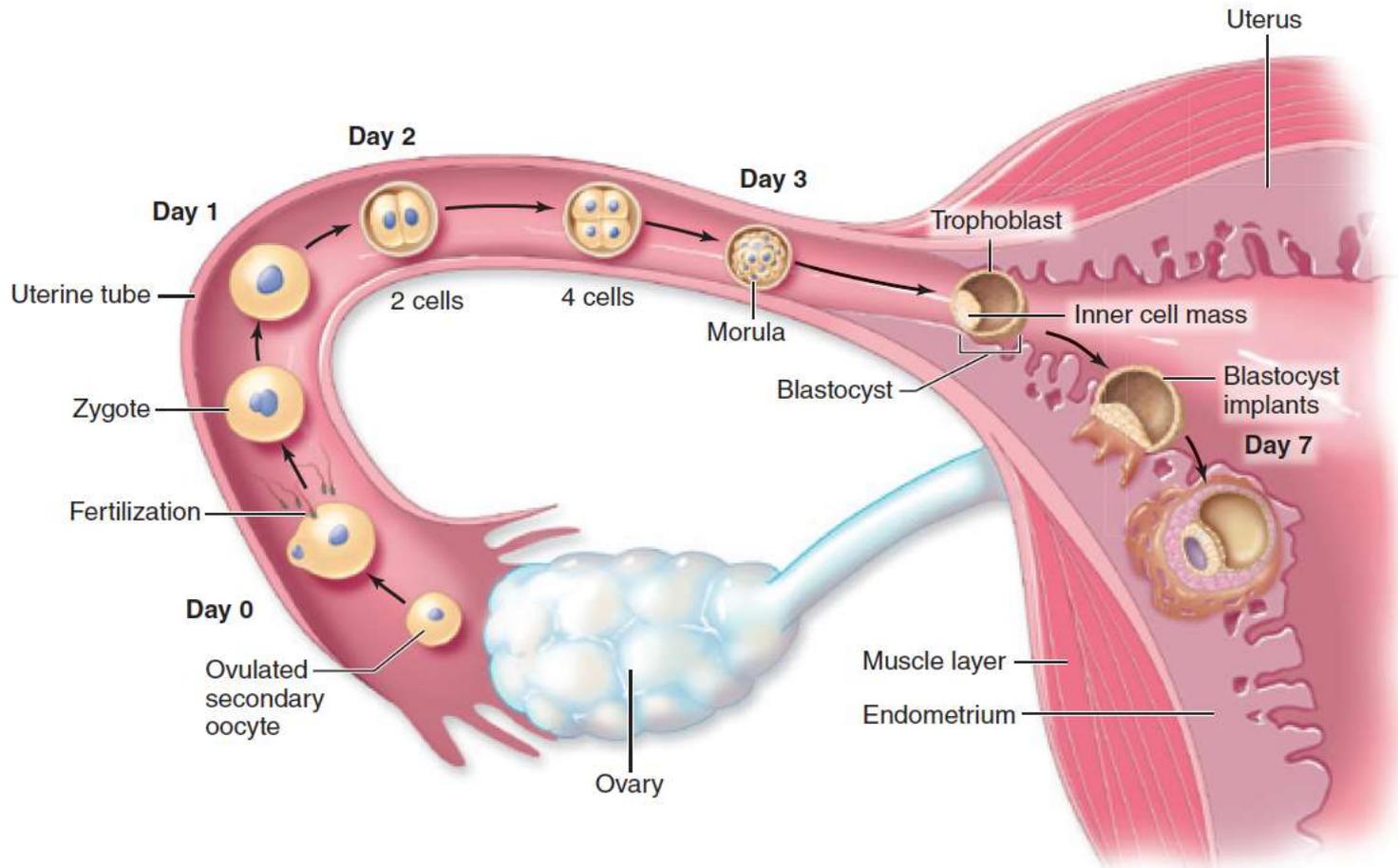
During fertilization:

- A sperm cell meets an egg cell.
- The sperm's acrosome releases enzymes that digest the follicle cells.
- Sperm nucleus is released into egg cell.
- Sperm nucleus fuses with egg nucleus, forming a diploid nucleus.



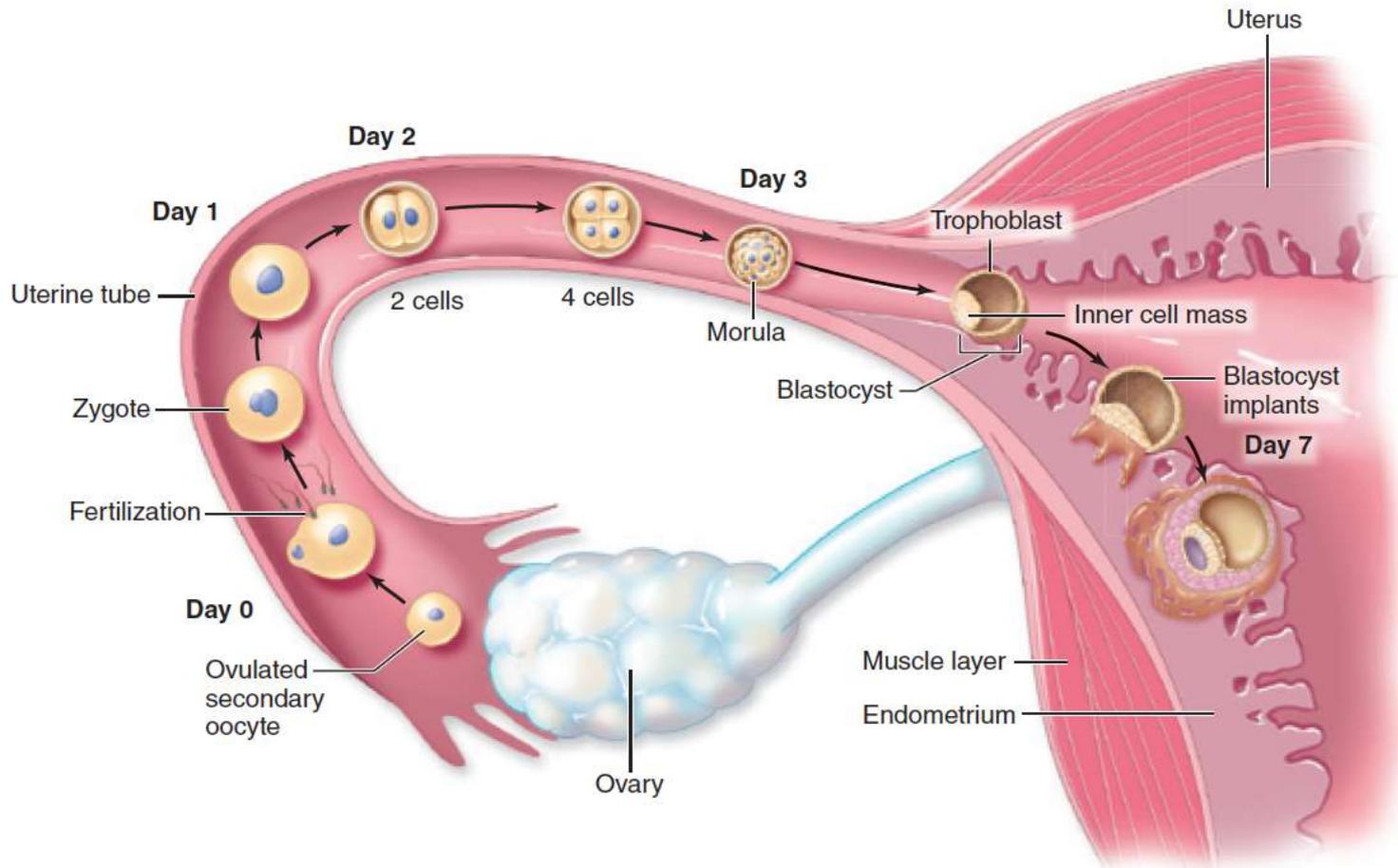
Human Reproduction: Fertilization to Birth

A day after fertilization, the zygote begins **cleavage**, a period of rapid mitotic division.



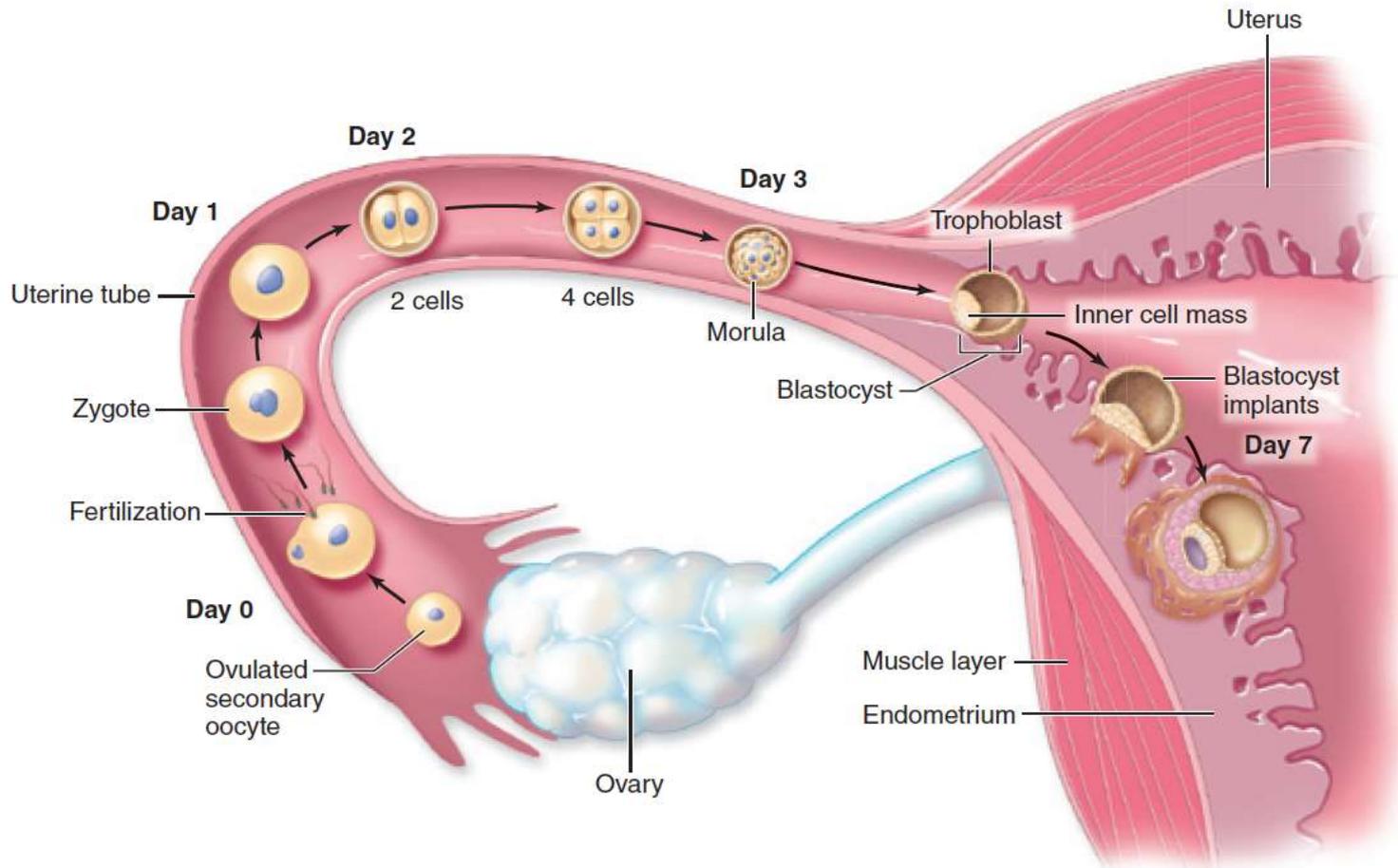
Human Reproduction: Fertilization to Birth

Cleavage results in a **morula** and then a **blastocyst**.



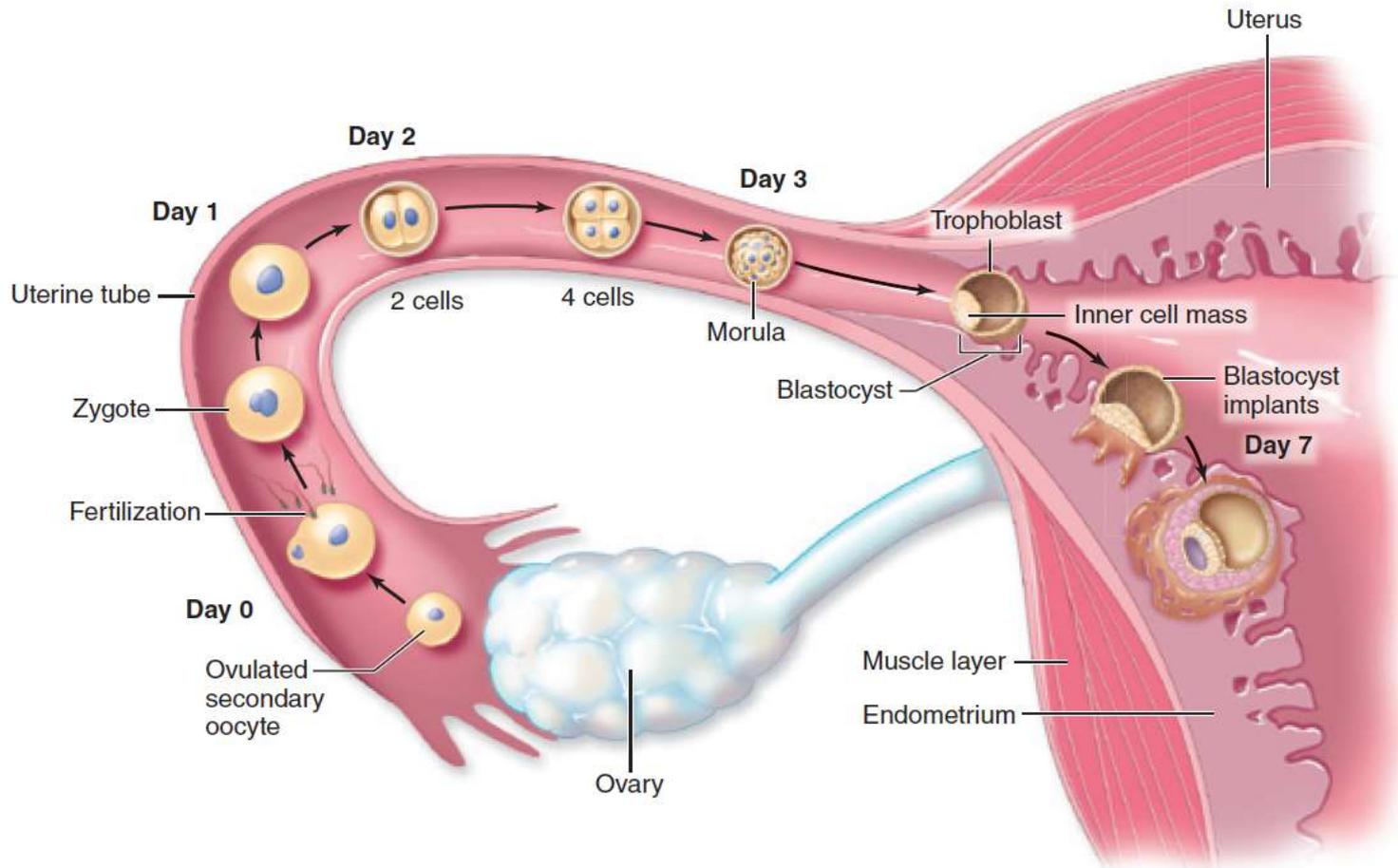
Human Reproduction: Fertilization to Birth

The outer layer of the blastocyst is called the trophoblast. These cells will become part of the placenta.



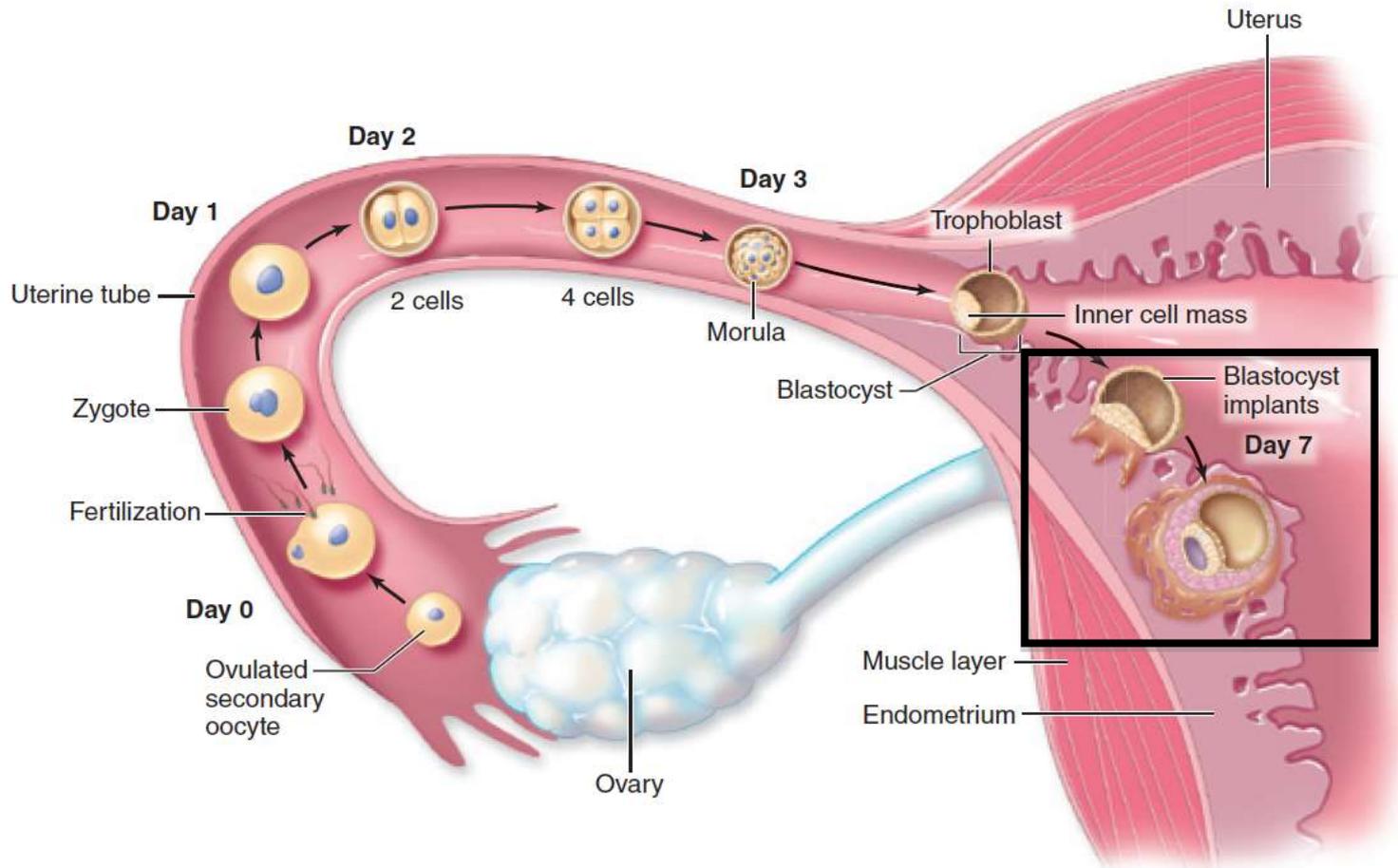
Human Reproduction: Fertilization to Birth

The cells inside the blastocyst form the **inner cell mass**. They will give rise to the embryo.



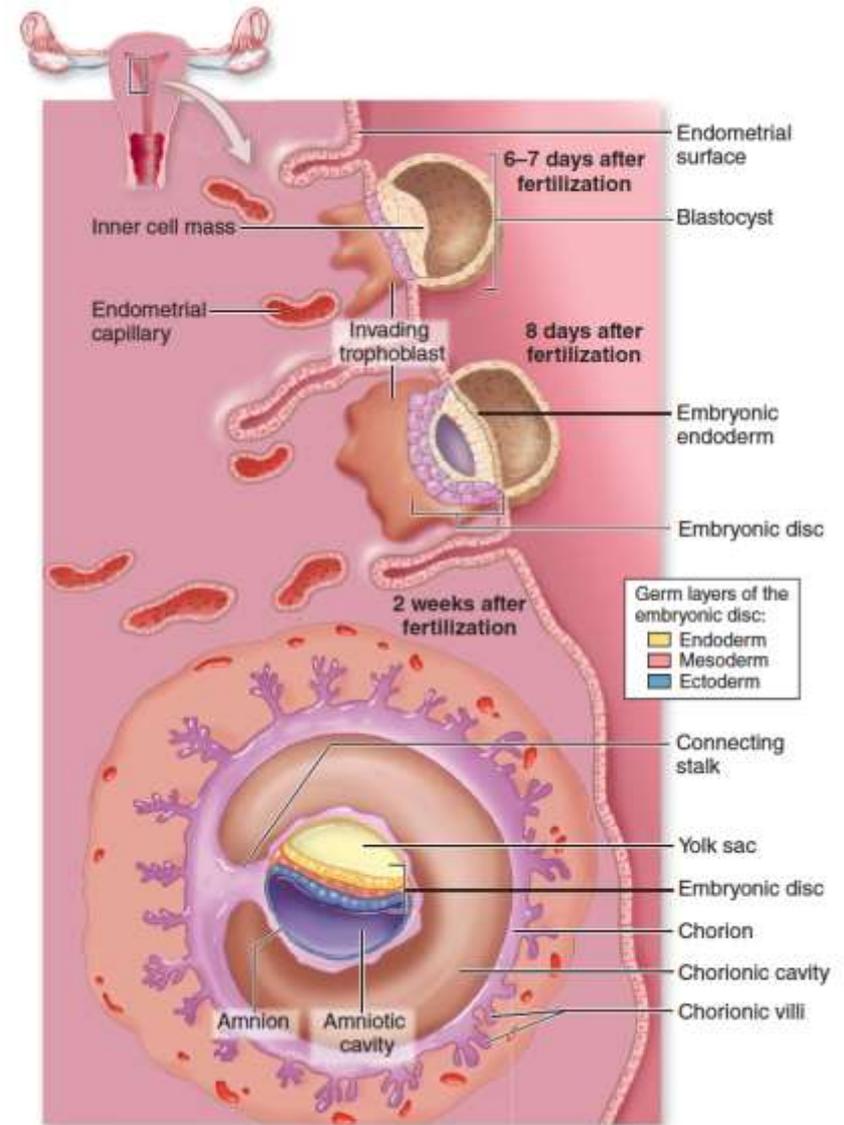
Human Reproduction: Fertilization to Birth

About a week after fertilization, the blastocyst becomes embedded in the uterine lining.



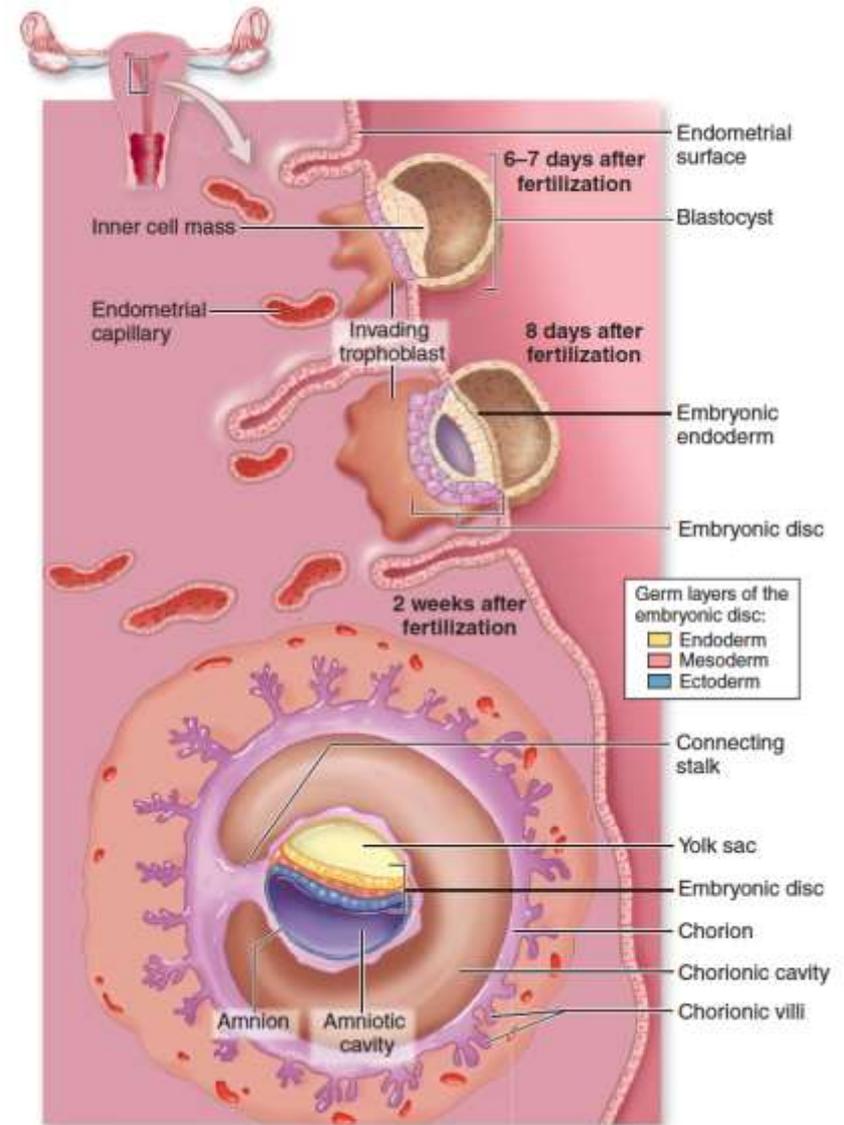
Human Reproduction: Fertilization to Birth

During **implantation**, the blastocyst digests and obtains nutrients from the uterine lining.



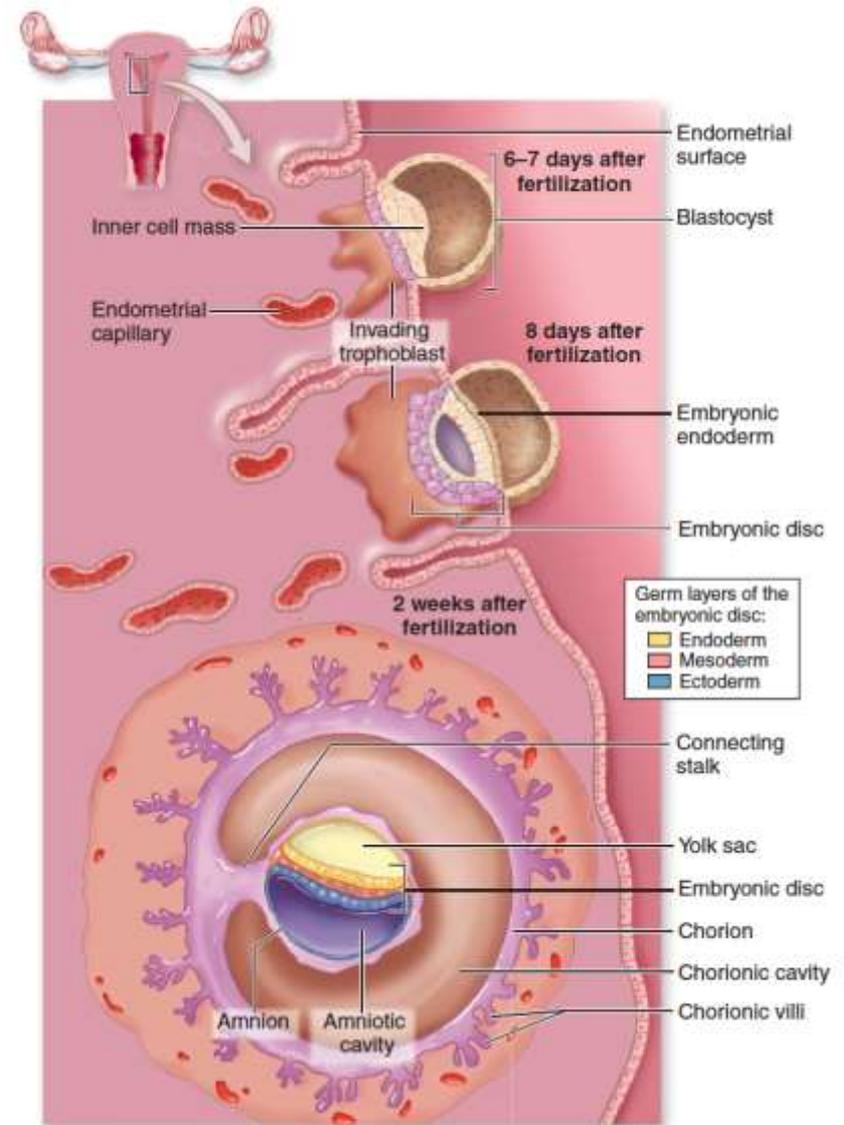
Human Reproduction: Fertilization to Birth

The blastocyst also secretes a hormone, human chorionic gonadotropin (**hCG**), which preserves the corpus luteum.



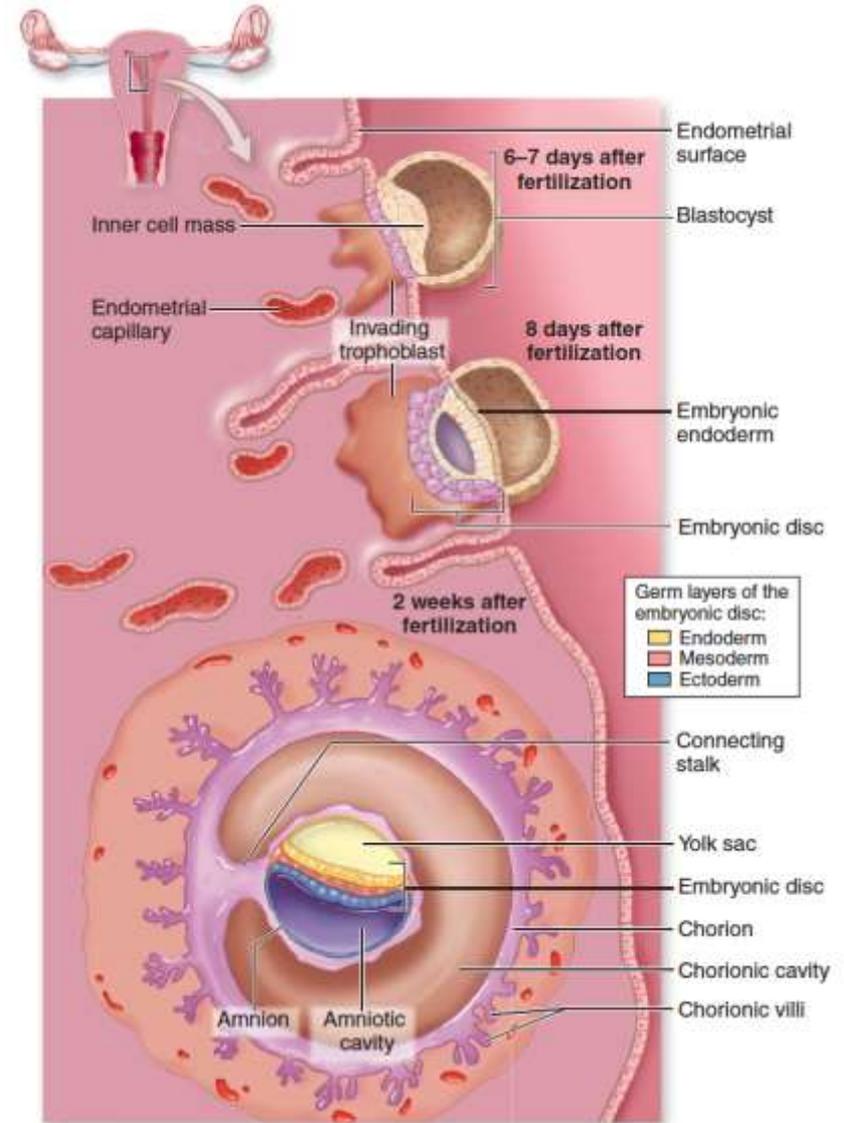
Human Reproduction: Fertilization to Birth

Since menstruation occurs only if the corpus luteum degenerates, secretion of hCG keeps the uterine lining intact.



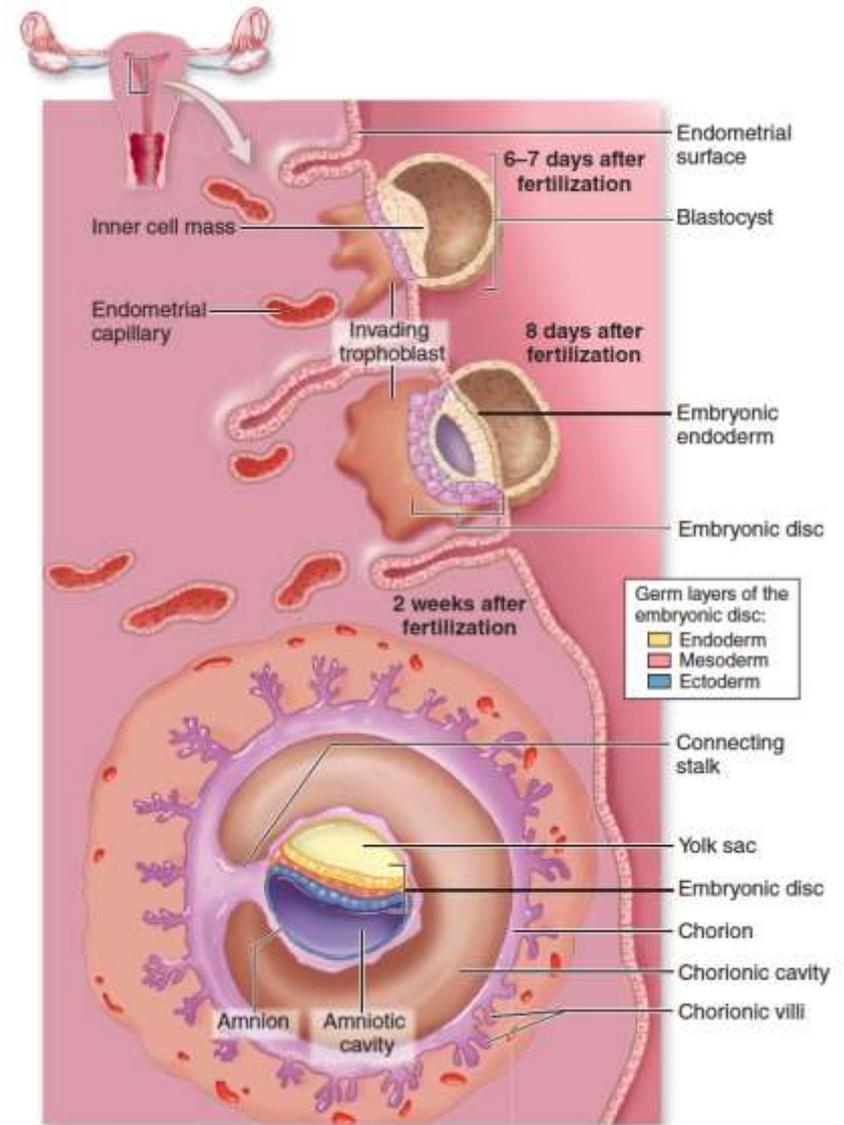
Human Reproduction: Fertilization to Birth

After implantation, the inner cell mass flattens to form the **embryonic disc**, which will develop into the embryo.



Human Reproduction: Fertilization to Birth

The embryonic disc undergoes gastrulation, during which it forms three germ layers: **ectoderm, endoderm, and mesoderm.**

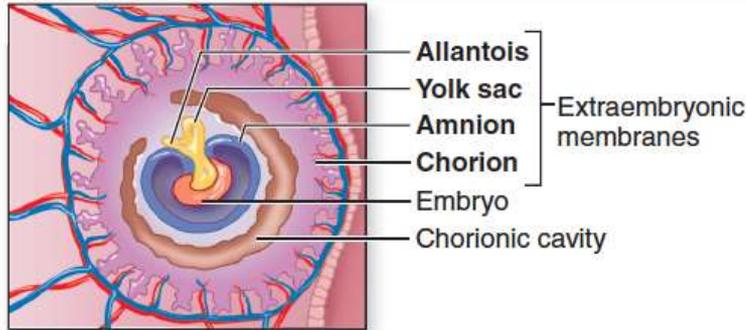


Human Reproduction: Fertilization to Birth

During the next few weeks, the blastula develops into a gastrula and then an embryo.

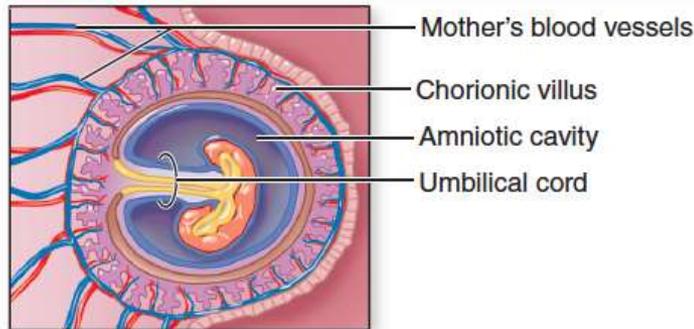


3 weeks



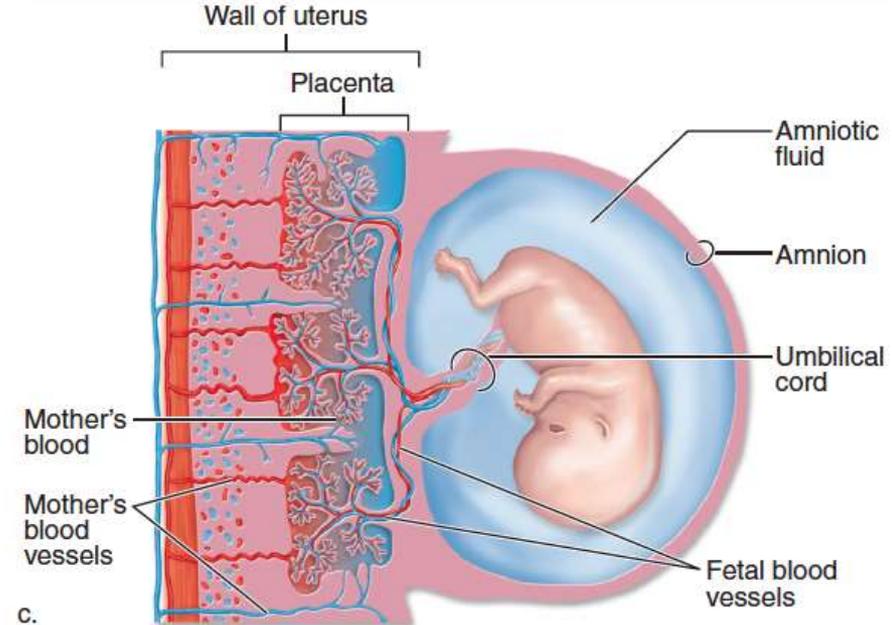
a.

4 weeks



b.

13.5 weeks



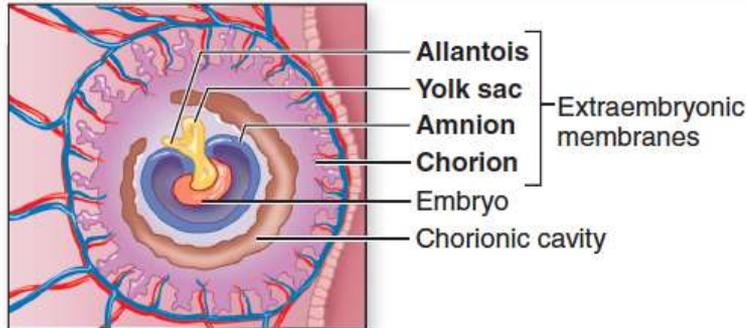
c.

Human Reproduction: Fertilization to Birth

Four membranes protect, support, and nourish the embryo.

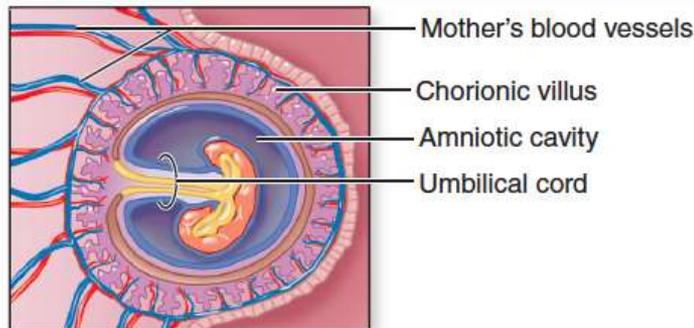


3 weeks



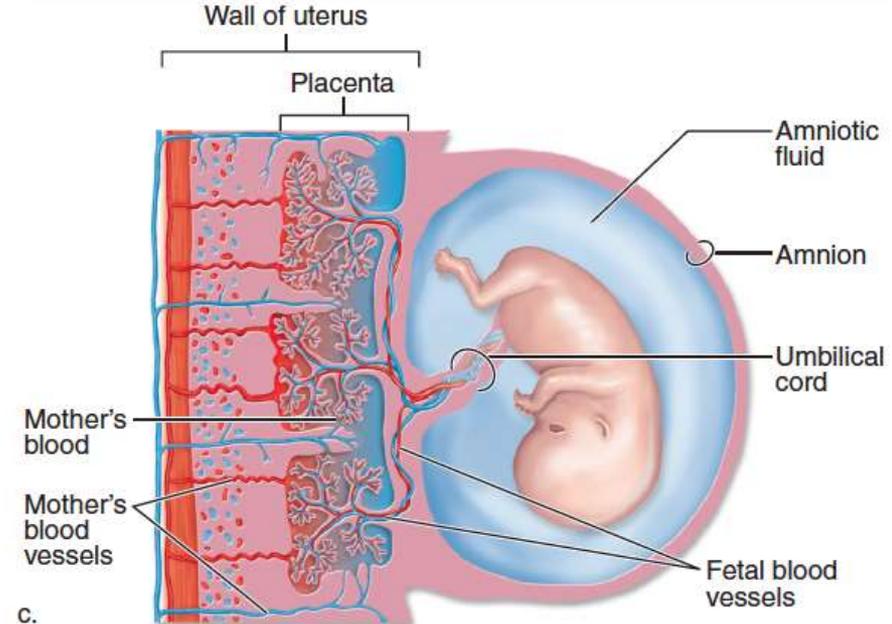
a.

4 weeks



b.

13.5 weeks



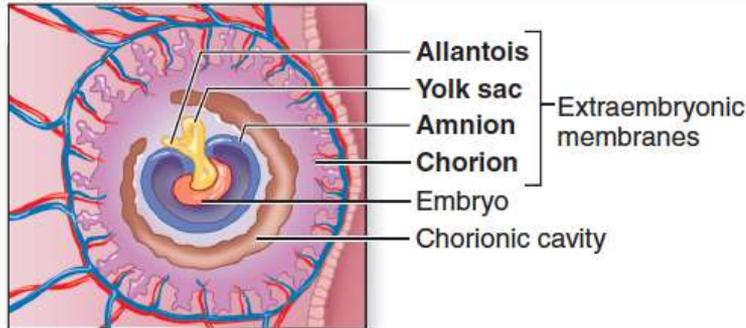
c.

Human Reproduction: Fertilization to Birth

The **yolk sac** manufactures blood cells.

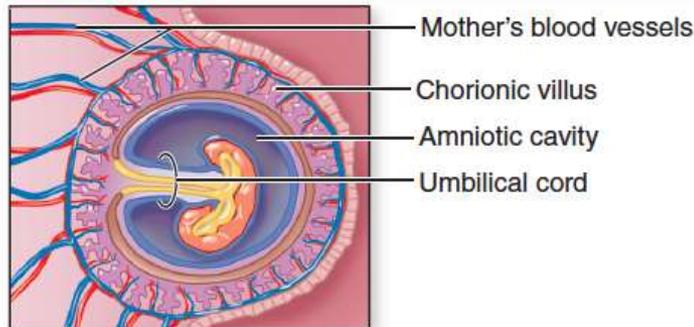


3 weeks



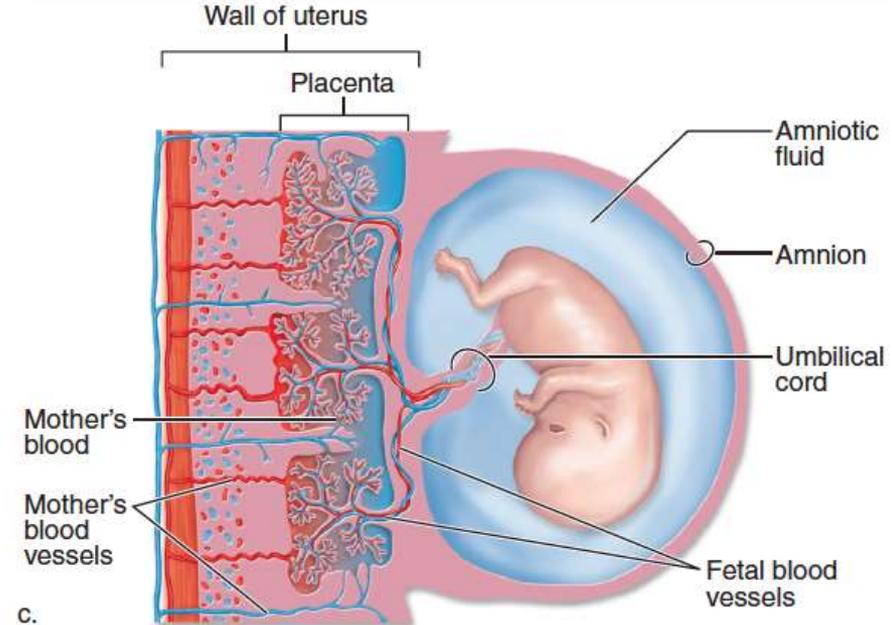
a.

4 weeks



b.

13.5 weeks



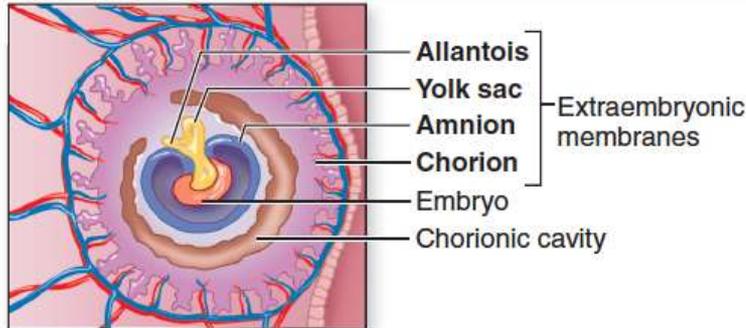
c.

Human Reproduction: Fertilization to Birth

An outpouching of the yolk sac forms the **allantois**, which gives rise to blood vessels in the umbilical cord.

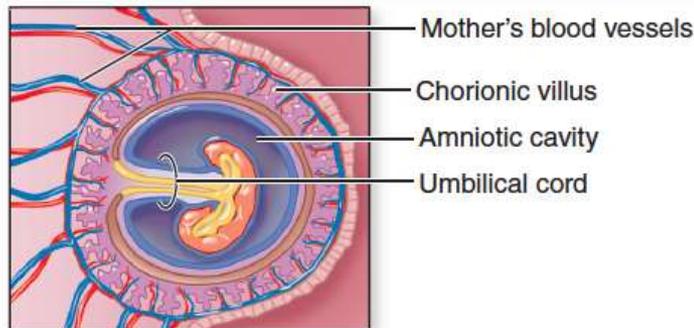


3 weeks



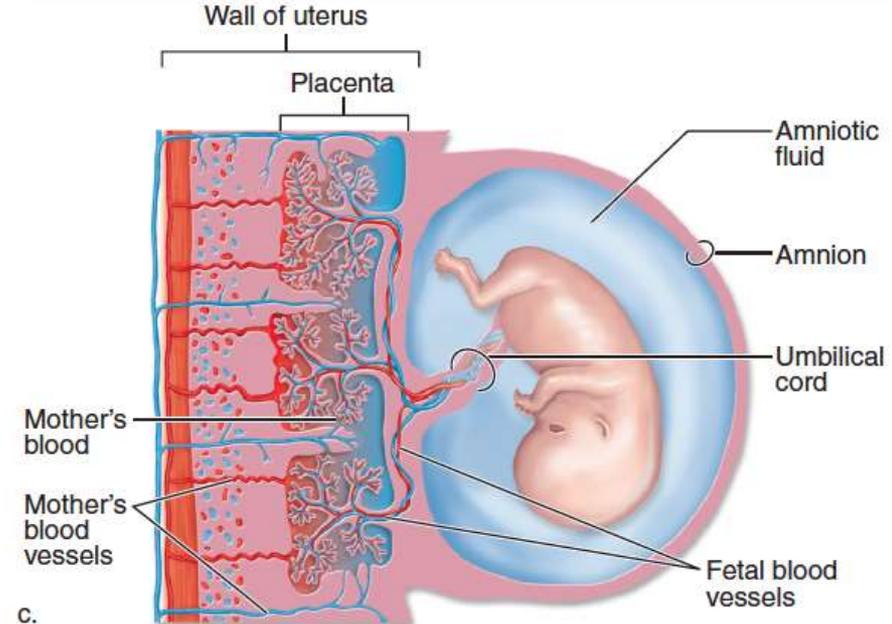
a.

4 weeks



b.

13.5 weeks



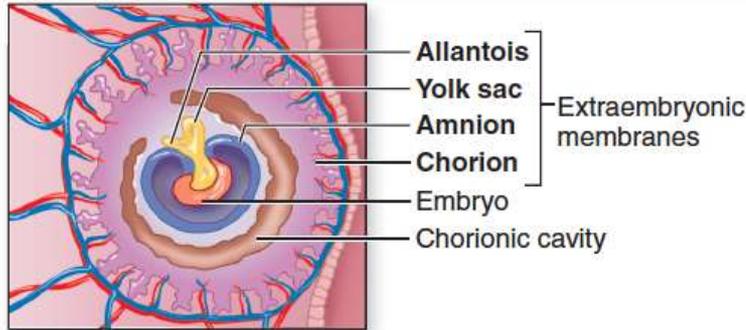
c.

Human Reproduction: Fertilization to Birth

The **amnion** contains fluid that cushions the embryo and maintains constant temperature and pressure.

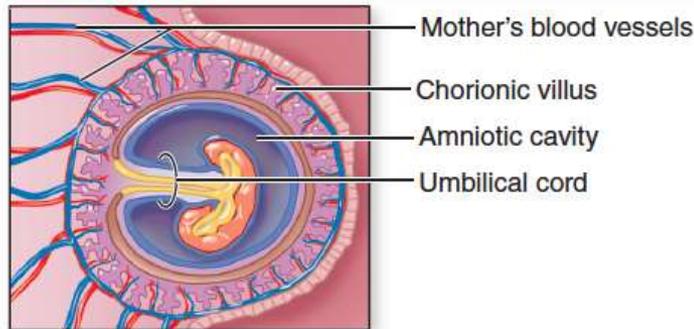


3 weeks



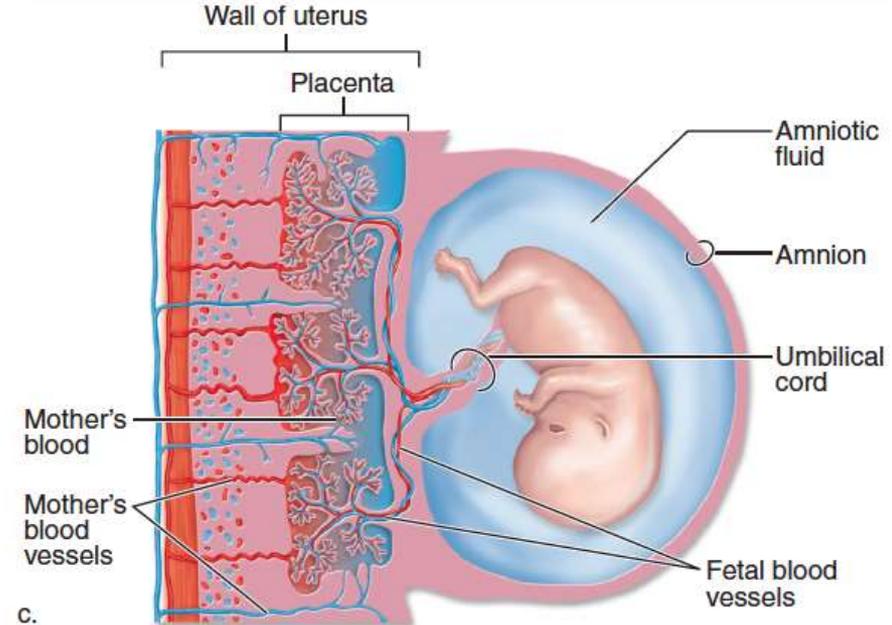
a.

4 weeks



b.

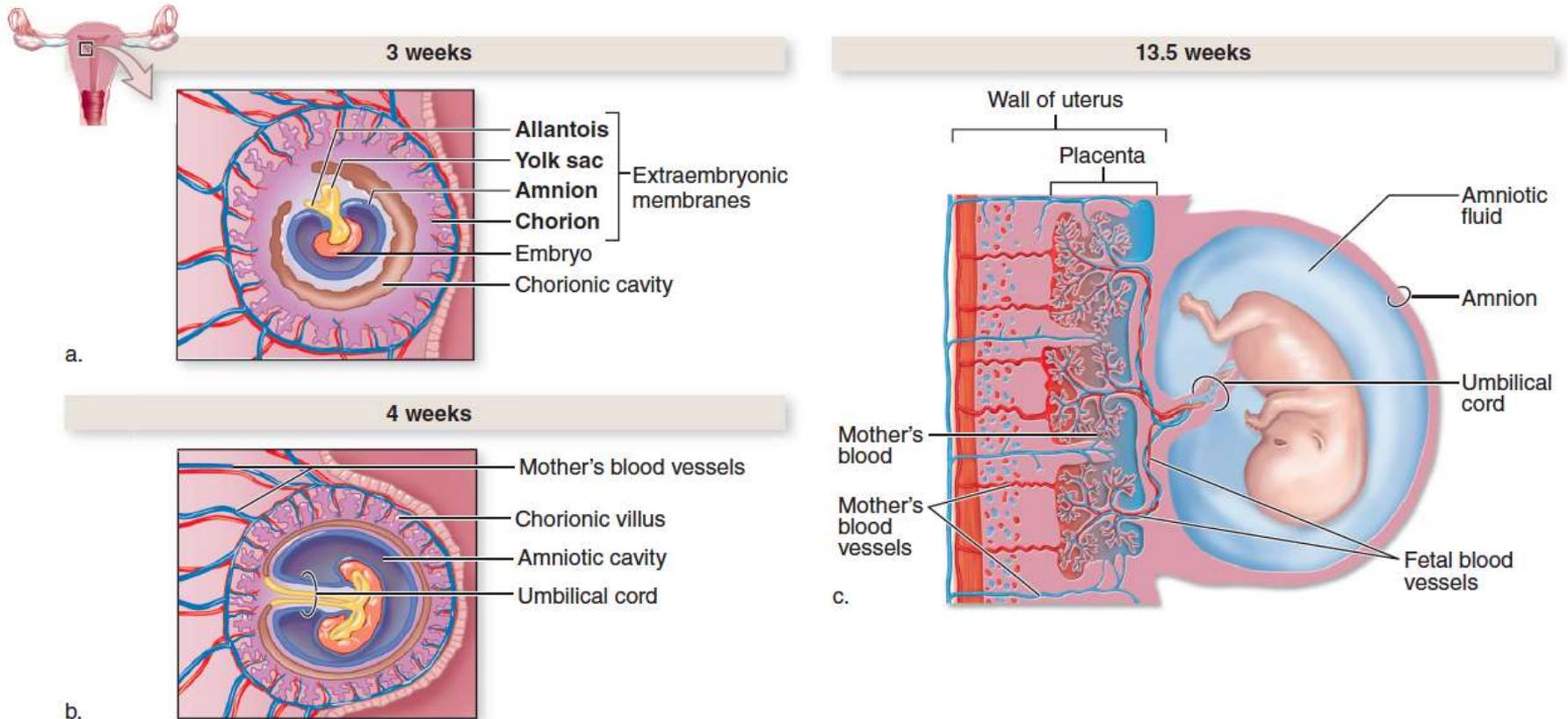
13.5 weeks



c.

Human Reproduction: Fertilization to Birth

The outermost membrane, called the **chorion**, produces **chorionic villi** that project into the uterine lining and exchange nutrients with maternal blood.

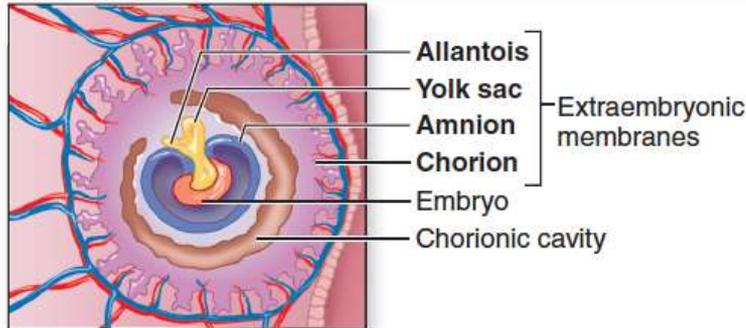


Human Reproduction: Fertilization to Birth

The chorionic villi eventually develop into the **placenta**, which is an intricate connection between fetal and maternal circulation.

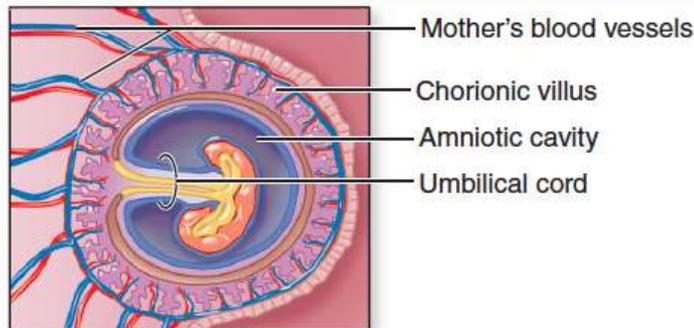


3 weeks



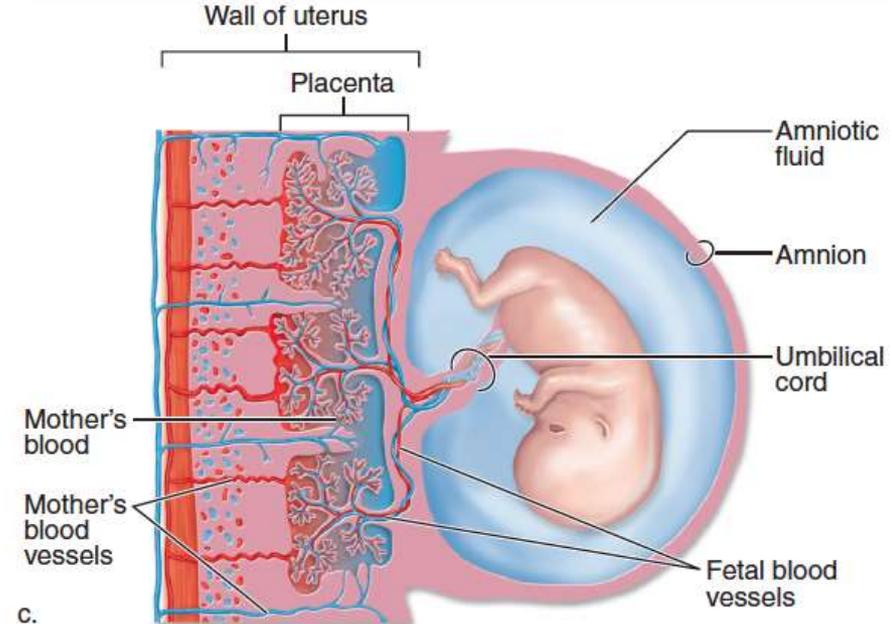
a.

4 weeks



b.

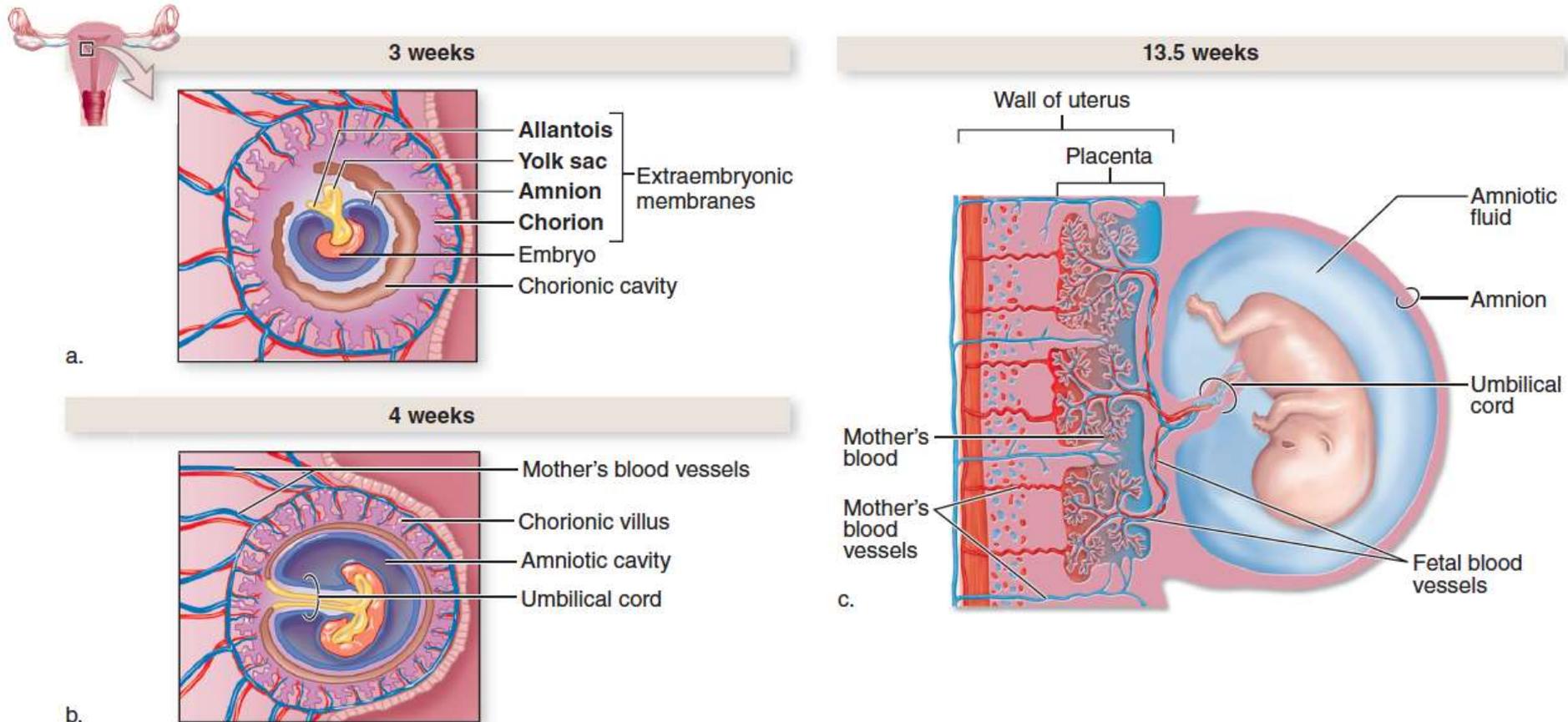
13.5 weeks



c.

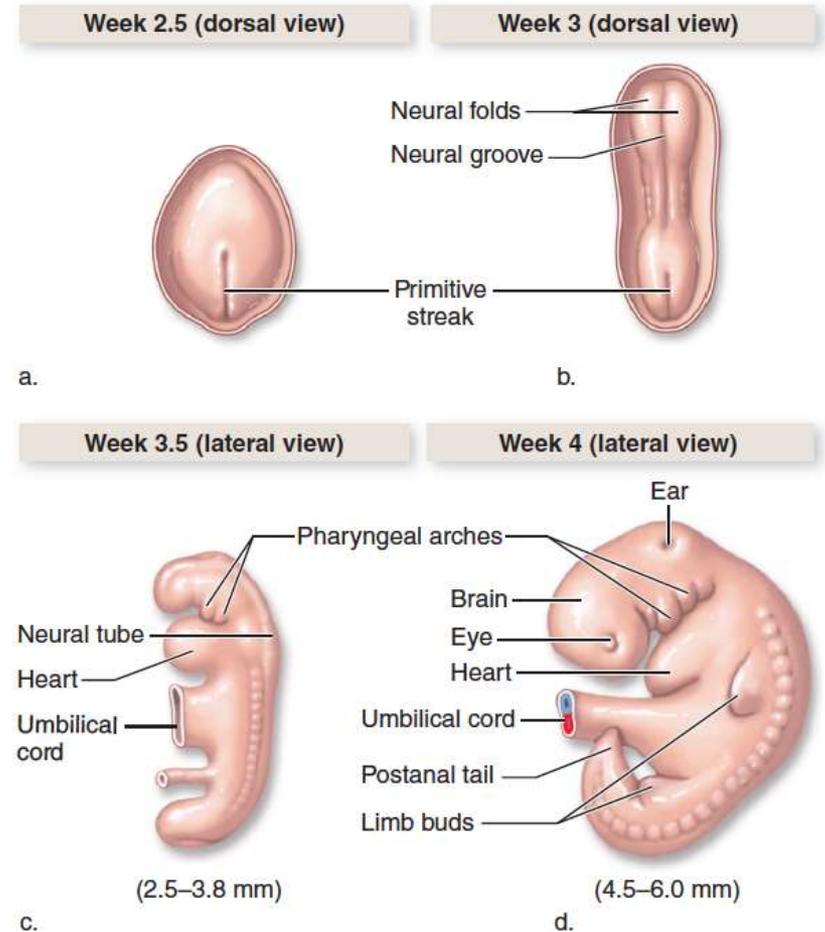
Human Reproduction: Fertilization to Birth

The placenta connects to the embryo through the **umbilical cord**.



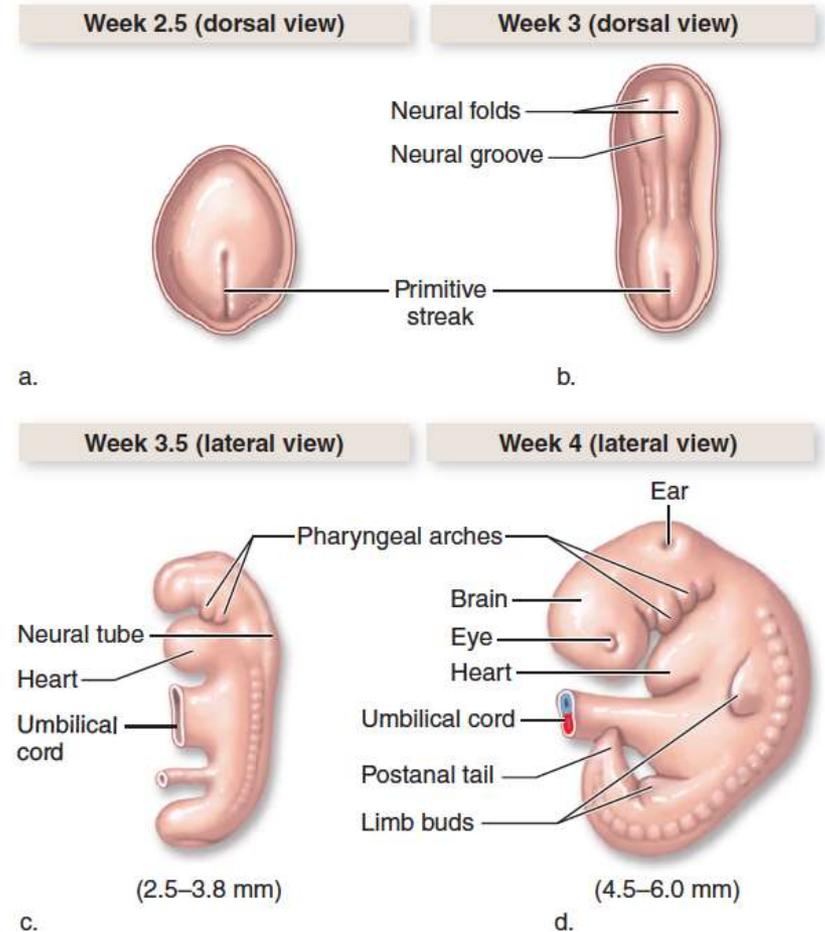
Human Reproduction: Fertilization to Birth

Organ formation begins in the third week of development.



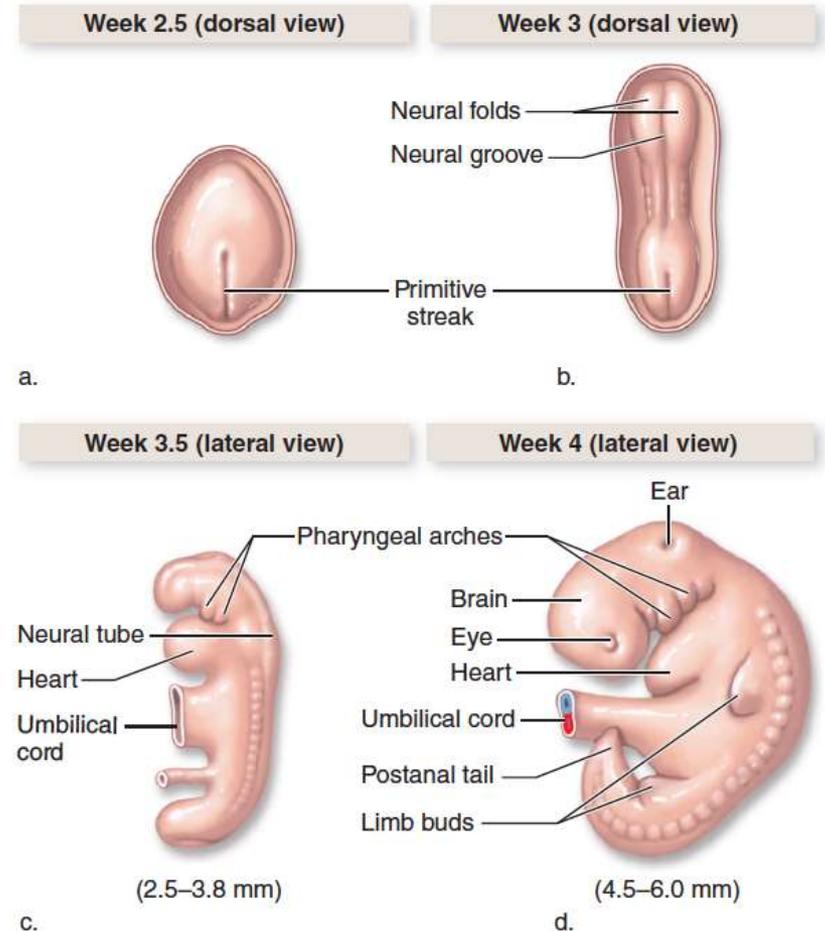
Human Reproduction: Fertilization to Birth

A furrow develops on the embryonic disc called a **primitive streak**. It is an axis around which other structures organize as they develop.



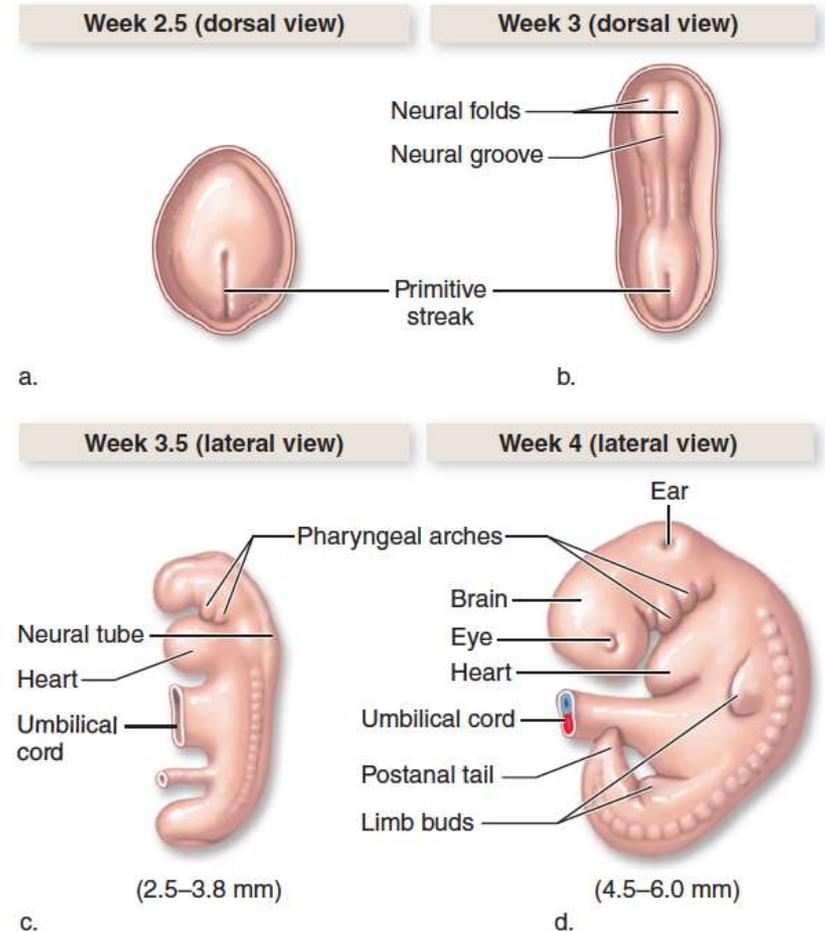
Human Reproduction: Fertilization to Birth

The primitive streak gives rise to the **notochord**, which forms the framework of the vertebral column.



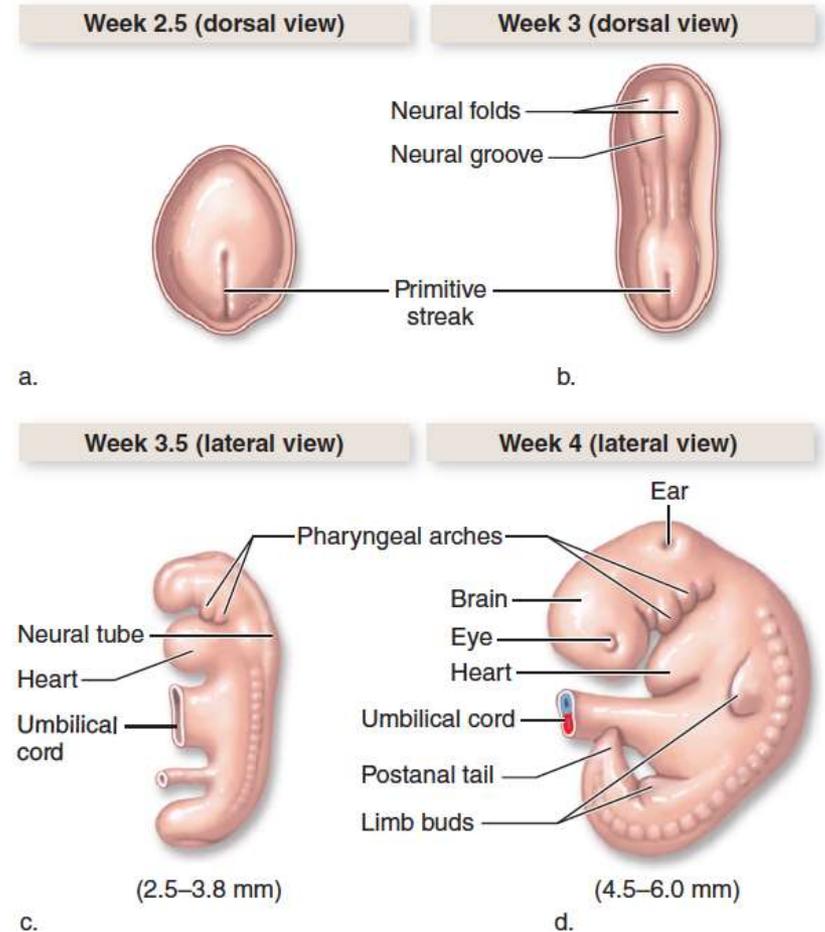
Human Reproduction: Fertilization to Birth

The notochord, in turn, induces the development of the central nervous system. The neural groove is the first step in nervous system development.



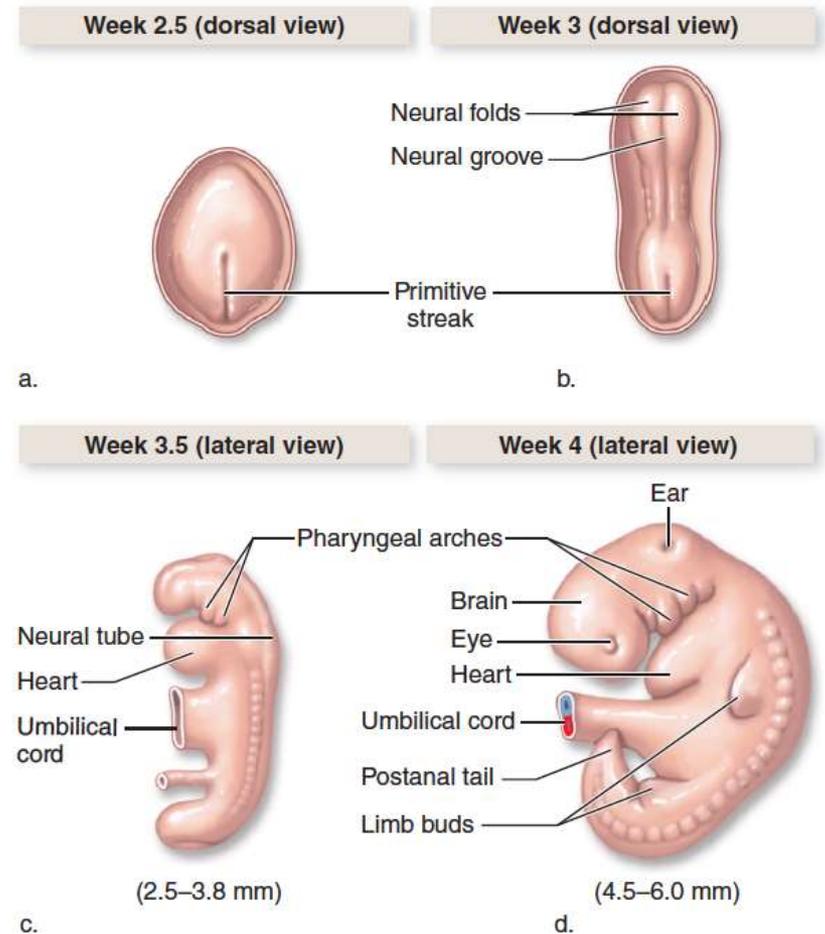
Human Reproduction: Fertilization to Birth

The neural groove folds into the **neural tube**, which will become the brain and spinal cord.



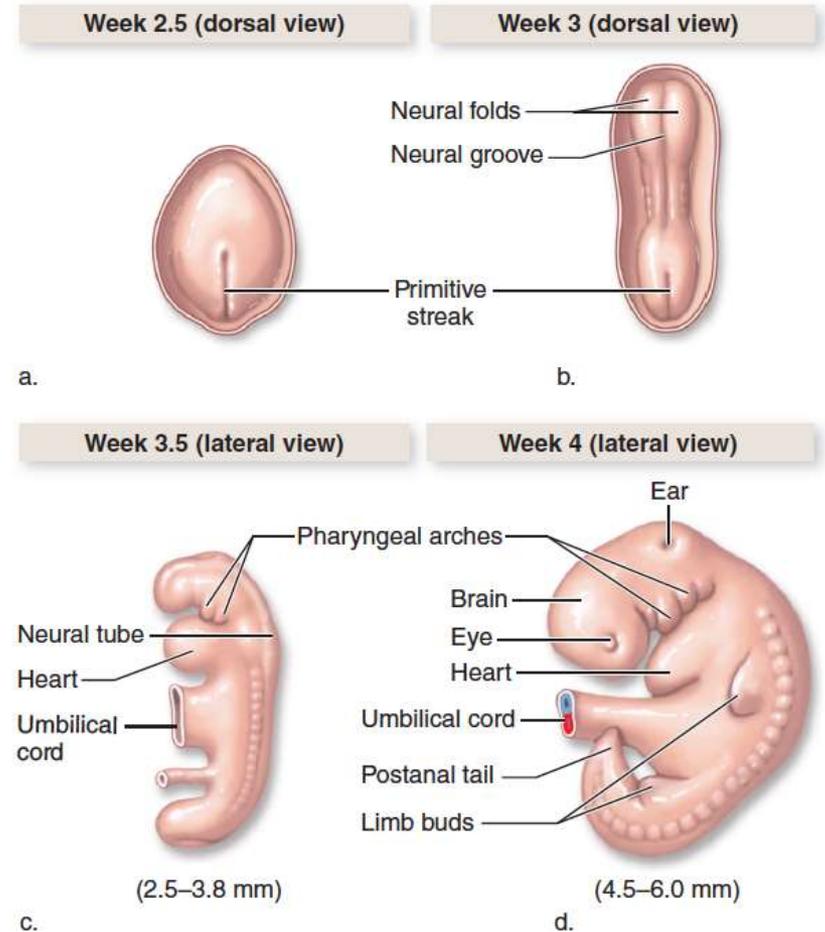
Human Reproduction: Fertilization to Birth

During the fourth week of development, the heart begins beating, immature lungs and kidneys appear, as do facial features.



Human Reproduction: Fertilization to Birth

In weeks 5 and 6, limbs, fingers, and toes develop.



Human Reproduction: Fertilization to Birth

Sex differences become apparent between 7 and 9 weeks after fertilization.

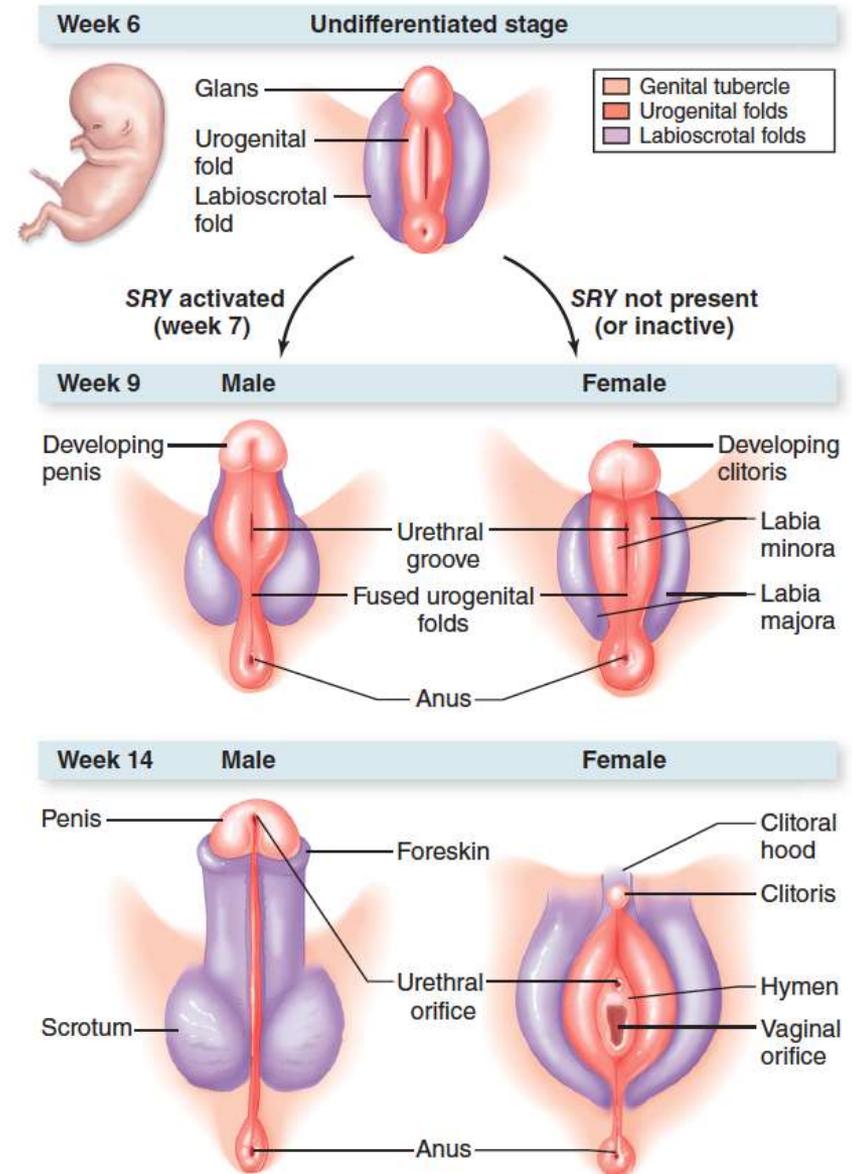


Figure 35.17

Human Reproduction: Fertilization to Birth

If the sex-determining gene on the Y chromosome is activated, development continues as a male. Otherwise, female genitals develop.

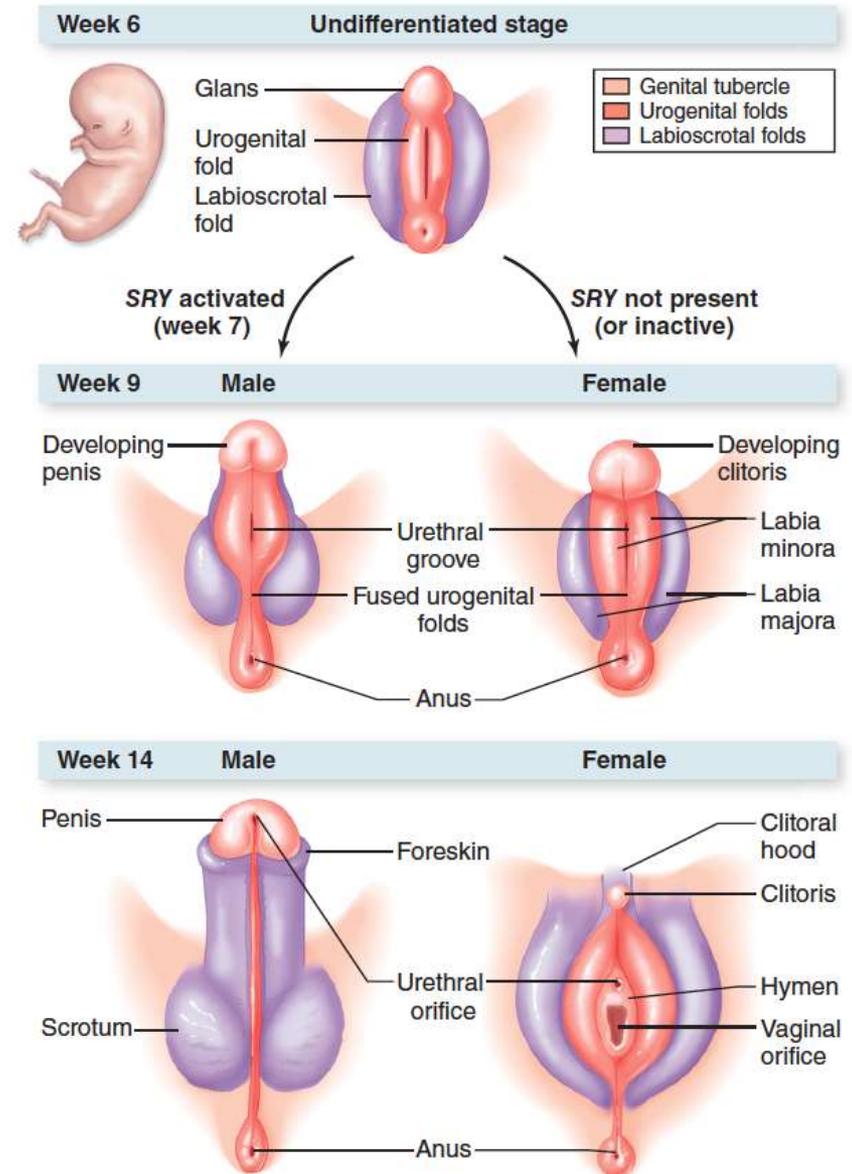


Figure 35.17

Human Reproduction: Fertilization to Birth

Week 9 marks the beginning of the **fetal stage** of development. During this stage, organs develop, bones replace cartilage, and nerves and muscles begin to coordinate actions.



Human Reproduction: Fertilization to Birth

Near the end of pregnancy, the digestive and respiratory systems mature and neural connections form in the brain.



Human Reproduction: Fertilization to Birth

After about 38 weeks, a baby is ready to be born.



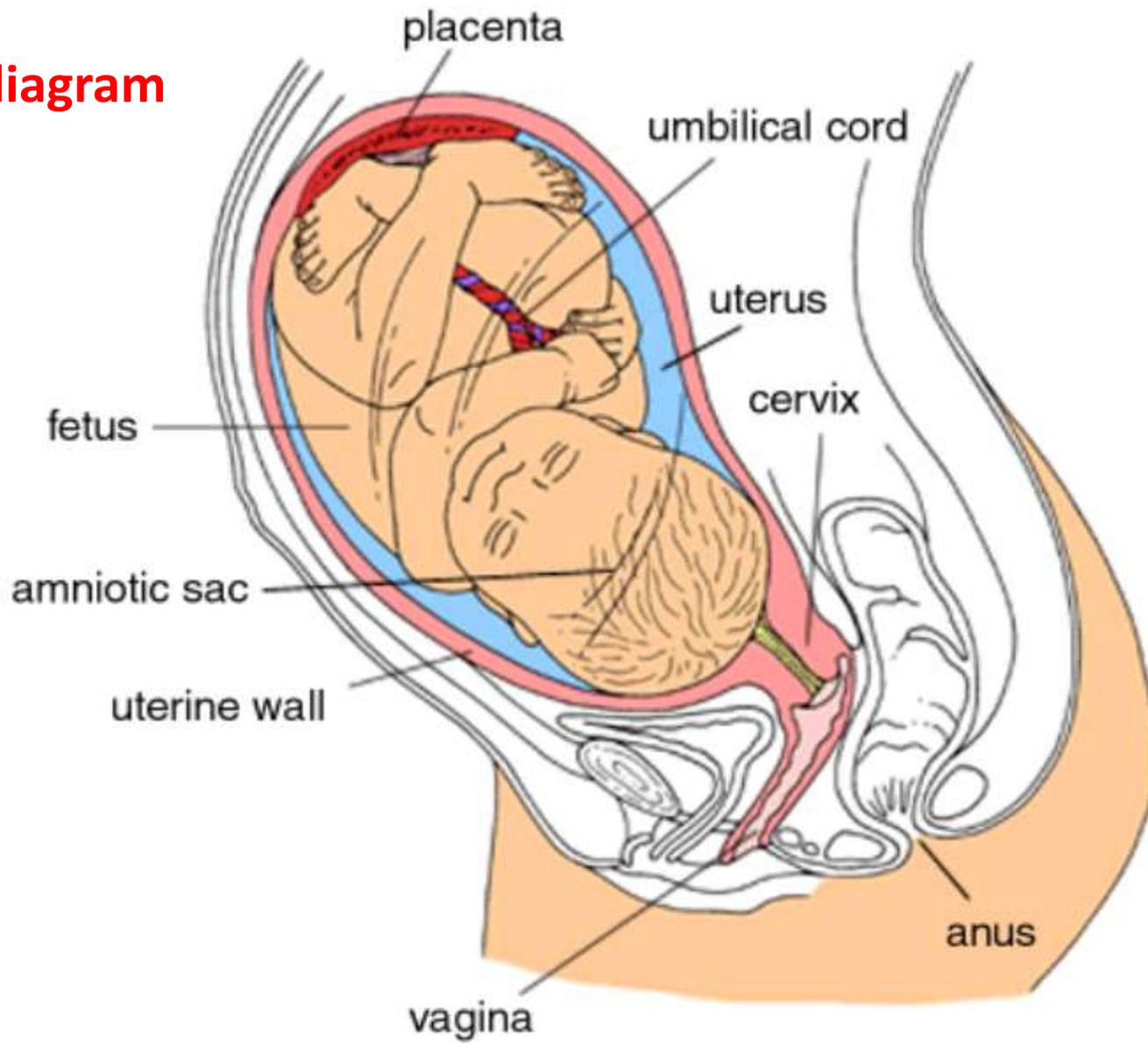
3 cm

3 cm

3 cm

3 cm

Know diagram



Human Reproduction: Fertilization to Birth

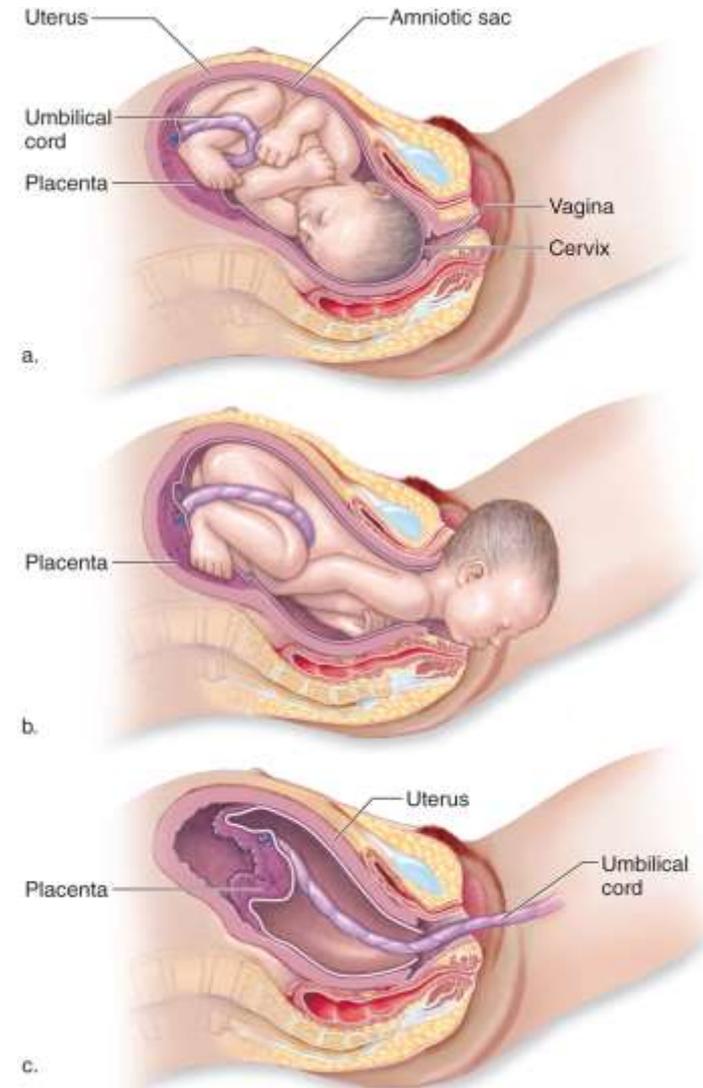
Birth is a three-step process:

1. Labor

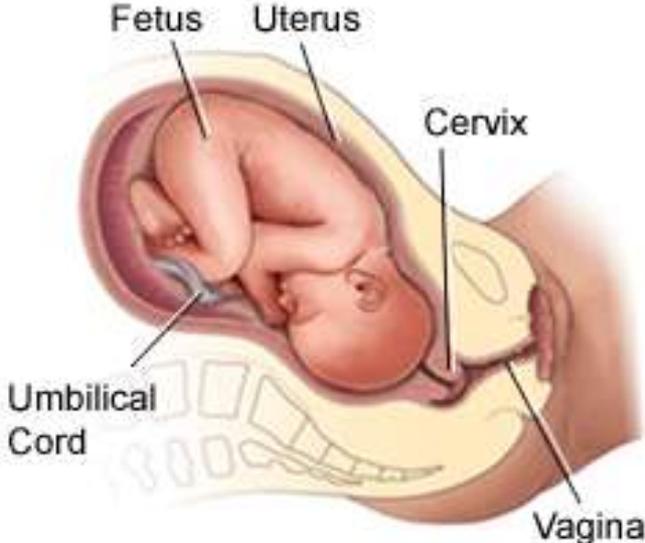
- The amniotic sac breaks.
- Hormone Oxytocin prompts uterine muscle contractions.
- The baby's head presses against and opens the cervix.

2. During delivery, **the baby descends** through the vagina.

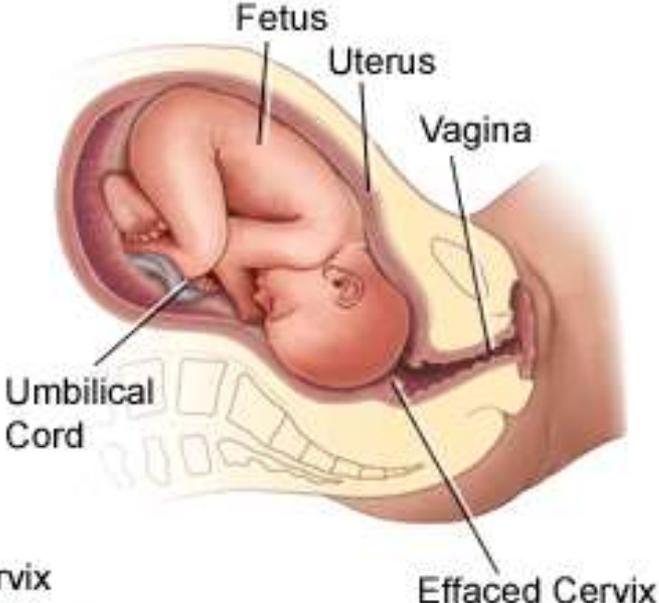
3. **The uterus expels the placenta.**



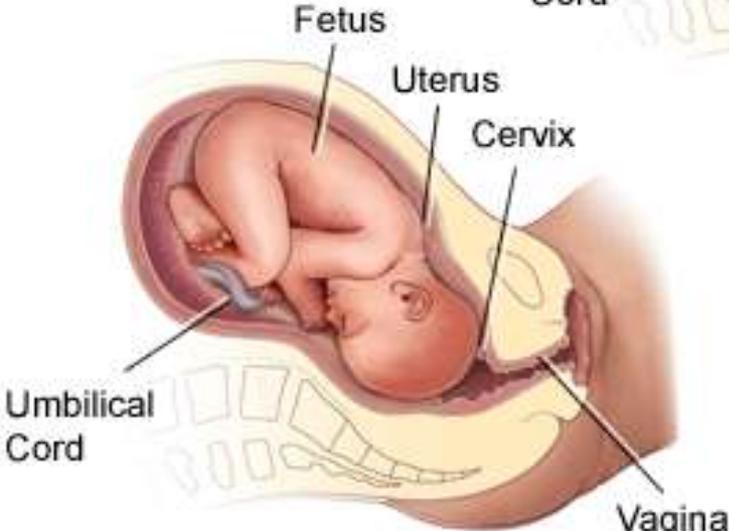
Initial (Latent) Phase Stage 1



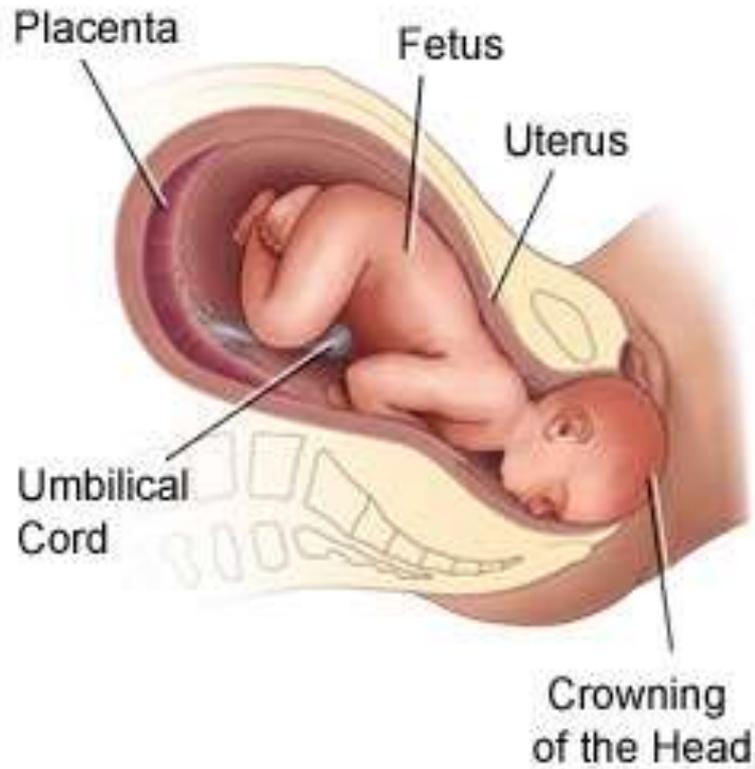
Active Phase



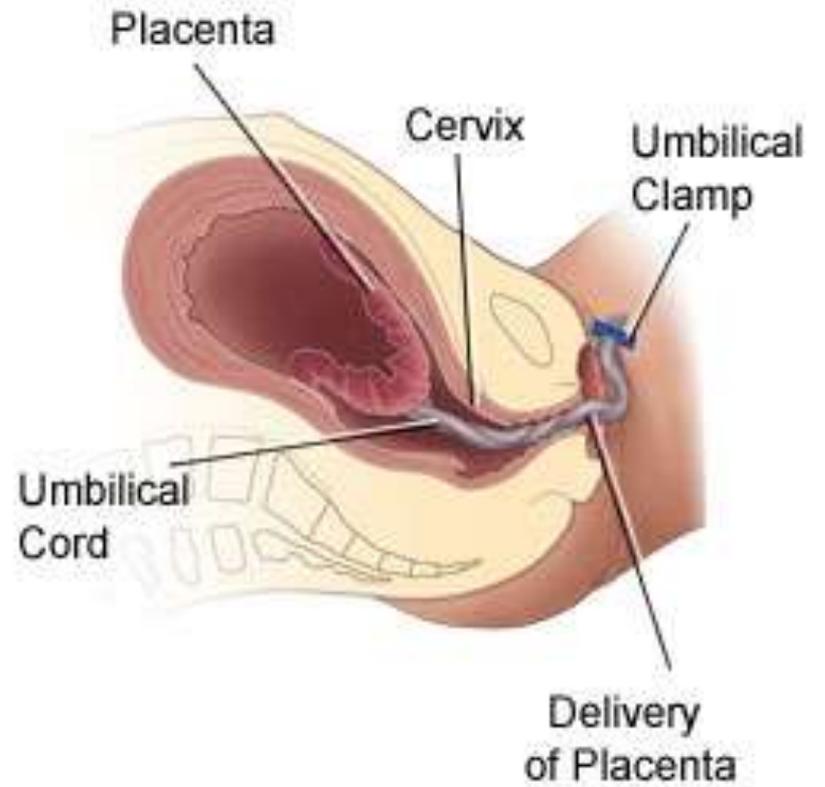
Transition Phase



Stage 2

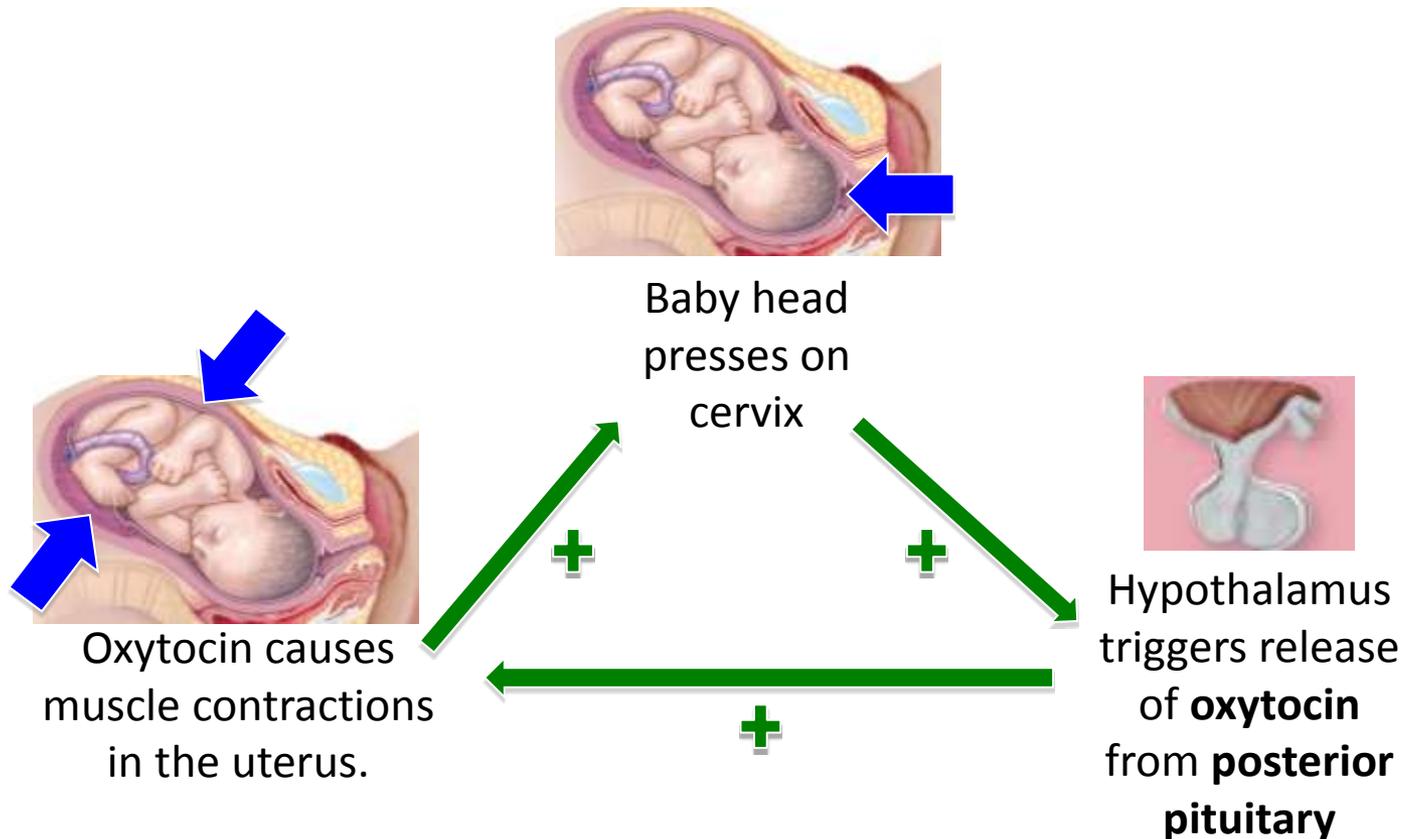


Stage 3



Human Reproduction: Fertilization to Birth

Childbirth illustrates positive feedback.

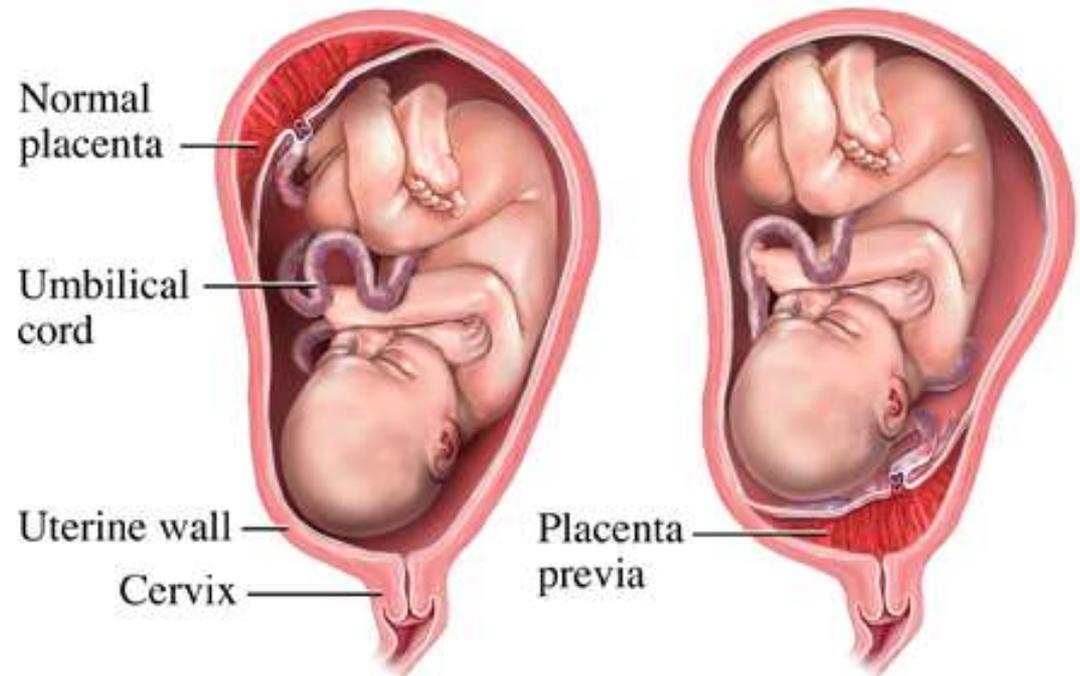


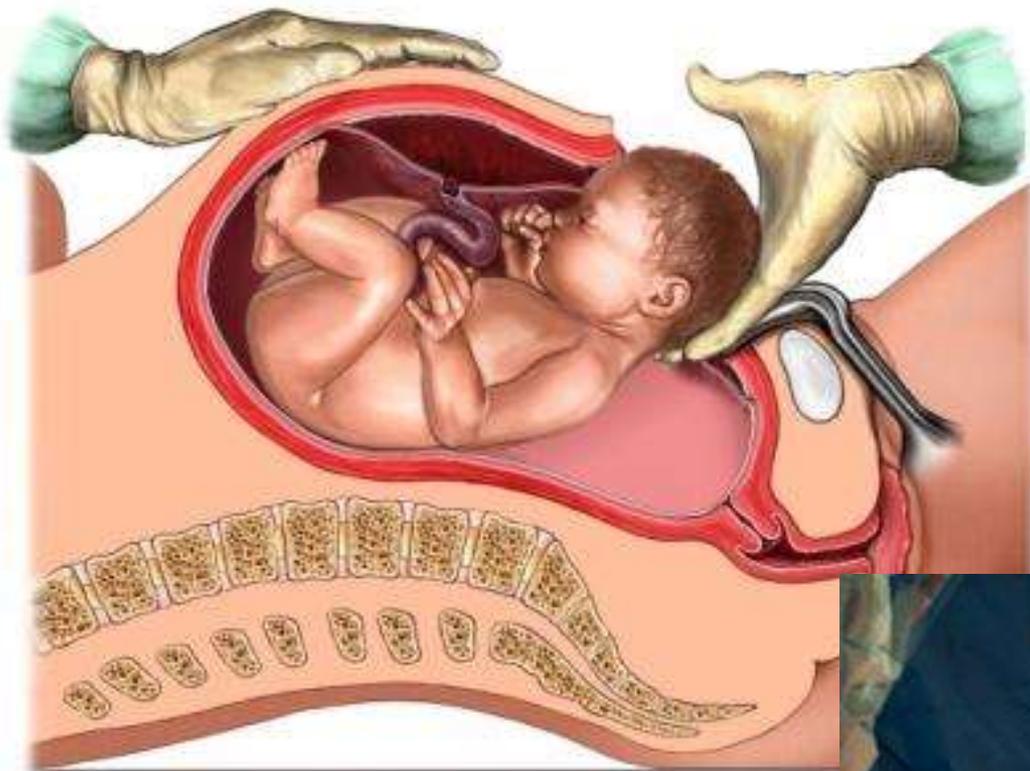
Complications During Birth

Placenta Previa

placenta is not attached to the top of the uterus, partially or fully blocks the cervix, this can cause bleeding during pregnancy

Solution: C-Section





Caesarean Section - baby is surgically removed from the mother

Performed when complications make vaginal delivery risky



Babies aren't so cute when they're born – it's a rough road to leave the womb



Some women advocate for home births using midwives.

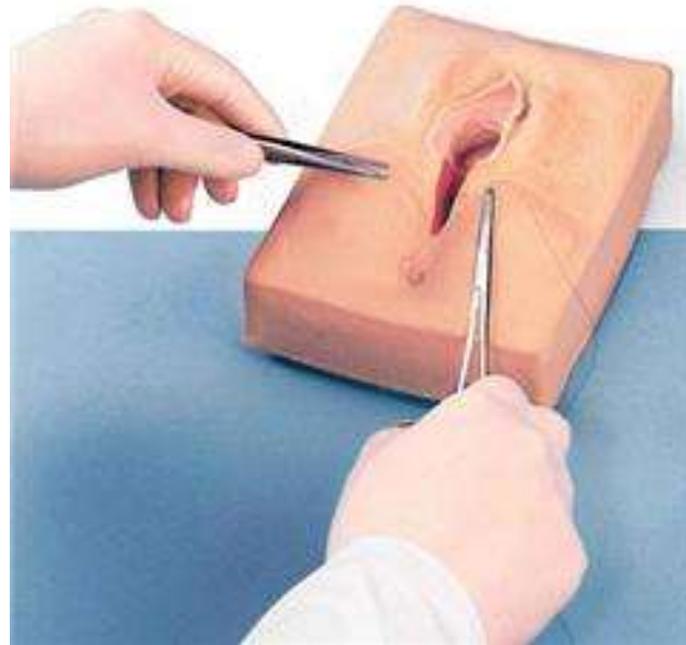
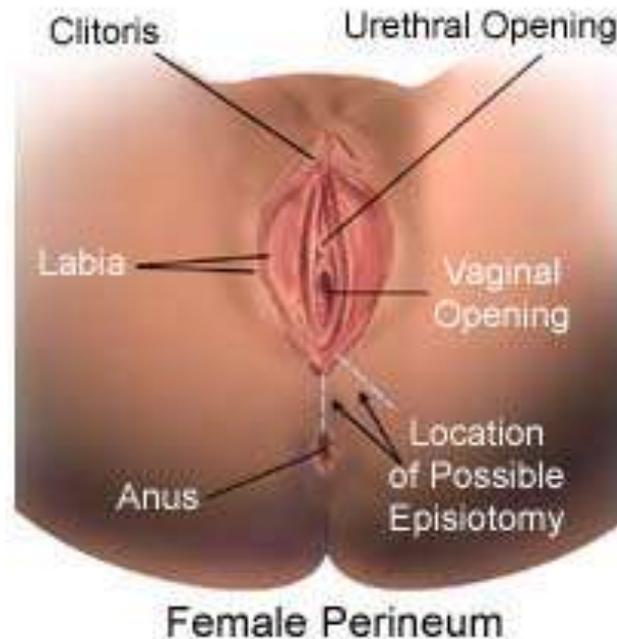


Most of the time, the amniotic sac breaks before the baby is born, in this photo, the baby is shown still inside it.



What Is An Episiotomy?

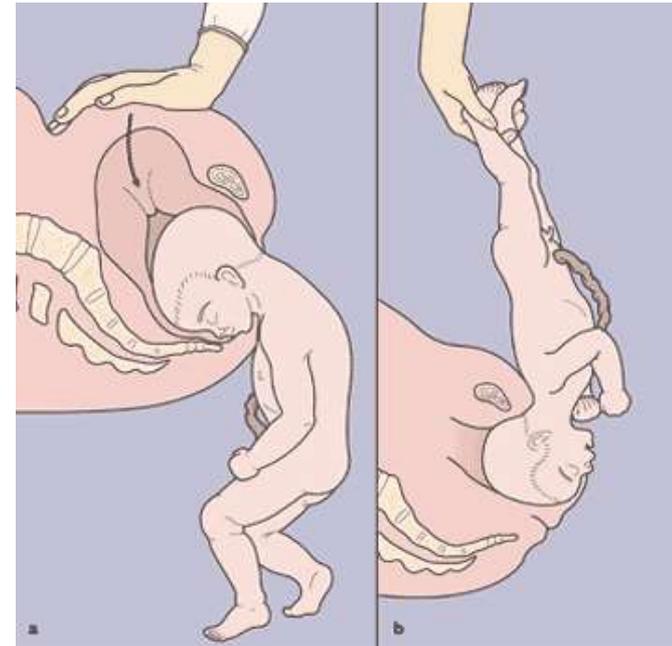
It is a surgical incision to open the perineum - the tissue between the anus and vagina. It is performed during the second stage of labor when the baby is being pushed through the vagina. The purpose of the procedure is to avoid tearing the delicate perineal tissue.



BREECH BIRTH (Footling)

Hyde/DeLamater *Understanding Human Sexuality*, 6e. Copyright © 1997. The McGraw-Hill Companies, Inc. All Rights Reserved.

Positions of Fetus During Birth



If the baby is rear or feet first, it is called a BREECH BIRTH. Doctors will attempt to turn the baby or even do an emergency C section. Breech births are dangerous for baby because the head can get stuck or umbilical cord gets tangled.

Solution: turning the baby before delivery, C-section, or footling birth - [photos](#) (graphic)

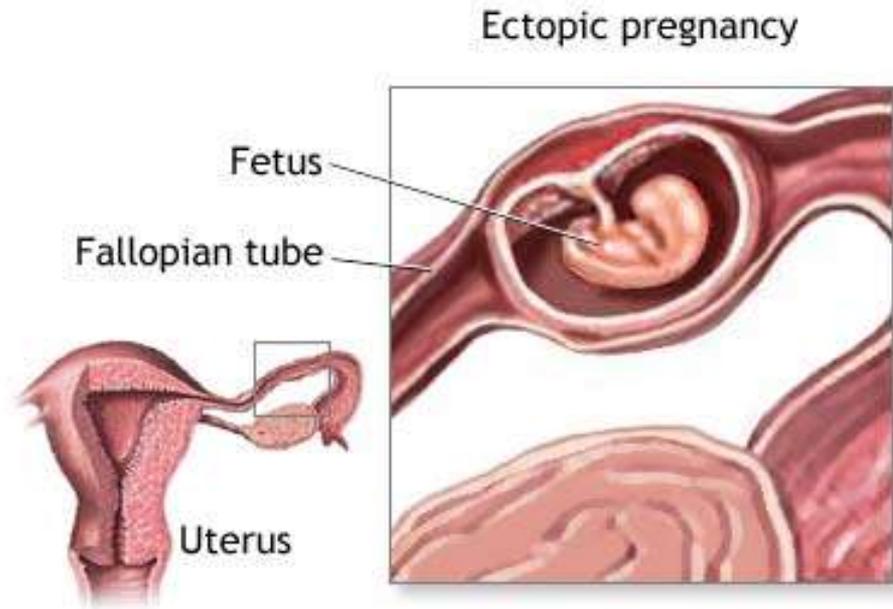
This [video](#) shows an episiotomy with a breech birth (graphic)

Ectopic Pregnancy

Fertilized egg attaches (or implants) someplace other than the uterus, most often in the fallopian tube. (sometimes called a tubal pregnancy.)

The pregnancy cannot continue to term, usually embryo is removed.

Can be very dangerous for woman.



Gestational Diabetes

Pregnancy hormones can block insulin from doing its job. When this happens, glucose levels may increase in a pregnant woman's blood.



What if you don't want to have a baby?

What are methods of birth control?

Are some more effective than others?

Are some more available than others?

Which types are specific for men? for women?

Where can you go to obtain contraception?



[Teen Pregnancy Statistics](#)

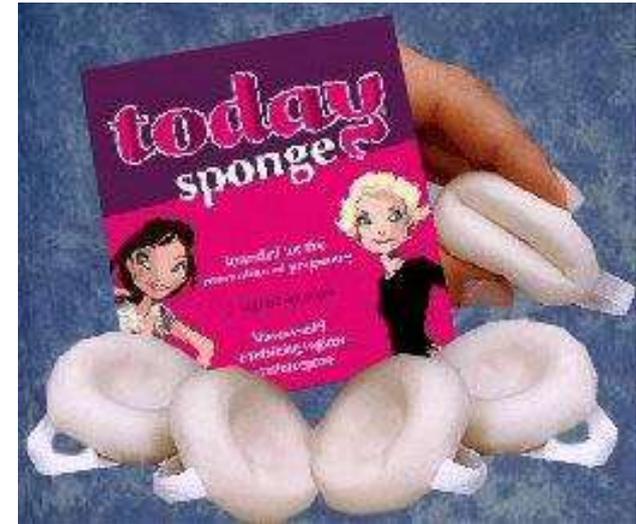
Methods of Birth Control

Barrier Methods

Condom (male & female)

Sponge

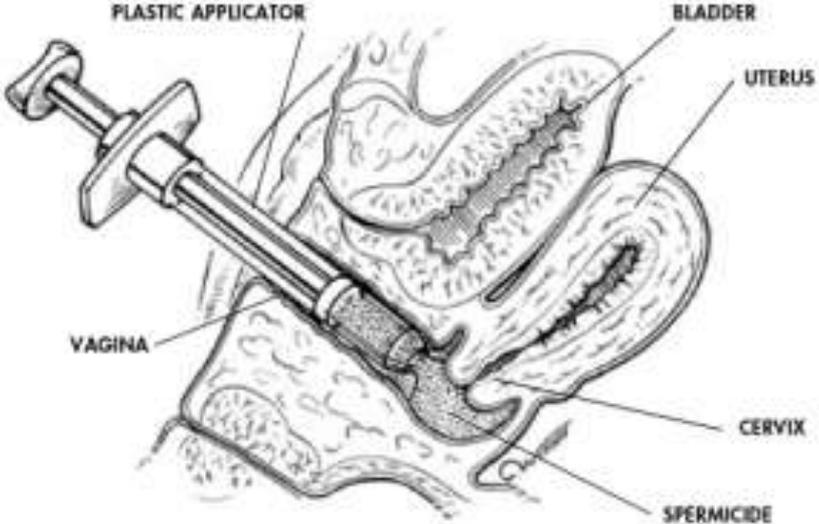
Diaphragm



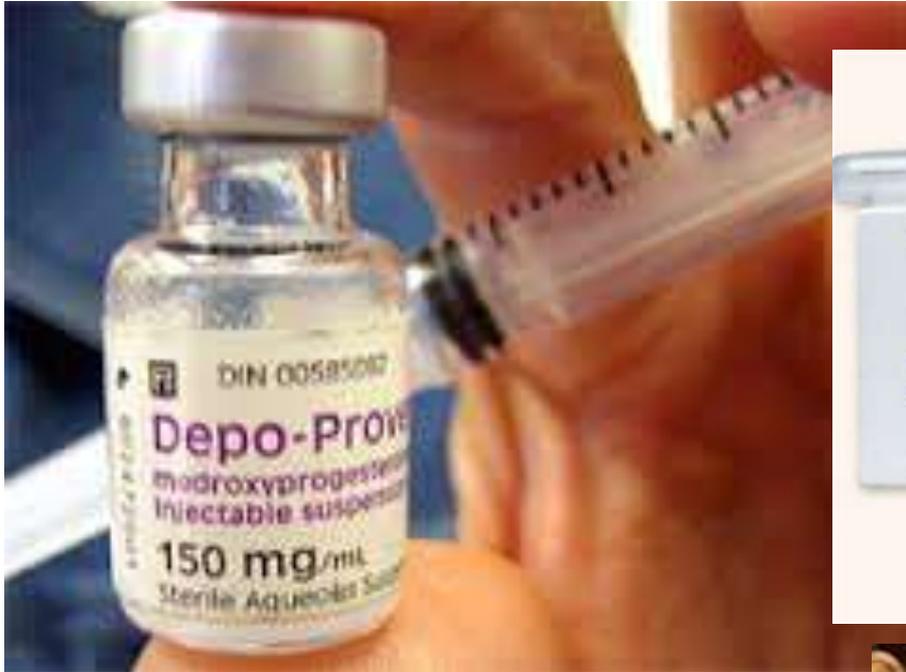
TROJAN[®]



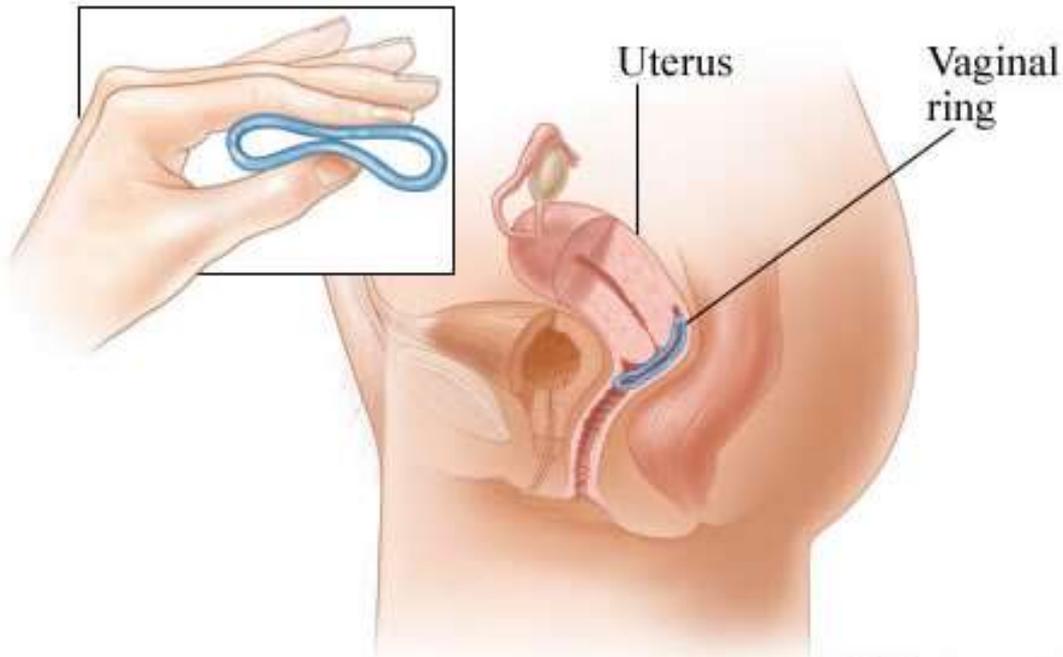
Spermicides or Contraceptive Gel



DEPO PROVERA SHOT



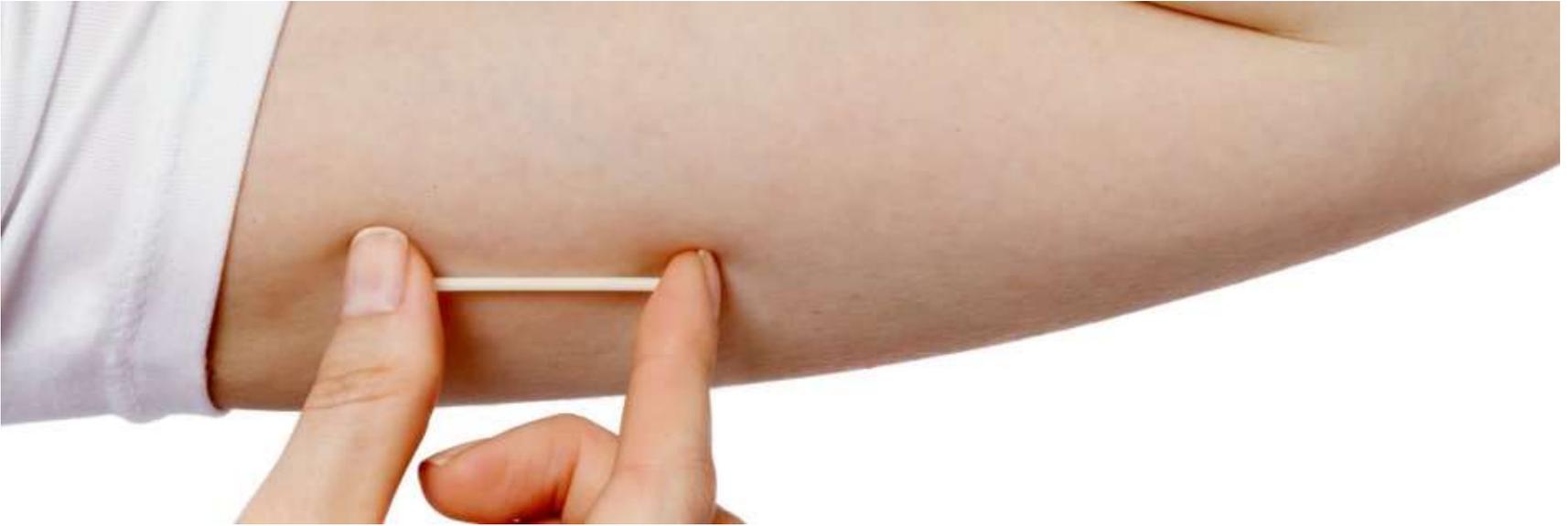
Nuva Ring



Provides estrogen and progesterone that prevents a woman from becoming pregnant - the same as used [oral contraceptive pills](#).

Remove the ring after 3 weeks. During the fourth week, the body will continue with a menstrual period as usual. After 7 days, insert a new ring to begin a new cycle. When used as directed, NuvaRing is a 99% effective method of birth control.

Birth Control Implant



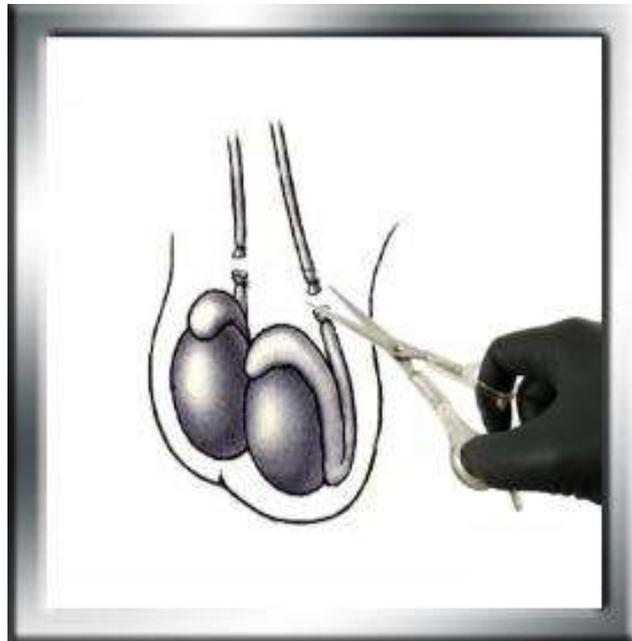
- a thin, flexible plastic implant about the size of a cardboard matchstick. It is inserted under the skin of the upper arm.
- It protects against pregnancy for up to three years.

The implant is available under the brand names Implanon and Nexplanon

Permanent Options...

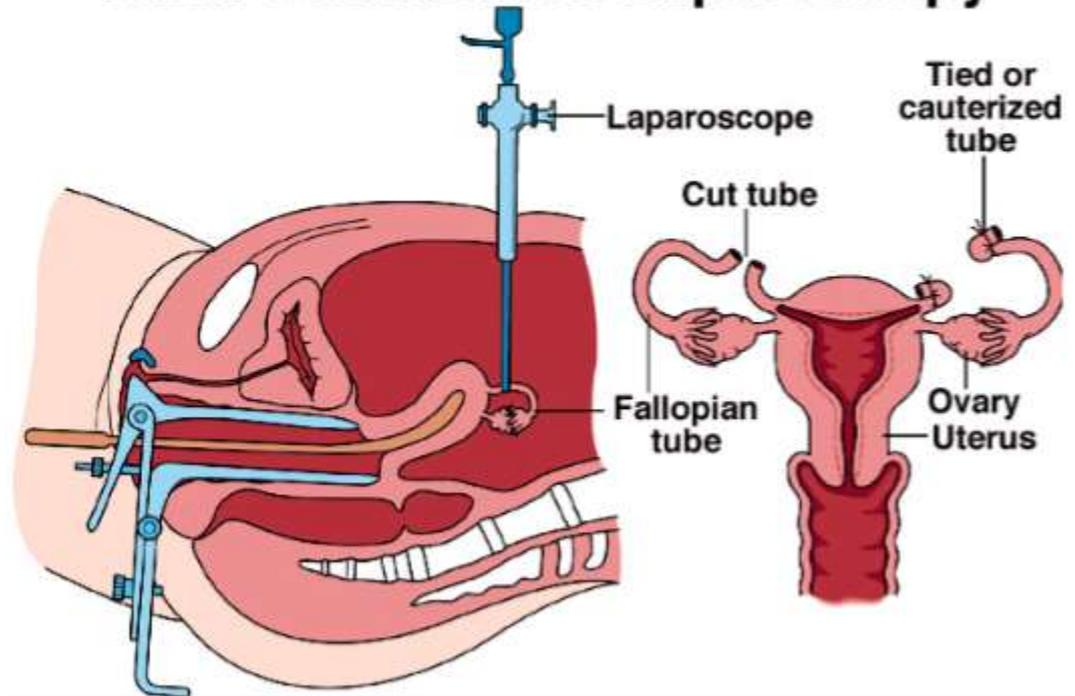
Vasectomy

Tubal Ligation



Byer/Shainberg/Galliano *Dimensions Of Human Sexuality*, 5e. Copyright © 1999. The McGraw-Hill Companies, Inc. All Rights Reserved.

Tubal Sterilization Laparoscopy



What about the morning after pill - also known as Plan B?

Plan B must be taken within 72 hours of unprotected sex, it prevents the egg from releasing or the sperm from fertilizing the egg. It may also prevent implantation of a fertilized egg.

Plan B does NOT work on women who are already pregnant.

It can be bought from pharmacies, though some states have age restrictions.

Now available to women of all ages - See [Article](#)



New Developments

Cats and Dogs may have a nonsurgical spaying and neutering option soon. An injection that causes permanent infertility could be used to control feral cat populations.

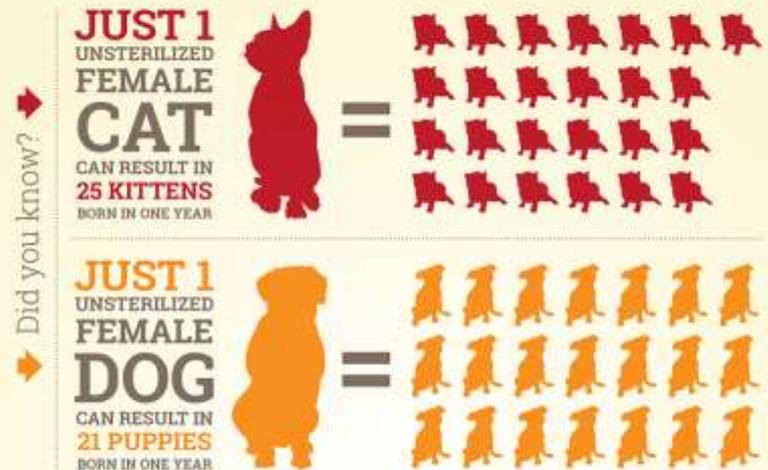
<http://www.sciencealert.com/a-one-off-injection-could-replace-the-need-to-spay-and-neuter-your-pets>

Could that be an option for humans someday?



WHY SPAY/NEUTER?

Spay/neuter ends companion animal **overpopulation**



Spay/neuter benefits **animals** and **people**



Health Benefits to Animal

Prevention of testicular cancer and prostate disease in males.
Prevention of mammary cancer and uterine infections in females.



Behavioural Benefits

Reduced roaming, aggression, urine spraying, and territorial marking in males.
Reduced aggression, howling, and house soiling in females.



Cost Savings

Reduced spending related to complaints, picking up, impounding, sheltering, caring for, and euthanizing stray & homeless animals. Reduced livestock death.



Public Health and Safety Benefits

Reduced incidence of dog bites and nuisances. Decreased transfer of rabies and other zoonotic disease from animals at large.



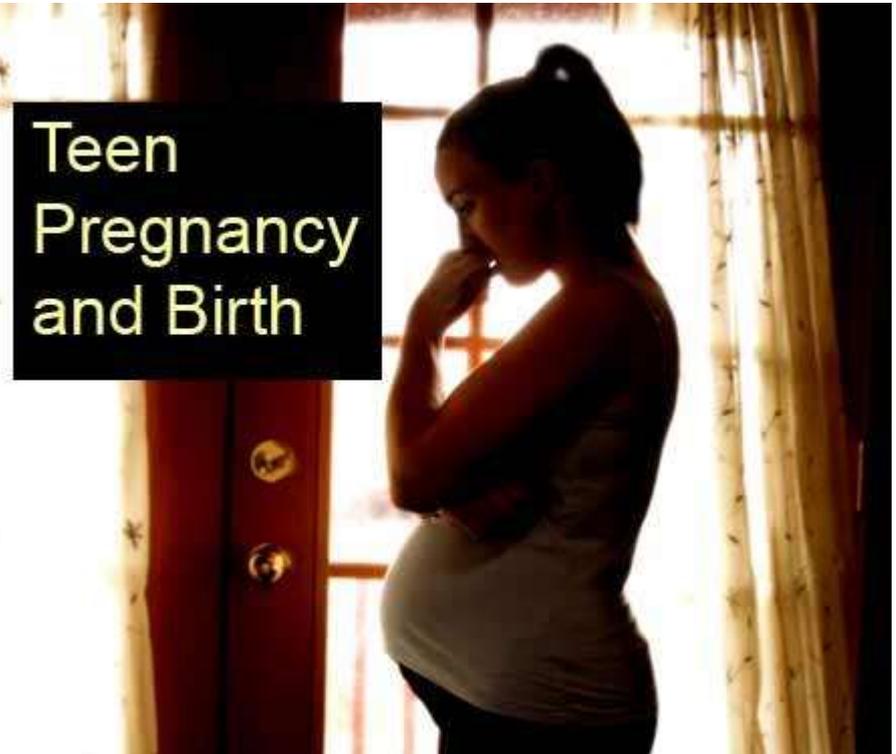
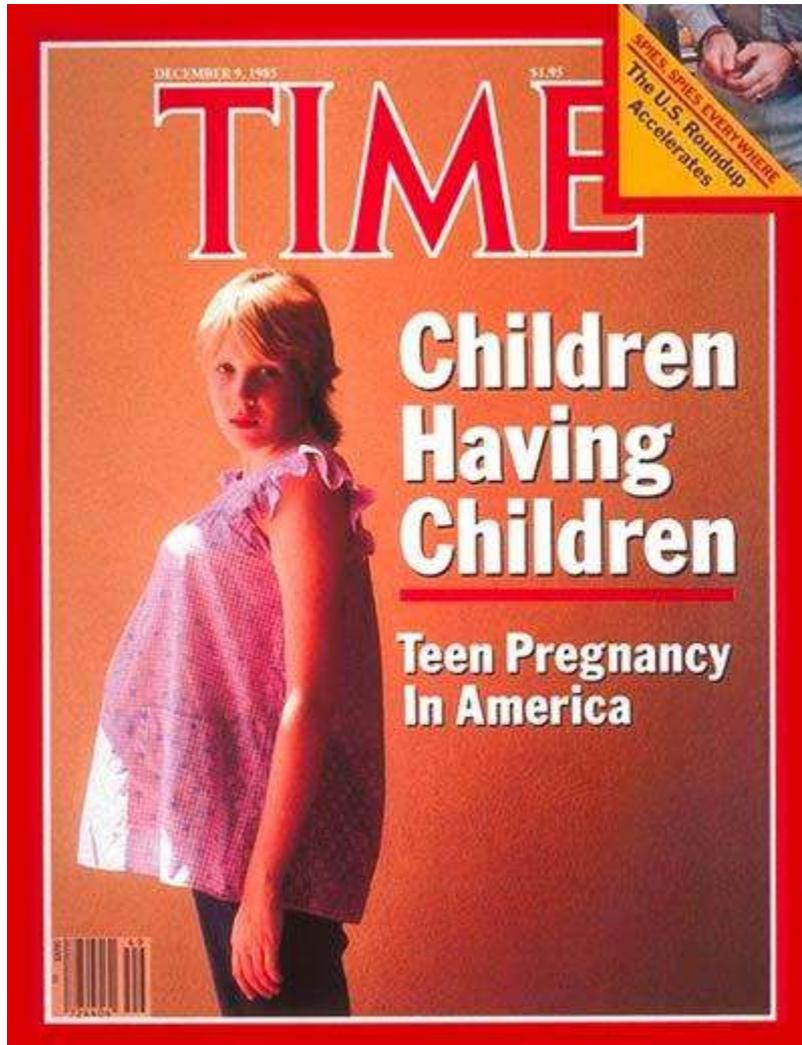
Additional Benefits to Society

Alleviating injury and death to wildlife. Decrease in direct suffering and death of animals. Less suffering to empathetic humans.

PLEASE **SPAY/NEUTER** YOUR ANIMALS
AND **ENCOURAGE OTHERS** TO DO THE SAME

With all these options, there is no reason why unplanned pregnancies should happen at all...

So why do they?





Clicker Question #4

Fertilization occurs in the

- A. uterine tube.
- B. ovary.
- C. seminiferous tubule.
- D. endometrium.
- E. vagina.



Clicker Question #4

Fertilization occurs in the

- A. uterine tube.
- B. ovary.
- C. seminiferous tubule.
- D. endometrium.
- E. vagina.

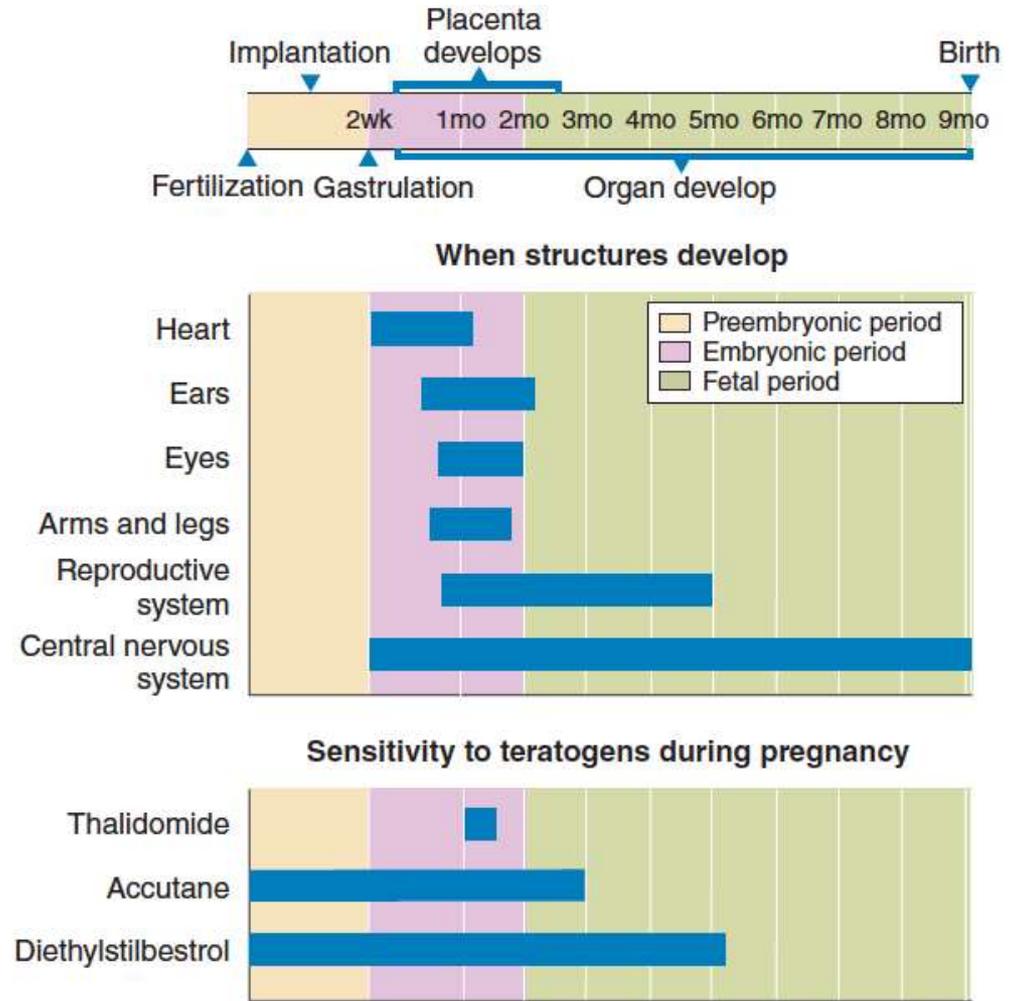
30.5 Mastering Concepts



Which supportive structures develop during the embryonic period? What are their functions?

Birth Defects Have Many Causes

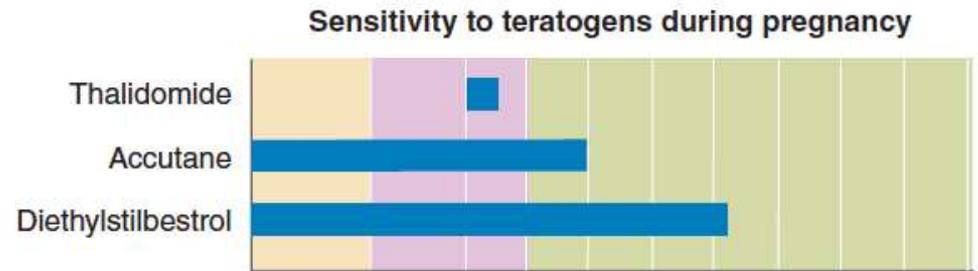
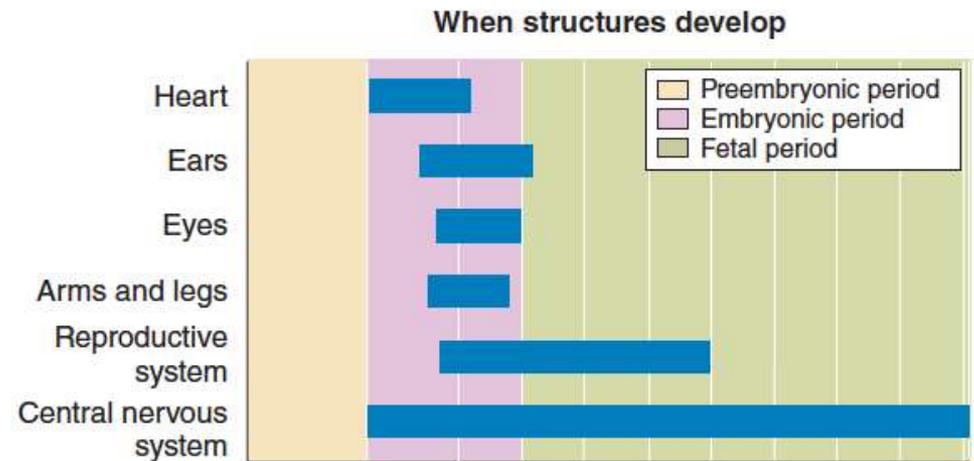
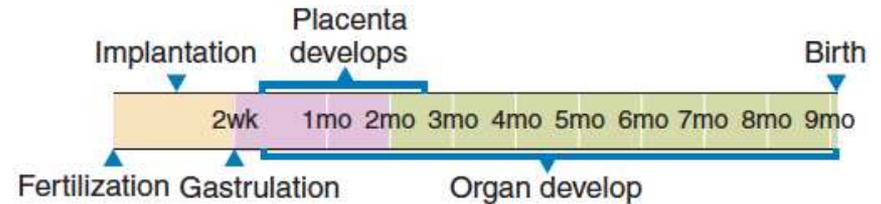
About 3% of newborns have an abnormality, or **birth defect**, that results in disability in the child.



Birth Defects Have Many Causes

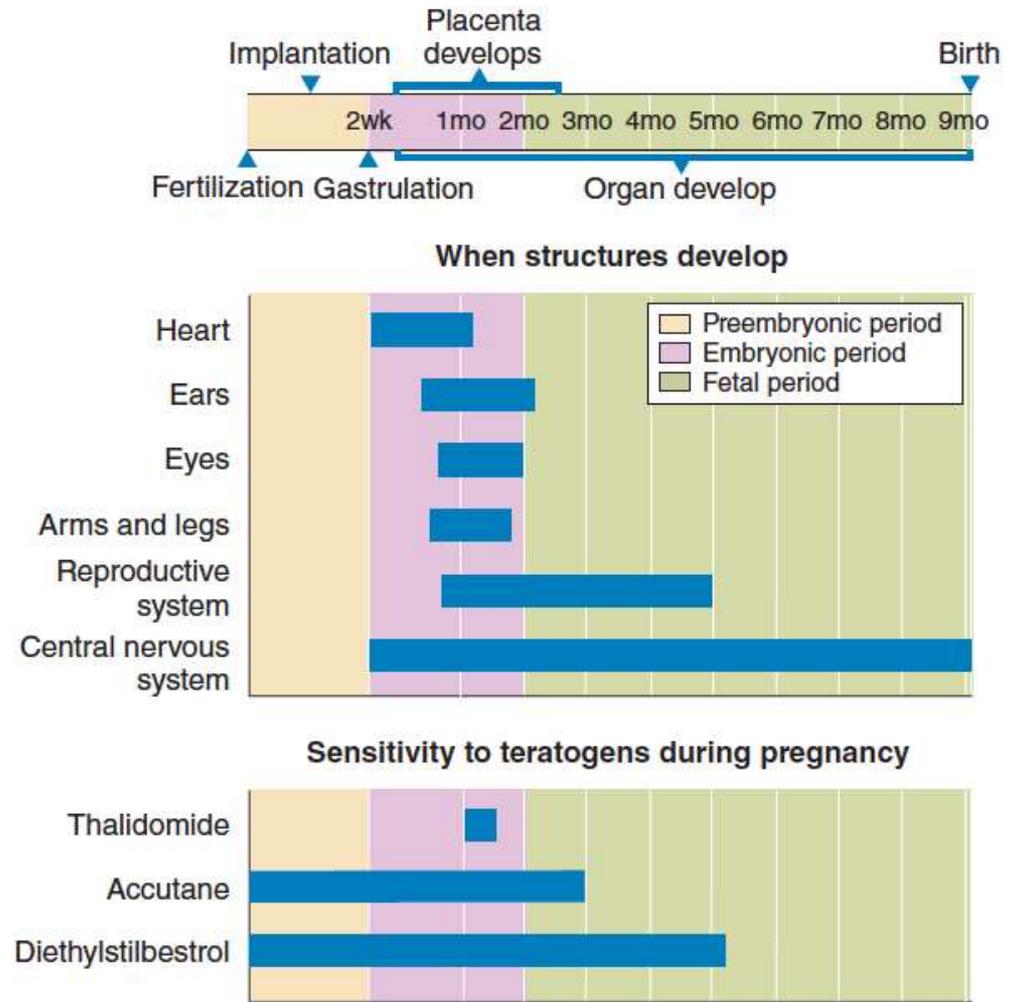
Teratogens are substances that cause birth defects.

- Chemicals and metals
- Alcohol
- Cigarettes
- Illicit drugs
- Prescription drugs
- Vitamins
- Viruses



Birth Defects Have Many Causes

Teratogen exposure during the “critical period” of a structure’s development may lead to defects in that structure.



35.6 Mastering Concepts



What are some examples of teratogens?

Investigating Life: The Ultimate Sacrifice

The two spiders in the photo below are the same species. The small male has about a 2/3 chance of being eaten by the much larger female.



Investigating Life: The Ultimate Sacrifice

Intuition might say that the male would try to avoid being cannibalized. However, during mating, he somersaults into the female's mouth, offering his body as food.



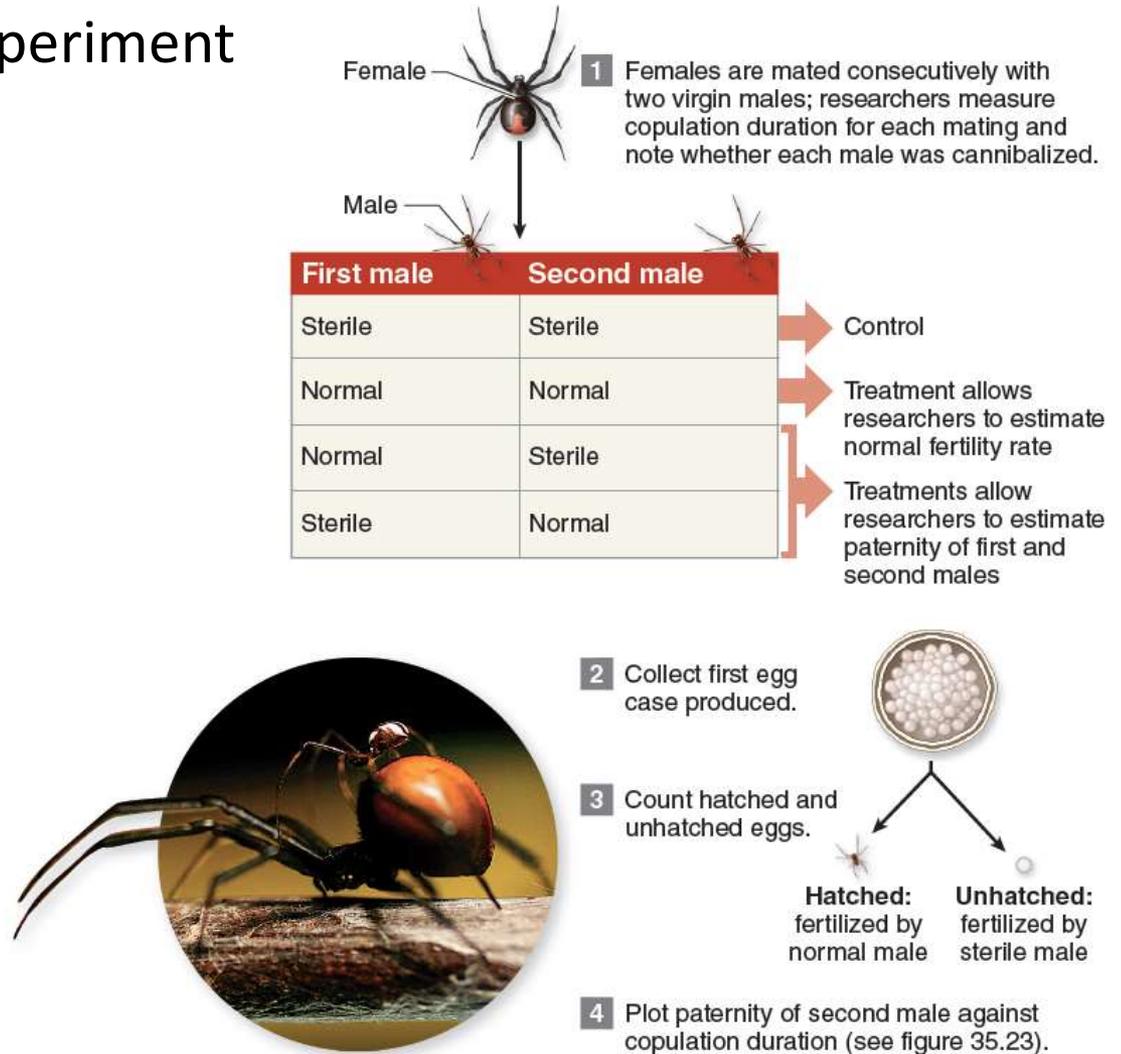
Investigating Life: The Ultimate Sacrifice

Why does natural selection favor the cannibalistic behavior of these spiders?



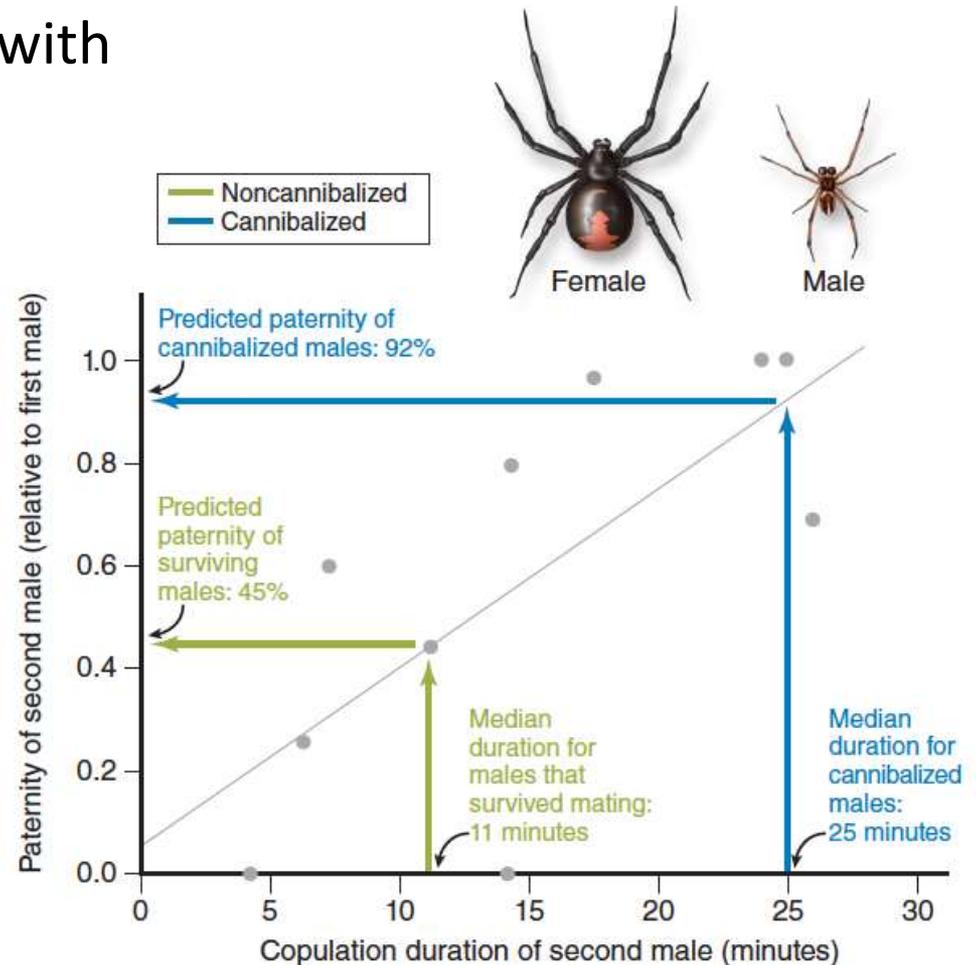
Investigating Life: The Ultimate Sacrifice

Researchers set up an experiment to find out.



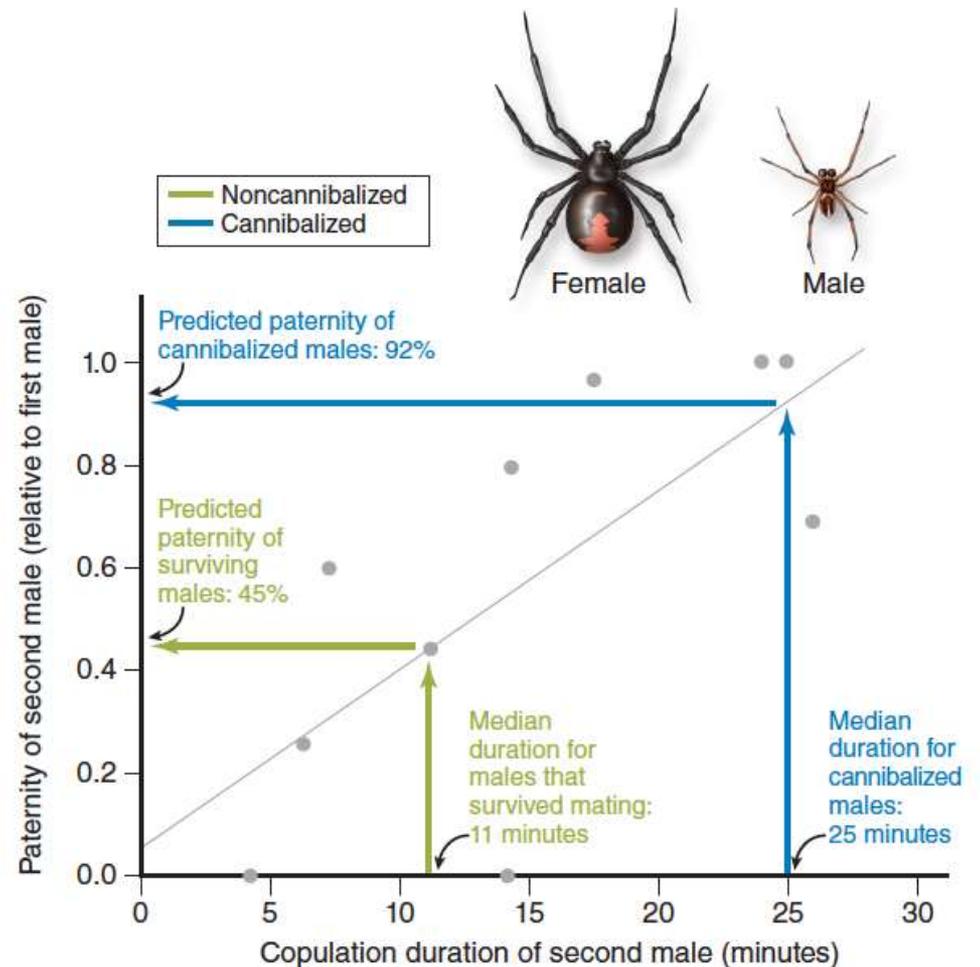
Investigating Life: The Ultimate Sacrifice

Their results indicated that cannibalized males copulated with females for much longer than noncannibalized males.



Investigating Life: The Ultimate Sacrifice

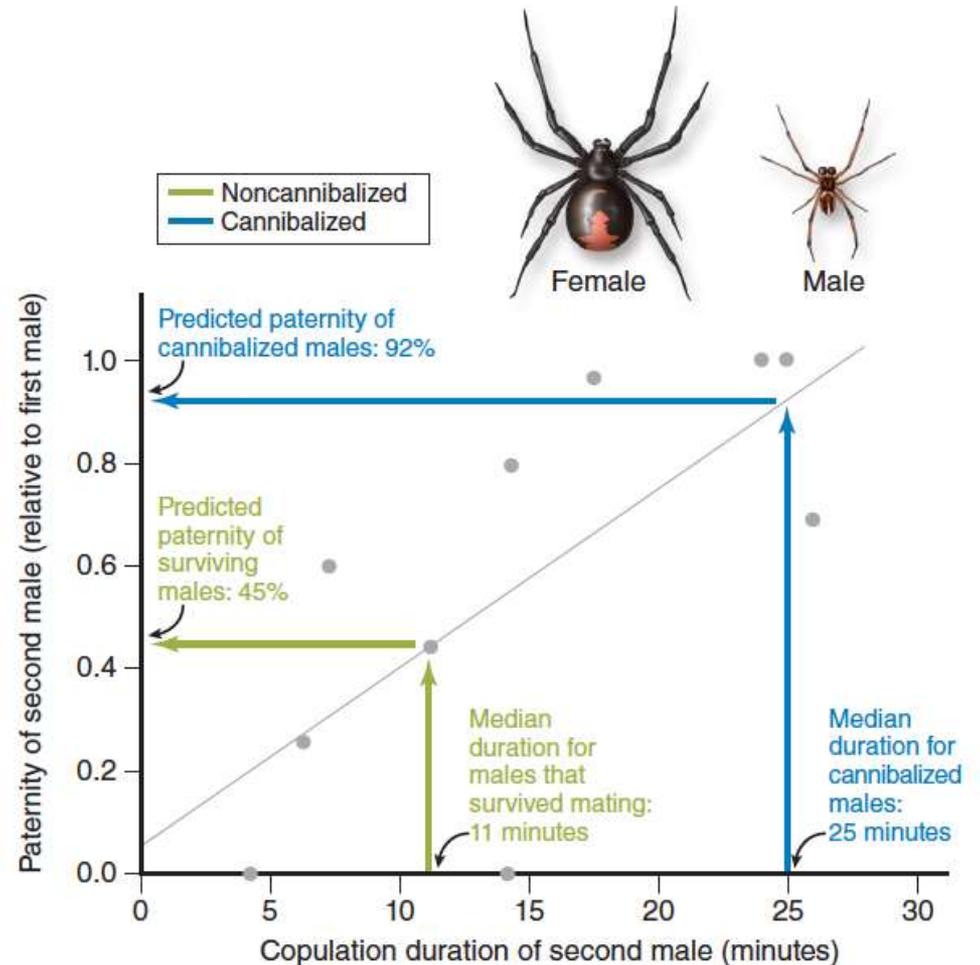
More importantly, cannibalized males fertilized more eggs.



Investigating Life: The Ultimate Sacrifice

More importantly, cannibalized males fertilized more eggs.

Since cannibalized males are more likely to pass on their genes, natural selection the males' sacrificial behavior.



Investigating Life: The Ultimate Sacrifice

This study is a reminder that natural selection does not favor *survival* but rather favors *reproductive success*.

Males are likely to only have one opportunity to mate, so any behavior (even a lethal one) that makes that opportunity a success is strongly selected.

