

THE REPRODUCTIVE SYSTEM

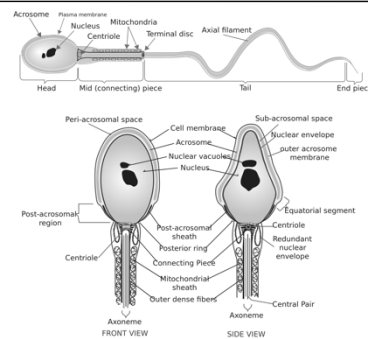
THE REPRODUCTIVE SYSTEM

- **Gonads – primary sex organs**
 - **Testes in males**
 - **Ovaries in females**

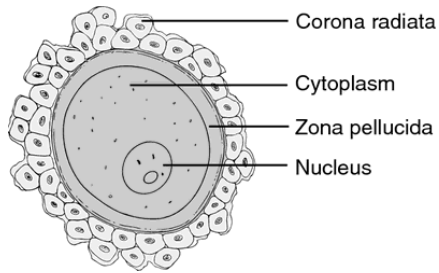
SEX CELLS

- **Sperm – Male gametes produced in the testes. Testosterone is the male sex hormone**
- **Ova (eggs) – Female gametes produced in the ovaries. Estrogen is the female sex hormone.**

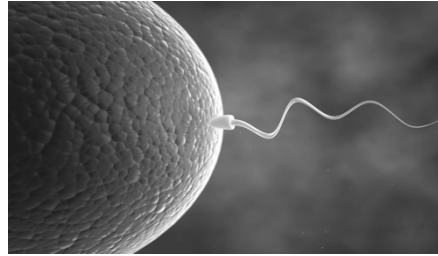
SPERM



EGG

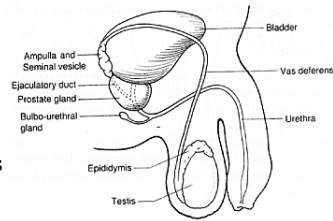


FERTILIZATION

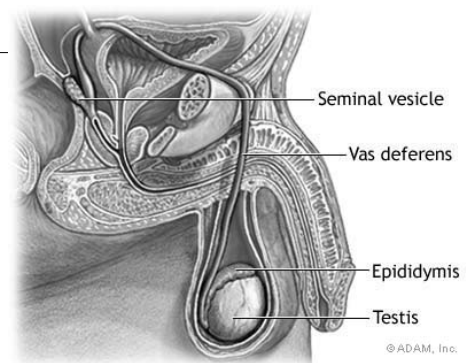


MALE REPRODUCTIVE SYSTEM

- Testes
- Duct system
 - Epididymis
 - Ductus deferens
AKA Vas deferens
 - Urethra



• Male Reproductive System



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TESTES

- Covered by the tunica albuginea, which is a capsule that surrounds each of the testes.

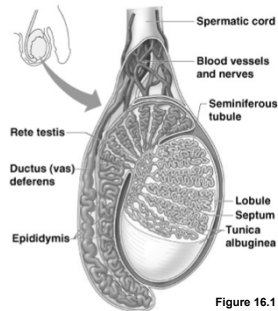
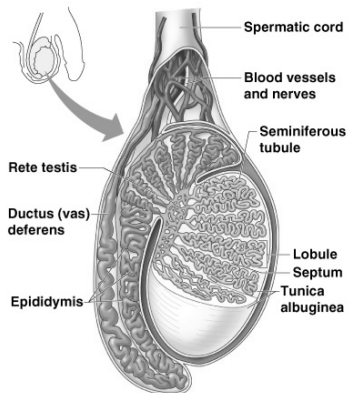


Figure 16.1

TESTES

- Each lobule contains 1 to 4 seminiferous tubules.
- Tightly coiled structures.
- Serve as sperm-forming factories.
- Empty sperm into the rete testis then to the epididymis.



EPIDIDYMIS

- Comma-shaped and tightly coiled tube found on the superior part of the testis and along the posterior lateral side.
- Functions to mature and store sperm cells (at least 20 days)
- Expels sperm with the contraction of muscles within the epididymis walls to the vas deferens.

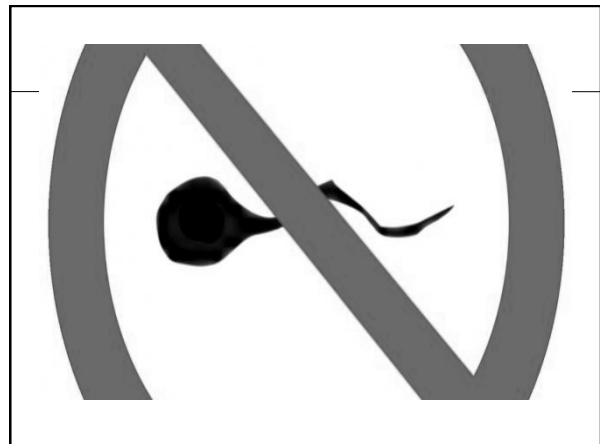
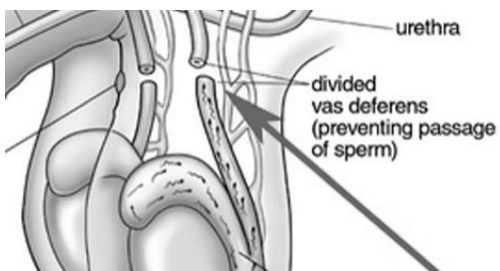
DUCTUS DEFERENS (VAS DEFERENS)

- Carries sperm from the epididymis to the ejaculatory duct.
- Moves sperm along the vas deferens by peristalsis and once in the uterus they move using their tail.

DUCTUS DEFERENS (VAS DEFERENS)

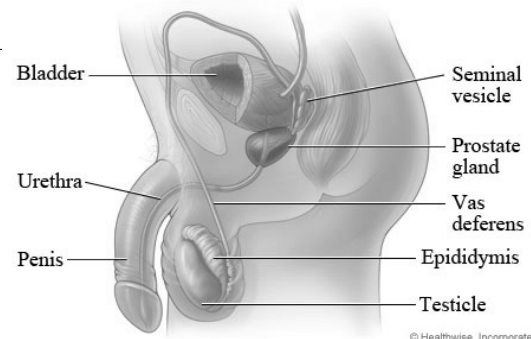
- Ends in the ejaculatory duct which unites with the urethra.
- Vasectomy – cutting of the ductus deferens at the level of the testes to prevent transportation of sperm out of the body.

VASECTOMY



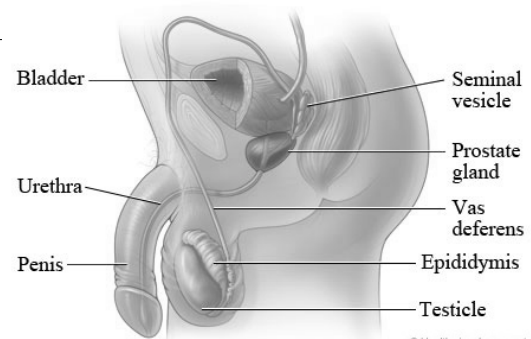
URETHRA

- Extends from the base of the urinary bladder to the tip of the penis.
- Carries both urine and sperm.
- Sperm enters from the ejaculatory duct.



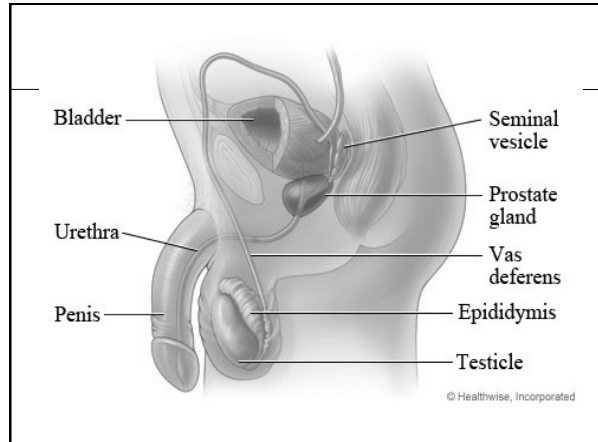
SEMINAL VESICLES

- Located at the base of the bladder.
- Produces a thick, yellowish secretion (60% of semen).



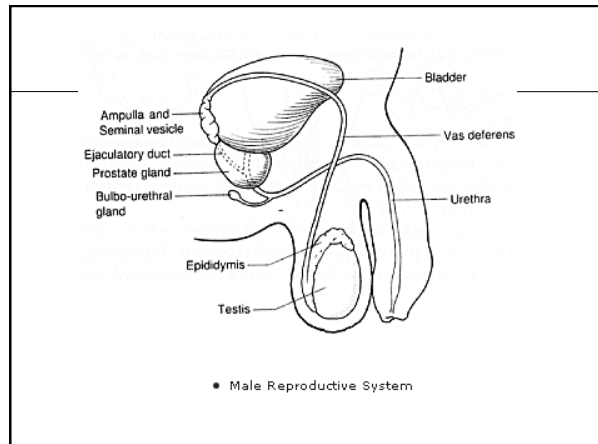
PROSTATE GLAND

- Encircles the upper part of the urethra.
- Secretes a milky fluid.
- Helps to activate sperm.
- Enters the urethra through several small ducts.



BULBOURETHRAL GLAND

- Pea-sized gland inferior to the prostate.
- Produces a thick, clear mucus.
- Cleanses the urethra of acidic urine.
- Serves as a lubricant during sexual intercourse.
- Secreted into the penile urethra.



SEMEN

- Mixture of sperm and accessory gland secretions.
 - Advantages of accessory gland secretions.
 - Fructose provides energy for sperm cells.
 - Alkalinity of semen helps neutralize the acidic environment of vagina.

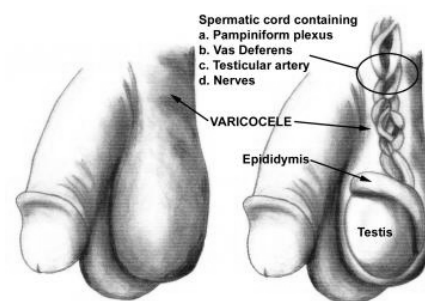
EXTERNAL GENITALIA

- **Scrotum.**
 - Divided sac of skin outside the abdomen.
 - Maintains testes at 3°C lower than normal body temperature to protect sperm viability.

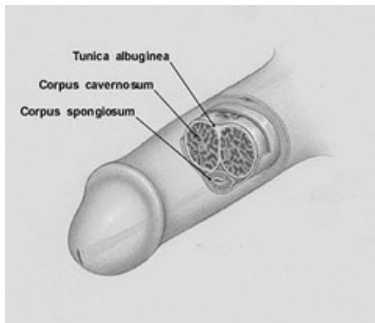
EXTERNAL GENITALIA

- Penis
 - Delivers sperm into the female reproductive tract.
 - Regions of the penis
 - Shaft
 - Glans penis (enlarged tip)

EXTERNAL GENITALIA

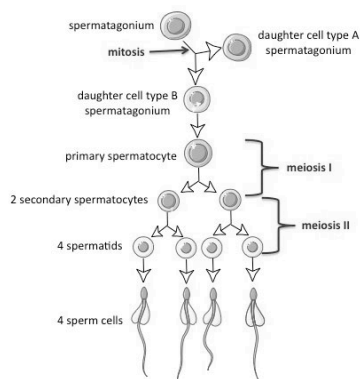


INTERNAL ANATOMY OF A PENIS



SPERMATOGENESIS

- Production of sperm cells.
- Begins at puberty and continues throughout life.
- Occurs in the seminiferous tubules.
- 4 functional cells are produced with flagella.



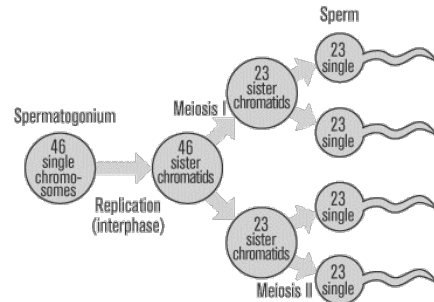
PROCESSES OF SPERMATOGENESIS

- Spermatogonia (stem cells) undergo rapid mitosis to produce more stem cells before puberty.
- Follicle stimulating hormone (FSH) modifies spermatogonia division.
 - One cell produced is a stem cell.
 - The other cell produced becomes a primary spermatocyte.

PROCESSES OF SPERMATOGENESIS

- Primary spermatocytes undergo meiosis and haploid spermatids are produced.
- That means they have half of the chromosomes of an adult human male.

HUMAN SPERM PRODUCTION



PROCESSES OF SPERMATOGENESIS

- Spermatogenesis
 - Late spermatids are produced with 3 distinct regions
 - Head – contains DNA covered by the acrosome
 - Midpiece-Contains mitochondria
 - Tail-Moves the sperm cell
 - Sperm cells result after maturing of spermatids
 - Spermatogenesis takes 64 to 72 days

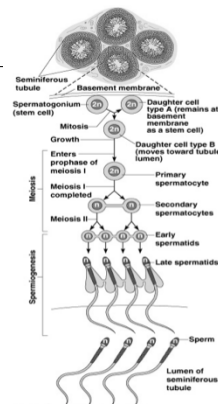


Figure 16.3

ANATOMY OF A MATURE SPERM CELL

- The only human flagellated cell
- DNA is found in the head
- The sperm is 60 μm long and 5 μm wide
- Sperm Cell Ratio

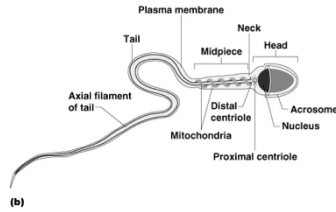


Figure 16.5b

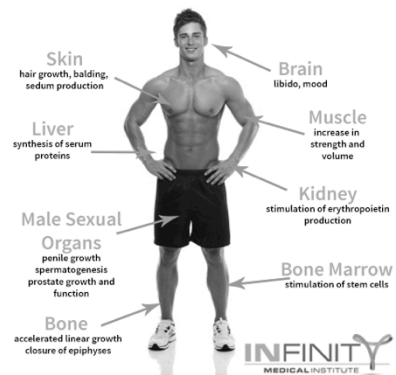
MALE SEX HORMONE

- The most important hormone of the testes is testosterone.

FUNCTIONS OF TESTOSTERONE

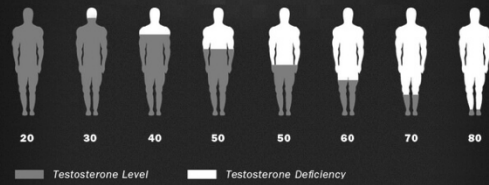
- Stimulates reproductive organ development
- Underlies sex drive
- Causes secondary sex characteristics
 - Deepening of voice
 - Increased hair growth
 - Enlargement of skeletal muscles
 - Thickening of bones

TARGET ORGANS OF TESTOSTERONE



EFFECTS WITH AGE

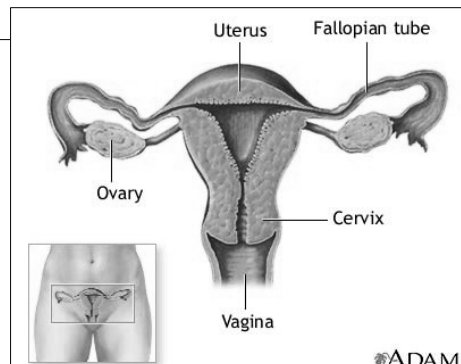
MALE TESTOSTERONE PRODUCTION WITH AGE



THE FEMALE REPRODUCTIVE SYSTEM

FEMALE REPRODUCTIVE SYSTEM

Ovaries
Uterine tubes (fallopian tubes)
Uterus
Vagina
External genitalia



FEMALE REPRODUCTIVE SYSTEM

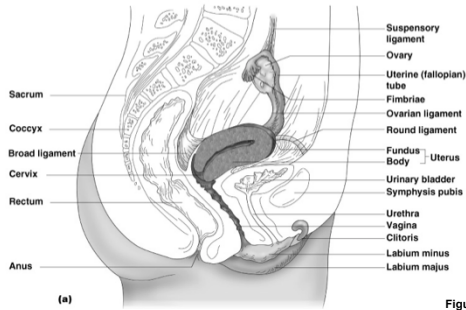


Figure 16.8a

OVARIES

Composed of ovarian follicles (sac-like structures)

Structure of an ovarian follicle
Oocyte
Follicular cells

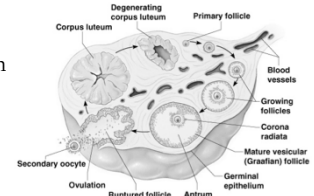


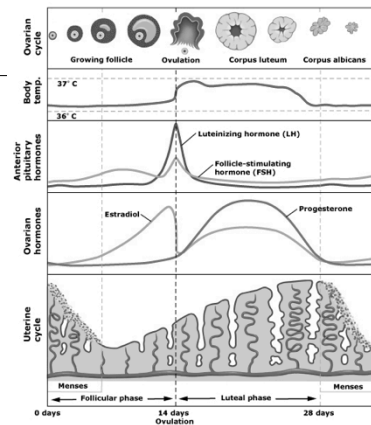
Figure 16.7

MENSTRUAL CYCLE

Once a female reaches sexual maturity, she begins a reproductive cycle called the menstrual cycle.

The cycle of changes takes place in the ovary over a 28 day period.

All of the reproductive cells a female will use in her life she has before she is born.

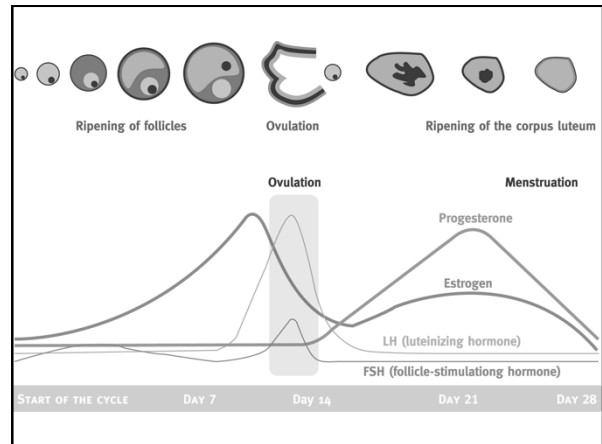


HORMONAL AND STRUCTURAL CHANGES

In addition to the maturation of a follicular cell, several hormonal and structural changes occur.

Estrogen levels rise just before ovulation.

LH and FSH spike on day 14 when the egg is released (ovulation).

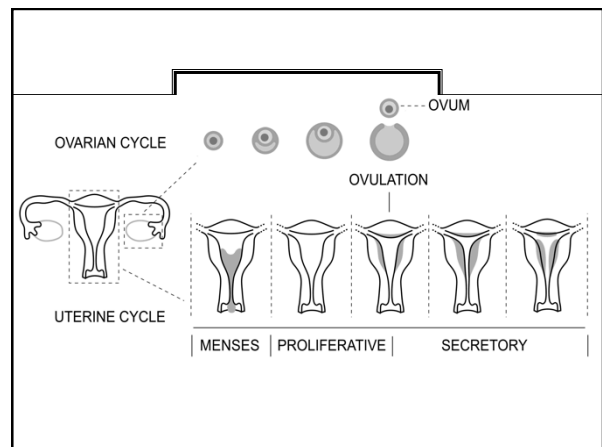


AFTER OVULATION

After ovulation, progesterone levels rise in preparation for potential implantation of the egg if it is fertilized.

The inner lining (endometrium) of the uterus thickens and becomes more vascular.

If the egg is not fertilized, the inner uterine lining is shed in a process called menstruation.



OVARIAN FOLLICLE STAGES

Primary follicle – contains an immature oocyte
Secondary follicle-mature egg cell that is ready to be released.

Ovulation – when the egg is mature the follicle ruptures

Occurs about every 28 days, but on the 14th
The ruptured follicle is transformed into a corpus luteum.

WHERE IT ALL BEGINS

All of the egg cells a female will release during her reproductive years she develops before she is born.

PRIMODIAL FOLLICLE

Primordial germ cells migrate into the developing gonads early in the development of the embryo. Some of these enlarge and develop into larger cells called primary oocytes and enter the first meiotic division. This occurs between 3 and 8 months of gestation in the human embryo.

PRIMARY FOLLICLE

These 'primary' oocytes become arrested in prophase of the first meiotic division until the female becomes sexually mature.

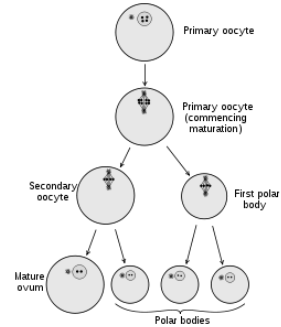
AT SEXUAL MATURITY

At sexual maturity, a small number of primary oocytes (20-50) mature each month and complete the first meiotic division to become secondary oocytes under the influence of follicle stimulating hormone (FSH).

The oocytes synthesize a coat called the 'zona pellucida'.

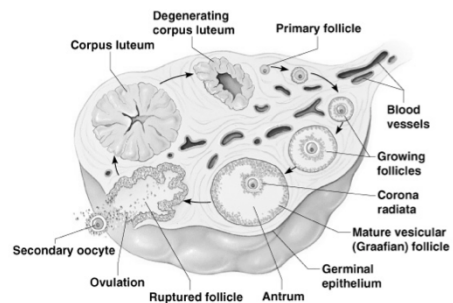
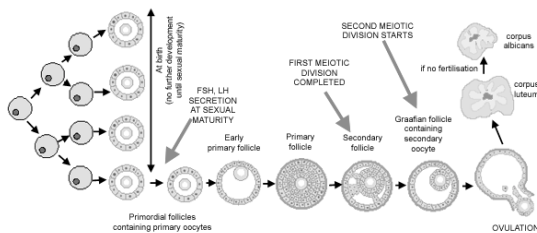
They also accumulate ribosomes, yolk, glycogen, lipid and the mRNA that will be used later on after fertilization to direct early development of the embryo.

SECONDARY FOLLICLE



OVA FORMATION

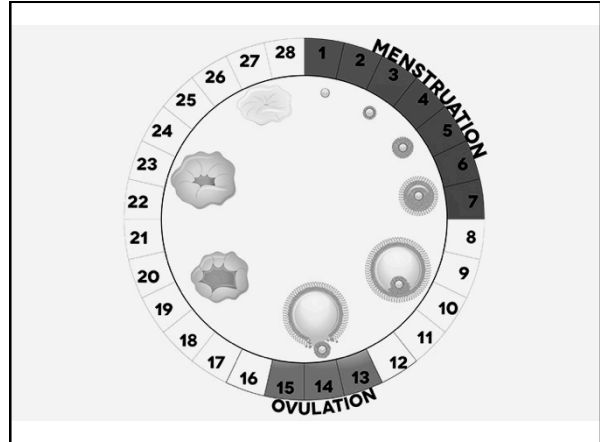
After the second meiotic division, the ova is formed.



OVULATION

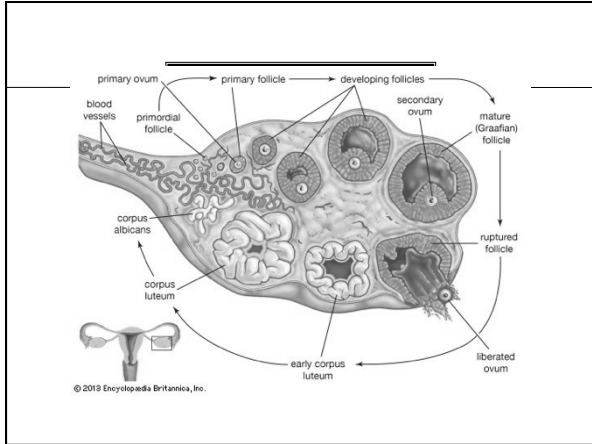
This is the release of the secondary oocyte (mature ova or egg cell). This cell will contain the n number of chromosomes and will be released into the fallopian tube and be ready to get fertilized if sperm cells are present.

This occurs on the 14th day of the menstrual cycle, not the 14th day of the month.



CORPUS LUTEUM

The corpus luteum is essential for establishing and maintaining pregnancy in females. The corpus luteum secretes progesterone, which is a steroid hormone responsible for the development and maintenance of the endometrium.

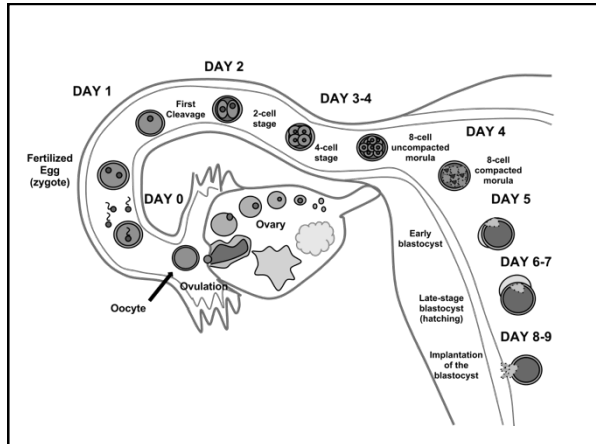


IF THE EGG IS NOT FERTILIZED

If the egg is not fertilized, the corpus luteum stops secreting progesterone and decays (after approximately 10 days in humans). It then degenerates into a corpus albicans, which is a mass of fibrous scar tissue.

IF THE EGG IS FERTILIZED

If the egg is fertilized and implantation occurs, the cells of the blastocyst secrete the hormone human chorionic gonadotropin (hCG, or a similar hormone in other species) by day 9 post-fertilization. hCG is the hormone used in pregnancy tests.



SUPPORT FOR OVARIES

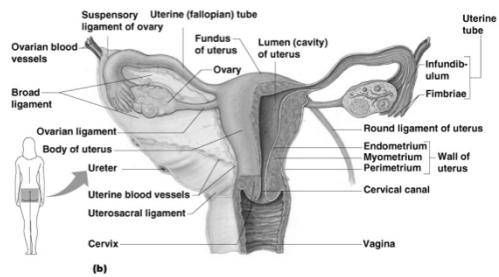
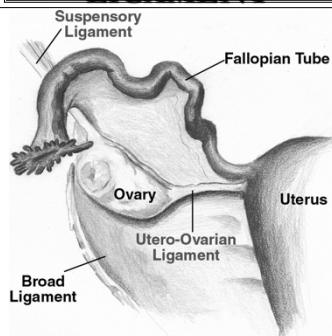


Figure 16.8b

OVARIAN LIGAMENT

The ovarian ligament is composed of muscular and fibrous tissue; it extends from the uterine extremity of the ovary to the lateral aspect of the uterus, just below the point where the uterine tube and uterus meet.

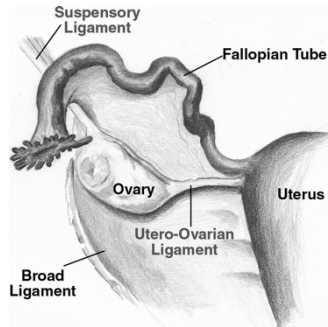
OVARIAN LIGAMENT



UTERINE (FALLOPIAN) TUBES

Receive the ovulated oocyte
 Provide a site for fertilization
 Attaches to the uterus
 Does not physically attach to the ovary
 Supported by the broad ligament

FALLOPIAN TUBES



UTERINE TUBE FUNCTION

Fimbriae – finger-like projections at the distal end that receive the oocyte.
Cilia inside the uterine tube slowly move the oocyte towards the uterus.
(takes 3–4 days)
Fertilization occurs inside the uterine tube.

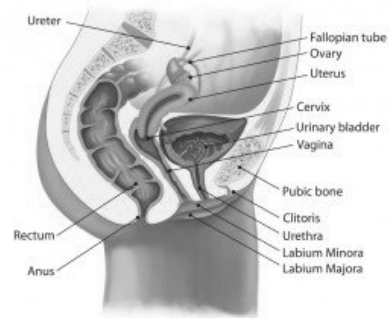
UTERUS

- Located behind the urinary bladder
- Hollow muscular organ

Functions of the uterus

- Receives a fertilized egg
- Retains the fertilized egg
- Nourishes the fertilized egg

LOCATION OF THE UTERUS

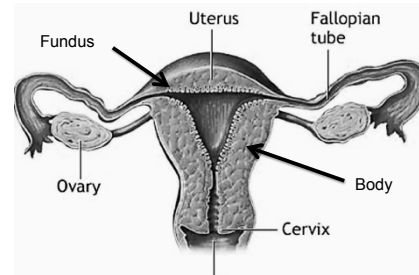


REGIONS OF THE UTERUS

Body – main portion

Fundus – area where uterine tube enters

Cervix – narrow outlet that protrudes into the vagina.



WALLS OF THE UTERUS

Endometrium

- Inner layer
- Allows for implantation of a fertilized egg
- Sloughs off if no pregnancy occurs (menses)

Myometrium – middle layer of smooth muscle

VAGINA

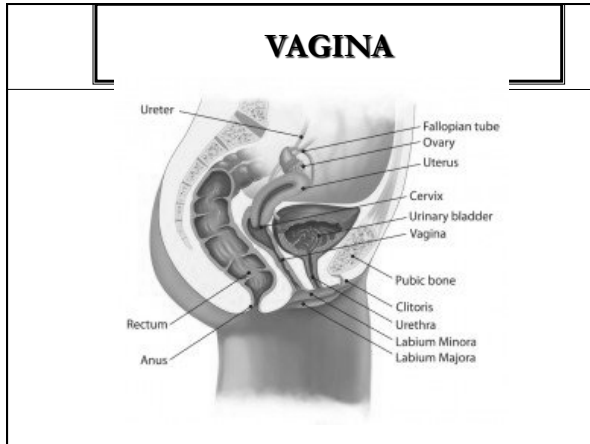
Extends from cervix to exterior of body

Behind bladder and in front of rectum

Serves as the birth canal

Receives the penis during sexual intercourse

Hymen – partially closes the vagina until it is ruptured



EXTERNAL GENITALIA (VULVA)

Mons pubis
Fatty area overlying the pubic symphysis
Covered with pubic hair after puberty

Figure 16.9

EXTERNAL GENITALIA (VULVA)

Clitoris
Labia – skin folds
Labia majora
Labia minora

Figure 16.9

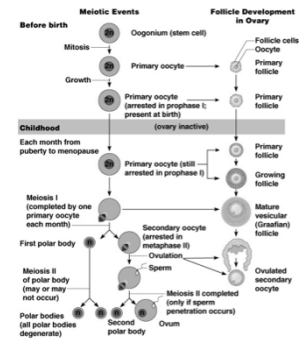
OOGENESIS

The total supply of eggs are present at birth
Ability to release eggs begins at puberty.
Reproductive ability ends at menopause.
Oocytes are matured in developing ovarian follicles.
The mature oocyte is about 130 μ m in diameter.

OOGENESIS

Primary oocytes are inactive until puberty
 Follicle stimulating hormone (FSH) causes
 some primary follicles to mature
 Meiosis starts inside maturing follicle
 Produces a secondary oocyte and the first polar
 body
 Meiosis is completed after ovulation only if
 sperm penetrates
 Two additional polar bodies are produced

OOGENESIS



THE BIRTHING PROCESS

MENSTRUAL (UTERINE) CYCLE

Cyclic changes of the endometrium
 Regulated by cyclic production of
 estrogens and progesterone.

LH and FSH are also involved.

(FSH) FOLLICLE STIMULATING HORMONE

FSH controls the first half of the menstrual cycle by stimulating the maturation of the ovarian follicles. Many follicles mature during each cycle, but the one that reaches maturity first will release the egg. FSH stimulates the follicle cells to produce the hormone estrogen, which stimulates the preparation of the endometrium, needed for implantation in case the egg is fertilized.

(LH) LUTEINIZING HORMONE

High levels of estrogen trigger the LH surge causing the release of the egg from the mature follicle. This process is called ovulation. LH stimulates the progesterone production from the corpus luteum, which supports the second half of the menstrual cycle. During this phase estrogen levels decrease while progesterone levels increase.

HORMONAL CONTROL OF THE OVARIAN AND UTERINE CYCLES

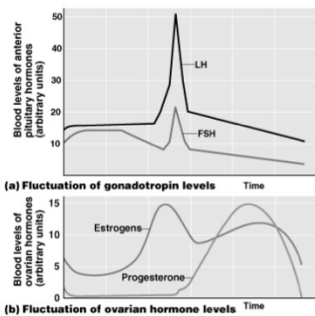


Figure 16.12a, b

HORMONAL CONTROL OF THE OVARIAN AND UTERINE CYCLES

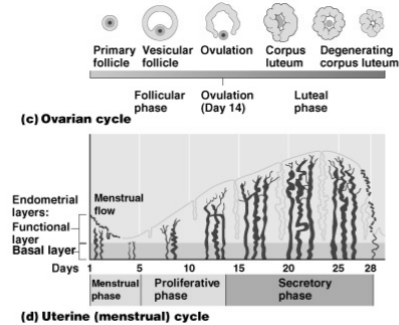


Figure 16.12c, d

HORMONE PRODUCTION BY THE OVARIES

Estrogens

Produced by follicle cells

Cause secondary sex characteristics

- Enlargement of accessory organs
- Development of breasts
- Appearance of pubic hair
- Increase in fat beneath the skin
- Widening and lightening of the pelvis
- Onset of menses

HORMONE PRODUCTION BY THE OVARIES

Progesterone

Produced by the corpus luteum

**Production continues until LH
diminishes in the blood**

Helps maintain pregnancy

MAMMARY GLANDS

Present in both sexes, but only
function in females

Modified sweat glands

Function is to produce milk

Stimulated by sex hormones (mostly
estrogens) to increase in size.

ANATOMY OF MAMMARY GLANDS

Areola – central pigmented area

Nipple – protruding central area of areola

Lobes – internal structures that radiate
around nipple

Alveolar glands – clusters of milk producing
glands within lobules

Lactiferous ducts – connect alveolar glands
to nipple

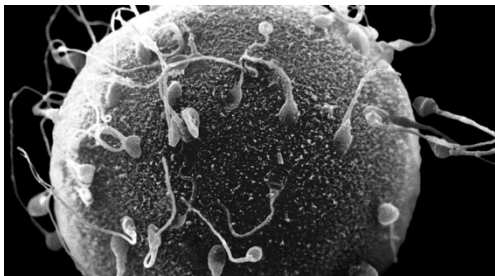
STAGES OF PREGNANCY AND DEVELOPMENT

Fertilization
Embryonic development
Fetal development
Childbirth

FERTILIZATION

The oocyte is viable for 12 to 24 hours after ovulation
Sperm are viable for 12 to 48 hours after ejaculation
Sperm cells must make their way to the uterine tube for fertilization to be possible

MANY WILL TRY BUT ONLY ONE WILL WIN



MECHANISMS OF FERTILIZATION

Membrane receptors on an oocyte pulls in the head of the first sperm cell to make contact
The membrane of the oocyte does not permit a second sperm head to enter
The oocyte then undergoes its second meiotic division
Fertilization occurs when the genetic material of a sperm combines with that of an oocyte to form a zygote

THE ZYGOTE

First cell of a new individual
The result of the fusion of DNA from sperm and egg
The zygote begins rapid mitotic cell divisions
The zygote stage is in the uterine tube, moving toward the uterus

THE BLASTOCYST

Ball-like circle of cells
Begins at about the 100 cell stage
Secretes human chorionic gonadotropin (hCG) to produce the corpus luteum to continue producing hormones
Functional areas of the blastocyst
Trophoblast – large fluid-filled sphere
Inner cell mass

THE BLASTOCYST

Primary germ layers are eventually formed
Ectoderm – outside layer
Mesoderm – middle layer
Endoderm – inside layer
The late blastocyst implants in the wall of the uterus (by day 14)

DERIVATIVES OF GERM LAYERS

Ectoderm

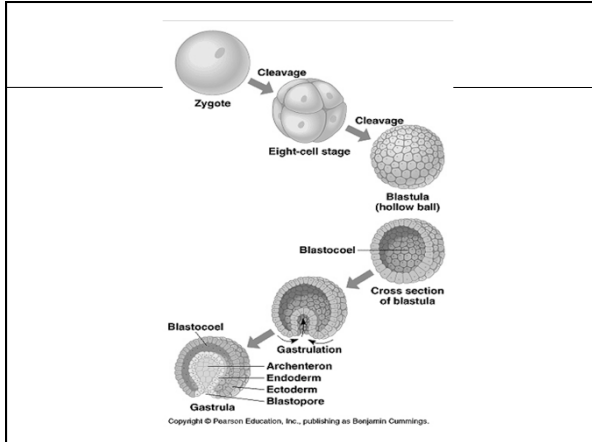
- Nervous system
- Epidermis of the skin

Endoderm

- Mucosae
- Glands

Mesoderm

- Everything else



DEVELOPMENT AFTER IMPLANTATION

Chorionic villi (projections of the blastocyst) develop

Cooperate with cells of the uterus to form the placenta

The embryo is surrounded by the amnion (a fluid filled sac)

An umbilical cord forms to attach the embryo to the placenta

THE EMBRYO

Developmental stage from the start of cleavage until the ninth week

The embryo first undergoes division without growth

The embryo enters the uterus at the 16-cell state

The embryo floats free in the uterus temporarily

Uterine secretions are used for nourishment

EMBRYO



DEVELOPMENT FROM OVULATION TO IMPLANTATION

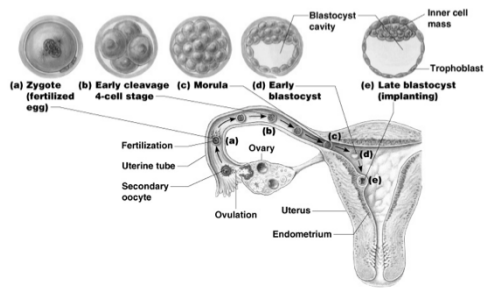


Figure 16.15

DEVELOPMENT AFTER IMPLANTATION

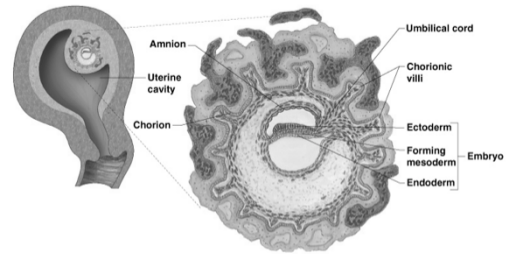


Figure 16.16

FUNCTIONS OF THE PLACENTA

- Forms a barrier between mother and embryo (blood is not exchanged)
- Delivers nutrients and oxygen
- Removes waste from embryonic blood
- Becomes an endocrine organ (produces hormones) and takes over for the corpus luteum
- Estrogen
- Progesterone
- Other hormones that maintain pregnancy

THE FETUS (BEGINNING OF THE NINTH WEEK)

All organ systems are formed by the end of the eighth week
 Activities of the fetus are growth and organ specialization
 A stage of tremendous growth and change in appearance

FETUS



THE EFFECTS OF PREGNANCY ON THE MOTHER

Pregnancy – period from conception until birth

Anatomical changes

Enlargements of the uterus

Accentuated lumbar curvature

Relaxation of the pelvic ligaments and pubic symphysis due to production of relaxin

EFFECTS OF PREGNANCY ON THE MOTHER

Physiological changes

Gastrointestinal system

Morning sickness is common due to elevated progesterone

Heartburn is common because of organ crowding by the fetus

Constipation is caused by declining motility of the digestive tract

MORNING SICKNESS

Morning sickness often begins 4 - 6 weeks after conception and may continue until the fourth month of pregnancy. Some women have morning sickness during their entire pregnancy. This happens most often for women who are carrying more than 1 baby.

It is called morning sickness because the symptoms are more likely to occur early in the day, but they can occur at any time. For some women, morning sickness lasts all day.

Most experts think changes in the woman's hormone levels during pregnancy cause it.

Other factors that can make the nausea worse include a pregnant woman's enhanced sense of smell and gastric reflux.

EFFECTS OF PREGNANCY ON THE MOTHER

Physiological changes
Urinary System
Kidneys have additional burden and produce more urine
The uterus compresses the bladder

EFFECTS OF PREGNANCY ON THE MOTHER

Physiological changes
Respiratory System
Nasal mucosa becomes congested and swollen
Vital capacity and respiratory rate increase

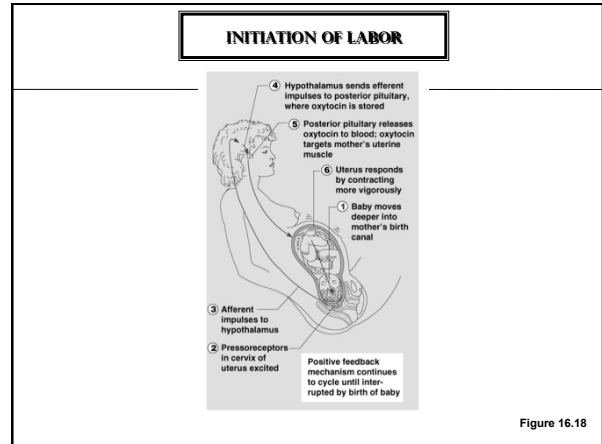
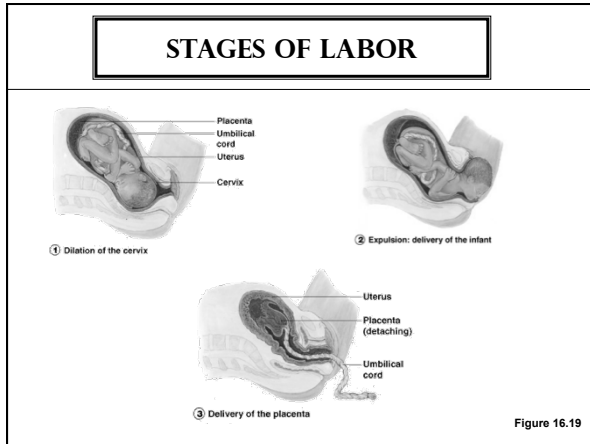
EFFECTS OF PREGNANCY ON THE MOTHER

Physiological changes
Cardiovascular system
Body water rises
Blood volume increases by 25 to 40 percent
Blood pressure and pulse increase
Varicose veins are common

CHILDBIRTH (PARTITION)

Labor – the series of events that expel the infant from the uterus.
Initiation of labor

1. Estrogen levels rise
2. Uterine contractions begin
3. The placenta releases prostaglandins
4. Oxytocin is released by the pituitary
5. Combination of these hormones produces contractions



STAGES OF LABOR

Dilation
Cervix becomes dilated
Uterine contractions begin and increase
The amnion ruptures

STAGES OF LABOR

Expulsion
Infant passes through the cervix and vagina
Normal delivery is head first
Placental stage
Delivery of the placenta

TWINS

There are three types of twins:

Monozygotic

Dizygotic

Polar Body Twins

MONOZYGOTIC

Identical

Form from one fertilized egg

1/3 of all twins are identical

Same sex and blood type

Not hereditary

May share one placenta or two placentas fused into one.

Normal Monochorionic Twins



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DIZYGOTIC

Fraternal

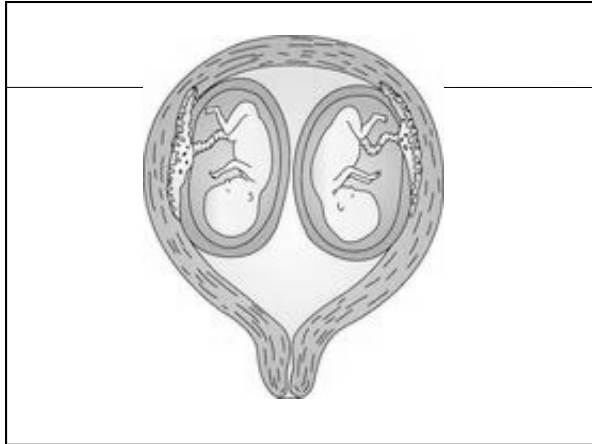
Two eggs fertilized by two sperm

2/3 of twins

May or may not be the same sex

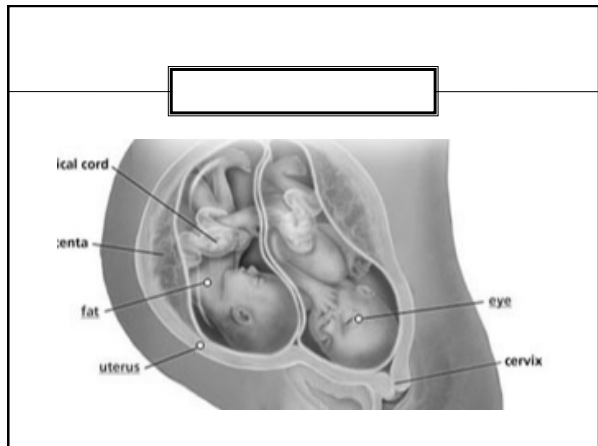
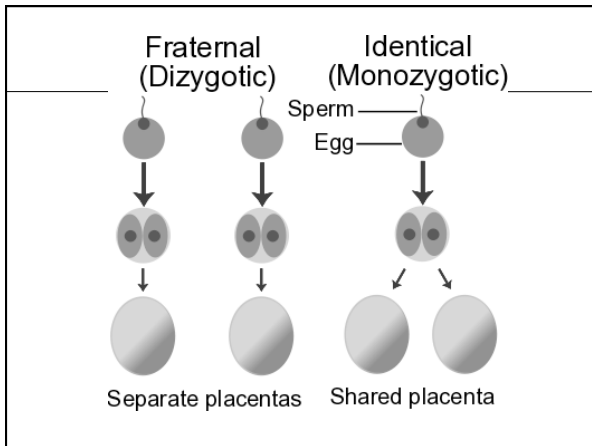
May be hereditary

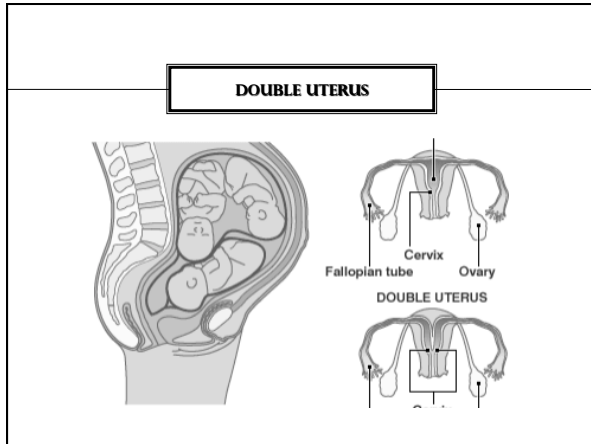
May have two placentas or two fused into one



POLAR BODY TWINS

A single unfertilized egg splits in two and are then fertilized by two sperm
 Half identical or hybrid
 Share half of their genetic information





DEVELOPMENTAL ASPECTS OF THE REPRODUCTIVE SYSTEM

Gender is determined at fertilization
 Males have XY sex chromosomes
 Females have XX sex chromosomes
 Gonads do not begin to form until the eighth week

WHAT ARE YOUR ODDS?

	X	X
X		
Y		

DEVELOPMENTAL ASPECTS OF THE REPRODUCTIVE SYSTEM

Testes form in the abdominal cavity and descend to the scrotum one month before birth
 The determining factor for gonad differentiation is testosterone

**DEVELOPMENTAL ASPECTS OF THE
REPRODUCTIVE SYSTEM**

Reproductive system organs do not
function until puberty
Puberty usually begins between ages 10
and 15
The first menses usually occurs about two
years after the start of puberty
Most women reach peak reproductive
ability in their late 20s

**DEVELOPMENTAL ASPECTS OF THE
REPRODUCTIVE SYSTEM**

Menopause occurs when ovulation and
menses cease entirely
Ovaries stop functioning as endocrine
organs
There is a no equivalent of menopause in
males, but there is a steady decline in
testosterone