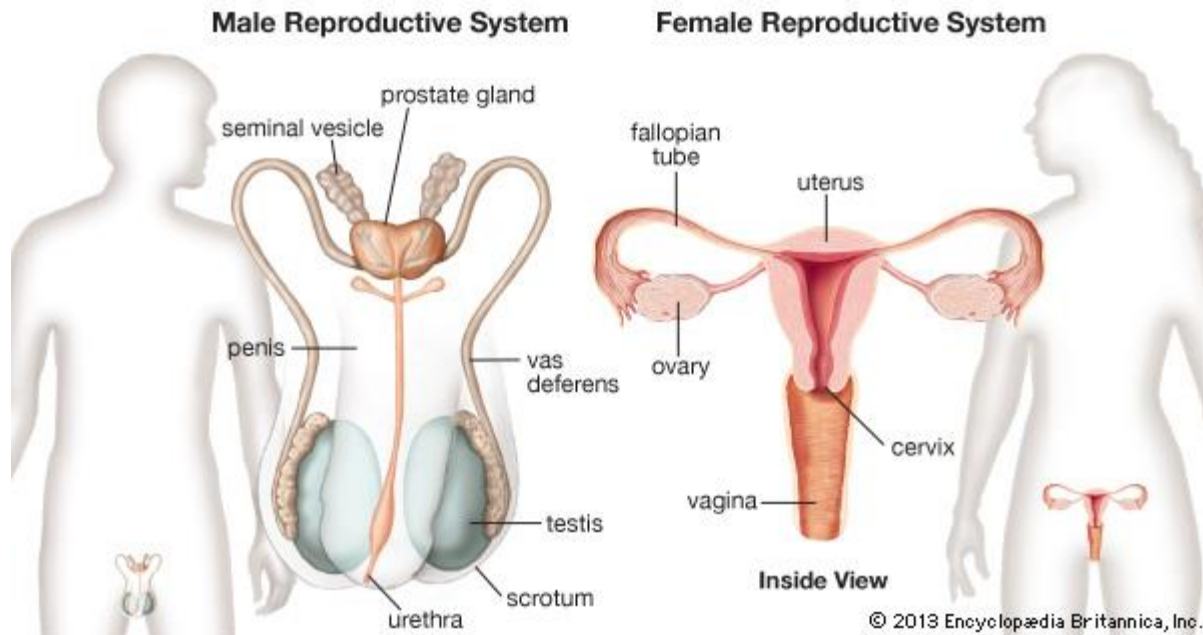


The Reproductive System



Male Reproductive System Delivers Sperm

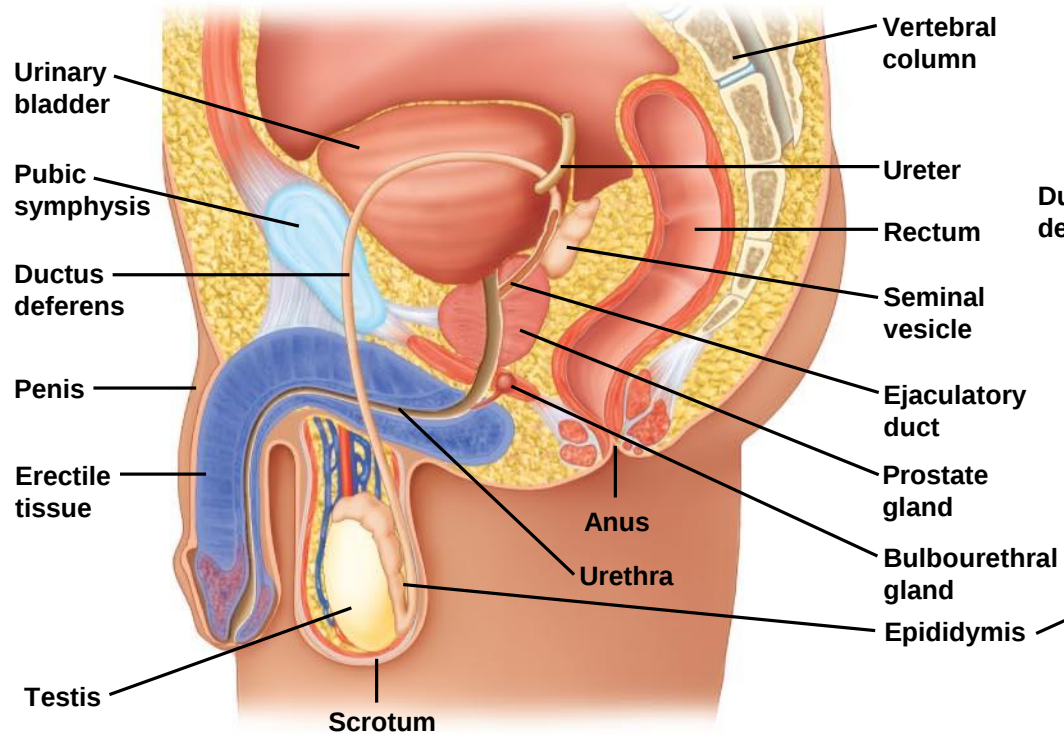
- **Testes** produce sperm
 - **Scrotum**
 - sac of skin and smooth muscle that holds the testes
 - Maintains testes at a slightly lower temperature
 - **Seminiferous tubules** within testes
 - produce sperm
- **Epididymis and ductus deferens**
 - sperm become motile and are stored here
- **Ductus deferens**
 - transports sperm to where it becomes the ejaculatory duct

Male Reproductive System Delivers Sperm

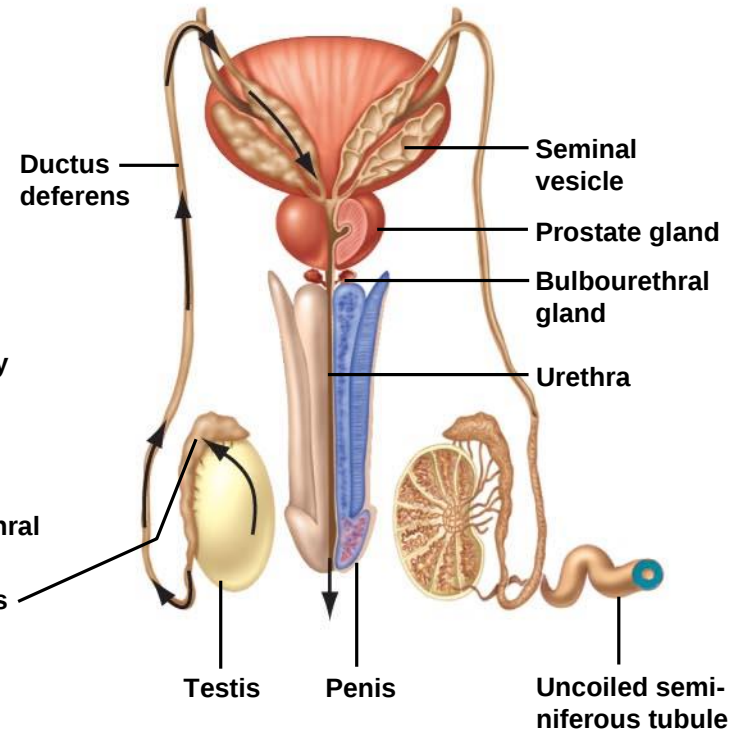
- Route of sperm through male reproductive structures
 1. Seminiferous tubules
 2. Epididymis
 3. Ductus deferens
 4. Ejaculatory duct
 5. Penis

Accessory Glands Help Sperm Survive

- Seminal vesicles
 - Secrete fructose (provides source of energy for sperm) and most of seminal fluid
- Prostate gland
 - Secretes watery alkaline fluid to raise vaginal pH
- Bulbourethral gland
 - Secretes lubricating mucus
 - Cleanses urethra



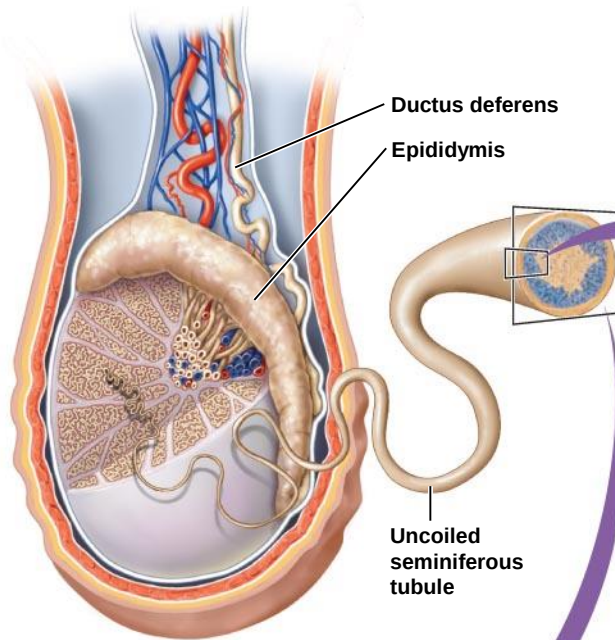
a) A sagittal cutaway view.



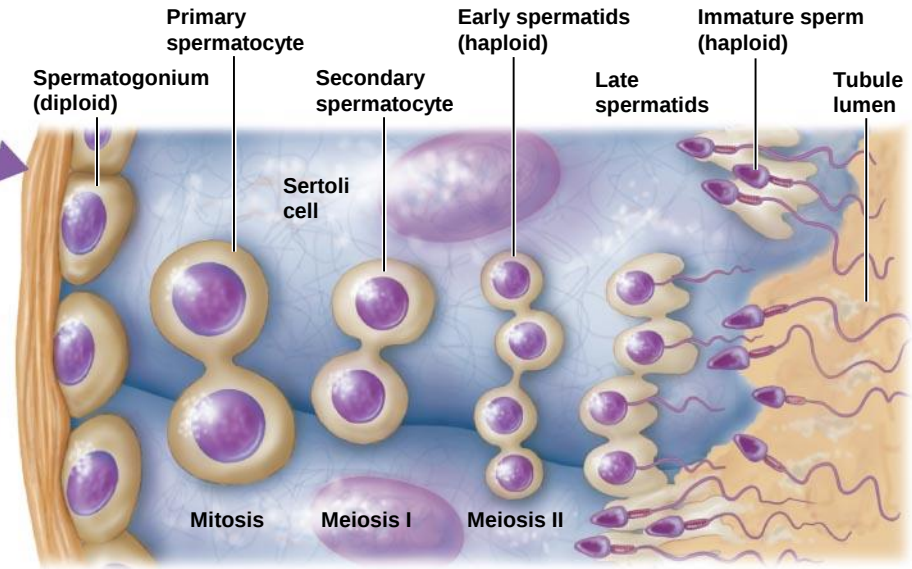
b) A posterior view of the reproductive organs and bladder.

Sperm Production Requires Several Cell Divisions

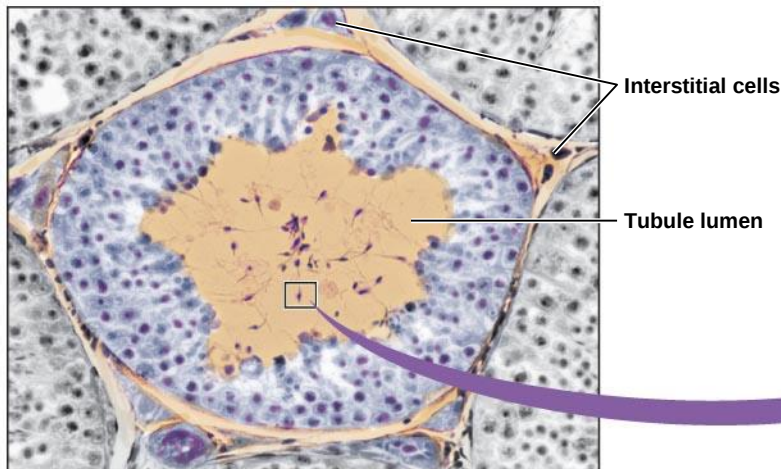
- Several cell divisions (mitosis and meiosis) in seminiferous tubules
- Purpose
 - Produce a large number of sperm with half the number of chromosomes of somatic cells (haploid)
- Sequence of cell types, leading to sperm
 - Spermatogonia ($2n$), primary spermatocyte ($2n$), secondary spermatocyte (n), spermatids (n), sperm (n)
- Sertoli cells provide support, nourishment



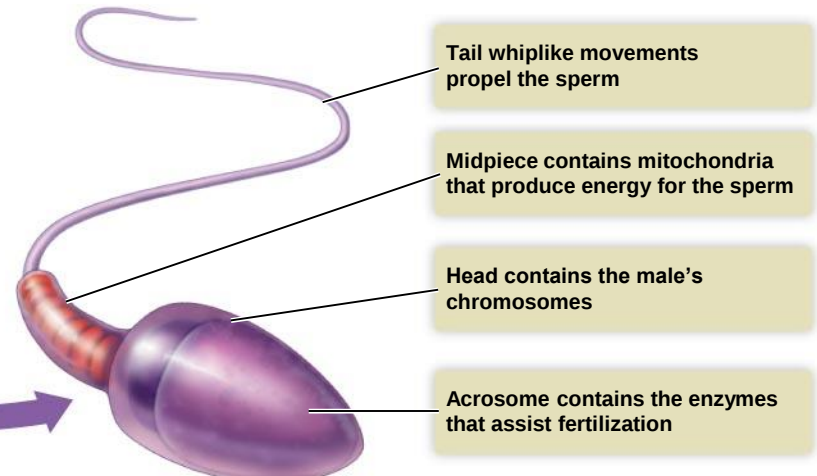
a) Partial cross section of a testis showing the coiled seminiferous tubules.



b) Sperm originate from undifferentiated spermatogonia located near the outer surface of a seminiferous tubule. The production of sperm is supported by Sertoli cells.



c) A cross section through a seminiferous tubule ($\times 100$) showing the location of the testosterone-producing interstitial cells between the tubules. Mature sperm are visible within the lumen of tubule.



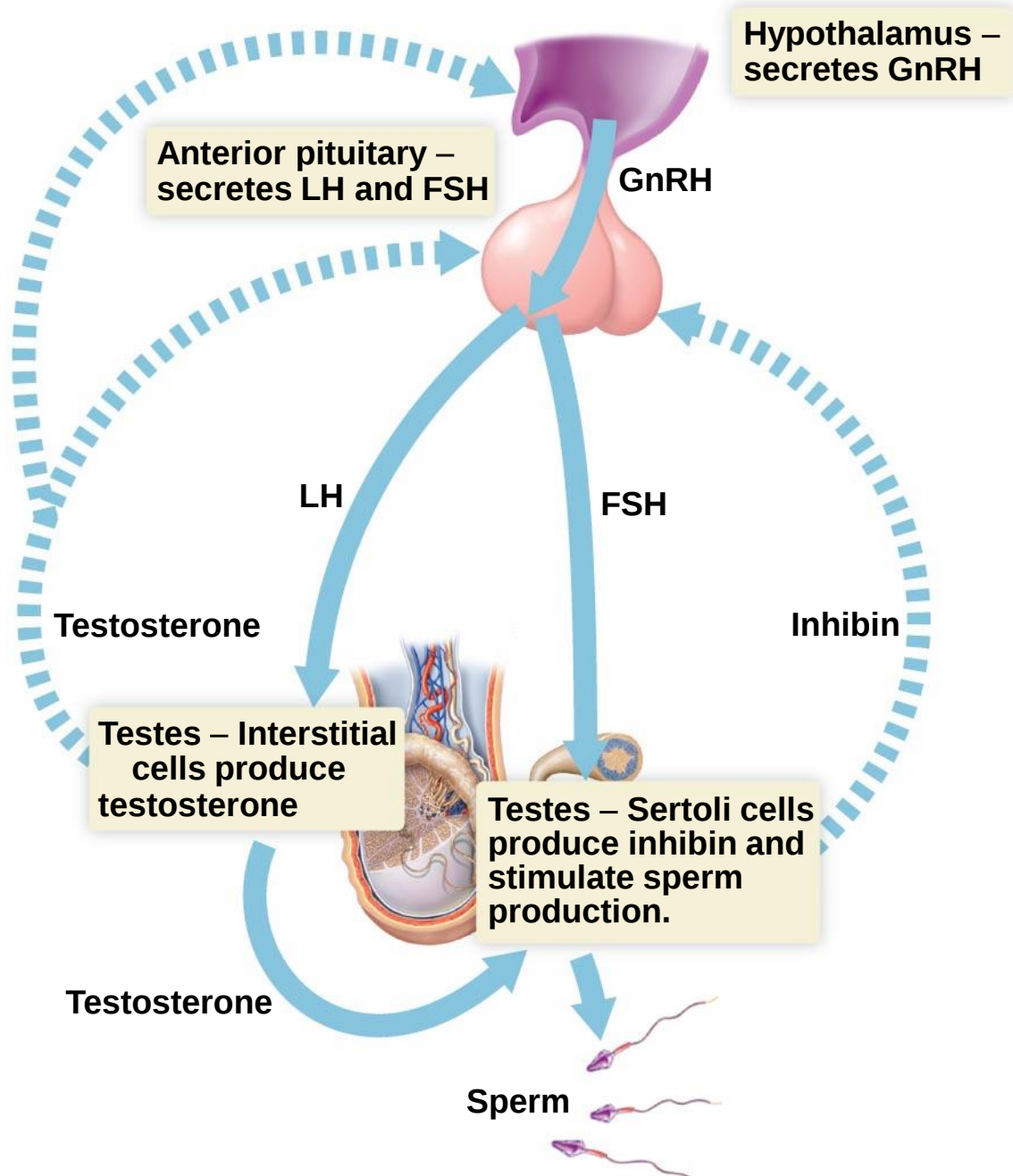
d) Illustration of a sperm, showing the head, midpiece, and tail.

Testosterone Affects Male Reproductive Capacity

- Testosterone
 - Steroid hormone produced by **interstitial cells** in testes (between seminiferous tubules)
 - Function
 - controls growth and function of male reproductive tissues
 - stimulates aggression and sexual behavior
 - secondary sexual characteristics
 - Determines rate of sperm formation

Testosterone Affects Male Reproductive Capacity

- Hormones that regulate testosterone and sperm production
 - Gonadotropin-releasing hormone (**GnRH**) from hypothalamus
 - **LH** (from anterior pituitary) stimulates production of testosterone
 - **FSH** (from anterior pituitary) may enhance sperm formation with Sertoli cells
 - **Inhibin**: produced by Sertoli cells, inhibits secretion of FSH



Female Reproductive System Produces Eggs and Supports Pregnancy

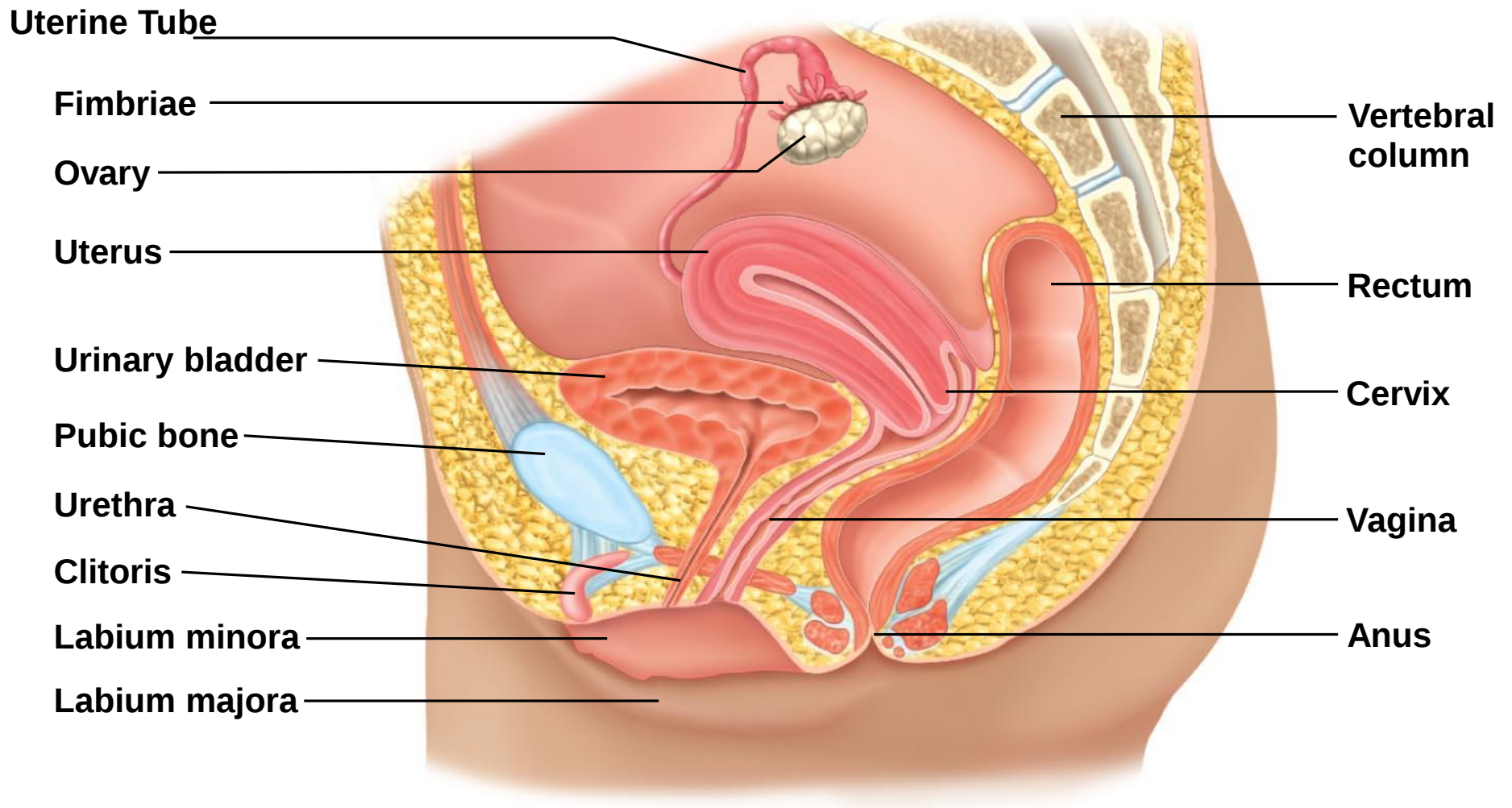
- Ovaries
 - Release oocytes (immature eggs) and secrete the hormones estrogen and progesterone
- Uterine Tube (oviduct / fallopian tube)
 - Leads from the ovary to the uterus
 - Fertilization occurs in the upper third of the uterine tube

Female Reproductive System Produces Eggs and Supports Pregnancy

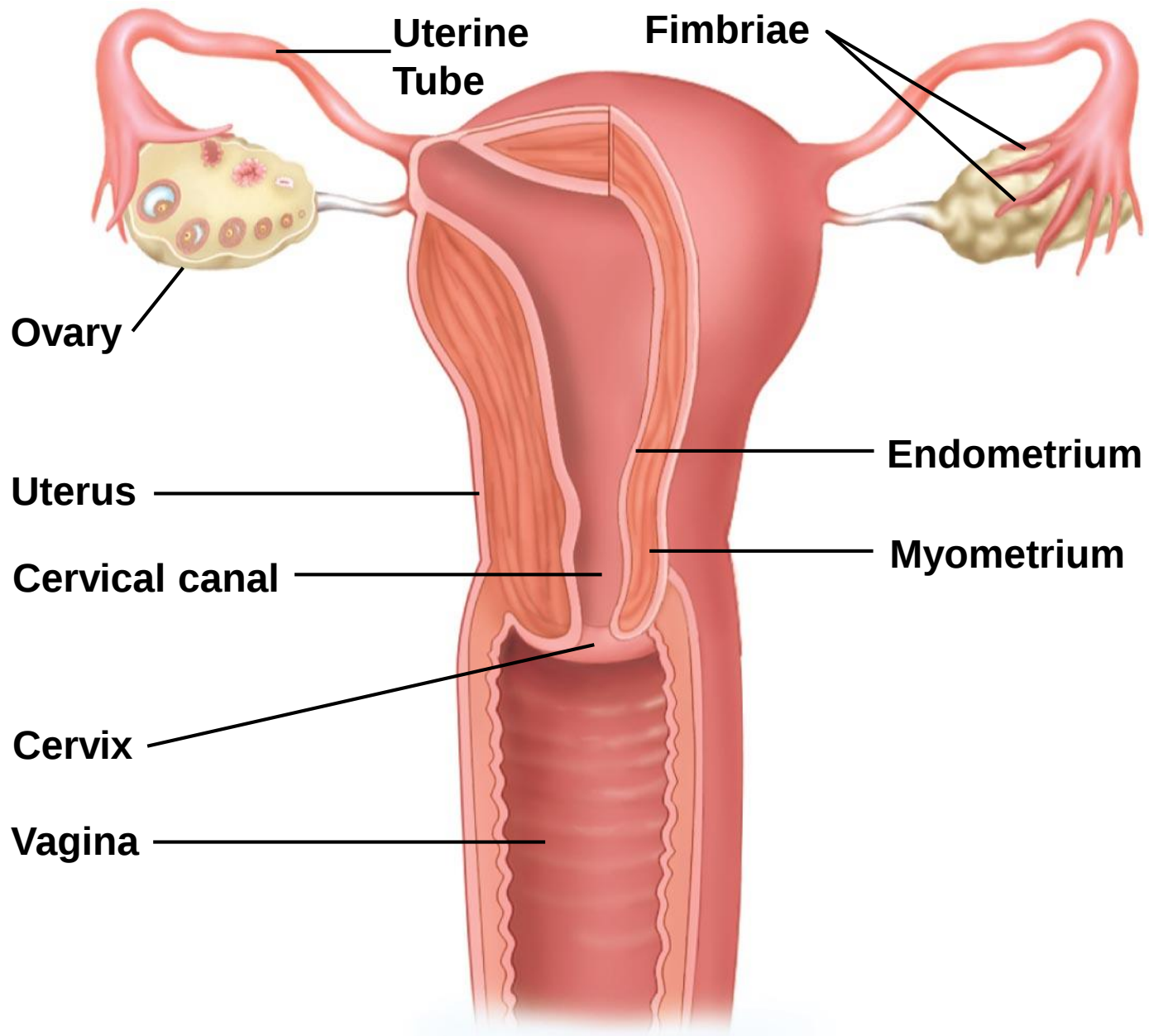
- Uterus
 - the hollow, pear-shaped organ where fertilized egg grows and develops
- Layers
 - **Endometrium**: supports fertilized egg, part of it sloughs off during menstrual flow
 - **Myometrium**: smooth muscle, expands during pregnancy, constricts during labor
 - **Cervix**: the narrow opening in the lower part of the uterus that permits sperm to enter the uterus and allows the fetus to exit during birth

Female Reproductive System Produces Eggs and Supports Pregnancy

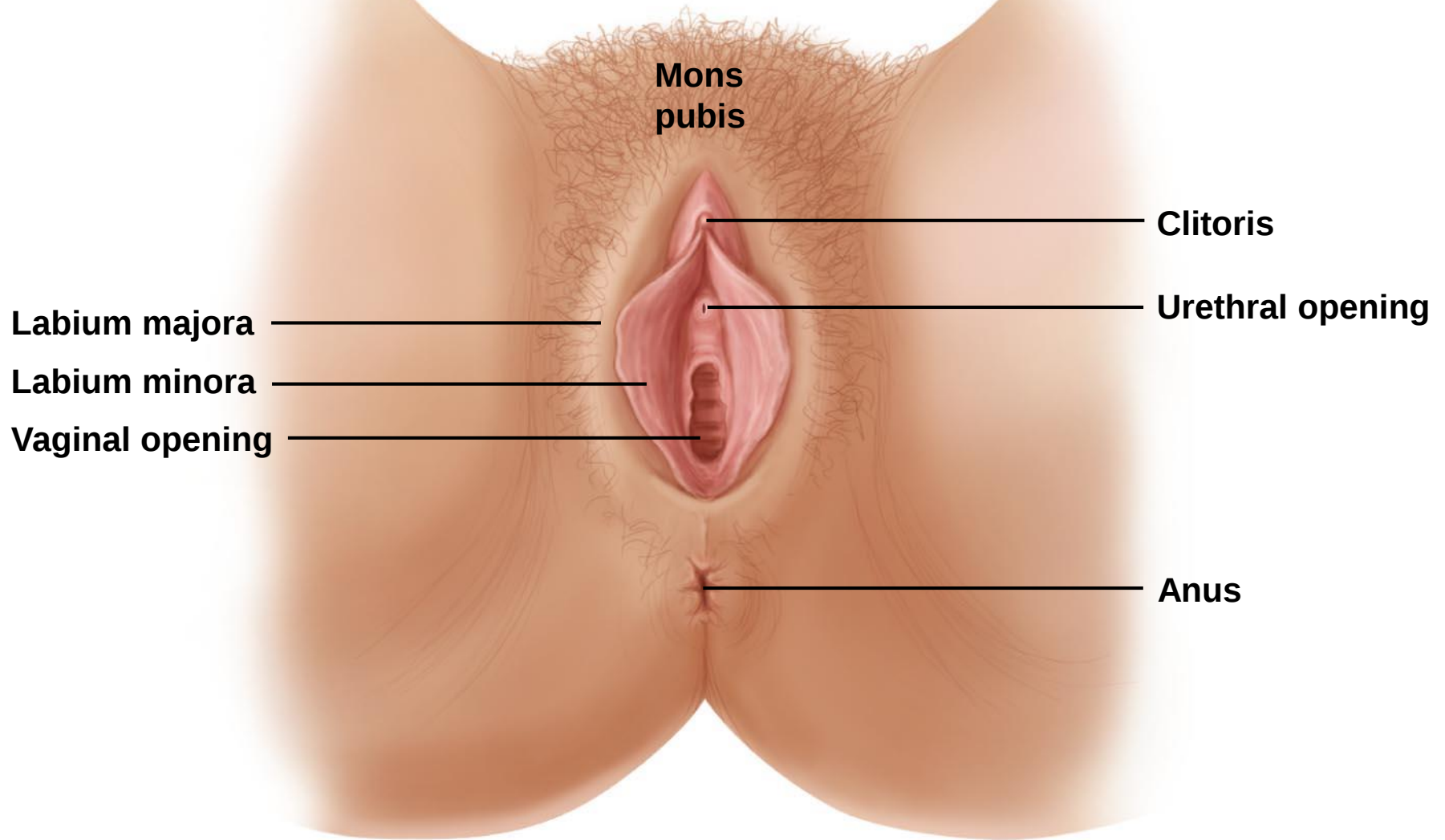
- Vagina
 - Organ of sexual intercourse and birth canal
- External genitalia
 - Labia majora and minora
 - Clitoris



a) Sagittal section showing the components of the system in relation to other structures.



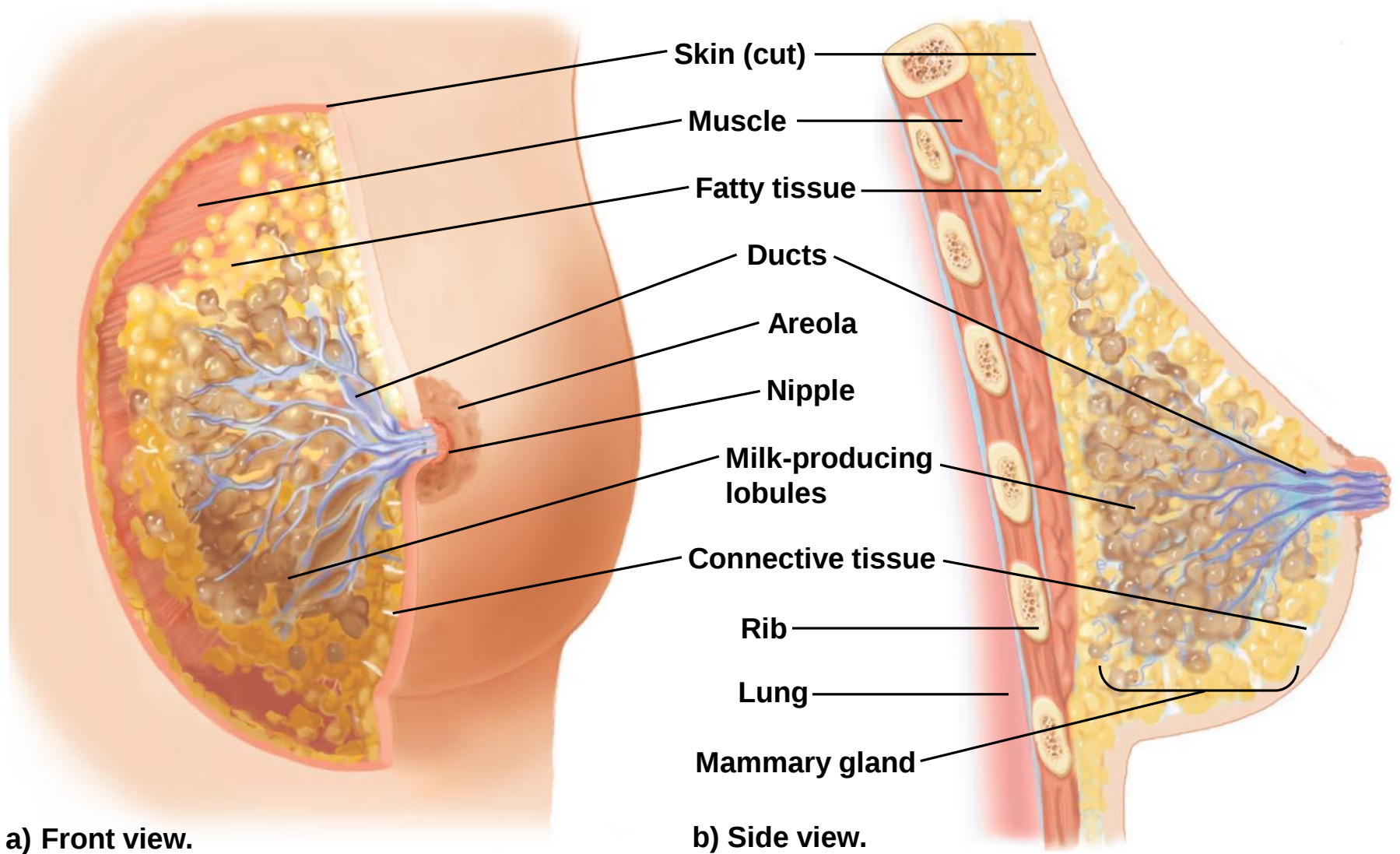
b) Anterior view of internal organs.



c) Vulva: The female external genitalia.

Mammary Glands Nourish the Infant

- Breasts contain mammary glands
- Technically, mammary glands are modified sweat glands, part of the integumentary system
- Specialized for lactation (production of milk)
- Hormonal control of lactation:
 - Prolactin (anterior pituitary hormone) – stimulates milk production
 - Oxytocin (posterior pituitary hormone) – stimulates contractions that eject milk

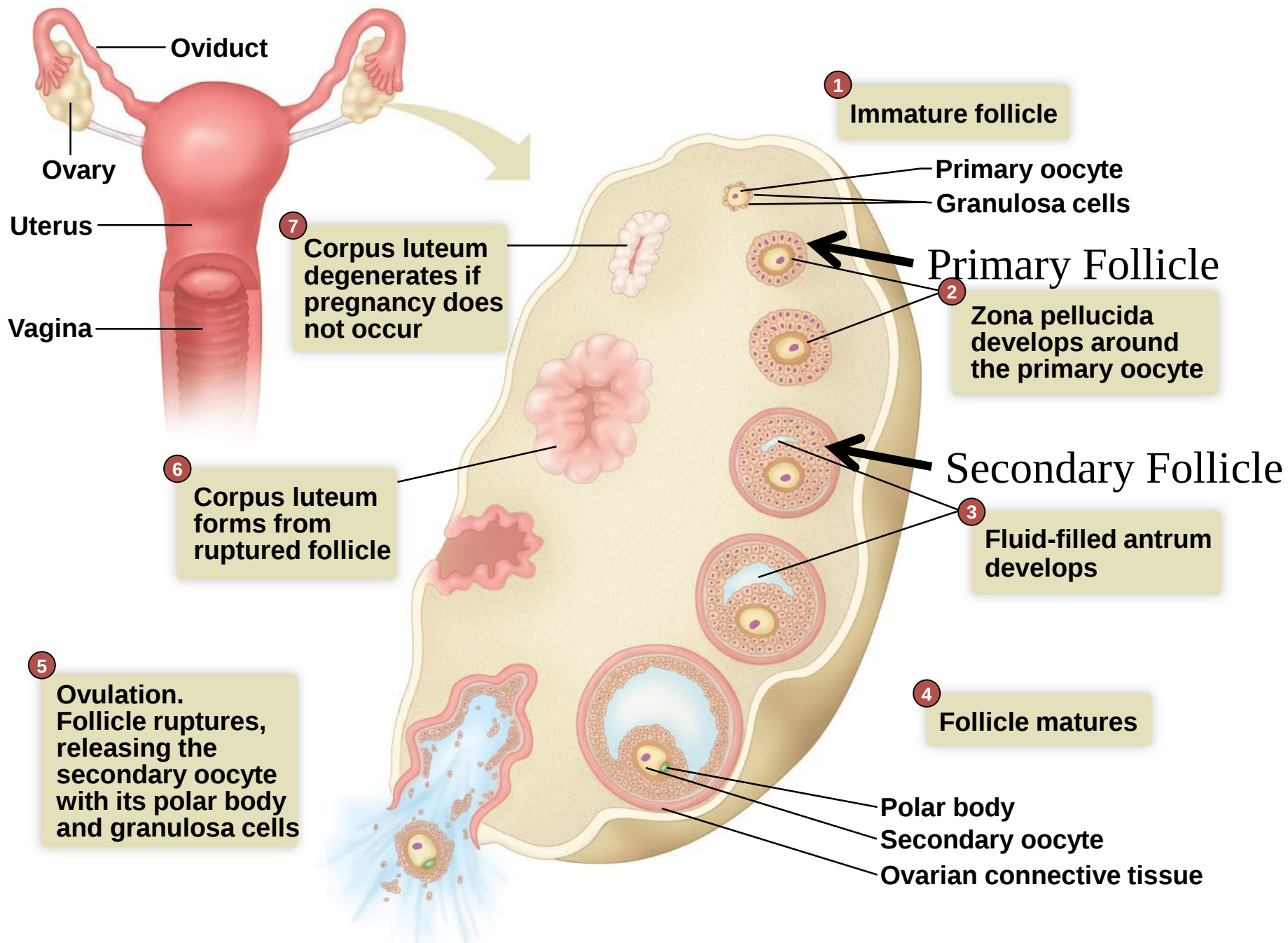


Menstrual Cycle

- Consists of two linked cycles
 - **Ovarian cycle**
 - Series of changes in ovaries associated with oocyte maturation
 - Controlled by FSH and LH
 - **Uterine cycle**
 - Changes in the endometrial lining of the uterus
 - Controlled by estrogen and progesterone

Ovarian Cycle: Oocytes Mature and are Released

- Immature follicle of primary oocyte and granulosa cell develops; FSH and LH increase
- Antrum develops within follicle; some estrogen and progesterone secreted
- Secondary oocyte and polar body produced; follicle matures (Graafian follicle)
- Increasing estrogen causes surge of LH; ovulation occurs
- Corpus luteum formed from follicle; large amounts of estrogen and progesterone secreted



Ovarian Cycle: Oocytes Mature and are Released

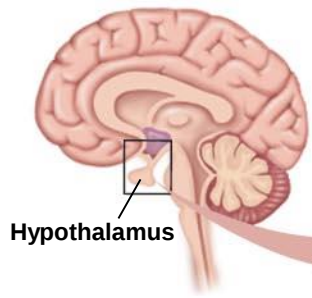
- If fertilization and pregnancy occurs
 - Chorion (embryonic tissue) secretes human chorionic gonadotropin (hCG)
 - hCG is detected by pregnancy tests
 - hCG causes corpus luteum to continue to produce estrogen and progesterone for another 9–10 weeks
 - After 9–10 weeks, the placenta takes over progesterone and estrogen production
 - High levels of estrogen and progesterone prevent ovulation during pregnancy

Uterine Cycle Prepares Uterus for Pregnancy

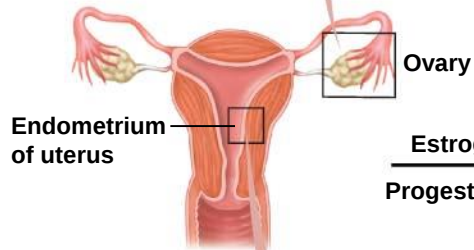
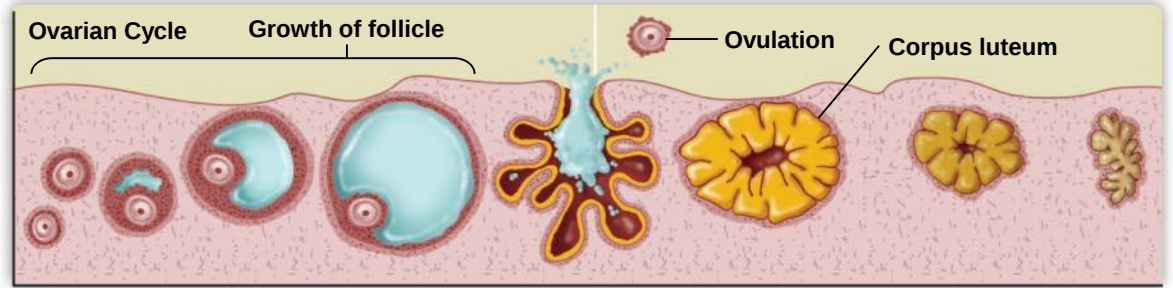
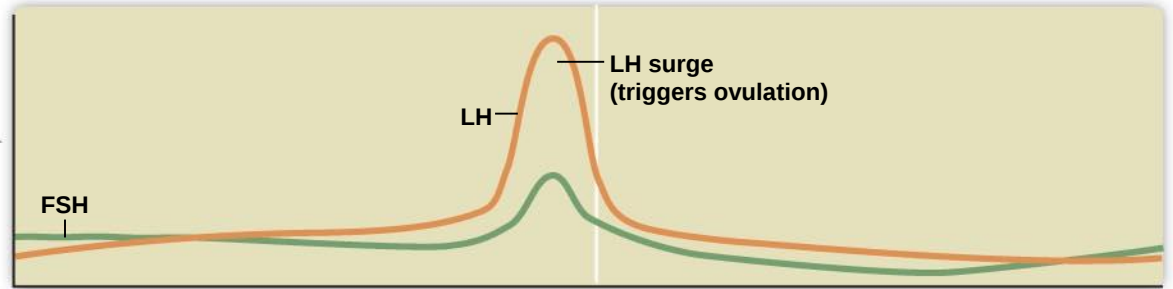
- Series of changes that occur in endometrium as it prepares for the possibility of a fertilized egg
- **Menstrual phase**
 - Days 1–5
 - Estrogen and progesterone decrease
 - Endometrial lining degenerates
 - Menstruation occurs
- **Proliferative phase**
 - Days 6–14
 - Estrogen and progesterone increase
 - Endometrial lining proliferates

Uterine Cycle Prepares Uterus for Pregnancy

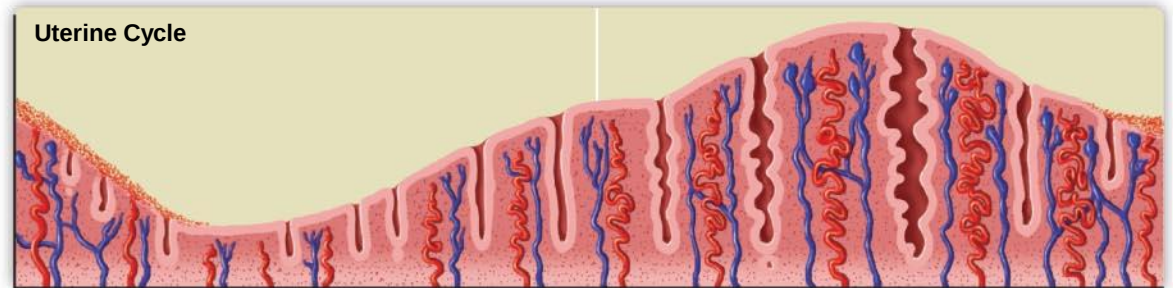
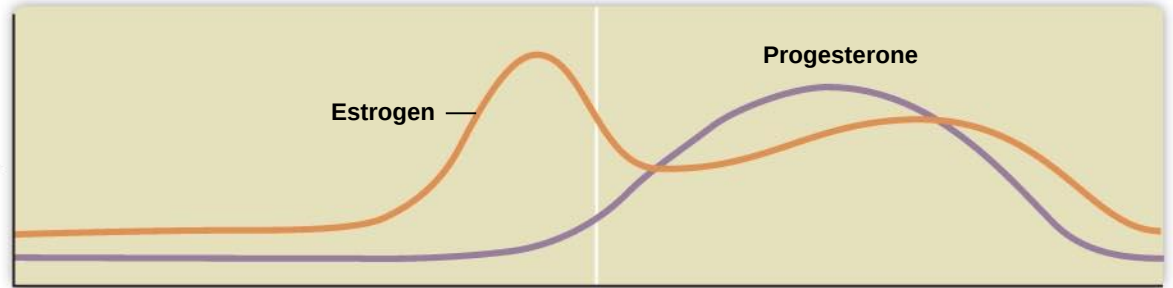
- **Ovulation**
 - Day 14
- **Secretory phase**
 - Days 15–28
 - Corpus luteum produces progesterone and estrogen
 - Endometrium continues to proliferate
 - Uterus is prepared to accept and nourish a fertilized egg



FSH
LH



Estrogen
Progesterone

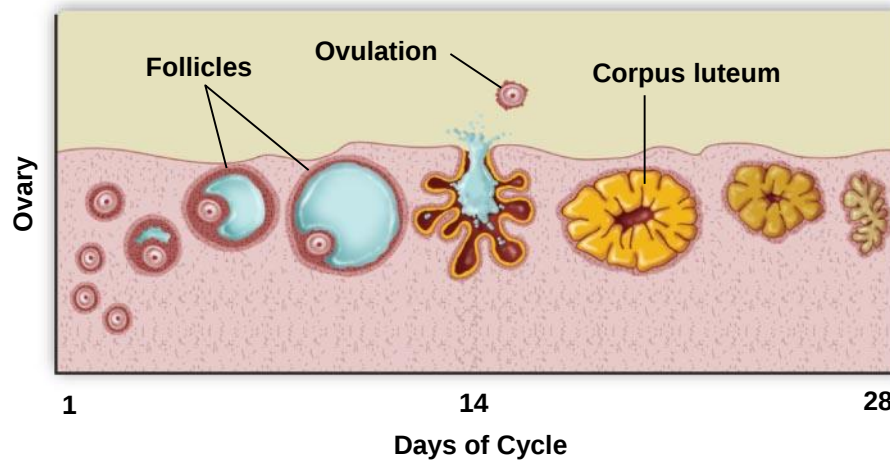
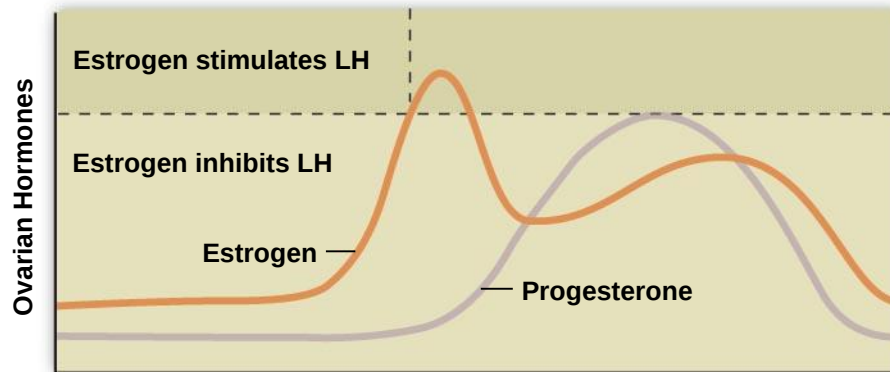
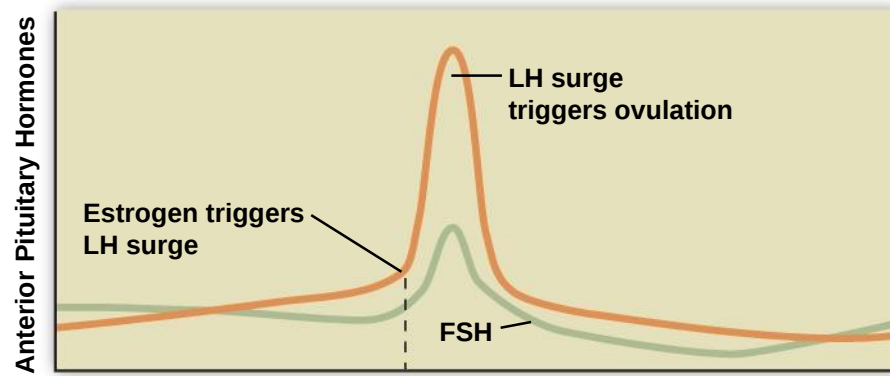


Days of one menstrual cycle (28 days, average)

1 Menstrual phase 5 Proliferative phase 14 Secretory phase 28

Cyclic Changes in Hormone Levels Produce Menstrual cycle

- Cycles of hormones
 - Positive feedback
 - Causes an event to continue
 - In proliferative phase, increasing estrogen causes surge in LH, which in turn causes ovulation
 - Negative feedback
 - Causes an event to be stopped / reversed
 - In secretory phase, steady levels of estrogen and progesterone inhibit LH and FSH release

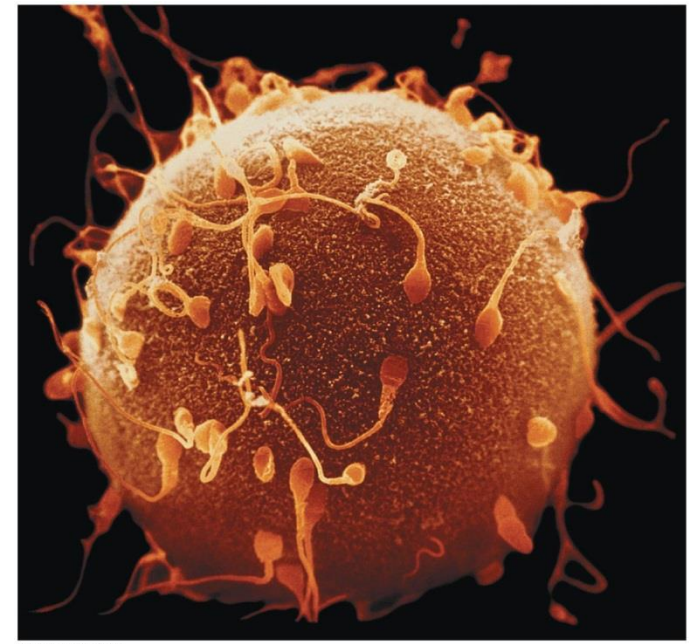


Human Sexual Response, Intercourse, and Fertilization

- Human sexual response
 - Excitement, plateau, orgasm, resolution
 - Male sexual response
 - orgasm, marked by ejaculation, refractory period
 - Female sexual response
 - orgasm, marked by rhythmic muscular contractions

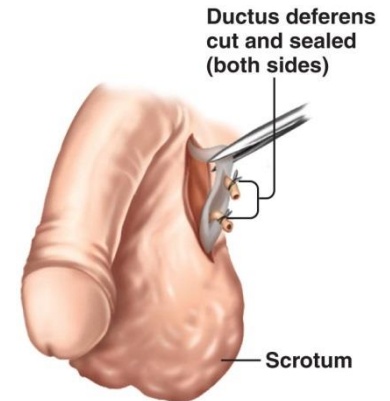
Human Sexual Response, Intercourse, and Fertilization

- Fertilization
 - Ejaculate may contain several hundred million sperm
 - One sperm penetrates egg



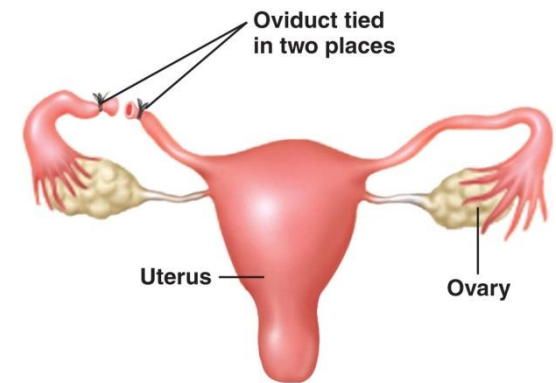
Birth Control Methods: Controlling Fertility

- Abstinence
 - not having intercourse
- Surgical sterilization
 - **Vasectomy** in males: cut and tie off both ductus deferens
 - **Tubal ligation** in females: cut and tie off both oviducts
 - **Hysteroscopy** in females: cauterize the oviducts to seal them



a) Vasectomy. Small incisions are made in the scrotum, and each ductus deferens is tied in two places and cut.

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b) Tubal ligation. An incision is made in a woman's abdominal wall, the two oviducts are located, and each is tied in two places and cut.

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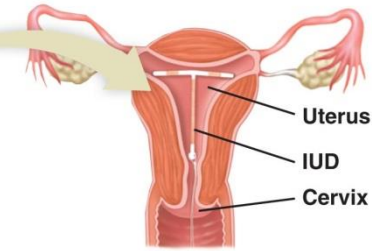
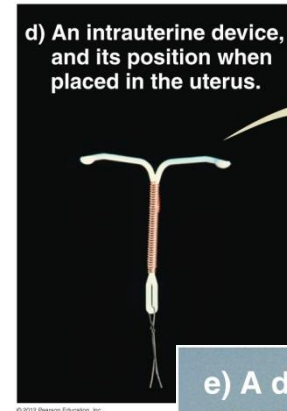
Birth Control Methods: Hormonal Methods

- Birth control pills (oral contraceptives)
 - Combination of synthetic progesterone and estrogen
 - Inhibit release of FSH and LH
 - Block ovulation
- Hormone injections
 - DepoProvera, Lunelle
- Hormone patch
 - Ortho Evra
- Vaginal ring
 - NuvaRing

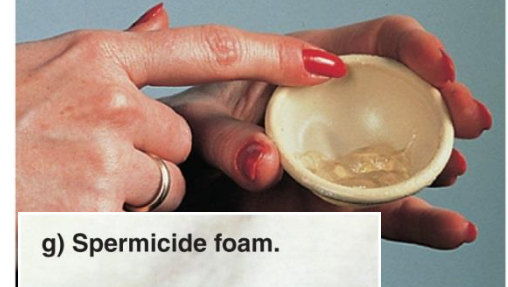


Birth Control Methods: Other

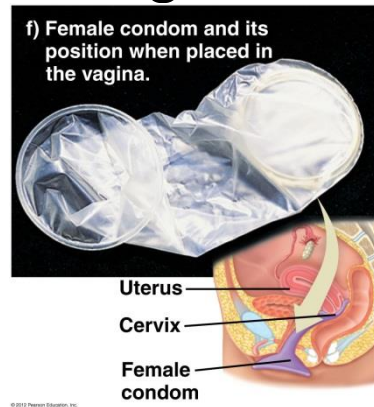
- IUDs (Intrauterine devices)
 - Small plastic or metal piece inserted into uterus
 - Create mild chronic inflammation that prevents fertilization or implantation
- Diaphragms and cervical caps
 - Prevent sperm from entering the cervix
- Chemical spermicides
 - Kill sperm cells
- Condoms
 - Trap ejaculated sperm



e) A diaphragm and spermicidal jelly.



g) Spermicide foam.



Uterus
Cervix
Female condom



Birth Control Methods: Other

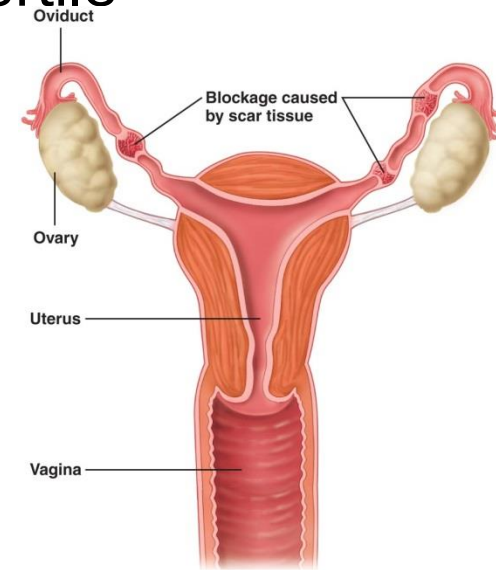
- Natural alternatives
 - Rhythm method, withdrawal
- Morning-after pills
 - Prevent pregnancy from continuing
 - Preven, Plan B, Mifeprex (RU-486)
- Abortion
 - Terminates pregnancy
- The future
 - Male birth control pill
 - Vaccines for women



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Infertility: Inability to Conceive

- Many causes of infertility
 - Number and quality of sperm
 - < 60 million/ejaculation is considered infertile
 - Pelvic inflammatory disease (PID)
 - Scarred, blocked oviducts
 - Abnormal production of FSH, LH
 - Irregular menstrual cycles
 - Endometriosis
 - Decreased reproductive capacity with age
 - Miscarriage (spontaneous abortion)



Enhancing Fertility

- Artificial insemination
- In vitro fertilization (IVF)
 - Fertilization in test tube outside of the body
- GIFT (gamete intrafallopian transfer)
 - Unfertilized eggs and sperm placed directly in oviduct

Enhancing Fertility (cont.)

- ZIFT (zygote intrafallopian transfer)
 - Fertilized egg is placed in oviduct
- Fertility-enhancing drugs
 - Boost production of developing eggs
- Surrogate motherhood

Sexually Transmitted Diseases (STDs): Worldwide Problem

- Transmitted by sexual contact, including
 - Genital, oral-genital, anal-genital
- Bacterial
 - Gonorrhea, syphilis, chlamydia
- Other
 - Yeasts (Candida), protozoan (Trichomonas), arthropod (pubic lice)



Sexually Transmitted Diseases (STDs): Worldwide Problem

- Viral
 - HIV, hepatitis B, genital herpes, HPV



a) Genital herpes on the external genitalia of the female. Genital herpes is generally caused by HSV-2.

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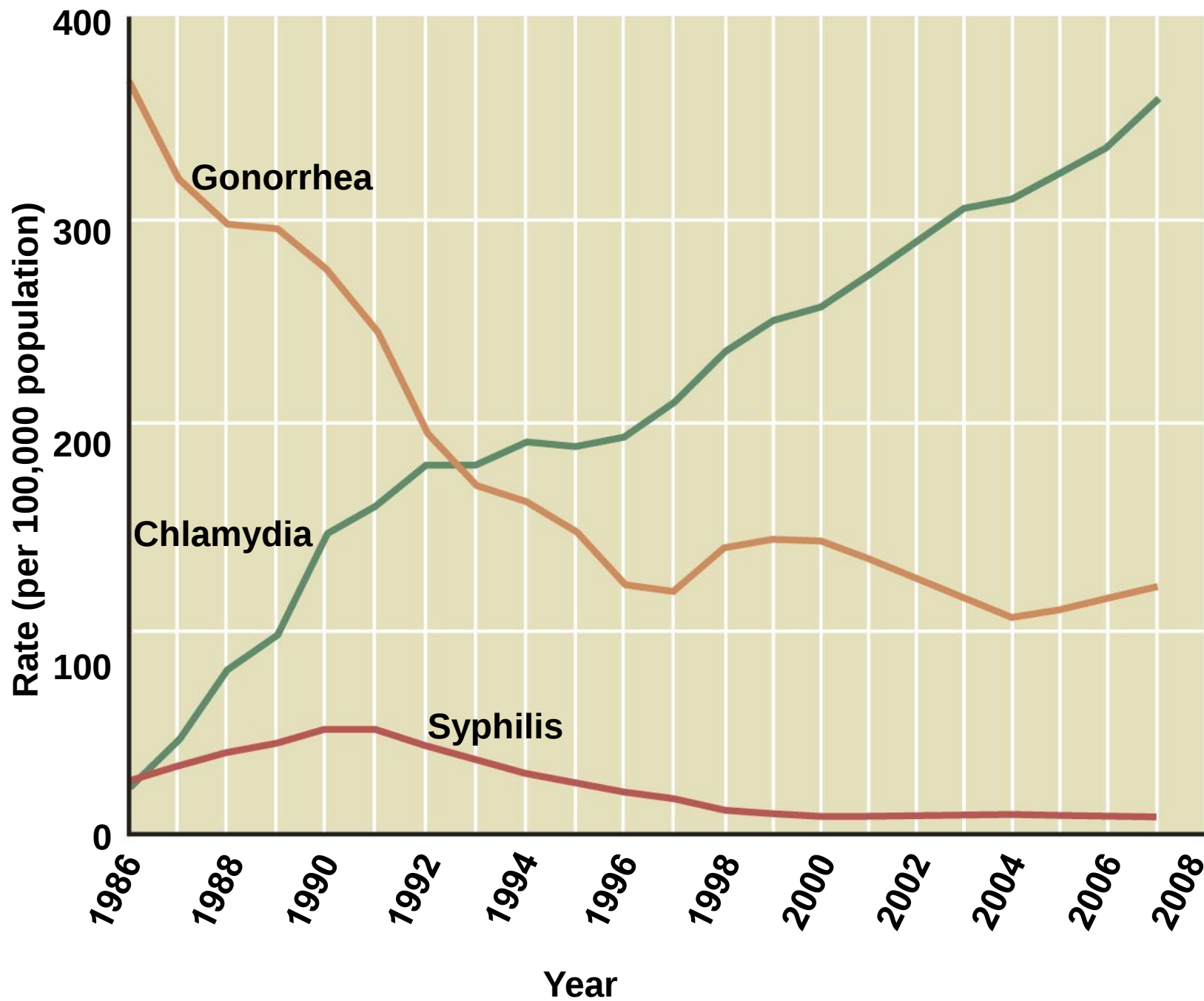
b) Genital herpes on the penis of the male.

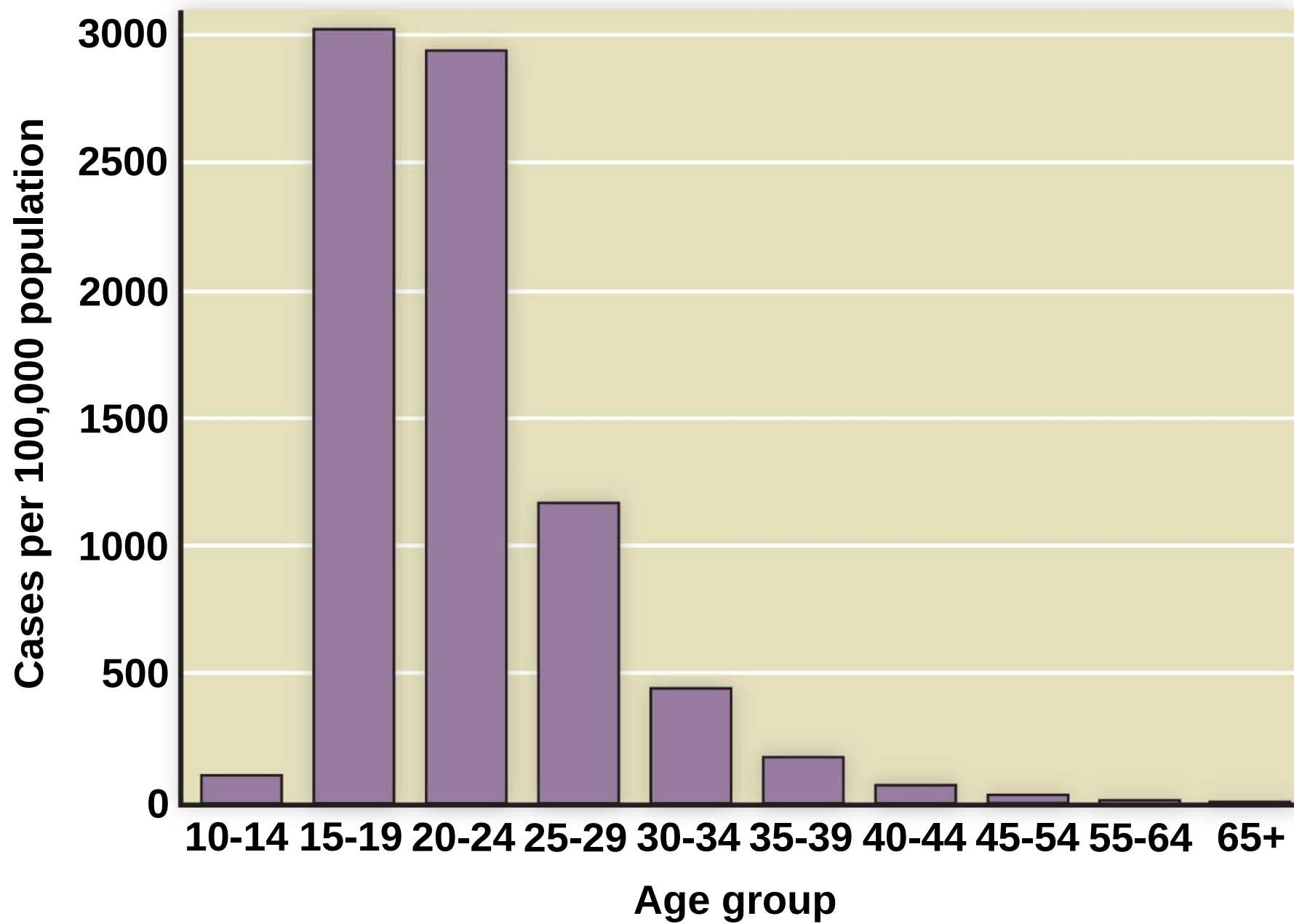
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c) Oral herpes. Cold sores on the lips (also called fever blisters) generally are caused by HSV-1.

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Sexually Transmitted Diseases (STDs): Worldwide Problem

- Prevention strategies
 - Choose partner wisely
 - Communicate
 - Use suitable barriers
 - Get tested and treated
 - Get vaccinated