Reproductive system

Premedical Biology

Reproductive System

- Primary sex organs (gonads) – **testes** in males, **ovaries** in females
- Gonads produce sex cells called **gametes** and secrete **sex hormones**
- Sex hormones – **androgens** (males), and **estrogens and progesterone** (females) The hormones are produced from the cholesterol molecule. They have a cell‘s receptor in the cytosplasm.
- Accessory reproductive organs

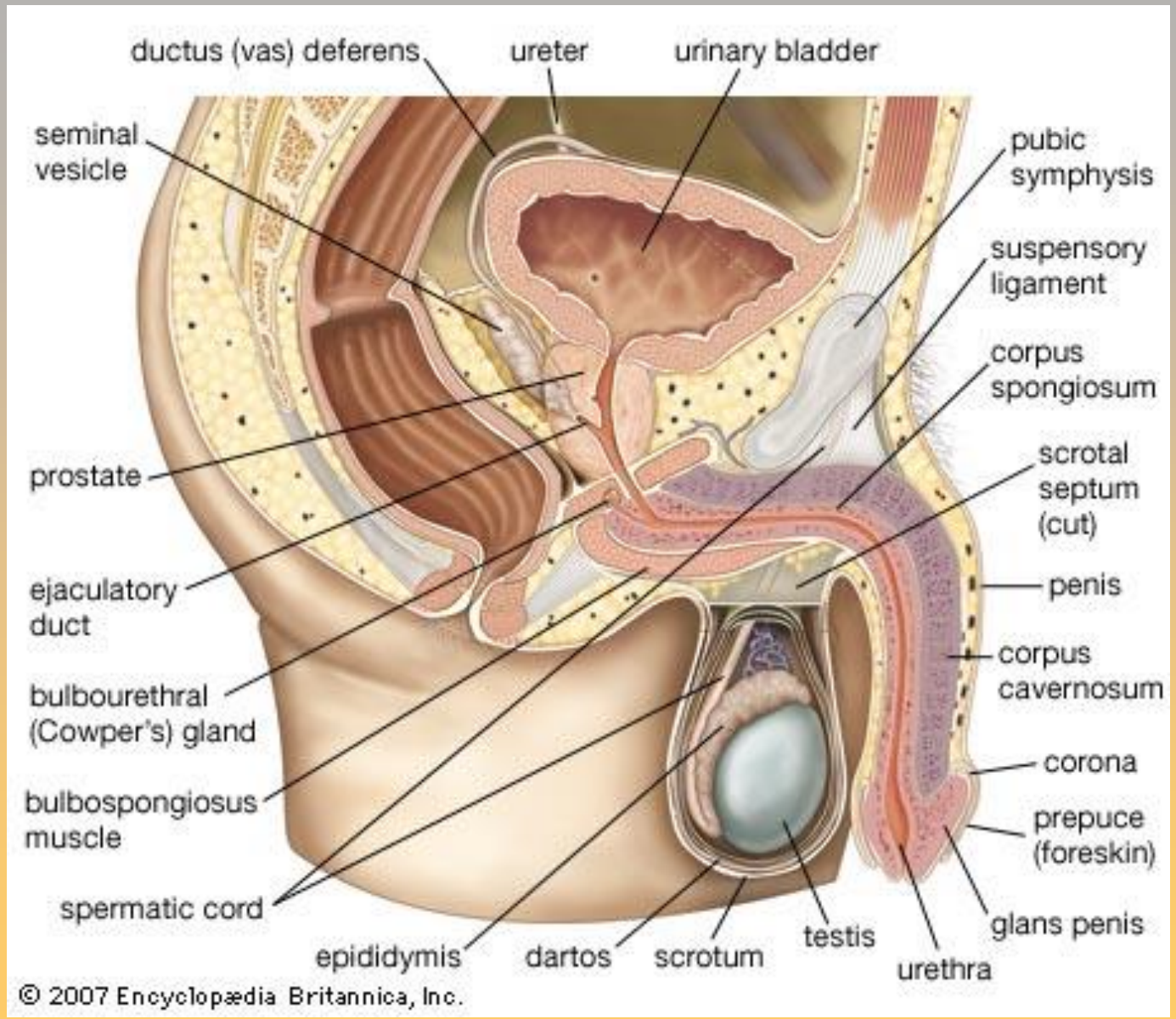
Reproductive System

- Gonads produce the hormones which are responsible for the development and function of reproductive organs and the development of gamets in meiosis and they affect many organs and tissue, for instance the skin, mucous membranes and a formation of skeletal muscles
- Sex hormones play roles in: sexual behavior

Male reproductive system

- **Testes**
- **Sperm** are delivered to the outside through a system of ducts: **epididymis, ductus deferens, ejaculatory duct and the urethra**
- **Accessory sex glands**:

  Include the **seminal vesicles, prostate gland**, and **bulbo-urethral gland**


ductus (vas) deferens
ureter
urinary bladder
seminal vesicle
pubic symphysis
suspensory ligament
corpus spongiosum
prostate
scrotal septum (cut)
ejaculatory duct
penis
corpus cavernosum
bulbourethral (Cowper's) gland
corona
bulbospongiosus muscle
prepuce (foreskin)
spermatic cord
glans penis
testis
epididymis
dartos
scrotum
urethra
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Scrotum

- Its external position keeps the testes in **3°C lower** temperature than core body temperature (needed for sperm production)

- Contains **paired testicles**

Testes/Testicles

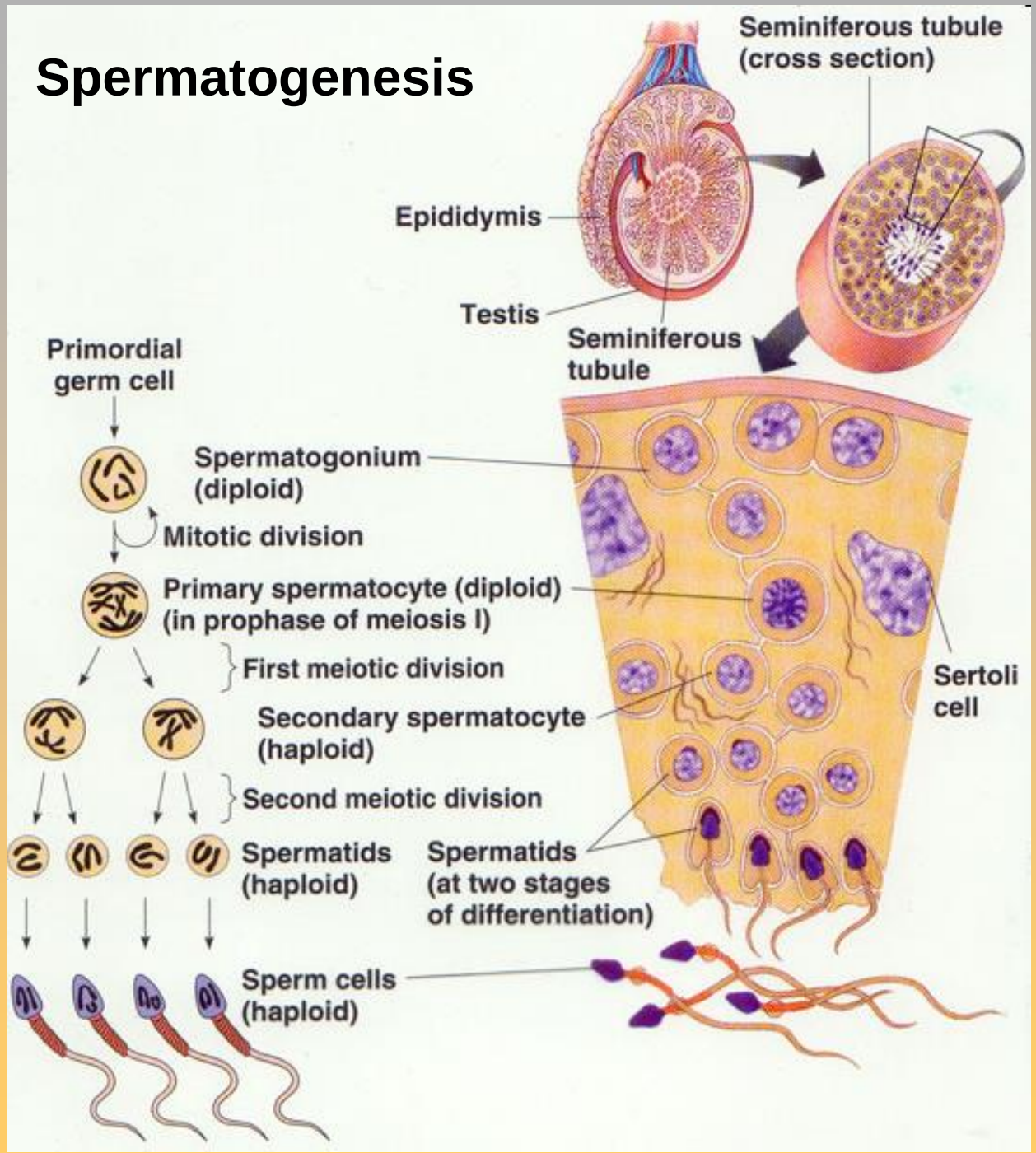
- **Seminiferous tubules:**

  interstitial tissue cells surround the seminiferous tubules

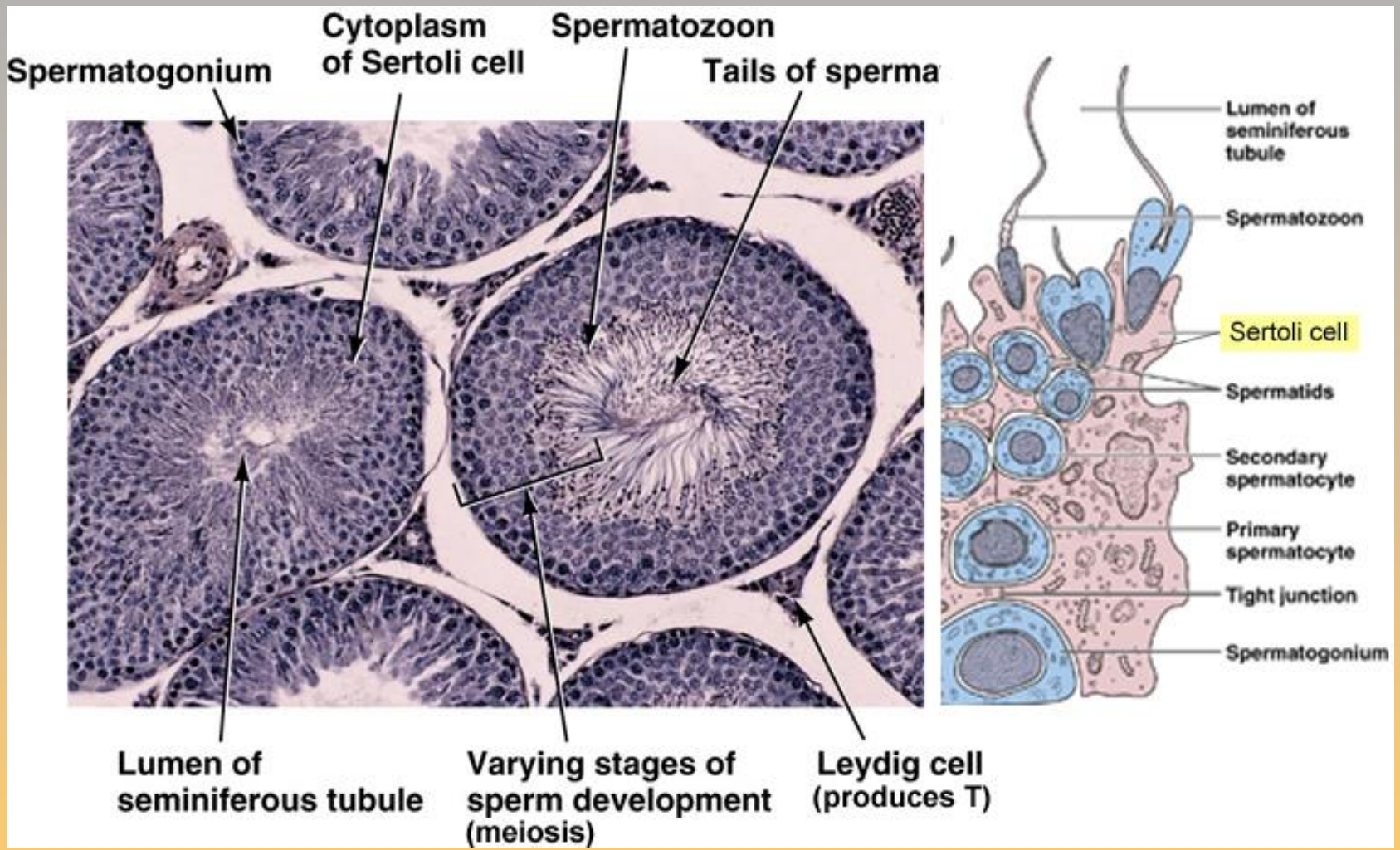
- **interstitial tissue with Leydig cells,** which produce the **male sex hormone, testosterone** in the presence of **Luteinizing hormone.** It is associated with FSH in this function.

  Gonadotropins from the anterior pituitary include the follicle-stimulating hormone (FSH), luteinizing hormone (LH), and human chorionic gonadotropin (hCG)

Spermatogenesis



Testicles



Sustentacular Cells (Sertoli Cells)

- to nurture the developing sperm cells, has also been called the **"mother" or "nurse" cell**, act as phagocytes.

http://www.colorado.edu/intphys/Class/IPHY3430-200/024reproduction.htm

Sertoli cells

- Their task is the production of a hemato-testicular barrier and the nourishment of the spermatozoa.
- Sertoli cells synthetize ca. 60 various proteins that are connected with reproduction. The most important are inhibin, androgen-binding-protein (ABP) and the antimüllerian hormone (AMH).
- The function of the supporting cells (Sertoli) is controlled by the FSH pituitary hormone (follicle-stimulating hormone).

Pituitary gland - hypophysis

Anterior pituitary – adenohypophysis

Adrenocorticotropic hormone (ACTH)

Thyroid-stimulating hormone (TSH)

Growth hormone

Prolactin

Luteinizing hormone - Lutropin

Follicle stimulating hormone

Melanocyte–stimulating hormones

These hormones are released from the anterior pituitary under the influence of the hypothalamus.

Posterior pituitary – neurohypophysis

stores and releases
Oxytocin
Antidiuretic hormone - vasopressin

Epididymis

- the superior aspect of the testis characterized by sperm reservoir and mature

Ductus deferens

- **two ducts**, connecting the left and right epididymis to the ejaculatory ducts
- collect secretions from the male accessory sex glands such as the seminal vesicles, prostate gland and the bulbo-urethral glands

Accessory Glands

secrete 60% of the volume of semen, which is viscous alkaline fluid containing **fructose, ascorbic acid, coagulating enzyme** (vesiculase), and **prostaglandins.**

Protection and activation of **sperm cells**, and facilitates their movement

Sperm and seminal fluid mix into ejaculate in the ejaculatory duct

❑ **Prostate gland** produce milky, slightly acid fluid, which contains citrate, enzymes, and prostate-specific antigen (PSA); Plays a role in the activation of sperm cells

❑ **Bulbourethral Glands** (Cowper's Glands) produce thick, clear, alkaline mucus that neutralizes traces of acidic urine in the urethra

Ejaculate

- **Prostaglandins** in semenal fluid:

  Decrease the viscosity of mucus in the cervix

  Stimulate reverse peristalsis in the uterus

  Facilitate the movement of sperm through the female reproductive tract

Ejaculation

Only **2-5 ml of semen** are ejaculated, but it contains **15 mil** sperm/ml. An ejaculatory centre is in lumbar spine segments (L2-L3). Ejaculation is controlled by sympathetic nervous system.

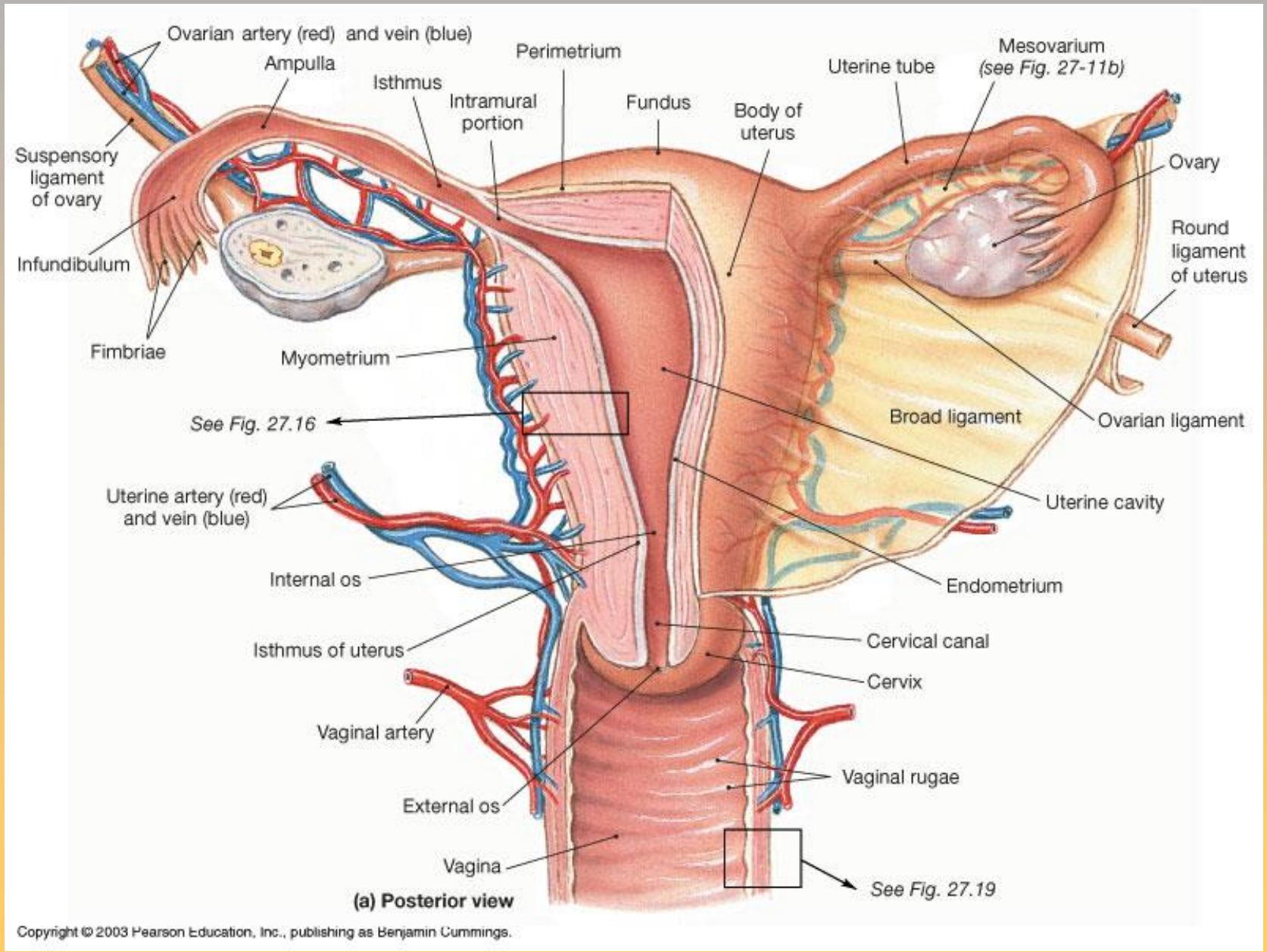
Female Reproductive Anatomy

- **Ovaries** are primary female reproductive organs
- Follicles are present in various developmental stages, but each contains **a single oocyte (germ cell) = oogenesis**
- Secrete **female sex hormones (estrogen, progesterone) = steroidogenesis**
- Accessory ducts include **fallopian tubes, uterus, and vagina,**

Internal genitalia – ovaries and the internal ducts

External genitalia – external sex organs

Female Reproductive System:



Pituitary gland

Anterior pituitary – adenohypophysis

Adrenocorticotropic hormone (ACTH)

Thyroid-stimulating hormone (TSH)

Growth hormone

Prolactin

Luteinizing hormone - Lutropin

Follicle stimulating hormone

Melanocyte–stimulating hormones

These hormones are released from the anterior pituitary under the influence of the hypothalamus.

Posterior pituitary – neurohypophysis

stores and releases
Oxytocin
Antidiuretic hormone - vasopressin

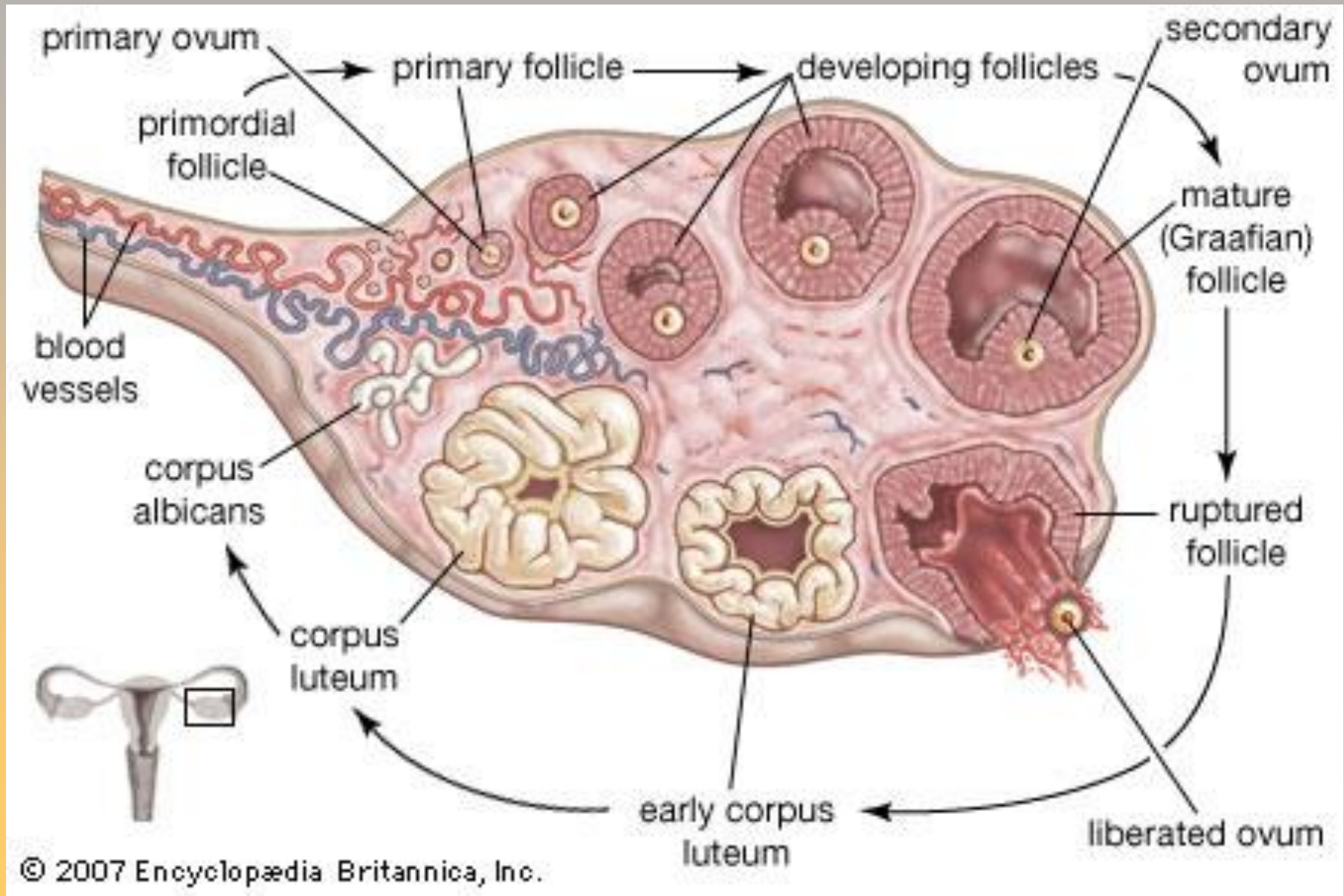
Ovaries

- Paired organs on each side of the uterus
- Embedded in the ovary cortex are **ovarian follicles**
- Each follicle consists of an **immature egg called an oocyte**
- Cells around the oocyte are called:

  Follicular cells (one thick layer of cell)

  Granulosa cells (when more than one layer is present)
- **Graafian follicle** – secondary follicle at its most mature stage that bulges from the surface of the ovary
- **Ovulation** – ejection of the oocyte from the ripening follicle
- **Corpus luteum** – ruptured follicle after Ovulation
- **Corpus albicans**

Ovaries


primary ovum
primary follicle
developing follicles
secondary ovum
primordial follicle
mature (Graafian) follicle
blood vessels
corpus albicans
ruptured follicle
corpus luteum
early corpus luteum
liberated ovum
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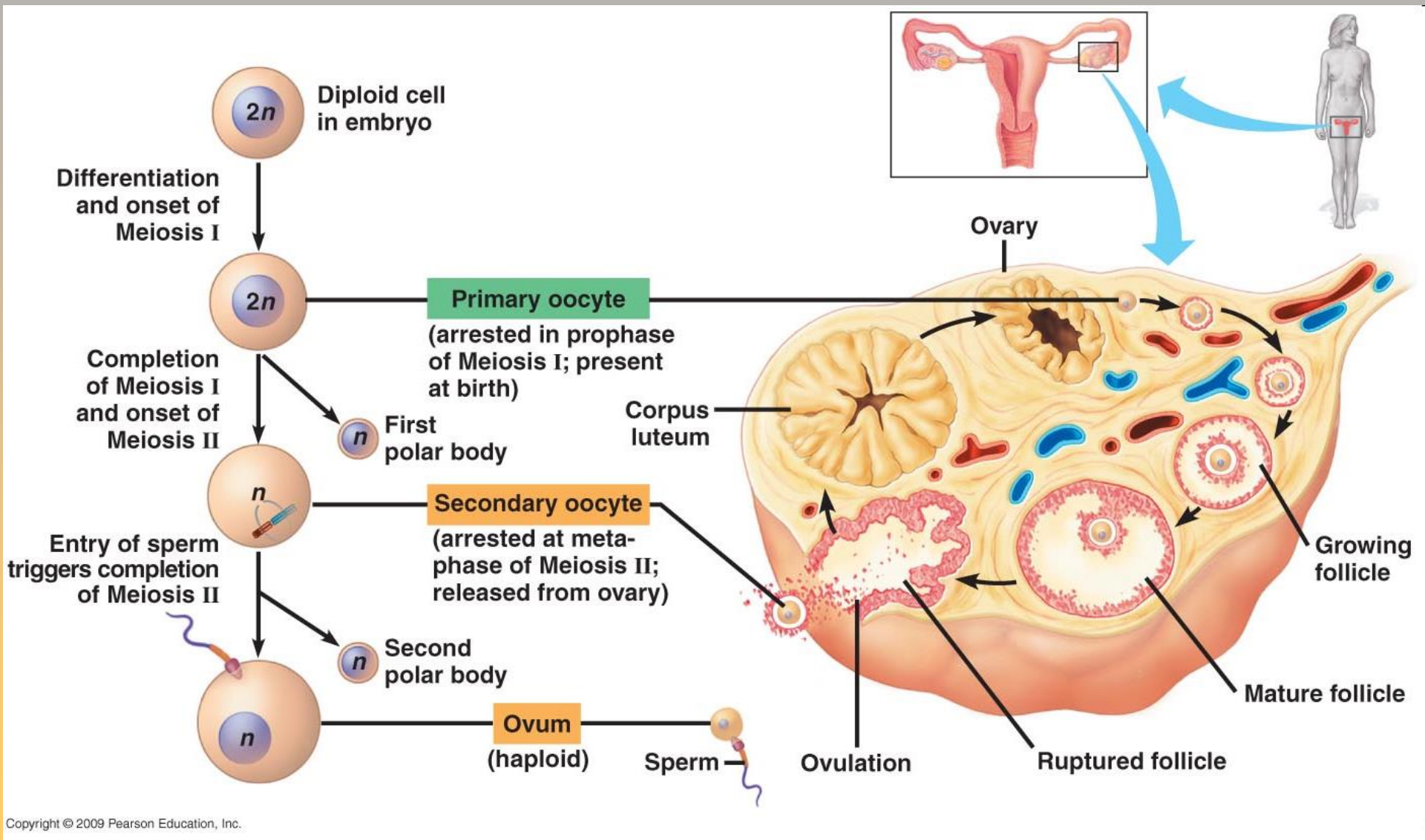
Oogenesis

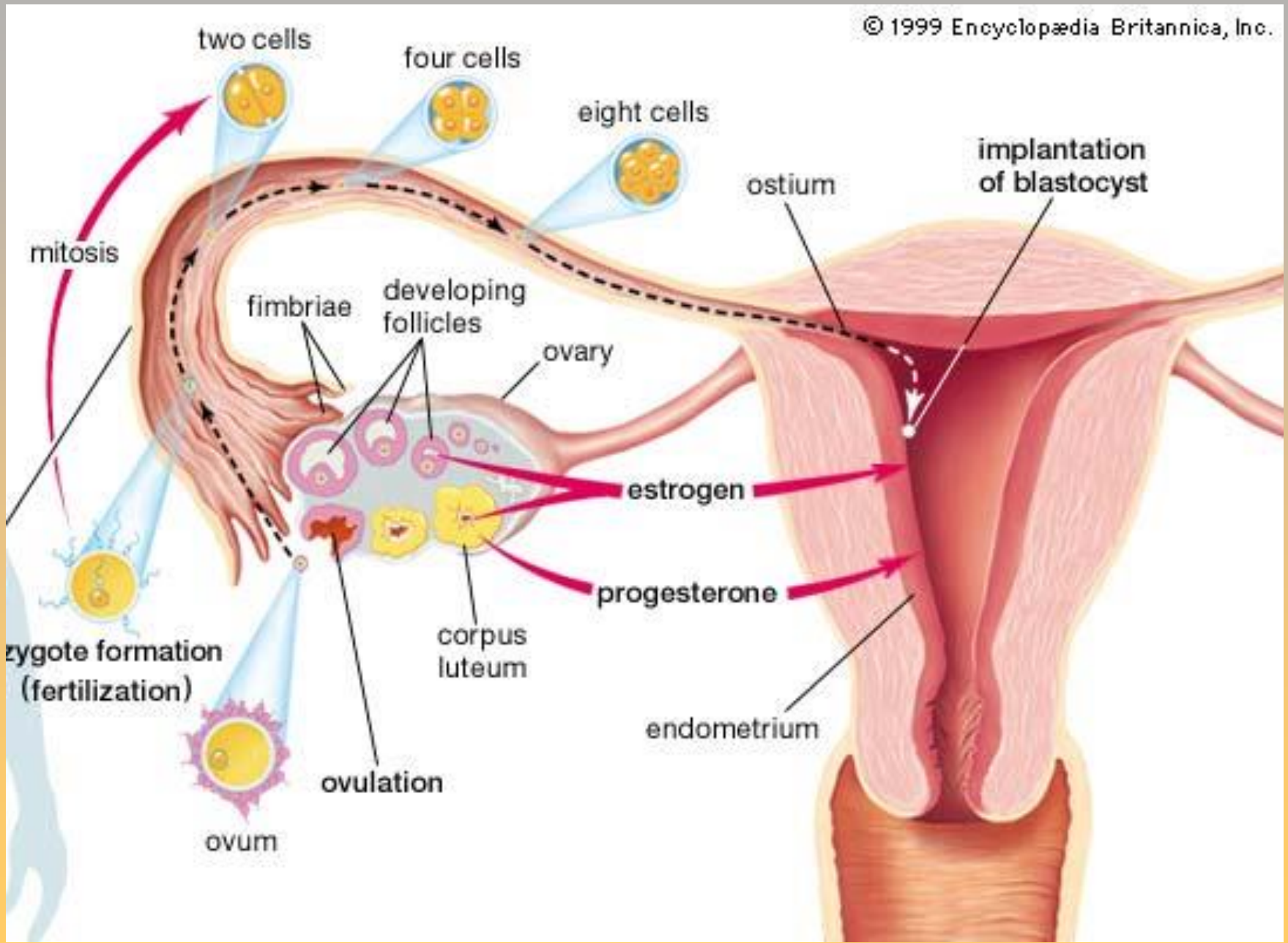


Fallopian Tubes/Oviducts

- Receive the ovulated oocyte and provide a site for fertilization. The tubes have no contact with the ovaries. The oocyte is carried alongside the uterus by **peristaltic movements and ciliary action**
- the serosa, muscle layer and mucosa – ampulla, **simple columnar epithelium with cilia**

- In the stage of blastocyst the embryo implant into wall of uterus

Oviduct and fertilization



Uterine Wall

Composed of three layers

- **Perimetrium** – outermost serous layer; the visceral peritoneum
- **Myometrium** – middle layer; interlacing layers of smooth muscle
- **Endometrium** – mucosal lining of the uterine,

Internal surface is lined by **single layer of columnar cells**

Cavity

Endometrium

- Has numerous uterine **tubular gland**s that change in length as the endometrial thickness changes. The surface is lined by simple columnar epithelium
- **Two layers: one (functionalis)** undergoes cyclic changes in response to ovarian hormones and is shed during menstruation
- **The second (basalis)** does not respond to ovarian hormones

  Degeneration and regeneration of spiral **arteries** causes the functionalis to shed during menstruation – two system of arteries

Uterus - cervix

- In cervix is a changing area of two epithelia: **single layer of columnar cells** and **squamous stratified cells.** In the place of junction very often occurs **Cervical cancer** with influence of **Human papillomavirus (HPV)** infection
- **Mucous glands** – cervical glands

Vagina

- Vaginal portion of the cervix is lined by nonkeratinized stratified squamous epithelium.
- Provides a passageway for birth, menstrual flow
- **Stratied squamous epithelium** - mucosa

Uterine glands produce

"infertile" mucus, it is thick (dense) and acidic. This mucus blocks sperm and bacteria from entering the uterus.

For several days around the time of ovulation, **"fertile" type of mucus** is produced. It is less viscous and more watery. It has a higher water content, are less acidic, and helps guide sperma through the cervix.

Methods for a thinning of the mucus may help to achieve pregnancy

Menstrual cycle

(B) ovarian and

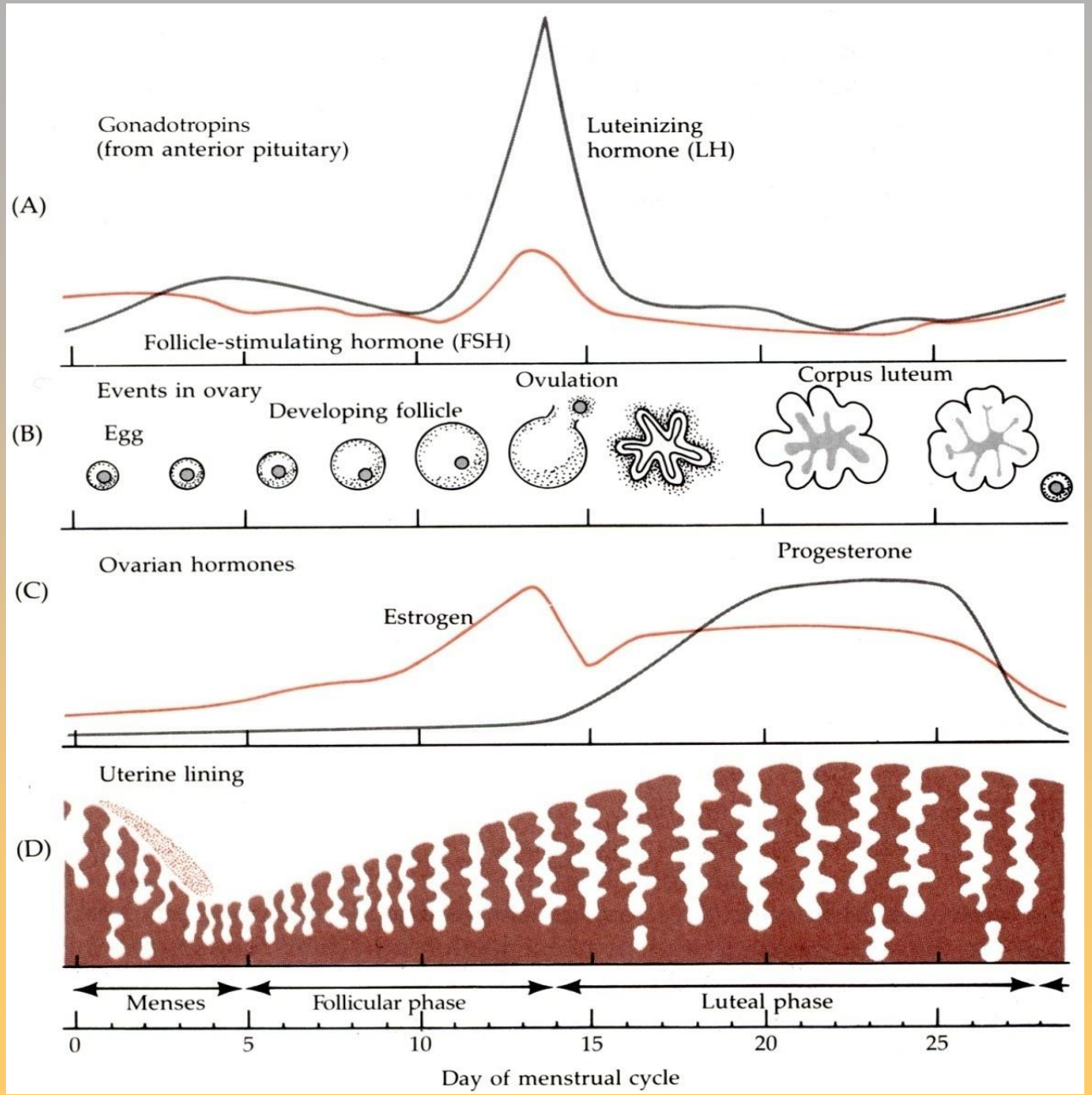
(D) uterine cycles

is controlled by

(A) the pituitary

and

(**C) the ovarian hormones**



Ovarian and uterine cycle is controlled by pituitary and ovarian hormones

Menses

Folicular and Proliferative phase – the egg matures within the follicle and uterine is getting prepared receive the blastocyst

The mature egg is released around **12 - 14 day - ovulation.**

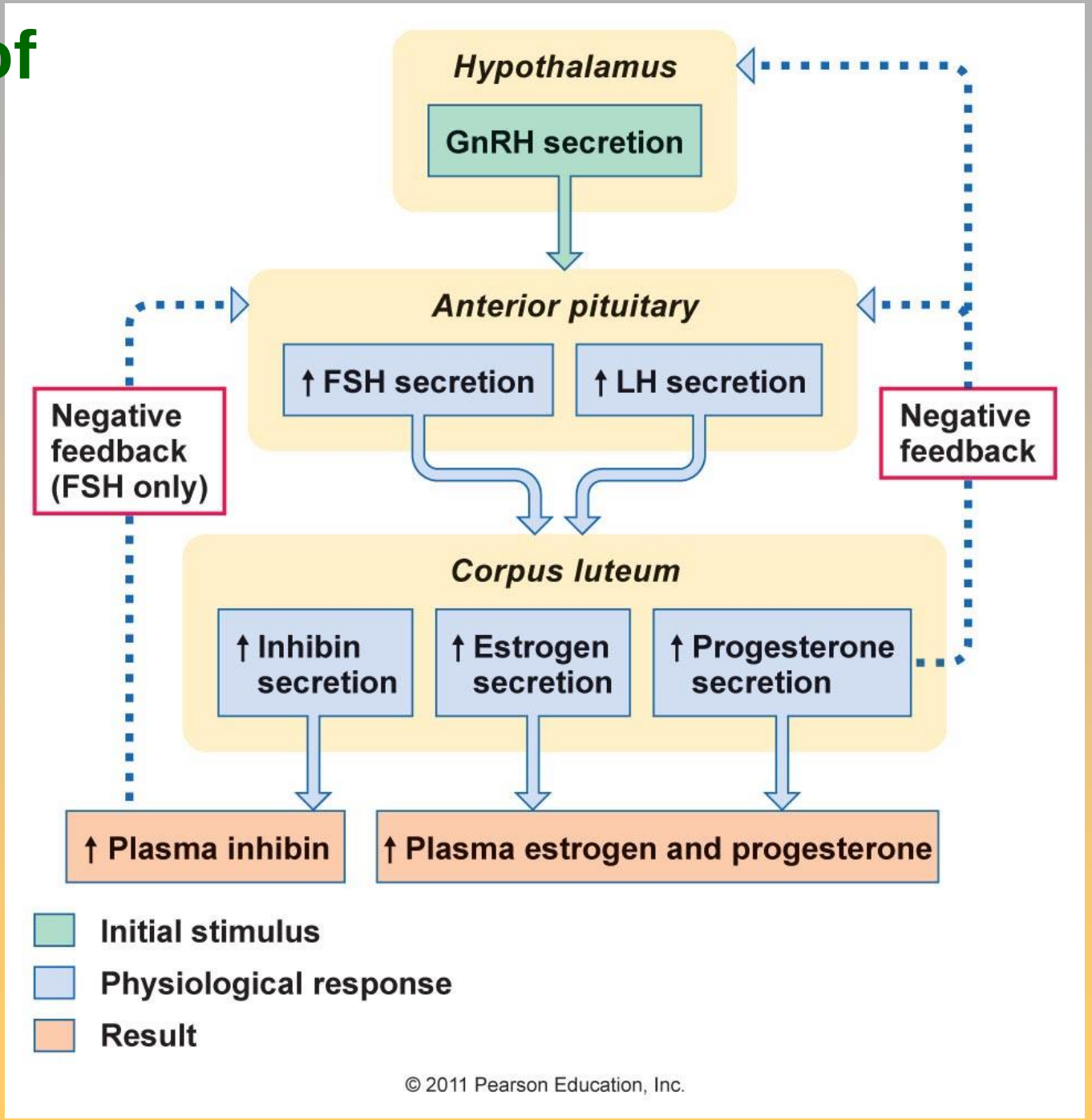
Luteal and Secretory phase – corpus luteum produces progesterone. Uterine is prepared receive the blastocyst. If the blastocyst does not implant in the uterus, the uterine wall begins to break down, leading to menstruation. And corpus luteum degenerates and on it‘s place remains tiny scar.

Estrogen – for growth and maturation of sex organs, for the developing of female sex characteristics and the development of mammary gland

Progesterone – prepare the internal sex organs for pregnancy and prepare the mammary gland for lactation.

Regulation of hormone‘s production

Levels of progesteron affect the production of hormones in hypothalamus.



External Genitalia:

Vulva (Pudendum)

Lies external to the vagina and includes the **mons pubis, labia, clitoris, and vestibular** structures

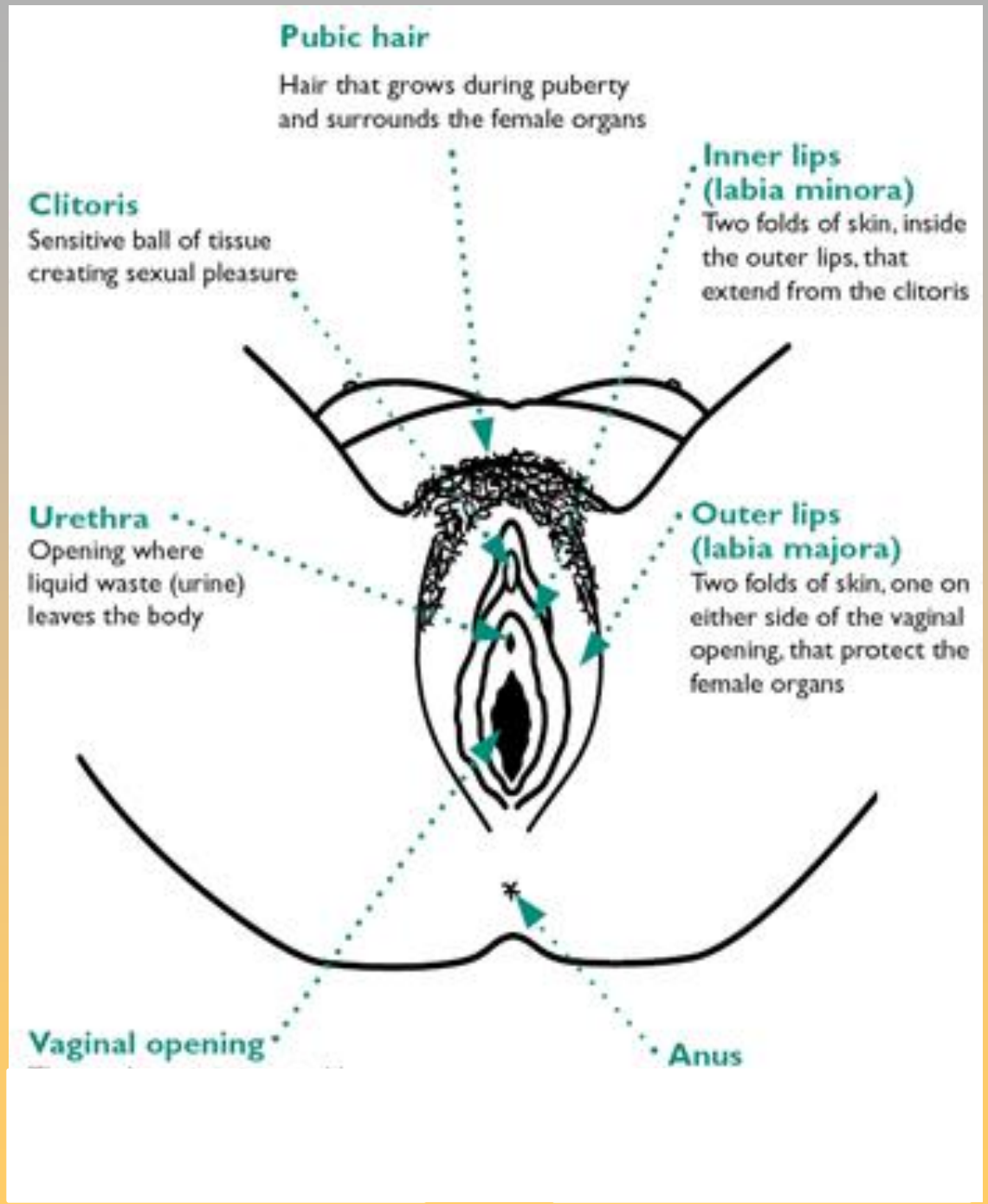
Labia majora – elongated, hair-covered, fatty skin folds homologous to the male scrotum

Labia minora – hair-free skin folds lying within the labia majora; homologous to the ventral penis

Clitoris (homologous to the penis)

Erectile tissue

Perineum diamond-shaped region between the pubic arch and coccyx


Pubic hair
Hair that grows during puberty and surrounds the female organs
Clitoris
Sensitive ball of tissue creating sexual pleasure
Inner lips (labia minora)
Two folds of skin, inside the outer lips, that extend from the clitoris
Urethra
Opening where liquid waste (urine) leaves the body
Outer lips (labia majora)
Two folds of skin, one on either side of the vaginal opening, that protect the female organs
Vaginal opening
Anus

Thank you for your attention

Campbell, Neil A., Reece, Jane B., Cain Michael L., Jackson, Robert B., Minorsky, Peter V.**, Biology**, Benjamin-Cummings Publishing Company, 1996 –2010.