

Animal physiology

Endocrinology

MSc.Students

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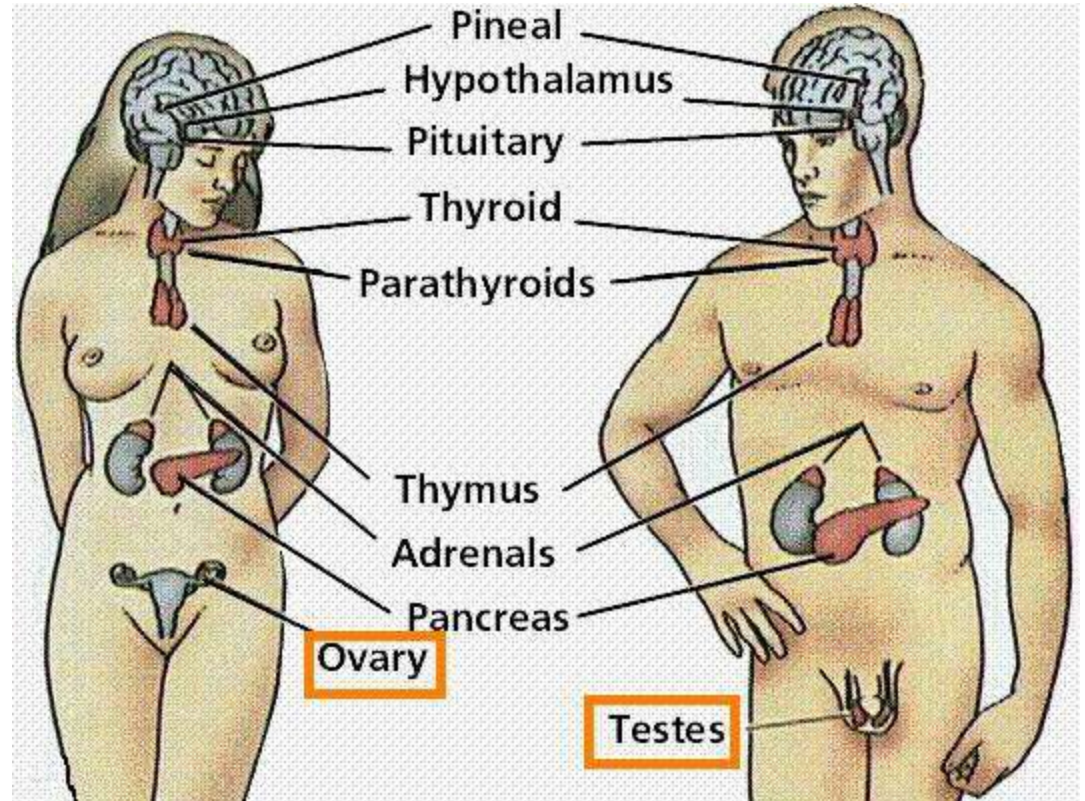
Gonads

Gonads =

Androgens (testosterone)

Estrogens (estradiol)

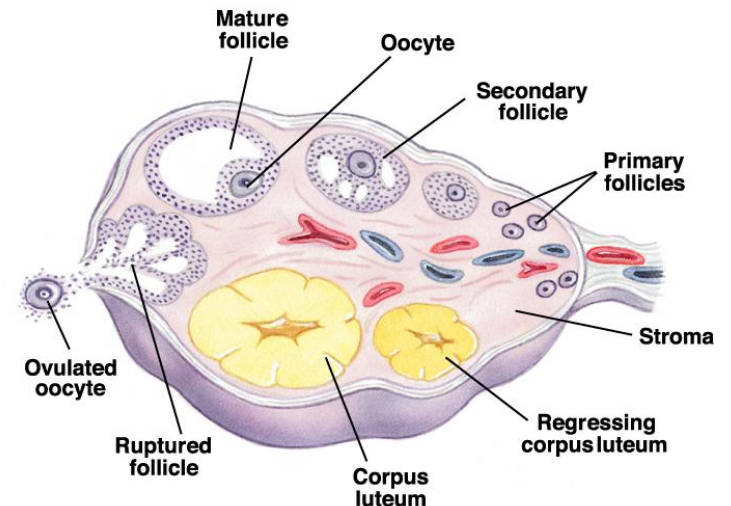
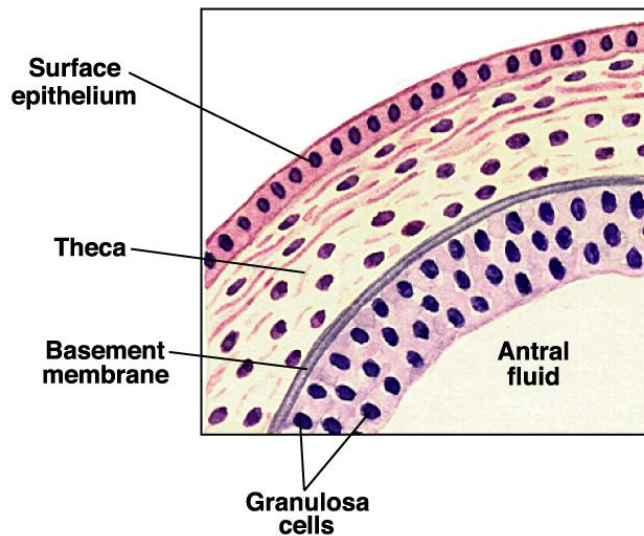
Progestins (progesterone)



Ovary Characteristics

▶ Ovaries

- Contain germinal cells
- Contain endocrine producing cells
 - Thecal
 - Granulosa
- Determine secondary structures and sexual characteristics

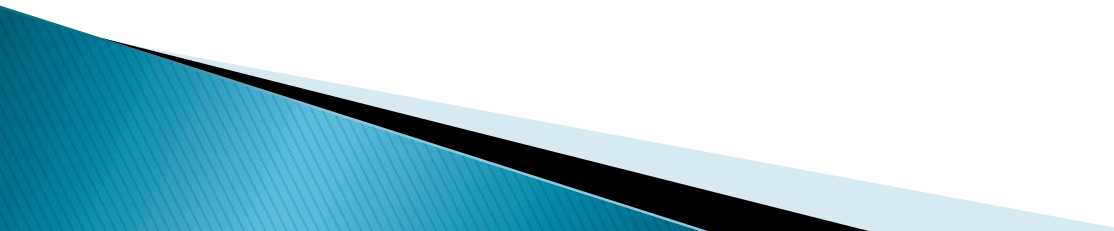


Female

▶ Ovaries

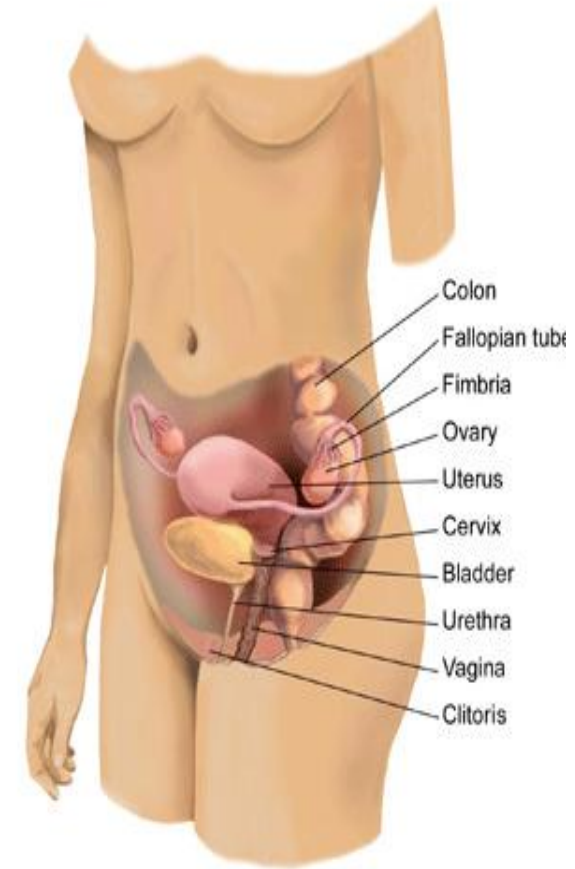
- Stimulated by follicle-stimulating hormone (FSH) and luteinizing hormone
- Synthesize and secrete estrogen and progesterone

Sex Hormones

- ▶ Endocrine glands: control development and function of the human reproductive system
 - ▶ Female: ovaries, fallopian tubes, uterus, and vagina
 - ▶ Male: testes, penis, seminal vesicles, prostate gland, and bulbourethral glands
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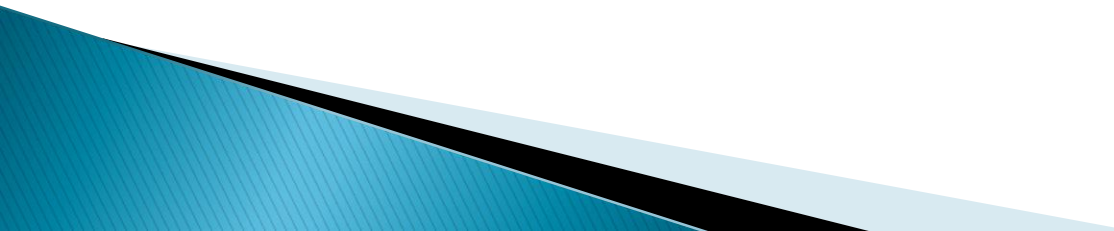
- ▶ The ovaries produce several estrogen hormones and progesterone. These hormones prepare the uterus for pregnancy, promote the development of mammary glands, play a role in sex drive, and develop secondary sex characteristics in the female

The Female Reproductive System

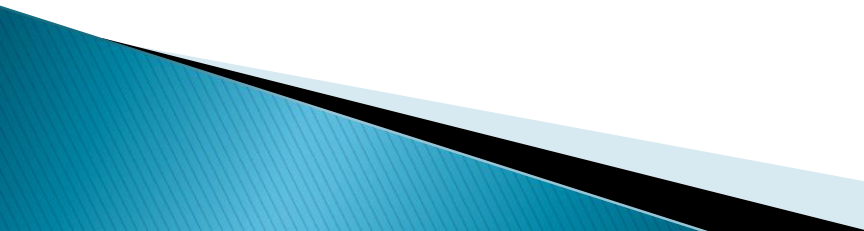


Estrogen is essential for the growth, development, and maintenance of female sex organs.

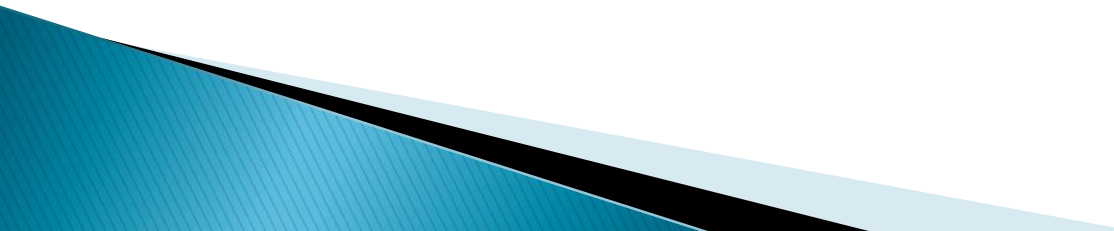
Estrogen and Progesterone

- ▶ Regulate the development and maintenance of the female reproductive system
 - ▶ Secondary sex characteristics
 - ▶ Cycling of FSH and estrogen influences the female menstrual cycle
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Estrogen receptor activity

- ▶ Two estrogen receptors (ERs): ER- α and ER- β
 - ▶ Both are present in the ovary, CNS & many other tissues
 - ▶ Estrogen has many complex beneficial and deleterious effects on the body
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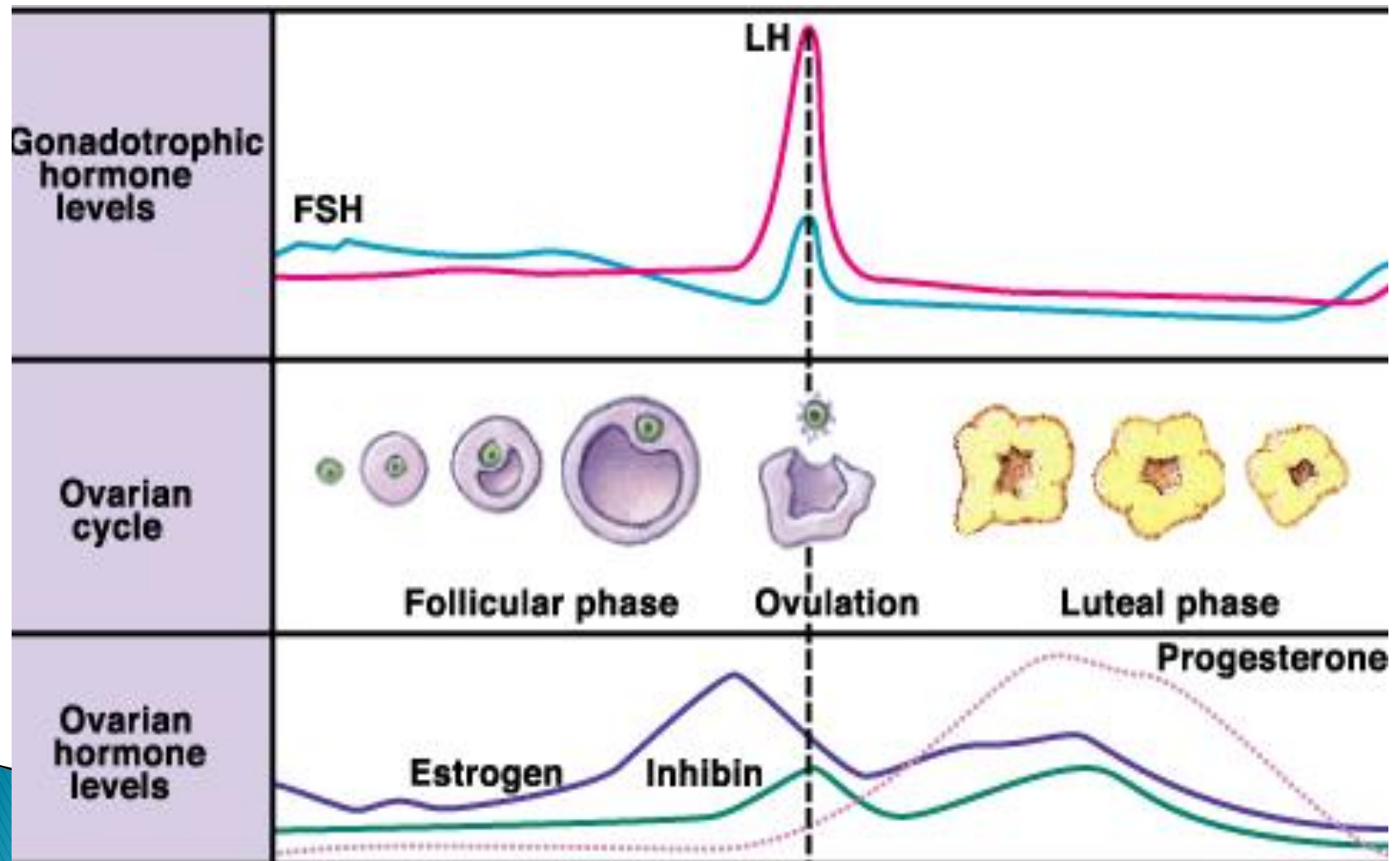
Adverse Effects of Estrogen

- ▶ Nausea
 - ▶ Vomiting
 - ▶ Breast swelling
 - ▶ Fluid retention
 - ▶ Weight gain
 - ▶ Thromboembolic disease
 - ▶ High blood pressure
 - ▶ Breast cancer
 - ▶ Uterine cancer
 - ▶ Cervical cancer
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Progesterone

- ▶ Secreted last 2 weeks of the menstrual cycle
 - Uterine lining begins secretory phase
- ▶ Essential for maintenance and integrity of the placenta and the embryo
- ▶ Adverse effects
 - Nausea, fever, weight gain, headache, dizziness, and diminished sex drive

Normal Female Hormone Patterns



Hormonal Changes From Aging

▶ Gonadotropins:

◦ LH

- Change to pulsatile pattern: ↑Duration, ↓Frequency

◦ FSH

- “Monotropic FSH ↑
- 1st Noticed prior to any change in cycle length

▶ Ovarian Steroidal Hormones

- Estrone levels ↑ early in the cycle in older ovulatory women

- Possible due to LH/FSH alterations

- Eventually, H–P–G axis is unable to generate LH surge needed for ovulation

Ovarian Structural Changes

- ▶ Abnormalities in Older Oocyte
 - Change in microtubule and chromosome placement at the second metaphase of meiosis
 - May be linked to increased aneuploidy seen in offspring of older women
- ▶ Declining Follicular Reserve
 - 2 Million Primordial Follicles during fetal development
 - Declines to 1 million at birth and 250,000 by puberty
 - Primordial Follicles develop to primary and secondary follicles independent of hormone status
 - In the absence of LH/FSH, follicles undergo atresia
 - Once follicles are depleted, ovarian hormone production declines

What is menopause

- ▶ *Menopause is a normal, natural event, defined as the final menstrual period (FMP), confirmed after 1 year of no menstrual bleeding*
- ▶ *Represents the permanent cessation of menses resulting from loss of ovarian follicular function, usually due to aging*

When is menopause

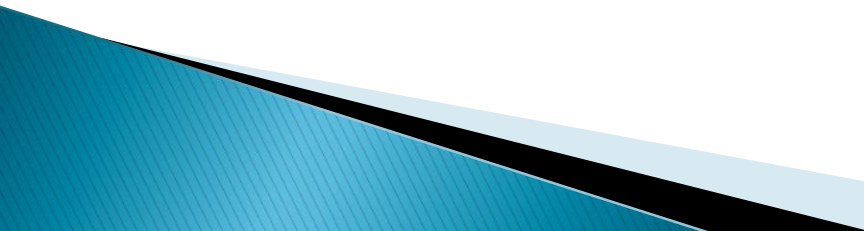
- Naturally (spontaneously) average age 51
- Prematurely from medical intervention (eg, bilateral oophorectomy, chemotherapy) at any time from impaired ovarian function

Menopause Symptoms

▶ Hot Flashes

- Most common reported symptom
- 70–80 % of women report signs of hot flashes
- This rate increases in women with oophorectomy and thin women that smoke
- Asian women have much lower rate
 - 10–25 % Reported
 - Possibly due to genetics, diet, lack of reporting

Physiological Characteristics of Hot Flashes

- ▶ Sweating
 - ▶ Increased Skin Conductance
 - ▶ Increased Core Body Temperature
 - ▶ Increased Metabolic Rate
 - ▶ Increased Skin Temperature
 - ▶ Hot flashes appear to be the result of noradrenergic control independent of estrogen regulation
 - ERT alleviates the symptoms of hot flashes
 - Adrenergic receptor agonists also show promise for treatment
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Effects on Non-Reproductive Steroidal Targets

- ▶ Skin
 - Thinning of epidermis
 - Atrophy of sebaceous glands
 - Increased sensitivity to temperature, humidity, and trauma
- ▶ Bladder
 - General Atrophy
 - Results in urinary incontinence
- ▶ Hair
 - Body hair undergoes redistribution

Menopause and Non-reproductive Targets

- ▶ **Skeletal System**
 - Osteoporosis
 - Decreased bone mass following menopause that appears to be the result of declining estrogen level
- ▶ **Central Nervous System**
 - Psychological
 - Anxiety/Depression
 - Cognition/Memory
- ▶ **Cardiovascular System**
 - Possibly due to role of estrogen in lipid metabolism

Serum hormone levels at menopause

- ▶ ↓ Circulating estrogens
- ▶ ↓ Ratio of estrogen
- ▶ ↓ Sex hormone-binding
- ▶ ↑ Peripheral aromatization of DHEA to estrone
- ▶ \rightleftharpoons Reversal of estradiol (E_2) to estrone (E_1) ratio
- ▶ \longleftrightarrow No significant change in testosterone levels