

Introduction To The Endocrine System:

The endocrine system is a complex of glands that produce and secrete hormones, which are chemical messengers that help regulate body functions.

Glands in the endocrine system include the hypothalamus, pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, ovaries (in women), and testis (in men) Each gland produces and secretes a specific hormone that is directed at a specific muscle or organ and is stimulated by a specific response.

The endocrine system plays an important role in the regulation of many body functions, including metabolism, growth and development, reproductive system, mood, and stress response. Some hormone such, such as neurotransmitters, act in a paracrine fashion to attract adjacent cells, or act in an autocrine way to affect behavior of the cell that produces the hormone (Silverthorn, 2015).

Endocrine glands play an important role in homeostasis and control of various other activities in the body through their hormones. Hormones are transported by blood target organs or tissues in different parts of the body, where the actions are executed. Endocrine system dysfunction can lead to medical conditions such as diabetes, thyroid disorders and hormonal imbalances (Davidson).

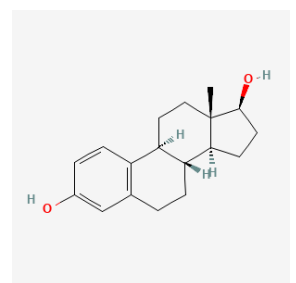
Chemical Structure of Estrogen:

The fundamental shape of estrogen is a steroid nucleus, which consists of three fused cyclohexane rings and one fused cyclopentane ring. The steroid nucleus is composed of 17 carbon atoms and has a planar, rigid shape.

The A-ring of the steroid nucleus contains a hydroxyl (-OH) group at position 3, whilst the B-ring consists of an aromatic ring with a hydroxyl group at position 17. The C-ring carries a ketone group (C=O) at function 3, and the D-ring contains a double bond among carbon atoms 1 and 2. In addition to the steroid nucleus, estrogen has a side chain connected to the D-ring.

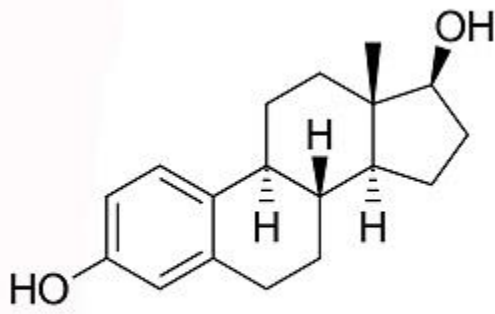
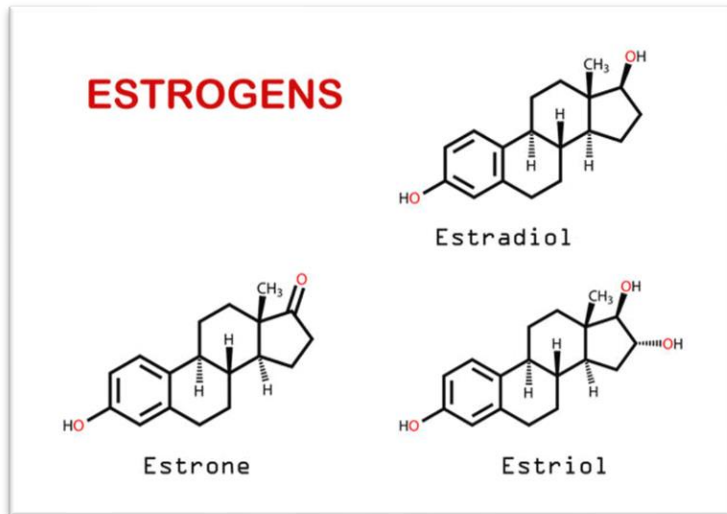
In 17 β -estradiol, this side chain includes an ethinyl group (C=C) at position 17 and a hydroxyl group at position 3. The chemical structure of estrogen lets in it to bind to precise receptors in target cells, which results in the activation of numerous biological pathways and the regulation of gene expression.

Estrogen receptors are found in many tissues in the body, along with the reproductive system, bone, liver, and brain (M.Grisham, 2014).

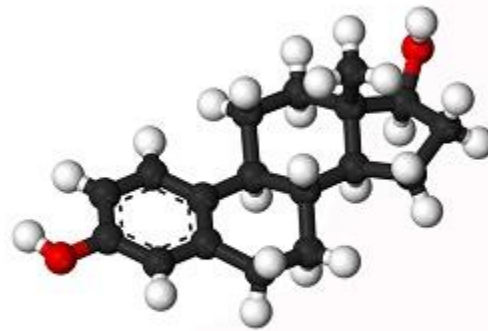


Structure and Functions of Estrogen:

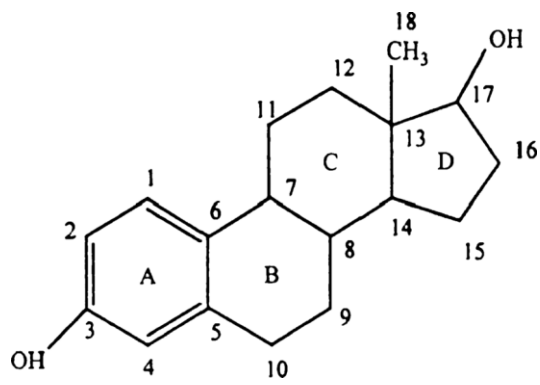
1) Structure:



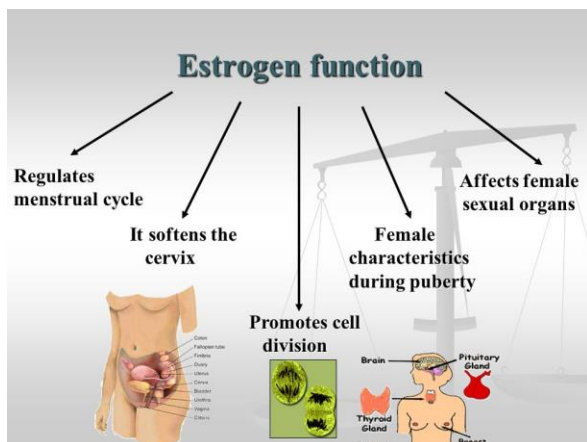
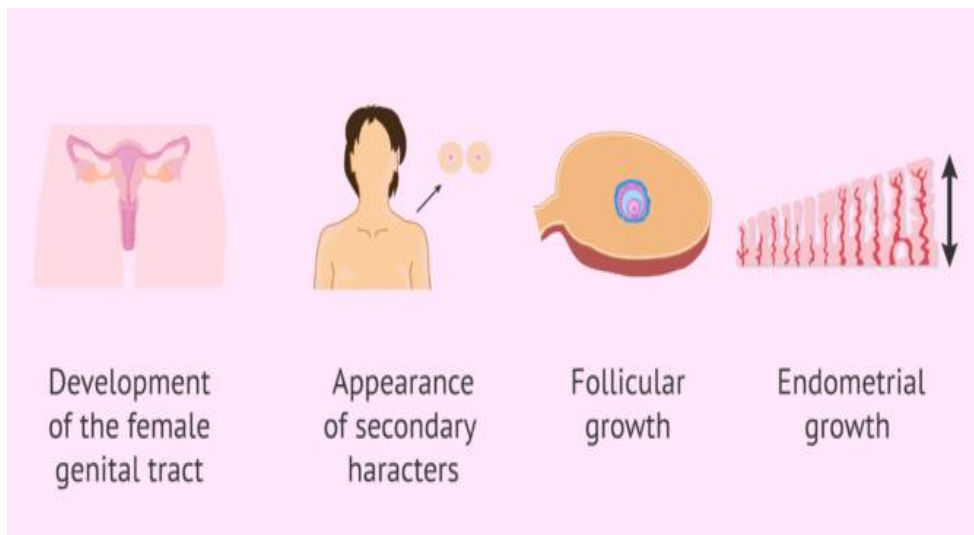
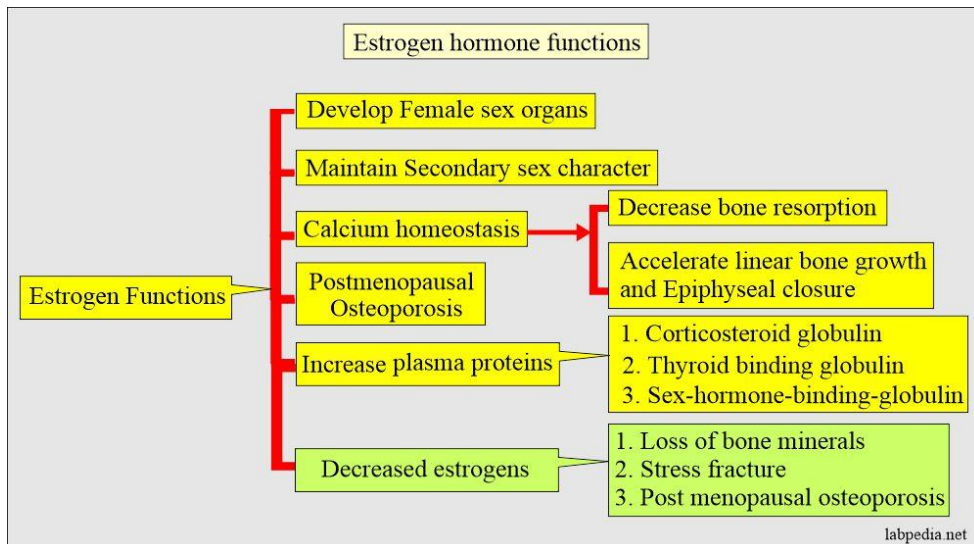
The chemical structure of estradiol



A ball-and-stick model of estradiol



2) Functions:



Sources of Estrogen Production:

Estrogen is produced in both sexes, although it is generally associated with female sexual development and reproductive function. Here are the basic mechanisms of estrogen:

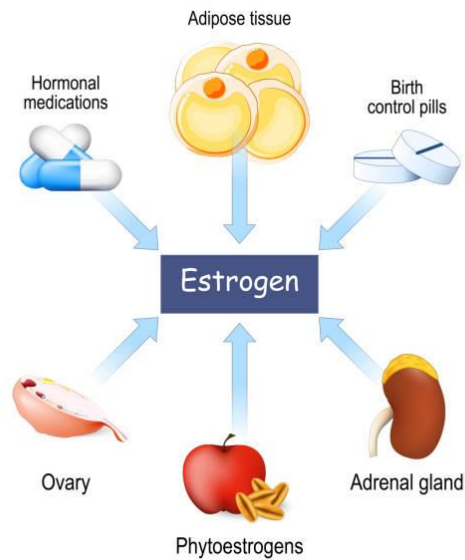
Ovaries: In women, the ovaries are the primary source of estrogen. The pituitary glands secrete estrogen during the menstrual cycle, with the highest peak occurring in the mid to late postmenopausal period, the ovaries continue to produce less estrogen, but estrogen production most of it goes to other tissues.

Fat tissue: Fat cells produce estrone, a type of estrogen that is converted from androgens (male hormones) by the enzyme aromatase. These changes occur primarily in peripheral tissues, such as adipose tissue, but also in other tissues, such as the brain and liver. **Adrenal glands:** The adrenal glands produce small amounts of estrogen, especially in men. This occurs through a process called androgen conversion, which converts androgen to estrogen via the enzyme aromatase.

Testes: In men, small amounts of estrogen are produced in the testes, primarily by the conversion of androgens to estrogen by aromatase.

Uterus: During pregnancy, the uterus produces estrogen to support the growth and development of the fetus. The uterus converts androgens produced by the uterine adrenal gland into estrogens.

Overall, estrogen production is regulated by a complex feedback system including the hypothalamus, pituitary gland, and reproductive organs. Dysregulation of this system can lead to metabolic imbalances and various health issues.



Mode of Action of Estrogen:

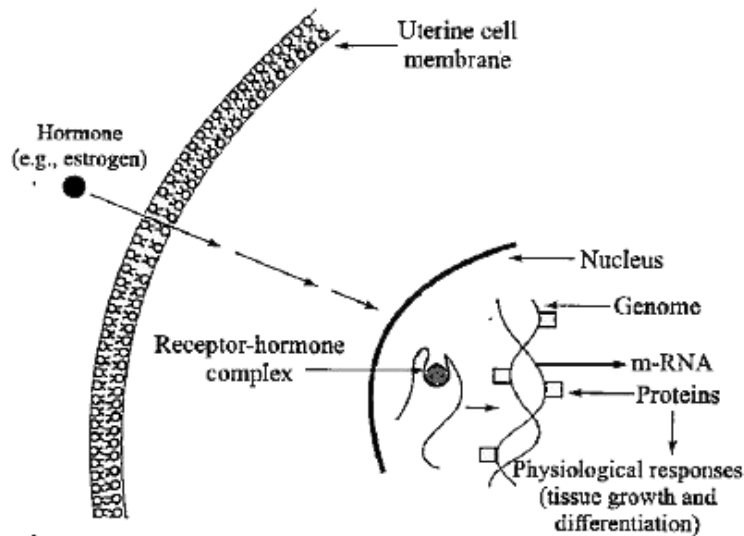
Estrogen exerts its biological effects by binding to the specific estrogen receptor (ER) on target cells. There are two main types of estrogen receptors: estrogen receptor alpha (ER α) and estrogen receptor beta (ER β). These glands are found in many tissues throughout the body, including the reproductive system, bone, liver, and brain.

Estrogen binding induces conformational changes in ERs that allow them to interact with coactivator proteins and bind to specific DNA sequences called estrogen response elements (EREs) in target genes thereby regulating genetics gene expression and activate biological pathways.

The specific effects of estrogen depend on the type of tissue and cell in which it acts. In general, estrogen contributes to the development and maintenance of female sexual characteristics, including breast and testicular growth, menstrual cycle regulation and plays a role in bone health, cardiovascular function, and cognitive function.

Estrogen can have both genomic and nongenomic effects. Genomic effects occur when estrogen binds to the ER and in the long-term causes changes in gene expression. Nongenomic effects occur rapidly and include signaling pathways outside the nucleus, such as activation of kinase cascades and regulation of ion channels.

Overall, estrogen plays an important role in many physiological processes throughout the body, and abnormal estrogen signaling affects diseases and conditions including breast cancer, osteoporosis and cardiovascular disease (Trevor, 2016).



Deficiency of Estrogen:

1) Menopause:

Due to the natural decrease in estrogen production, menopause causes symptoms including hot flashes, night sweats, vaginal dryness, mood changes and sleep disorders.

Hormone replacement therapy (HRT) is a common treatment for menopause and is designed to replace a hormone that the body cannot produce.

HRT is often taken to relieve menopausal symptoms and reduce the risk of certain health issues associated with estrogen deficiency, such as osteoporosis and heart disease, estrogen alone or in combination with progesterone (in uterine women). HRT can be taken in a variety of formulations forms including pills, patches, gels, creams and vaginal rings.

However, while HRT can be effective in reducing menstrual symptoms, it's important to discuss the potential risks and benefits with a health care provider, as HRT is the associated increased risk factor for health issues such as anemia, stroke, and breast cancer.

Other treatments for menopause include lifestyle changes such as regular exercise, a healthy diet, and various stress management strategies. Some women also find relief from menopausal symptoms by taking natural supplements such as black cohosh, soy isoflavones, or herbal supplements, but it is important to discuss these options with a health care provider before trying them.

2) Osteoporosis:

Estrogen plays an important role in maintaining bone health, and estrogen deficiency increases the risk of bone loss and osteoporosis. Treatment of estrogen deficiency-induced osteoporosis may require a combination of lifestyle modification and medication.

Lifestyle changes: Regular physical activity, especially weight-bearing exercises like walking can help build bone density and reduce the risk of osteoporosis. Proper diet calcium and vitamin D content is also important for bone health.

Calcium and vitamin D supplements: Calcium and vitamin D supplements may be recommended if dietary intake is inadequate.

Hormone replacement therapy (HRT): Estrogen replacement therapy can help prevent further bone loss and increase bone density in women with osteoporosis due to estrogen deficiency but the use of HRT should be discussed with a healthcare provider will be used for osteoporosis, as it can increase the risk for certain health issues.

Medications: Other medications, such as bisphosphonates or selective estrogen receptor modulators (SERMs), can be used to help prevent bone loss and reduce the risk of fractures. **Prevent falls:** Preventing falls is important for individuals with osteoporosis, as even small falls can lead to fractures. Fall prevention strategies include removing fall hazards from the home, wearing appropriate footwear, and engaging in balance exercises and strength training.

It is important to discuss the best treatment options for osteoporosis with a health care provider, as the most appropriate treatment will depend on the person's age, overall health and the severity of their osteoporosis.

Other Disorders caused by Estrogen Deficiency:

Cardiovascular disease: Estrogen has a protective effect on the cardiovascular system, and estrogen deficiency is associated with an increased risk of heart disease and stroke.

Cognitive decline: Estrogen plays a role in cognitive function and memory, and estrogen deficiency has been linked to an increased risk of cognitive decline and dementia.

Sexual dysfunction: Estrogen deficiency can lead to a decrease in libido and sexual function, as well as vaginal dryness and pain during intercourse.

Mood disorders: Estrogen is thought to play a role in regulating mood, and estrogen deficiency has been associated with an increased risk of depression and anxiety.

References

Davidson, S. S. (n.d.). *Davidson's Principle and Practice of Medicine*. ELSEVIER.

M.Grisham, R. H. (2014). *Biochemistry*.

Silverthorn, D. U. (2015). *Human Physiology: An Integrated Approach*.

Trevor, K. a. (2016). *Pharmacology*.