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Oestrogen and progesterone

Estrogen is the primary female sex hormone and is responsible for development and regulation of the female reproductive system and secondary sex characteristics. The steroid **17β-estradiol is the most potent and prevalent endogenous estrogen**, although several metabolites of estradiol also have estrogenic hormonal activity. Synthetic estrogens are used as part of some oral contraceptives, in estrogen replacement therapy for postmenopausal women, and in hormone replacement therapy for women.

Progesterone is an endogenous steroid and progestogen sex hormone involved in the menstrual cycle, pregnancy, and embryogenesis of humans and other species. It belongs to a group of steroid hormones called the progestogens, and is the major progestogen in the body. Progesterone is also a crucial metabolic intermediate in the production of other endogenous steroids, including the sex hormones and the corticosteroids, and plays an important role in brain function as a neurosteroid.

The ovarian steroid hormones, progesterone and 17-beta-estradiol, are synthesized by the ovarian follicles through the combined functions of the granulosa cells and the theca cells. They have many physiologic actions on target tissues. They function in a coordinated fashion to support reproductive activity of the female including development of the ovum, development and maintenance of the corpus luteum to sustain a fertilized ovum, maintenance of pregnancy, and preparation of the breasts for lactation.

The female body can synthesize 3 types of estrogens: estradiol, estrone and estriol. Of the three, the ovaries synthesize estradiol, which is the most biologically active of them all, and accounts for the majority of sex-specific changes that begin in puberty - like monthly ovulation and menstruation as well as the development of the secondary sex characteristics. Small amounts of estrogen are also produced by the adrenal cortex and fat

cells in adipose tissue, and the placenta secretes these hormones during pregnancy, as well. But during the reproductive period, it's the ovaries that produce the majority of estrogen and progesterone in the female body.

Before puberty, the hypothalamus secretes small amounts of a hormone called gonadotropin releasing hormone, or GnRH. That GnRH travels to the nearby pituitary, which secretes two hormones of its own - follicle stimulating hormone, or FSH, and luteinizing hormone, or LH. Once puberty hits, the hypothalamus starts to secrete GnRH in pulses, sometimes more and sometimes less, and FSH and LH make the ovarian follicles develop and secrete hormones. The ovarian follicles are scattered throughout the ovaries, and each ovarian follicle is made up of a ring of follicular cells surrounding a primary Oocyte at its core. As the ovarian follicles develop, the follicular cells differentiate into theca cells and granulosa cells, which both play a role in the synthesis of progesterone and estrogen.

How much of these hormones are secreted is directly related to the phases of the female menstrual cycle. The menstrual cycle lasts 28 days on average, and it's centered around a surge of FSH and LH happening on day 14 - which makes ovulation possible. The variations in FSH and LH levels result in fluctuating levels of estrogen and progesterone that vary according to the phases of the menstrual cycle - the two weeks before ovulation are called **the follicular phase**, during which mostly **estrogen is produced**. The two weeks following ovulation are called the **luteal phase**, during which **progesterone is the dominant** hormone. During the follicular phase of the menstrual cycle, estrogen makes the superficial layer of the uterus, the endometrium, thicken up and sprout progesterone receptors. **During the follicular phase, estrogen acts as a negative feedback signal, making the pituitary secrete less FSH as estrogen levels rise.** Right before ovulation, the really high estrogen levels make the pituitary much more sensitive to the actions of hypothalamic GnRH, and so, they turn into a positive feedback signal, leading to a massive surge of FSH and LH that leads to ovulation. **During the luteal phase, progesterone binds to receptors in the endometrium, and stimulates the endometrial glands to produce more secretions that prepare the uterus for a potential pregnancy. Progesterone acts as a negative feedback signal during the luteal phase - making the pituitary secrete less LH. In turn, the levels of progesterone decrease as well, and menstruation follows.**

Both estrogen and progesterone are steroid hormones, so their production starts with cholesterol. Cholesterol reaches the theca cells, and inside there's an enzyme called cholesterol desmolase, which converts cholesterol to pregnenolone. Another enzyme in theca

cells called 3-beta hydroxysteroid dehydrogenase converts some of the pregnenolone into progesterone. However, most of the pregnenolone is converted to 17-hydroxypregnenolone, and then into dehydroepiandrosterone, or DHEA. 3-beta-hydroxysteroid dehydrogenase, is quite the over achieving enzyme because it also acts on DHEA and converts it into androstenedione - a testosterone precursor. Androstenedione diffuses to the nearby granulosa cells, which have two enzymes of their own.