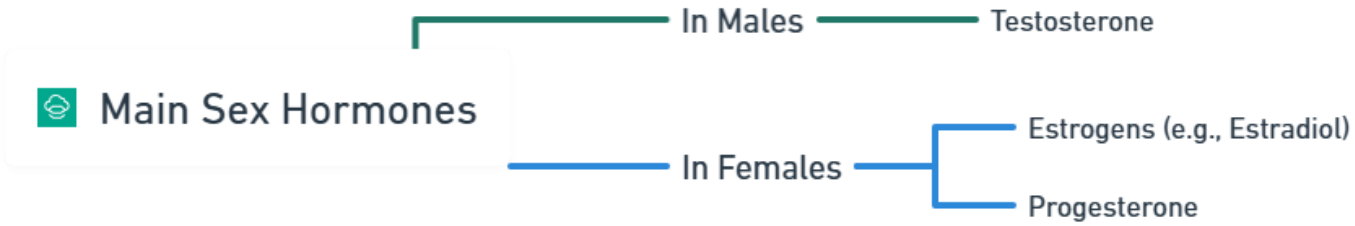
Steroidal Hormones

Sex Hormones and Their Regulation in Males and Females

Definition of Sex Hormones

- Sex hormones are steroid hormones that play pivotal roles in the development, maintenance, and regulation of reproductive systems and secondary sexual characteristics in both males and females.
- They influence various physiological processes, including growth, metabolism, and behavior.

Main Sex Hormones



1. **In Males:**

Testosterone

- **Type:** Androgen
- **Functions:**
  - Development of male reproductive tissues (e.g., testes, prostate)
  - Promotion of secondary sexual characteristics (e.g., facial hair, deep voice)
  - Regulation of libido, sperm production, and muscle mass

2. **In Females:**

Estrogens (e.g., Estradiol)

- **Functions:**
  - Development of female reproductive tissues (e.g., ovaries, uterus)
  - Promotion of secondary sexual characteristics (e.g., breast development, menstrual cycle regulation)
  - Maintenance of bone density and cardiovascular health

Progesterone

- **Functions:**
  - Preparation of the uterine lining for implantation
  - Regulation of the menstrual cycle
  - Maintenance of pregnancy

Regulation of Sex Hormones

Both male and female sex hormones are regulated through the **Hypothalamic-Pituitary-Gonadal (HPG) Axis**, a feedback loop involving the hypothalamus, pituitary gland, and gonads (testes in males, ovaries in females).

Step-by-Step Regulation:

1. Hypothalamus:

- Secretes **Gonadotropin-Releasing Hormone (GnRH)** in a pulsatile manner.

2. Pituitary Gland:

- **GnRH** stimulates the anterior pituitary to release:
  - Luteinizing Hormone (LH)
  - Follicle-Stimulating Hormone (FSH)

3. Gonads:

A. In Males:

- **LH** stimulates the Leydig cells in testes to produce **Testosterone**.
- **FSH** acts on Sertoli cells to promote **spermatogenesis**.

B. In Females:

- **LH** triggers ovulation and stimulates the corpus luteum to produce **Progesterone**.
- **FSH** stimulates follicle development and **Estrogen** production in the ovaries.

4. Feedback Mechanism:

- Testosterone, Estrogen, and Progesterone exert negative feedback on both the hypothalamus and pituitary to regulate the secretion of GnRH, LH, and FSH, maintaining hormonal balance.

Key Points in Regulation

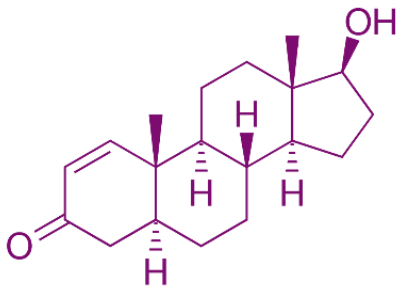
- **Negative Feedback:** Elevated levels of sex hormones inhibit further release of GnRH, LH, and FSH to prevent overproduction.
- **Pulsatile Release:** The hypothalamus releases GnRH in pulses, which is crucial for the proper functioning of the HPG axis. Continuous release can lead to downregulation of receptors and decreased hormone levels.
- **Sex-Specific Responses:** Although the HPG axis functions similarly in both sexes, the specific responses and outcomes (e.g., sperm production vs. menstrual cycle regulation) differ based on the sex hormones involved.

Various Sex hormones

1. Testosterone

Structure

- Testosterone is the primary male sex hormone and an anabolic steroid. It features a four-ring cyclopentanoperhydrophenanthrene structure with hydroxyl and ketone functional groups.
- Chemical Formula: $C_{18}H_{28}O_2$



Mode of Action

- **Androgen Receptor Activation:** Testosterone binds to androgen receptors in various tissues, initiating gene transcription that promotes the development and maintenance of male characteristics.
- **Anabolic Effects:** Stimulates protein synthesis, muscle mass increase, and bone density.
- **Sexual Development:** Essential for the development of male reproductive tissues, secondary sexual characteristics, and libido.
- **Erythropoiesis:** Enhances red blood cell production in the bone marrow.

Uses

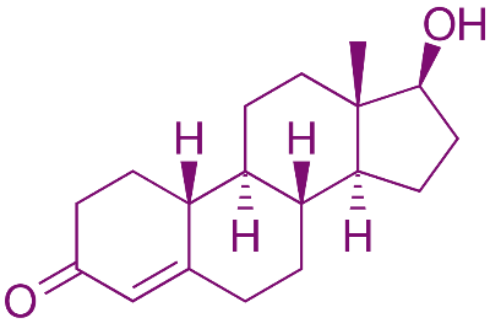
- **Hormone Replacement Therapy (HRT):** Treats conditions like hypogonadism and delayed puberty in males.
- **Anabolic Steroid Therapy:** Used (often illicitly) to enhance muscle mass and athletic performance.
- **Gender-Affirming Therapy:** Assists in masculinizing effects for transgender men.
- **Breast Cancer Treatment:** Sometimes used in hormone-sensitive breast cancers to inhibit estrogen effects.

2. Nandrolone

Structure

- Andralone is an anabolic androgenic steroid with a modified cyclopentanoperhydrophenanthrene structure. It typically includes additional functional groups to enhance its anabolic properties.

- **Chemical Formula:** $C_{20}H_{28}O_2$



Mode of Action

- **Androgen Receptor Activation:** Similar to testosterone, Andralone binds to androgen receptors, promoting anabolic effects.
- **Enhanced Anabolic Activity:** Modified structure aims to increase muscle-building effects while reducing androgenic side effects.
- **Protein Synthesis Stimulation:** Promotes muscle growth and repair.

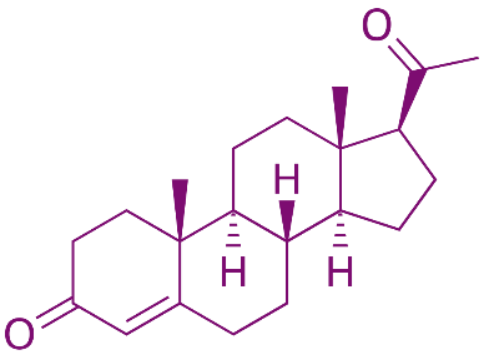
Uses

- **Bodybuilding and Athletic Performance:** Utilized (often illicitly) to increase muscle mass and strength.
- **Therapeutic Applications:** Limited clinical use due to potential side effects and regulatory restrictions.

3. Progesterones

Structure

- Progesterones are a group of steroid hormones with a cyclopentanoperhydrophenanthrene structure, featuring ketone and hydroxyl functional groups at specific positions.
- **Chemical Formula:** $C_{20}H_{30}O_2$



Mode of Action

- **Progesterone Receptor Activation:** Binds to progesterone receptors in target tissues, regulating gene expression.

- **Reproductive Role:** Prepares the endometrium for implantation, maintains pregnancy, and regulates the menstrual cycle.
- **Neuroprotective Effects:** Exhibits protective roles in the central nervous system.
- **Anti-inflammatory Actions:** Modulates immune responses and reduces inflammation.

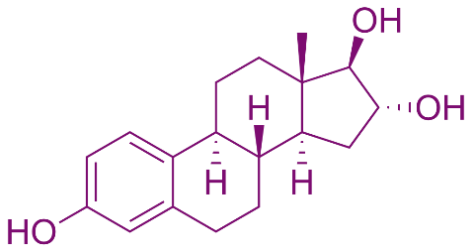
Uses

- **Contraception:** Combined with estrogens in oral contraceptives to prevent ovulation and implantation.
- **Menstrual Disorders:** Manages irregular menstrual cycles, premenstrual syndrome (PMS), and endometriosis.
- **Hormone Replacement Therapy (HRT):** Used in postmenopausal women to prevent endometrial hyperplasia when combined with estrogens.
- **Assisted Reproductive Technology (ART):** Supports implantation and maintenance of early pregnancy.

4. Oestriol

Structure

- Oestriol is one of the three major endogenous estrogens, characterized by a cyclopentanoperhydrophenanthrene structure with three hydroxyl groups.
- Chemical Formula: $C_{18}H_{24}O_3$



Mode of Action

- **Estrogen Receptor Activation:** Binds to estrogen receptors, regulating gene transcription involved in reproductive and non-reproductive functions.
- **Bone Density Maintenance:** Promotes bone formation and inhibits resorption, reducing osteoporosis risk.
- **Cardiovascular Health:** Enhances lipid profiles and vasodilation, contributing to cardiovascular protection.
- **Skin Health:** Promotes collagen synthesis and skin elasticity.

Uses

- **Hormone Replacement Therapy (HRT):** Used in postmenopausal women to alleviate menopausal symptoms.

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