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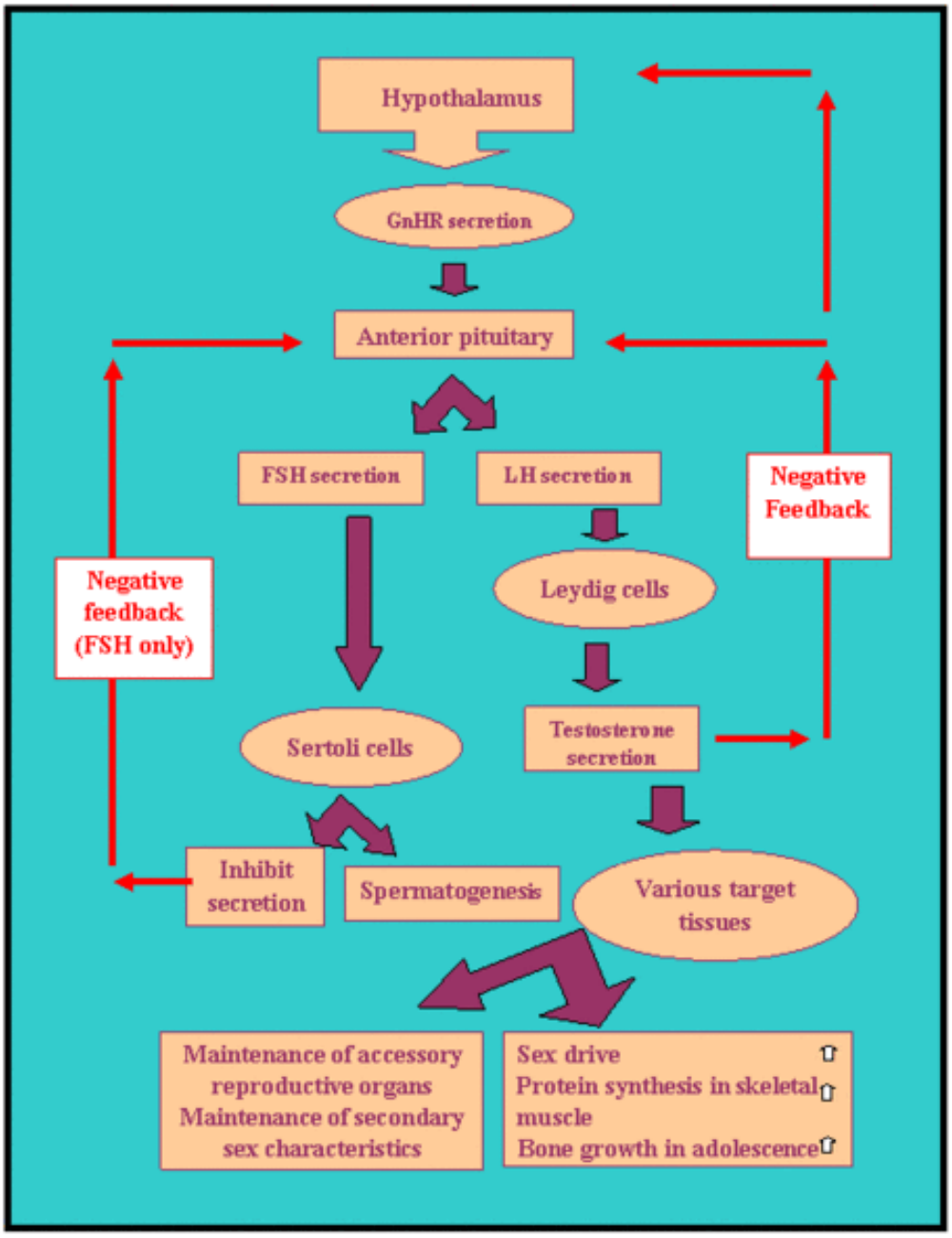
Male Reproductive System



Gametes… of the sexes

Females

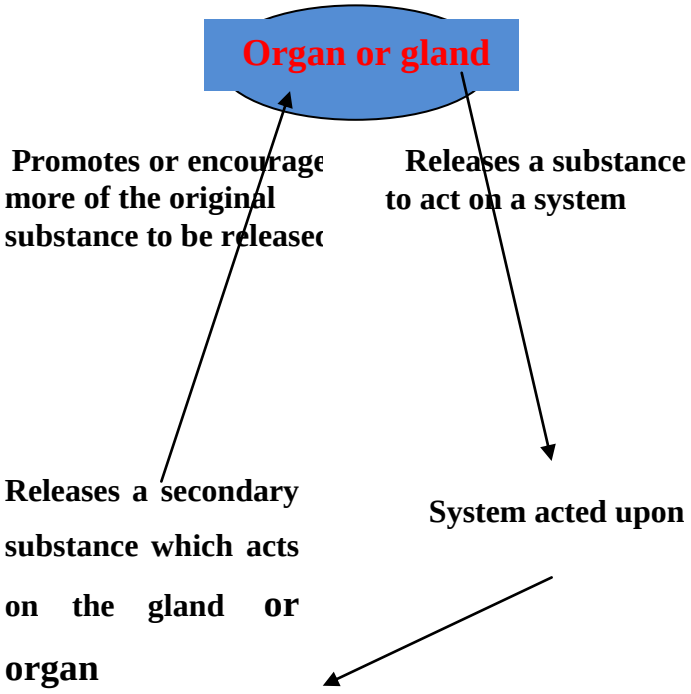
- Eggs Develop in the Ovaries
- All the gametes an individual will ever produce are already present at birth and are stored as undeveloped follicles

Males

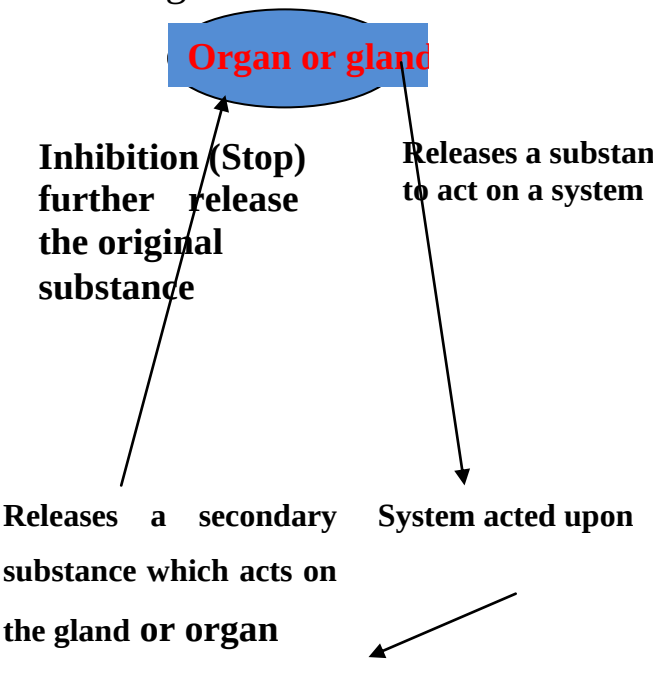
- Sperm is produced in the male scrotum
- Male gametes arise from undifferentiated stem cells that continually divide and regenerate over the male's lifetime

Two Types of Feedback

- Positive Feedback



Negative Feedback



Three Primary Hormones of Sexual Development

- Estrogen
- Progesterone
- Testosterone

Estrogen's Effects on Female Sexual Development

- Works with Progesterone through "Feedback Loops" to establish regular reproductive cycles
- Growth and Maturation of Female Sex Organs
- During Puberty, triggers lengthening of long bones, and changes in pelvic structure
- Stimulates: the appearance of Axillary and Pubic hair, Hydration of the Skin and Female patterns of fat deposits
- During pregnancy Estrogen also plays a major role (with Progesterone) in Embryonic Development and physical adaptations needed to accommodate Pregnancy and Child Birth

Testosterone's Effects on Male Sexual Development

- Growth and Maturation of Male Sex Organs, Must be held at Adequate levels to maintain functioning of Male Sex Organs
- At puberty stimulates the growth of axillary, pubic, facial and chest hair.
- Enlargement of Larynx (deepening voice)
- Thickens Skin and Increases Oiliness
- Enhances Growth and Density of Bones
- Increases Muscles in Size and Mass
- Boosts the Basal Metabolic Rate and Influences Behavior (Sex Drive)
- "Masculinizes" the Brain (Promotes Aggressiveness)

Summary of Hormonal Effects

Females (Estrogens)

- Establishes reproductive cycles w/Progesterone
- Moistens Skin and feminizes shape
- Promotes fetal growth and phys. changes during pregnancy

Males (Testosterone)

- Promotes growth of facial & chest hair & growth of pharynx
- Increases mass and density of muscles & bones
- Boosts BMR, & Masculinizes Brain

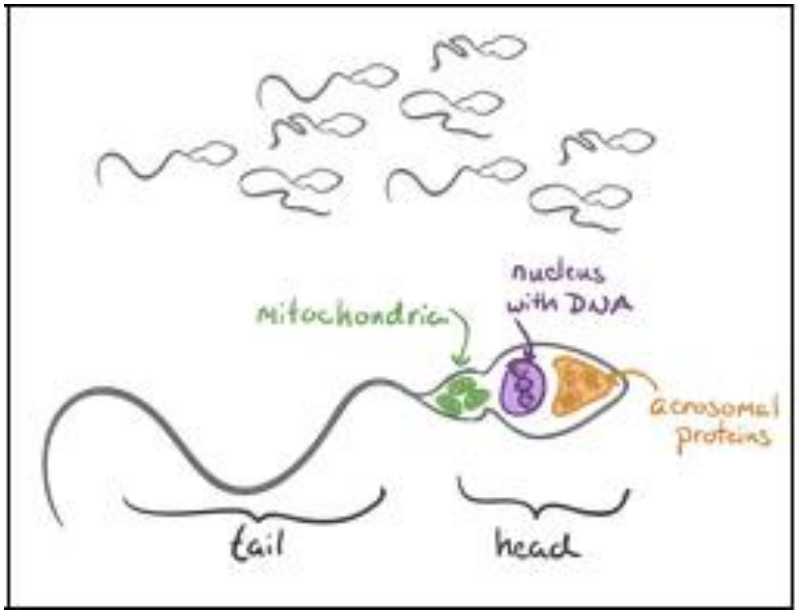
Male Reproductive System

Male reproductive organs include the testes, epididymis, urethra, vas deferens, prostate gland, seminal vesicle and penis.

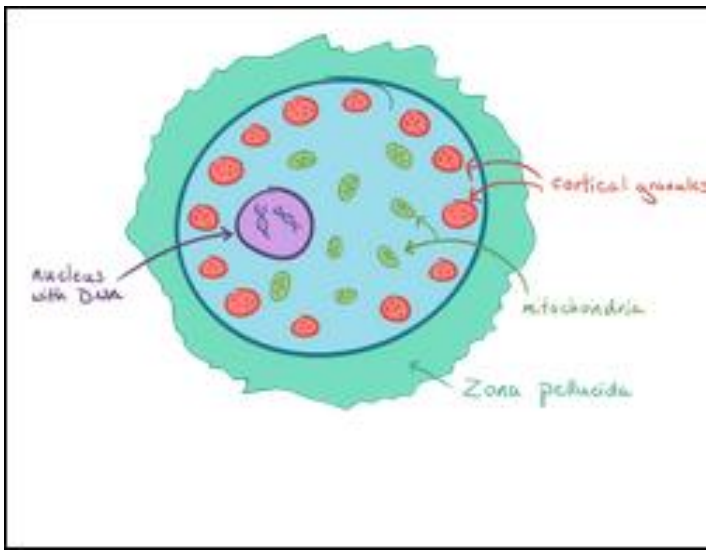
The testes are composed of coiled structures called seminiferous tubules, which are the sites of sperm production (Spermatogenesis takes place inside a male's testes, specifically in the walls of the seminiferous tubules). The structure on top of the seminiferous tubules in the testes is the epididymis is a tortuously coiled structure topping the testis. The sperm migrate from of the seminiferous tubules to the epididymis. Within the epididymis, the sperm mature while they are stored in this structure.

The ejaculation process begins as the penis fills with blood and becomes erect. With sufficient stimulation, mature sperm travel from epididymis through the vas deferens, a muscular tube, which propels sperm forward through smooth muscle contractions. The sperm arrive first at the ampulla, where secretions from the seminal vesicle are added.

From the ampulla, seminal fluid is propelled forward through the ejaculatory ducts toward the urethra, passing the first by the prostate gland, where a milky fluid is added to form semen. Finally, the semen is ejaculated through the far end of the urethra.



When ejaculation occurs, sperm is forcefully expelled from the tail of the epididymis into the ductus deferens. Sperm travels through the ductus deferens and up the spermatic cord into the pelvic cavity, over the ureter to the prostate behind the bladder. Here, the vas deferens joins with the seminal vesicle to form the ejaculatory duct, which passes through the prostate and empties into the urethra. Upon the sperm's exit from the testes, into the vas deferens, muscular movements take over. When ejaculation occurs, rhythmic muscle movements of *peristalsis* propel the sperm forward. This continues throughout the remainder of the sperm's journey through the male reproductive system.



Sperm cells become even more active when they begin to interact with the *fertilizing layer* of an egg cell. They swim faster and their tail movements become more forceful and erratic. This behavior is called "hyper activation."

A recent discovery links hyper activation to a sudden influx of calcium ions into the tails. The whip-like tail (flagellum) of the sperm is studded with ion channels formed by proteins called CatSper. These channels are selective, allowing only calcium ion to pass. The opening of CatSper channels is responsible for the influx of calcium. The sudden rise in calcium levels causes the flagellum to form deeper bends, propelling the sperm more forcefully through the viscous environment.

The sperm use their tails to push themselves into the epididymis, where they complete their development. It takes sperm about 4 to 6 weeks to travel through the epididymis. The sperm then move to the vas deferens, or sperm duct. The seminal vesicles and prostate gland produce a whitish fluid called seminal fluid, which mixes with sperm to form semen when a male is sexually stimulated.

The penis, which usually hangs limp, becomes hard when a male is sexually excited. Tissues in the penis fill with blood and it becomes stiff and erect (an erection). The rigidity of the erect penis makes it easier to insert into the female's vagina during sexual intercourse, and the extended length allows it to reach deeper into the female's *oviduct*, the passage from the ovaries to the outside of the body (allowing a shorter travel distance for the spermatozoa).

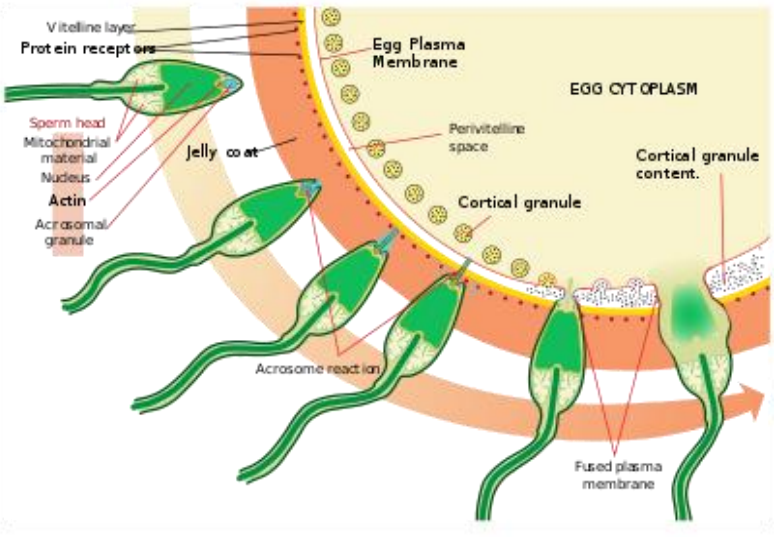
When the erect penis is stimulated to orgasm, muscles around the reproductive organs contract and force the semen through the duct system and urethra. Semen is pushed out of the male's body through his urethra - ejaculation. The speed of the semen is about 70 mph when ejaculation comes and it can contain 100 to 600 million sperm cells. When the male ejaculates during intercourse, semen is deposited into the fornix at the base of the female's vagina, near the cervix. From the fornix, the sperm make their way up through the cervix and move through the uterus with help from uterine contractions.

Sperm hyperactivity is necessary for breaking through two physical barriers that protect the egg from fertilization. The first barrier to sperm is made up of so-called cumulus cells embedded in a gel-like substance made primarily of hyaluronic acid. The cumulus cells develop in the ovary with the egg and support it as it grows.

The second barrier coating the oocyte is a thick shell formed by glycoproteins called the zona pellucida. One of the proteins that make up the zona pellucida binds to a partner molecule on the sperm. This lock-and-key type mechanism is species-specific and prevents the sperm and egg of different species from fusing. There is some evidence that this binding is what triggers the acrosome to release the enzymes that allow the sperm to fuse with the egg.

When a sperm cell reaches the egg the acrosome releases its enzymes. These enzymes weaken the shell, allowing the sperm cell to penetrate it and reach the plasma membrane of the egg. Part of the sperm's cell membrane then fuses with the egg cell's membrane, and the sperm cell sinks into the egg (at which point the sperm tail falls off).

Upon penetration, the egg cell membrane undergoes a change and becomes impenetrable, preventing further fertilization.



The binding of the sperm to an ovum is called a zygote. A zygote is a single cell, with a complete set of chromosomes, that normally develops into an embryo.