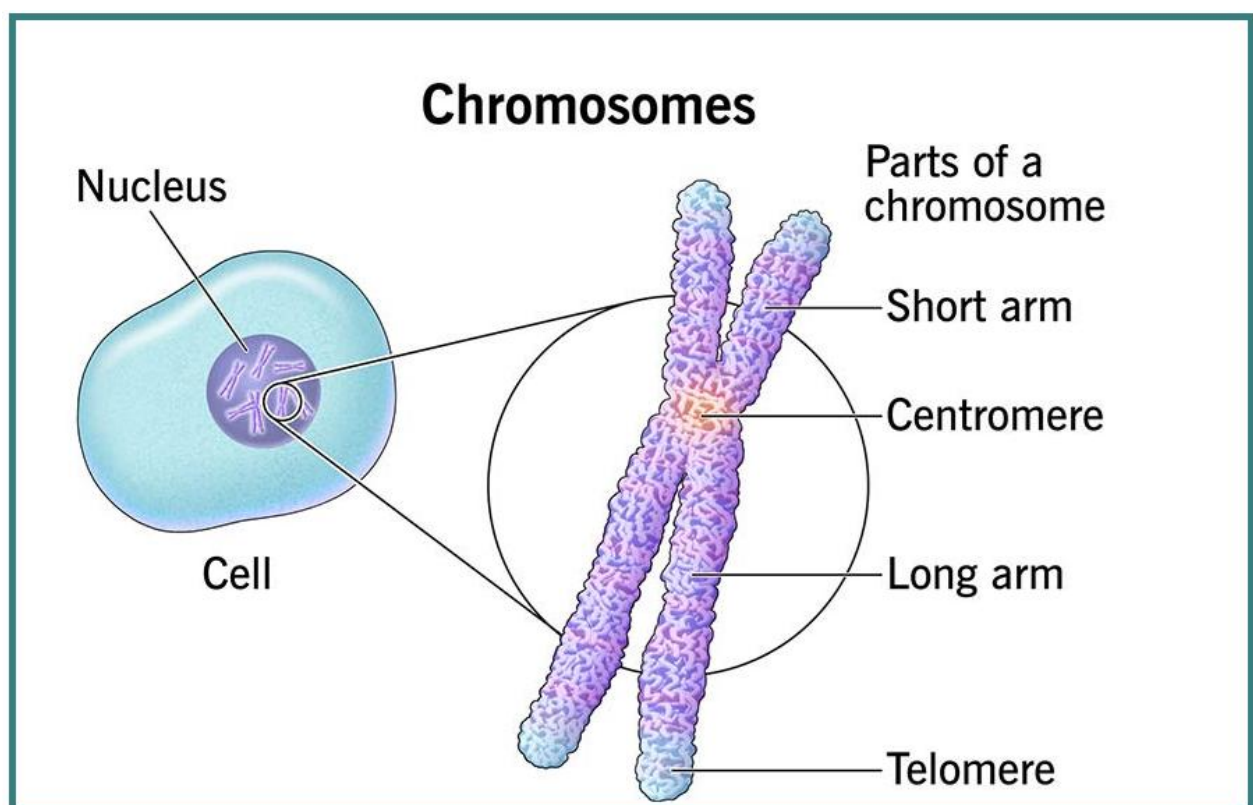


The role of chromosomes and hormones (testosterone, oestrogen and oxytocin) in biological sex.

Chromosomes

Chromosomes are thread-like structures located inside animal and plant cells, within the cell's nucleus. Each chromosome is made up of protein, and a single molecule of DNA contains the specific instructions that make each type of living creature unique.

Your DNA is tightly wrapped around helper proteins called histones, which keep the long strands compact. Each chromosome features a centre pinch point called a centromere (which divides it into a short p-arm and a long q-arm) and tips called telomeres that protect the genetic code.

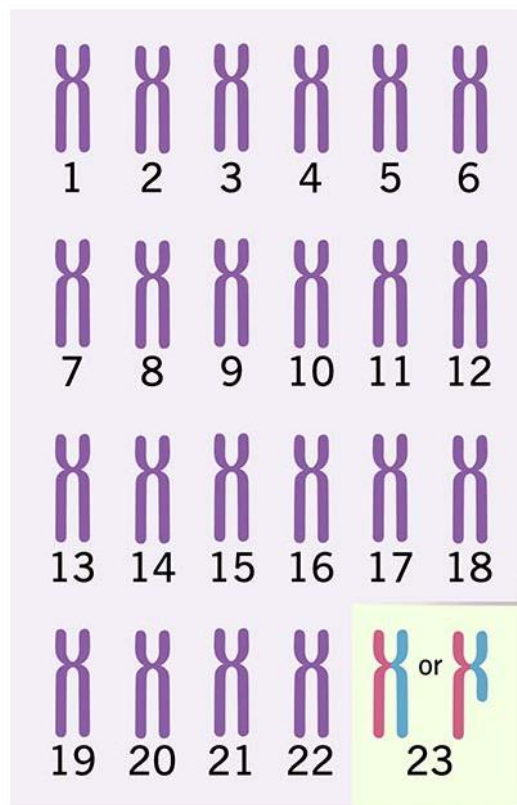


Humans typically have 46 chromosomes arranged in 23 pairs per cell. You receive one set of 23 chromosomes from your mother and another set of 23 from your father. Pairs 1 through 22 are non-sex autosomes and the final 23rd pair consists of sex chromosomes.

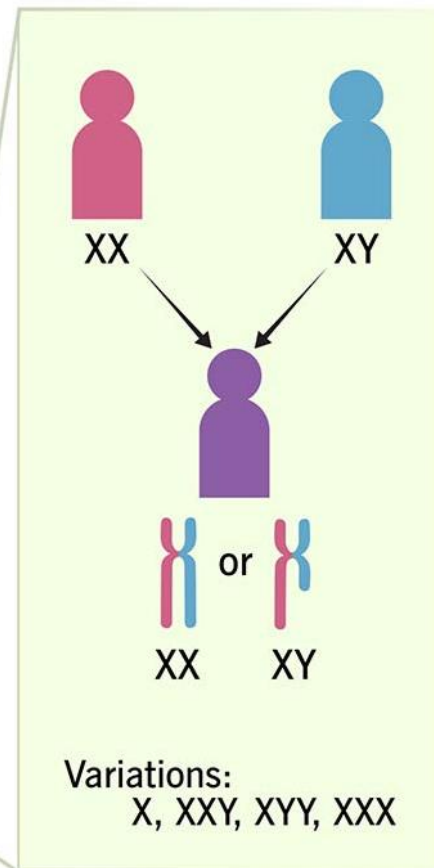
Males and females differ in this pair of chromosomes (sex chromosomes). Females have two X chromosomes (XX) in their cells, while males have one X and one Y chromosome (XY).

Humans have 23
pairs of chromosomes:

22 autosomal



1 sex



Some variations in chromosomal pattern result in conditions which can affect gender development.

Hormones

Hormones are the body's chemical messengers that travel through the bloodstream and influence many different processes. Hormones are released from glands and flow through the endocrine system to a target organ. The male sex glands are the testes, and the female sex glands are the ovaries.

The same sex hormones exist in both males and females, but they differ in terms of quantity and the effect that they have upon different parts of the body. The main sex hormones are testosterone, oestrogen and oxytocin. These hormones can affect development and behaviour both before and after birth.

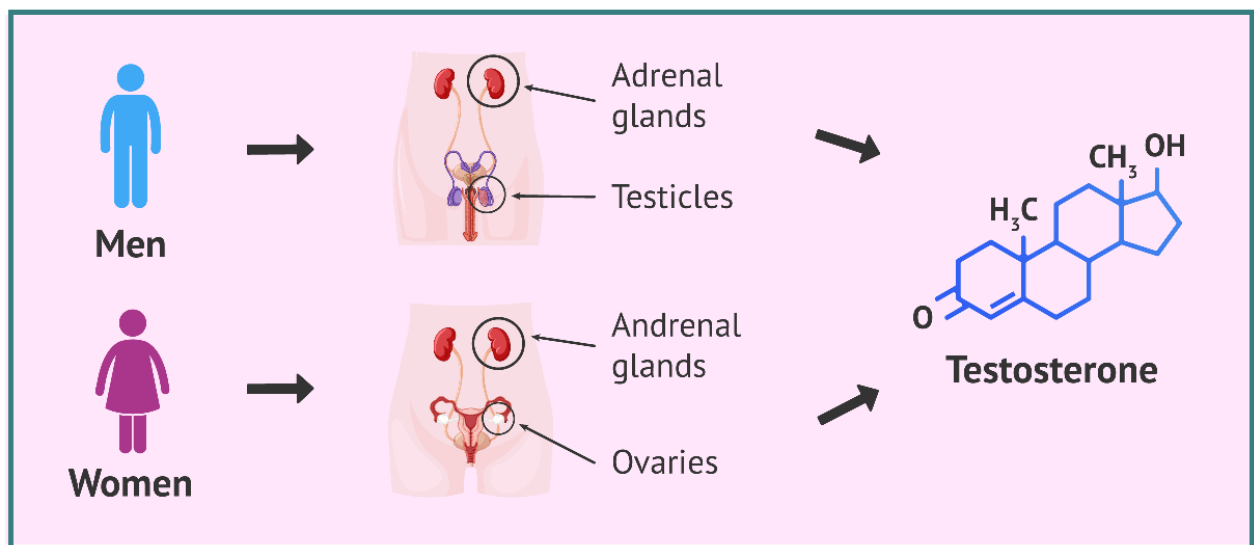
Testosterone

Testosterone is an androgen (group of hormones prompting male characteristics) that is present in larger quantities in males than in females, and it affects development and behaviour both before and after birth. If testosterone is released in the womb at seven weeks (when 'maleness' is switched on by the SRY gene on the Y chromosome) it causes the development of male sex organs (gonads) as well as acting on the hypothalamus, resulting in the masculinisation of the brain.

It has been found that an area of the hypothalamus at the base of the brain, called the sexually dimorphic nucleus, is much larger in male than in females. Your adrenal glands also produce small amounts of testosterone in both males and females.

Your hypothalamus releases gonadotropin-releasing hormone (GnRH), which triggers your pituitary gland to release luteinising hormone (LH). LH travels to your gonads and stimulates the release of testosterone.

As testosterone increases, it blocks the gonadotropin-releasing hormone, which helps maintain normal levels of testosterone. Any problem with this process can lead to abnormally high or low testosterone levels.

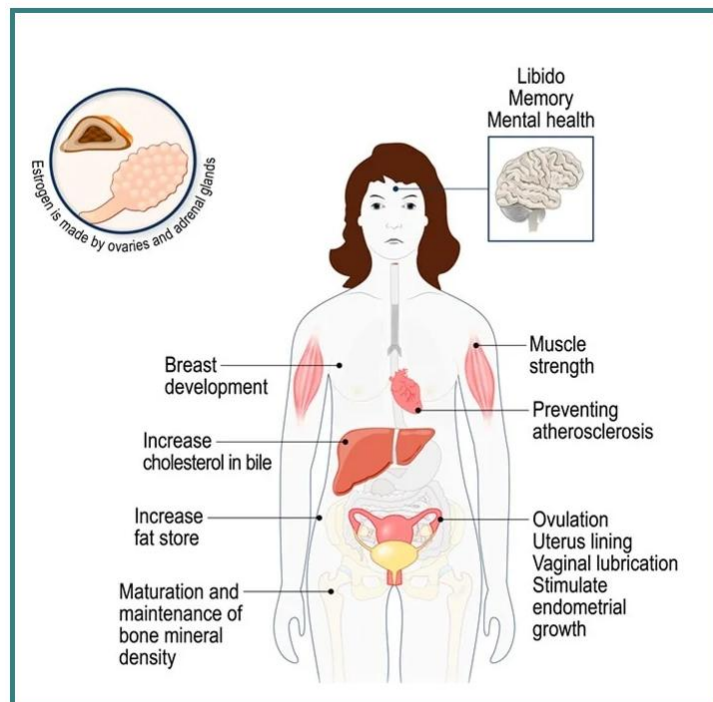


Testosterone is believed to be responsible for typical male behaviours, such as aggression, competitiveness and superior visuo-spatial abilities. Males also have a surge of testosterone during puberty, and this is responsible for secondary sexual characteristics such as facial hair and deepening voice.

Oestrogen

Oestrogen is a primary female sex hormone essential for sexual development, reproductive health, and the regulation of the menstrual cycle.

Females do not need hormones to direct prenatal genital development in the same way that males do as all fetuses start off genetically female. However, there is some evidence to suggest that oestrogen might have prenatal effects, such as causing a smaller brain size (Shi et al, 2015). However, oestrogen does play a major role from puberty onwards, as it promotes the development of secondary sexual characteristics (such as breast development) and directs the menstrual cycle.



While commonly viewed as a female hormone, men naturally produce oestrogen by converting testosterone through an enzyme called aromatase. It helps support sperm production, testicular function, and libido.

Oxytocin

Oxytocin is a natural hormone and neuropeptide produced in the hypothalamus in the brain and released by the pituitary gland, which manages reproductive functions and social behaviours. It is primarily produced when mothers give birth, promoting strong attachment urges with their newborns. Oxytocin produces feelings of contentment and calmness. It is released into the bloodstream during labour and also when the nipples are stimulated during breastfeeding. This helps the mother to bond with her baby and to produce milk.

Females have higher levels of oxytocin than men, as oestrogen has been found to increase oxytocin secretion. Some researchers have linked this oxytocin to increased sociability and the formation of bonds and attachments between people.

Oxytocin is often called the 'love' hormone because it promotes feelings of bonding/attachment in both men and women.

At times of stress, oxytocin dampens the fight-or-flight response and triggers the 'tend and befriend' response in females to ensure that they look after their young and form protective alliances with other women.

