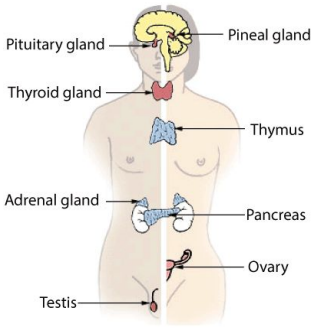
6.6 HORMONES, HOMEOSTASIS AND REPRODUCTION

HORMONES

Hormones are chemical messengers that are directly secreted into the blood. They are carried to target tissues where they change the condition of the tissue. This change is monitored through negative feedback.

Main endocrine glands are-



Control of Blood glucose by Insulin and Glucagon

- Pancreatic cells monitor blood glucose.
- The absorption of glucose from digestion in the intestine increases blood sugar levels whereas fasting decreases blood sugar levels.
- hormones are released from pancreatic pits (called the islets of Langerhans) and act principally on the liver

Blood Glucose levels are too high -

- ➔ B cells of the pancreas produce insulin
- ➔ Insulin stimulates the uptake of glucose to cells
- ➔ Stimulates the liver and teh fat cells to store glucose as glycogen
- ➔ This leads to a decrease in blood glucose levels

Blood glucose levels are too low-

- ➔ Alpha cells of the pancreas produce glucagon
- ➔ It stimulates the liver to break glycogen into glucose
- ➔ This leads to an increase in the blood sugar levels

Thyroxin

Produced by thyroid glands

- Increases the metabolic rate or the rate of protein synthesis
- This, in turn, increases the heat production
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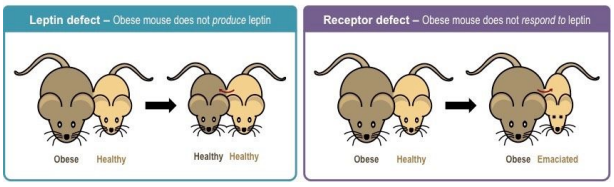
Leptin

Produced by adipose cells

- Controls the appetite
- As the adipose tissue increases, teh leptin secretions also increase in the blood which causes appetite inhibition and results in reduced food intake.



Used as a treatment for obesity

- ➔ 1949 - scientists discovered the obese mouse which is a mutant mouse that eats excessively and becomes obese.
- ➔ It was found that the obese mice possess two recessive alleles and therefore don't produce any leptin.
- ➔ These mice when treated with leptin, showed large loss of weight

Clinical Trials in Humans failed

- ➔ Most people have naturally high levels of leptin
- ➔ If assumed that obesity is linked to leptin, the obese people would have some resistance to leptin
- ➔ Only a few patients in teh clinical trial experienced a significant weight loss whereas most of them experienced side effects such as skin irritation.

Melatonin

Produced by the pineal gland when there is darkness

It results in the synchronization of the circadian rhythm which includes sleep time and the blood pressure regulation

Jet Lag -

It is a condition caused by traveling rapidly between time zones.

Symptoms of Jet lag -

Sleep disturbance

Headaches

Fatigue

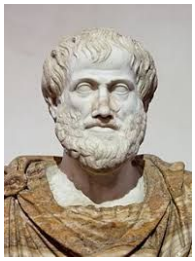
Irritability

- ➔ It is caused by the pineal gland continuing to set a circadian rhythm for the point of origin rather than the current time zone.
- ➔ People take melatonin close to the sleep time of the destination time zone which helps alleviate the symptoms.

SEXUAL REPRODUCTION

Soil and seed theory by Aristotle

- The male produces a 'seed' which forms an 'egg' when mixed with menstrual blood (the 'soil').
- The 'egg' then develops into a fetus inside the mother according to the information contained within the male 'seed' alone.




Debunking the soil and seed theory

- Harvey studied the sexual organs of a female deer after mating
- There was no embryo growing inside the deer's womb even after 6-7 weeks after mating.
- Debunked teh original theory by concluding that menstrual blood had no role in the development of a fetus.

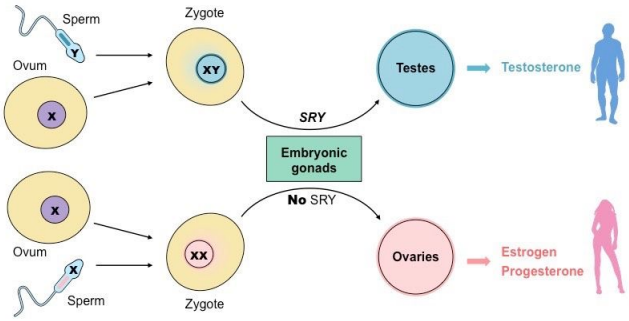
SEX DEVELOPMENT

- The 23rd pair of chromosomes in humans are sex chromosomes.
- Females have XX chromosomes whereas males have XY.
- The Y chromosome contains the SRY gene which leads to male development.
  - codes for a testis-determining factor (TDF) that causes embryonic gonads to form into testes (male gonads)
  - absence of the TDF protein (i.e. no Y chromosome), the embryonic gonads will develop into ovaries (female gonads).

Hormones produced by males and females for the development of sexual characteristics-

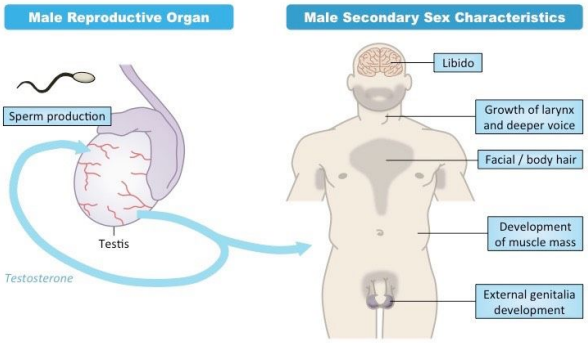
Females - Estrogen and Progesterone

Males - Testosterone



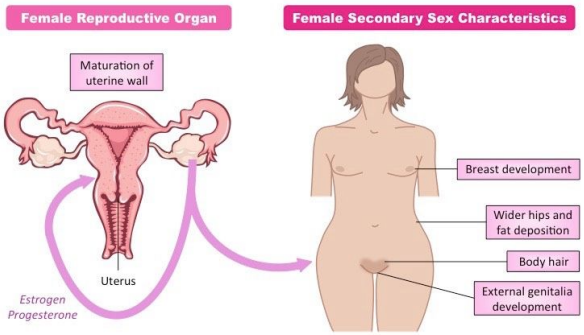
Testosterone

- Causes the development of male genitalia in the prenatal stage
- involved in sperm production following the onset of puberty
- aids in the development of secondary sex characteristics

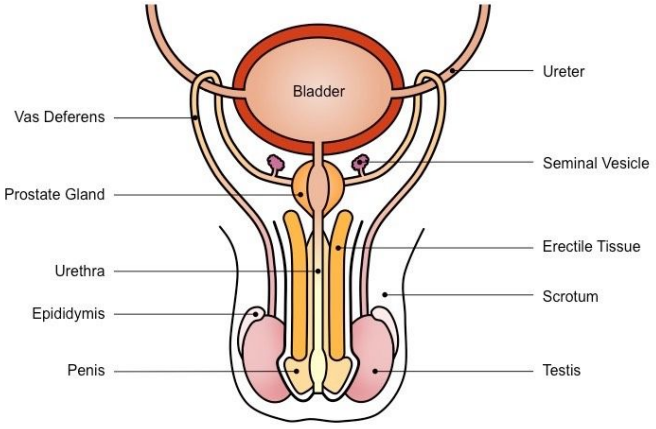


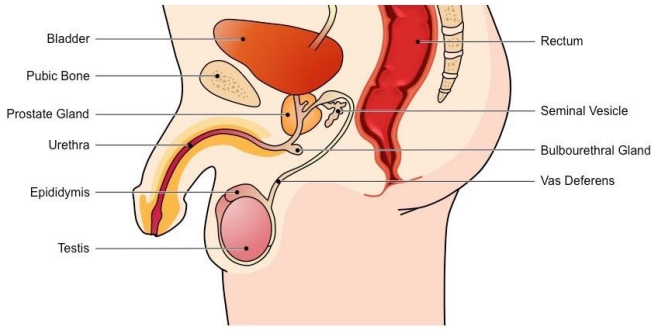
Estrogen

- Promotes the prenatal development of female genitalia
- responsible for the development of secondary sex characteristics
- involved in monthly preparation of egg release following puberty
- estrogen and progesterone are secreted by the mother's ovaries and then the placenta – until female reproductive organs develop



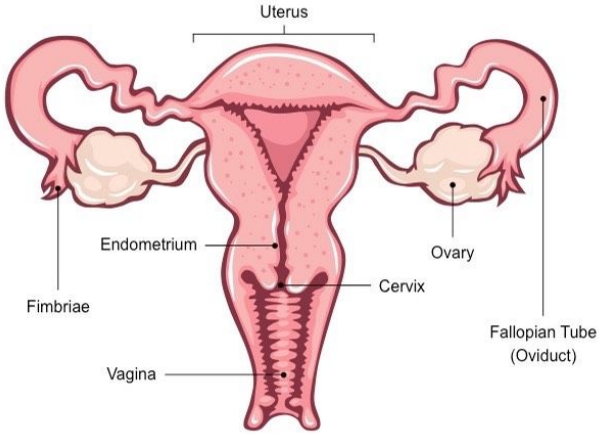
Male Reproductive System

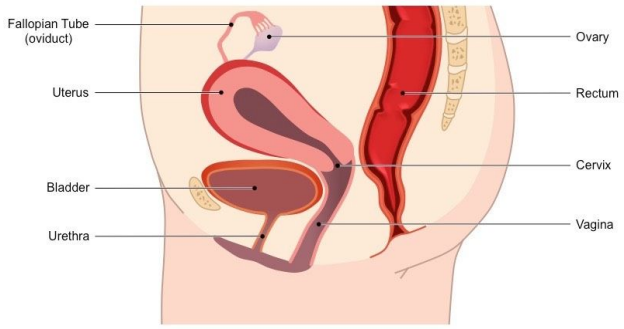




Structure	Function
Testis	production of sperms and testosterone
Epididymis	Site where the sperm matures and develops the ability to by motile
Vas Deferens	Long tube which connects the sperm from the testes to the prostate gland during ejaculation
Seminal Vesicle	Secretes fluid containing fructose - nourishes the sperm Mucus- protects the sperm and Prostaglandin- trigger uterine contractions
Prostate Gland	Secretes alkaline fluid to neutralize the vaginal acids
Urethra	Conducts the sperm from the prostate gland to the outside of the body via the penis

Female Reproductive System





Structure	Function
Ovary	oocytes mature prior to release and responsible for estrogen and progesterone secretion
Fimbria	fringe of tissue adjacent to an ovary that sweeps an oocyte into the oviduct
Oviduct	transports the oocyte to the uterus and the site of fertilization
Uterus	organ where a fertilized egg will implant and develop
Endometrium	mucous membrane lining of the uterus, it thickens in preparation for implantation or is otherwise lost
Vagina	Passage leading to the uterus by which the penis can enter (uterus protected by a muscular opening called the cervix)

MENSTRUAL CYCLE

It describes the recurring changes that occur within a female reproductive system to make pregnancy possible.

It lasts roughly 28 days and begins at puberty before ending at menopause.

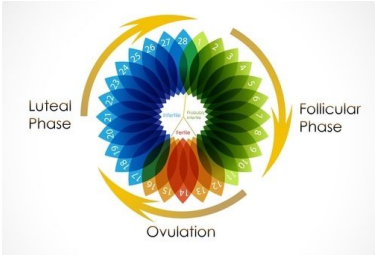
Hormones that take part in the menstrual cycle

Pituitary Hormones - FSH and LH

Ovarian Hormones - Estrogen and Progesterone

Hormone	Function
Follicle Stimulating Hormone	Stimulates follicle growth in ovaries Stimulates estrogen secretion
Leutenizing hormone	A surge causes ovulation Results in the formation of a Corpus Luteum
Estrogen	Thickens the endometrium Inhibits FSH and LH Stimulates the FSH and LH production pre-ovulation
Progesterone	Thickens the endometrium Inhibits FSH and LH

Key events in the menstrual cycle



Menstrual phase

- Shedding of the endometrium
- Low levels of estrogen and progesterone
- The egg isn't fertilized

Follicular phase

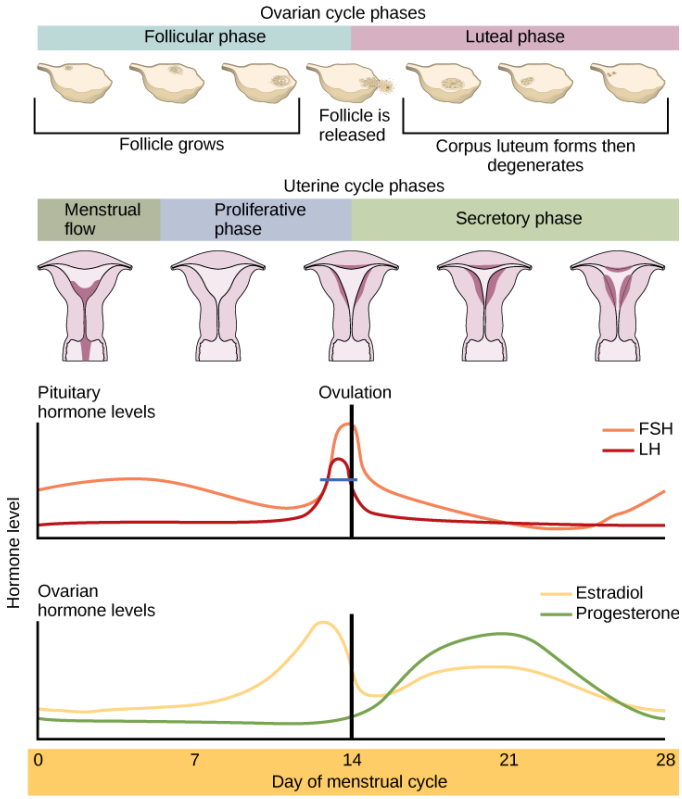
- Rising amounts of FSH are secreted
- Acts on the ovaries to promote the development of follicles, each one containing an egg.
- End of the cycle, ovaries secrete high levels of estrogen which causes the endometrium to thicken in the preparation of the fertilized egg.

Ovulatory Phase

- There is a release of LSH mid-way through the cycle
- This causes the mature follicle to bulge out from the surface of the ovary and burst, releasing the egg.
- The egg travels down the fallopian tube into the uterus.

Luteal Phase

- Ruptured follicle develops into a structure called the corpus luteum
- Corpus luteum secretes increasing amounts of progesterone which causes the endometrium to thicken further and prepare for embryonic development.



In vitro fertilization

It refers to the fertilization that occurs outside the body.

The key stages of IVF

Down-Regulation

Drugs are used to halt the regulation of hormones such as FSH, LH, Progesterone, and estrogen to control the timing and the quantity of egg production by the ovaries.

Superovulation

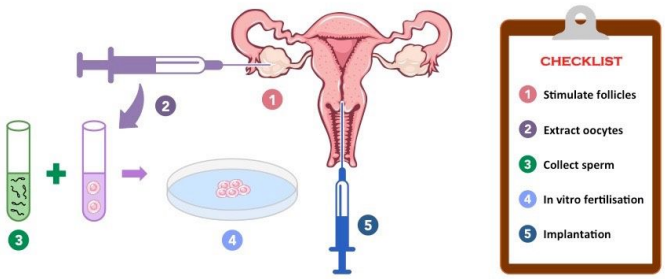
Artificial doses of hormones are used to develop and collect multiple eggs from the woman.

Fertilization

The eggs are incubated in the presence of a sperm sample from the male donor.

Implantation

The embryos are transferred into the uterus. Two weeks after the procedure, a pregnancy test is taken to determine if the process has been successful.



Ethical Considerations with IVF

- the quality of consent obtained from the parties
- the motivation of the parents
- the uses and implications of preimplantation genetic diagnosis
- the permissibility of sex-selection (or the choice of embryos for other traits)
- the storage and fate of surplus embryos.