Physiology of the Reproductive System

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Reproductive system

Embryologically, the human reproductive system is one of the last systems to begin formation, and hence one of the last to become mature. In fact, it is the only human system which does not mature and reach full function until ten or more years after birth. In both sexes, it develops as three parts:

a) The gonads, testicles (testes) or ovaries;
b) A series of ducts or tubes;
c) The external genitalia

Hormonal Control of the male reproductive System

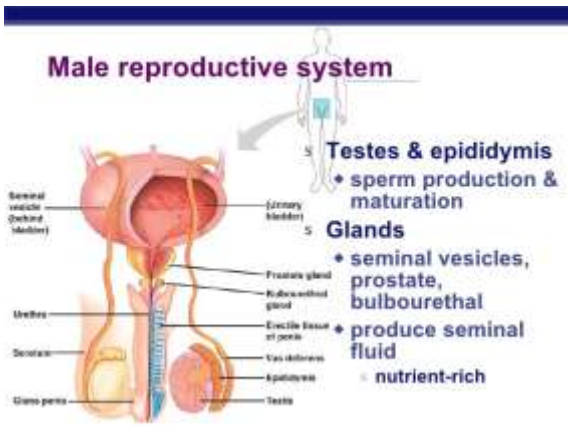
The male reproductive system is probably the more simple of the two. Sperm are produced in the testicles, then transported through the epididymis, vas deferens, and urethra to be deposited in the female reproductive tract during sexual intercourse, maturing along the way. Specialized cells in the testes also produce testosterone. Seminal vesicles and the prostate gland secrete the fluids which together with the sperm will form the semen

Hormonal Control of the male reproductive System

The penis contains erectile bodies which harden when they fill with blood, allowing the semen to be deposited deeply within the vagina of the female. Testosterone production, under the stimulus of luteinizing hormone, varies little from day to day. Millions of sperm are produced every day under the stimulus of follicle stimulating hormone. If ejaculation does not occur, these are simply lost into the urine

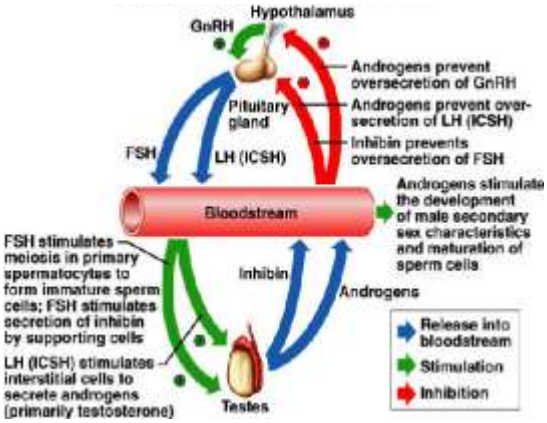
Hormonal Control of the male reproductive System

The hormonal system regulating male reproduction and sexuality is a carefully orchestrated interaction of brain and body. In order to keep it functioning optimally, men should eat a balanced diet, exercise regularly, and get at least eight hours of sleep each night



Hormonal Control of the male reproductive System

There are six major hormones involved in the male reproductive system. Gonadotropin Releasing Hormone (GnRH) is mainly made in the preoptic area of the hypothalamus from where it travels to the pituitary gland where it stimulates the synthesis and secretion of the gonadotropins, follicle-stimulating hormone and luteinizing hormone

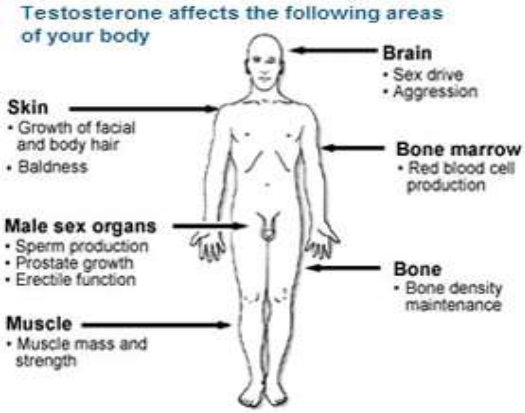


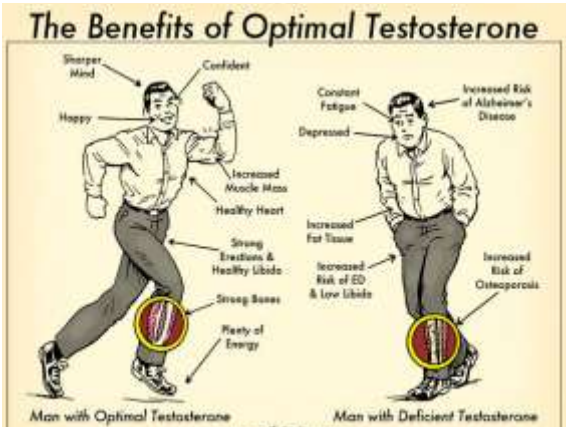
Hormonal Control of the male reproductive System

Follicle Stimulating Hormone (FSH) is released by the anterior pituitary gland. Its presence in males is necessary for the maturation of spermatozoa. Luteinizing Hormone (LH) is released by the anterior pituitary gland. In the testes, LH binds to receptors on Leydig cells, which stimulates the synthesis and secretion of testosterone. It also stimulates the testes to produce the hormone androgen

Hormonal Control of the male reproductive System

Testosterone is a steroid hormone from the androgen group and is found in humans and other vertebrates. In humans and other mammals, testosterone is secreted primarily by the testicles of males and, to a lesser extent, the ovaries of females. Small amounts are also secreted by the adrenal glands. It is the principal male sex hormone and an anabolic steroid. It acts as a negative feedback, going to the brain to slow the release of FSH and GnRH





Hormonal Control of the female reproductive System

The female reproductive system is functionally more complex. The ovaries produce oocytes (eggs) and secrete estrogen and progesterone. Sperm which are deposited in the vagina during sexual intercourse are transported through the uterus and oviducts (Fallopian tubes) to where one of them can fertilize the oocyte

Hormonal Control of the female reproductive System

The resulting zygote and early embryo are then transported by the oviduct to the uterus, where it implants for continued development and is nourished and supported before being expelled during childbirth. Unlike that of the male, the female reproductive system has a distinct cyclical pattern to its function

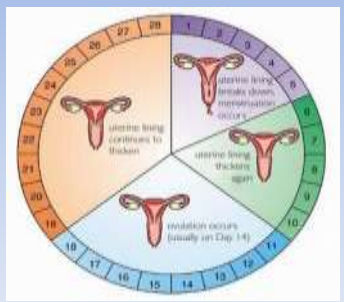
Hormonal Control of the female reproductive System

Under the stimulation of follicle stimulating hormone, only one or two oocytes are produced each month while the ovary produces estrogen. Luteinizing hormone triggers ovulation, then simulates the ovarian cells to switch to progesterone secretion

Hormonal Control of the female reproductive System

If fertilization and subsequent pregnancy do not occur, the inner lining of the uterus, where the embryo would have implanted, is sloughed off each month during menstruation. Also unlike the male, there is a rather abrupt cessation of reproductive function at menopause as the pituitary stops secreting its stimulatory hormones

Menstrual cycle

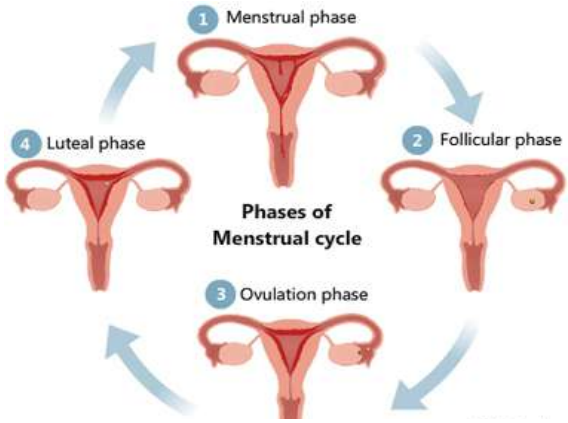


Menstrual cycle

The menstrual cycle is the scientific term for the physiological changes that can occur in fertile women for the purposes of sexual reproduction and fertilization. The menstrual cycle, under the control of the endocrine system

Menstrual cycle

Menstrual cycle divided into three phases: the follicular phase, ovulation, and the luteal phase; although some sources use a different set of phases: menstruation, proliferative phase, and secretory phase. Menstrual cycles are counted from the first day of menstrual bleeding



Menstrual cycle

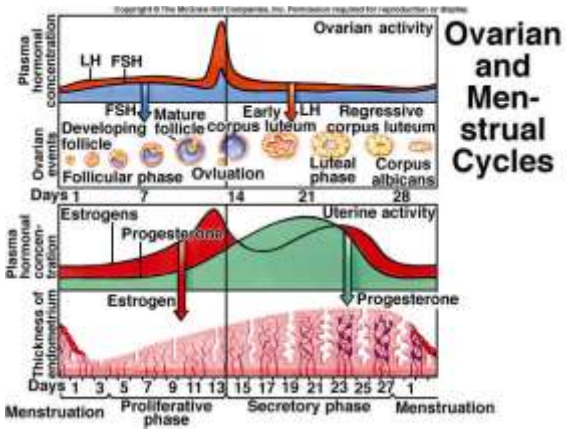
The follicular phase (or proliferative phase) is the phase of the menstrual cycle during which follicles in the ovary mature. It ends with ovulation. The main hormone controlling this stage is estradiol. During the follicular phase, follicle-stimulating hormone (FSH) is secreted by the anterior pituitary gland. FSH secretion begins to rise in the last few days of the previous menstrual cycle and is highest and most important during the first week of the follicular phase. The rise in FSH levels recruits five to seven tertiary-stage ovarian follicles (this stage follicle is also known as a Graafian follicle or antral follicle) for entry into the menstrual cycle. These follicles compete with each other for dominance

Menstrual cycle

FSH induces the proliferation of granulosa cells in the developing follicles, and the expression of luteinizing hormone (LH) receptors on these granulosa cells. Two or three days before LH levels begin to increase, usually by day seven of the cycle, one (or occasionally two) of the recruited follicles has emerged as dominant

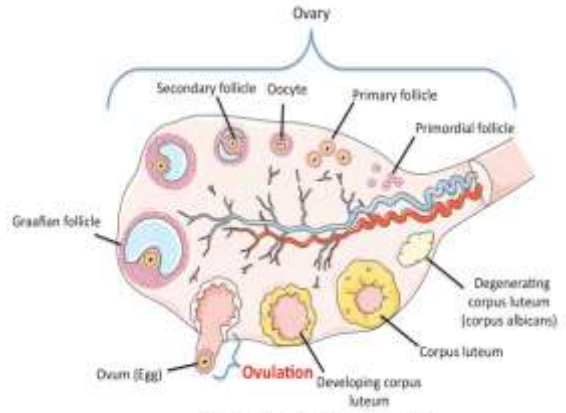
Menstrual cycle

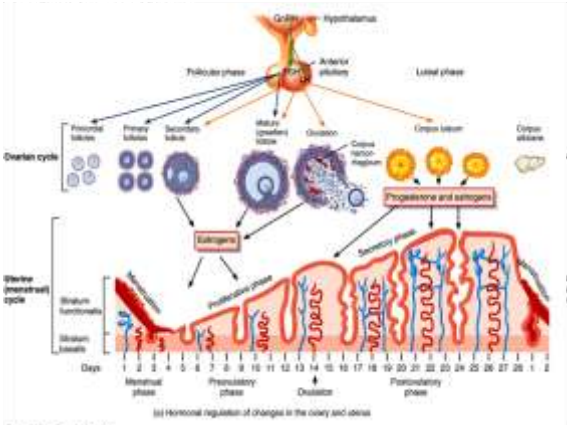
These high estrogen levels initiate the formation of a new layer of endometrium in the uterus. Crypts in the cervix are also stimulated to produce fertile cervical mucus that reduces the acidity of the vagina, creating a more hospitable environment for sperm. In addition, basal body temperature may lower slightly under the influence of high estrogen levels. Ovulation normally occurs 30 (± 2) hours after the beginning of the LH surge (when LH is first detectable in urine)



Ovulation

Ovulation is the process in female's menstrual cycle by which a mature ovarian follicle ruptures and discharges an ovum (also known as an oocyte, female gamete, or casually, an egg). Ovulation also occurs in the estrous cycle of other female mammals, which differs in many fundamental ways from the menstrual cycle. The time immediately surrounding ovulation is referred to as the ovulatory phase or the periovulatory period



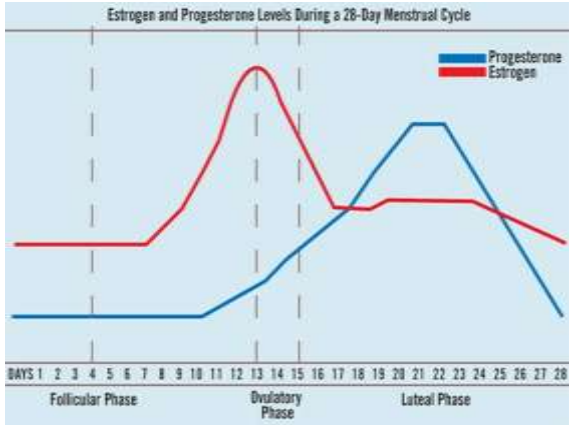


The Luteal Phase

The luteal phase (or secretory phase) is the latter phase of the menstrual or estrous cycle. It begins with the formation of the corpus luteum and ends in either pregnancy or luteolysis. The main hormone associated with this stage is progesterone, which is significantly higher during the luteal phase than other phases of the cycle. Some sources define the end of the luteal phase to be a distinct "ischemic phase"

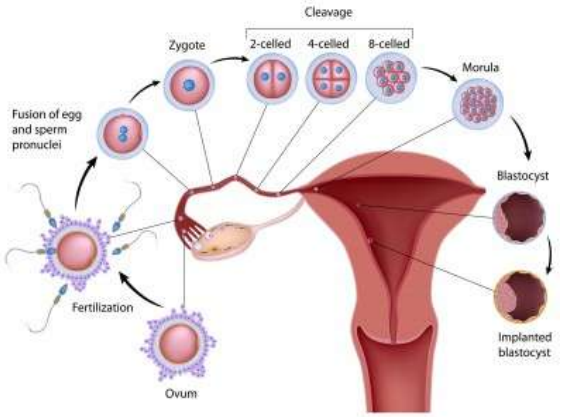
The Luteal Phase

After ovulation, the pituitary hormones FSH and LH cause the remaining parts of the dominant follicle to transform into the corpus luteum. It continues to grow for some time after ovulation and produces significant amounts of hormones, particularly progesterone, and, to a lesser extent, estrogen. Progesterone plays a vital role in making the endometrium receptive to implantation of the blastocyst and supportive of the early pregnancy; it also has the side effect of raising the woman's basal body temperature

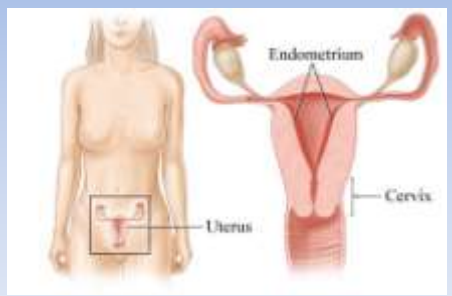


Menstrual cycle

The loss of the corpus luteum can be prevented by implantation of an embryo. After implantation, human embryos produce human chorionic gonadotropin (hCG), which is structurally similar to LH and can preserve the corpus luteum. Because the hormone is unique to the embryo, most pregnancy tests look for the presence of hCG. If implantation occurs, the corpus luteum will continue to produce progesterone (and maintain high basal body temperatures) for eight to twelve weeks, after which the placenta takes over this function



Continued endometrium during pregnancy



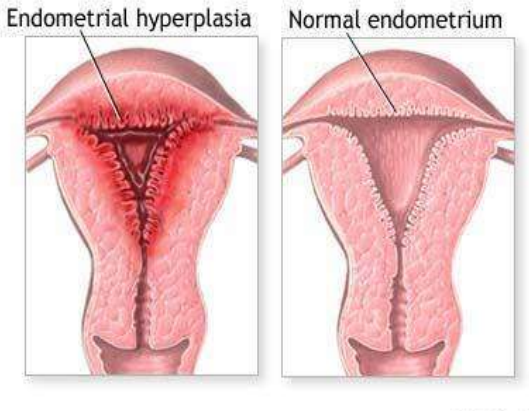
Continued endometrium during pregnancy

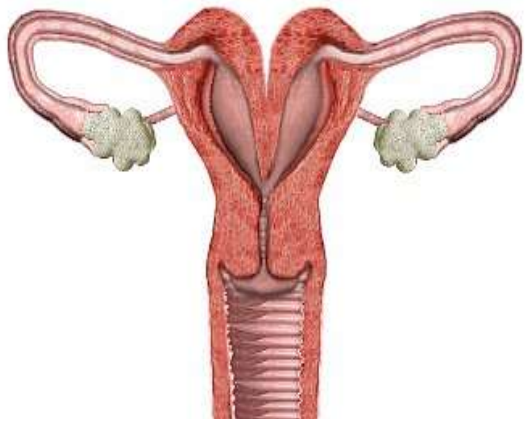
The endometrium consists of a single layer of columnar epithelium plus the stroma on which it rests. The stroma is a layer of connective tissue that varies in thickness according to hormonal influences. Simple tubular uterine glands reach from the endometrial surface through to the base of the stroma, which also carries a rich blood supply of spiral arteries

Continued endometrium during pregnancy

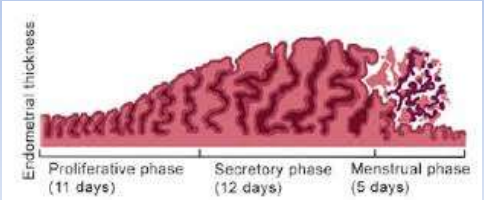
In a woman of reproductive age, two layers of endometrium can be distinguished. These two layers occur only in endometrium lining the cavity of the uterus, not in the lining of the uterine (Fallopian) tubes:

- The *functional layer* is adjacent to the uterine cavity. This layer is built up after the end of menstruation during the first part of the previous menstrual cycle. Proliferation is induced by estrogen (follicular phase of menstrual cycle), and later changes in this layer are engendered by progesterone from the corpus luteum (luteal phase). It is adapted to provide an optimum environment for the implantation and growth of the embryo. This layer is completely shed during menstruation.
- The *basal layer*, adjacent to the myometrium and below the functional layer, is not shed at any time during the menstrual cycle, and from it the functional layer develops





In the absence of progesterone, the arteries supplying blood to the functional layer constrict, so that cells in that layer become ischemic and die, leading to menstruation



Sexual intercourse

Sexual intercourse

Sexual intercourse, or coitus or copulation, is principally the insertion and thrusting of a male's penis, usually when erect, into a female's vagina for the purposes of sexual pleasure, reproduction, or both. This is also known as vaginal intercourse or vaginal sex

Sexual Response Cycle

The sexual response cycle refers to the sequence of physical and emotional changes that occur as a person becomes sexually aroused and participates in sexually stimulating activities, including intercourse and masturbation

Sexual Response Cycle

The sexual response cycle has four phases:

- excitement
- plateau
- orgasm
- resolution

Both men and women experience these phases, although the timing usually is different

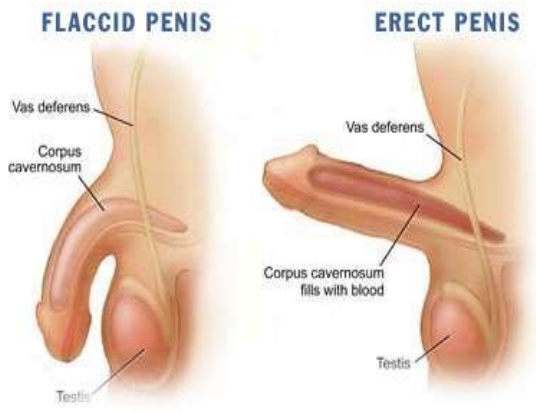
Excitement

Excitement occurs with physical and psychological stimulation (sight, sound, emotion etc.) that causes parasympathetic nerve stimulation. This leads to arterial dilation and venous constriction in the genital area. The resulting increased blood supply leads to vasocongestion and increasing muscular tension. In woman, this causes the clitoris to increase in size and mucoid fluid to appear on vaginal walls as lubrication. The vagina widens in diameter and increases in length. The nipples become erect

Excitement

In men : penile erection occurs, as well as scrotal thickening and elevation of the testes.

In both sexes, there is an increase in heart and respiratory rates and blood presuare



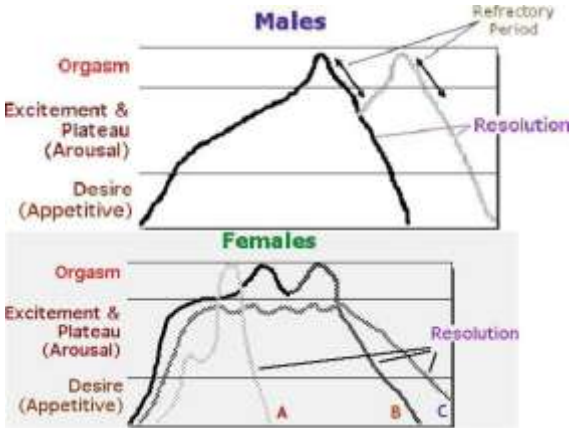
Plateau

The plateau stage is reached just before orgasm. In the woman, the clitoris is drawn forward and retracts under the clitoral prepuce; the lowest part of the vagina becomes extremely congested and there is increased nipple elevations.

In men: the vasocongestion leads to distention of the penis. Heart rate increases to 100 to 175 beats per minute and respiratory rate to approximately 40 respirations per minute

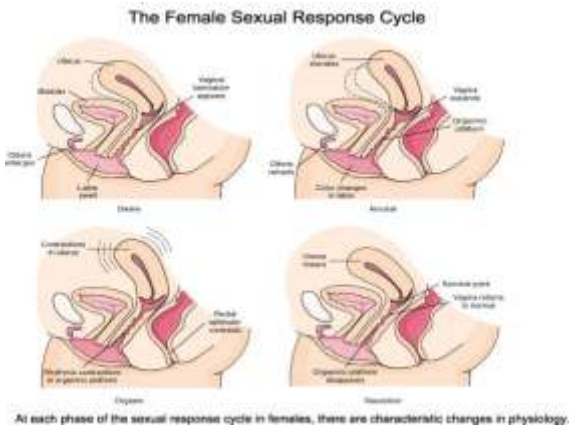
Orgasm

Orgasm occurs when stimulation proceeds through the plateau stage to a point at which the body suddenly discharges accumulated sexual tension. A vigorous contraction of muscles in the pelvic area expels or dissipates blood and fluid from the area of congestion. The average number for the woman is 8 to 15 contractions at intervals of one every 0.8 seconds. In men, muscle contractions surrounding the seminal vessels and prostate project semen into the proximal urethra. These contractions are followed immediately by three to seven propulsive ejaculatory contractions, occurring at the same time interval as in woman, which force semen from the penis

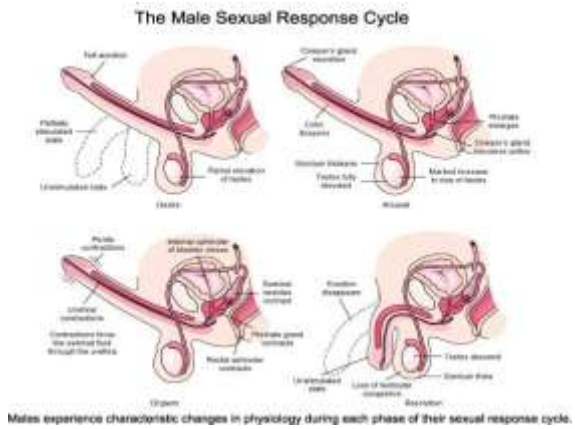


Resolution

Resolution is the period during which the external and internal genital organs return to an unaroused state. For the male, a refractory period occurs during which further orgasm is impossible. Women do not go through this refractory period, so it s possible for women to have additional orgasm immediately after the first. The resolution usually taken 30 min for both men and women

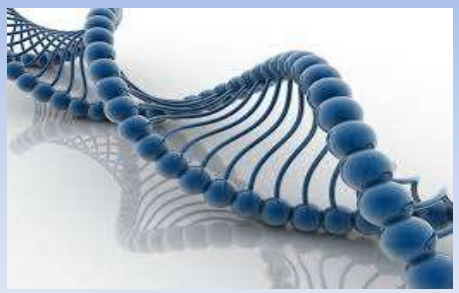


At each phase of the sexual response cycle in females, there are characteristic changes in physiology.

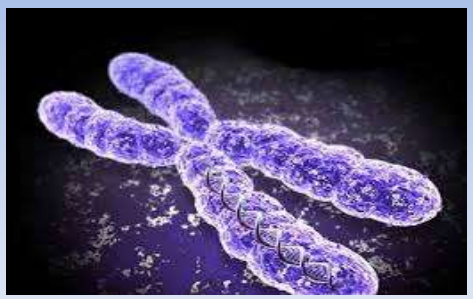


Males experience characteristic changes in physiology during each phase of their sexual response cycle.

Chromosomes, genes, genetic counseling

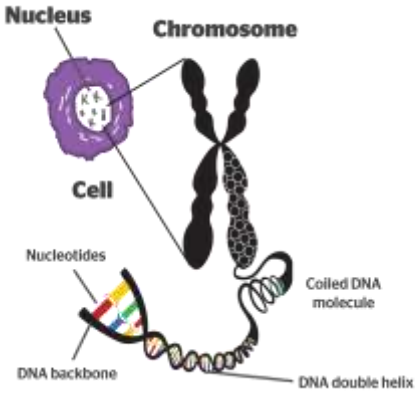


Chromosome



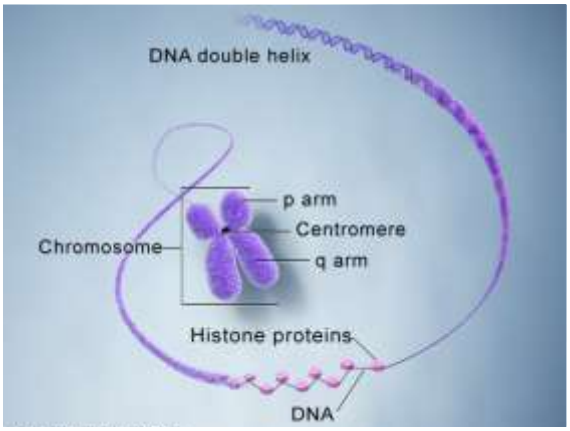
Chromosome

Chromosomes are thread-like structures located inside the nucleus of animal and plant cells. Each chromosome is made of protein and a single molecule of deoxyribonucleic acid (DNA). Passed from parents to offspring, DNA contains the specific instructions that make each type of living creature unique. The term chromosome comes from the Greek words for color (chroma) and body (soma). Scientists gave this name to chromosomes because they are cell structures, or bodies, that are strongly stained by some colorful dyes used in research



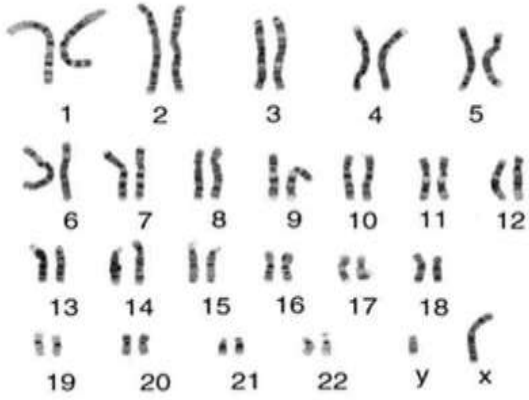
Chromosome

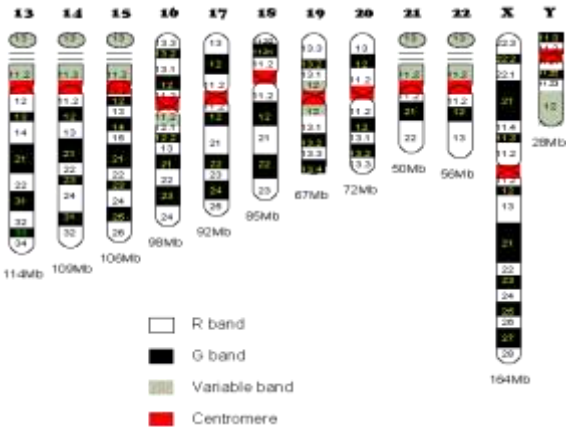
Each chromosome has a constriction point called the centromere, which divides the chromosome into two sections, or “arms.” The short arm of the chromosome is labeled the “p arm.” The long arm of the chromosome is labeled the “q arm.” The location of the centromere on each chromosome gives the chromosome its characteristic shape, and can be used to help describe the location of specific genes



Chromosome

Chromosomes in humans can be divided into two types: autosomes and sex chromosomes. Certain genetic traits are linked to a person's sex and are passed on through the sex chromosomes. The autosomes contain the rest of the genetic hereditary information. All act in the same way during cell division. Human cells have 23 pairs of chromosomes (22 pairs of autosomes and one pair of sex chromosomes), giving a total of 46 per cell. In addition to these, human cells have many hundreds of copies of the mitochondrial genome

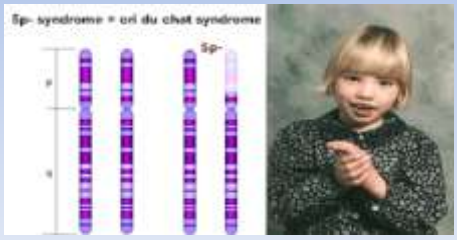




Chromosome

Chromosomal aberrations are disruptions in the normal chromosomal content of a cell and are a major cause of genetic conditions in humans, such as Down syndrome, although most aberrations have little to no effect. Some chromosome abnormalities do not cause disease in carriers, such as translocations, or chromosomal inversions, although they may lead to a higher chance of bearing a child with a chromosome disorder. Abnormal numbers of chromosomes or chromosome sets, called aneuploidy, may be lethal or may give rise to genetic disorders. Genetic counseling is offered for families that may carry a chromosome rearrangement

Cri du chat, which is caused by the deletion of part of the short arm of chromosome 5. "Cri du chat" means "cry of the cat" in French; the condition was so-named because affected babies make high-pitched cries that sound like those of a cat. Affected individuals have wide-set eyes, a small head and jaw, moderate to severe mental health problems, and are very short

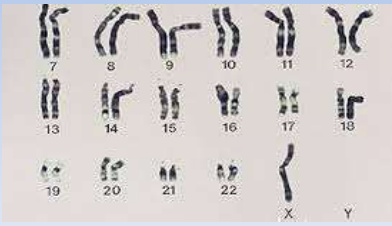


Down's syndrome, the most common trisomy, usually caused by an extra copy of chromosome 21 (trisomy 21). Characteristics include decreased muscle tone, stockier build, asymmetrical skull, slanting eyes and mild to moderate developmental disability

Edwards syndrome, or trisomy-18, the second most common trisomy. Symptoms include motor retardation, developmental disability and numerous congenital anomalies causing serious health problems. Ninety percent of those affected die in infancy. They have characteristic clenched hands and overlapping fingers

Klinefelter syndrome (XXY). Men with Klinefelter syndrome are usually sterile, and tend to be taller and have longer arms and legs than their peers. Boys with the syndrome are often shy and quiet, and have a higher incidence of speech delay and dyslexia. Without testosterone treatment, some may develop gynecomastia during puberty

Turner syndrome (X instead of XX or XY). In Turner syndrome, female sexual characteristics are present but underdeveloped. Females with Turner syndrome often have a short stature, low hairline, abnormal eye features and bone development and a "caved-in" appearance to the chest



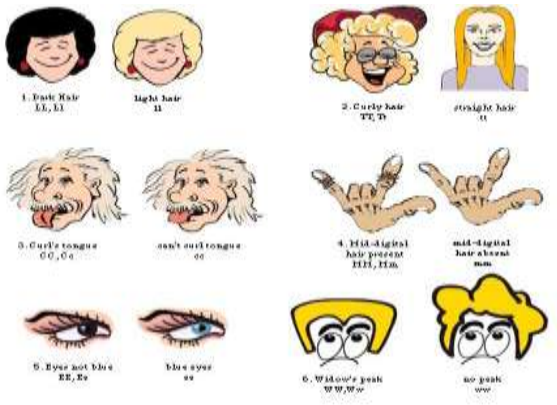
Gene

Gene

A gene is a locus (or region) of DNA that encodes a functional RNA or protein product, and is the molecular unit of heredity. The transmission of genes to an organism's offspring is the basis of the inheritance of phenotypic traits. Some genetic traits are instantly visible, such as eye colour or number of limbs, and some are not, such as blood type, risk for specific diseases, or the thousands of basic biochemical processes that comprise life

Gene

Genes can acquire mutations in their sequence, leading to different variants, known as alleles, in the population. These alleles encode slightly different versions of a protein, which cause different phenotype traits



Genetic counseling

Genetic counseling is the process by which the patients or relatives at risk of an inherited disorder are advised of the consequences and nature of the disorder, the probability of developing or transmitting it, and the options open to them in management and family planning. This complex process can be separated into diagnostic (the actual estimation of risk) and supportive aspects

Genetic counseling

The National Society of Genetic Counselors (NSGC) officially defines genetic counseling as the understanding and adaptation to the medical, psychological and familial implications of genetic contributions to disease. This process integrates:

- Interpretation of family and medical histories to assess the chance of disease occurrence or recurrence.
- Education about inheritance, testing, management, prevention, resources
- Counseling to promote informed choices and adaptation to the risk or condition

Families or individuals may choose to attend counseling or undergo prenatal testing for a number of reasons

- Family history of a genetic condition or chromosome abnormality
- Molecular test for single gene disorder
- Increased maternal age (35 years and older)
- Increased paternal age (40 years and older)
- Abnormal maternal serum screening results or ultrasound findings
- Increased nuchal translucency measurements on ultrasound
- Strong family history of cancer
- Predictive testing for adult-onset conditions

Prenatal genetic counseling

If an initial noninvasive screening test reveals a risk to the baby, clients are encouraged to attend genetic counseling to learn about their options. Further prenatal investigation is beneficial and provides helpful details regarding the status of the fetus, contributing to the decision-making process. Decisions made by clients are affected by factors including timing, accuracy of information provided by tests, and risk and benefits of the tests. Counselors present a summary of all the options available. Clients may accept the risk and have no future testing, proceed to diagnostic testing, or take further screening tests to refine the risk. There is often no therapy or treatment available for these conditions, and as such parents may choose to terminate the pregnancy