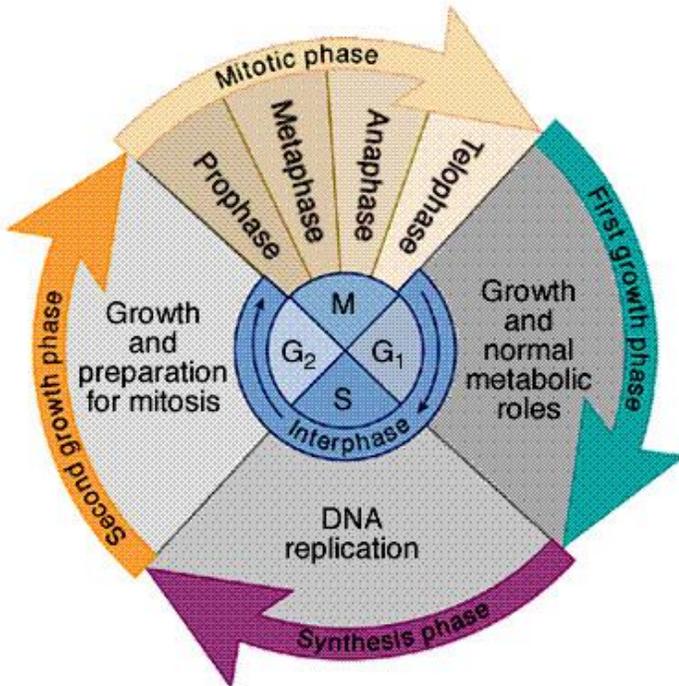


Unit II - Reproduction and Development

The cell cycle is divided into two parts:

- A) growth stage
- B) division stage

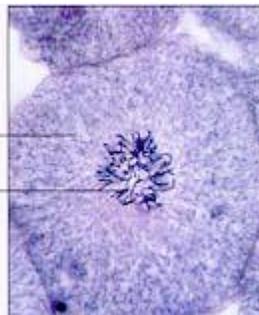
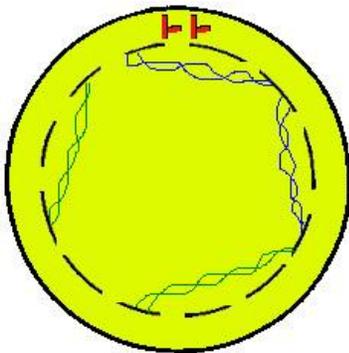


Mitosis – produces 2 daughter cells with the same number of chromosomes as the original parent.

Ex. Humans have 46 chromosomes. A human cell that undergoes mitosis will produce 2 identical cells both with 46 chromosomes

Why is mitosis important?

1. new cells are needed for growth maintenance and repair
 2. cells can regenerate damaged tissues(cuts)
 3. cells that do not function properly must be replaced
 4. cells die (blood cells)
 5. chromosome number must be maintained
- The stages of the cell cycle can be broken down into five stages:
 - Interphase, Prophase, Metaphase, Anaphase, Telophase
 - *As Noted: above Interphase involves normal day to day cellular activity.*



Prophase - the first stage of mitosis.

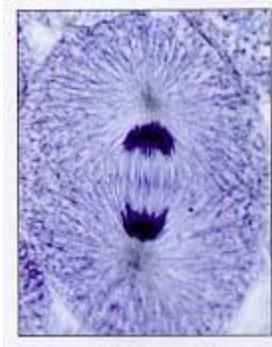
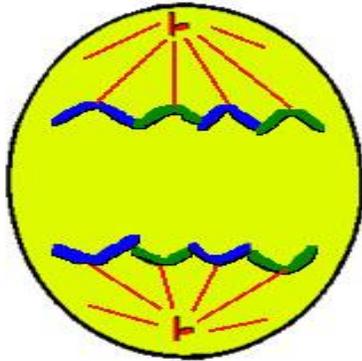
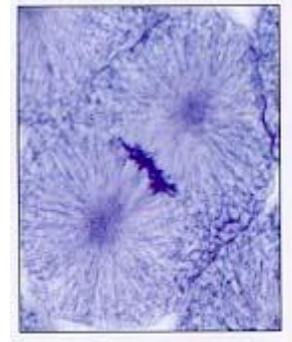
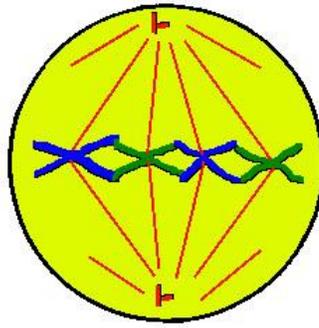
- The chromosomes condense and become visible
- The centrioles form and move toward opposite ends of the cell ("the poles")
- The nuclear membrane dissolves
- The mitotic spindle forms (from the centrioles in animal cells)

Spindle fibers from each centriole attach to each sister chromatid at the kinetochore

Metaphase

- The Centrioles complete their migration to the poles

The chromosomes line up in the middle of the cell ("the equator")



Anaphase

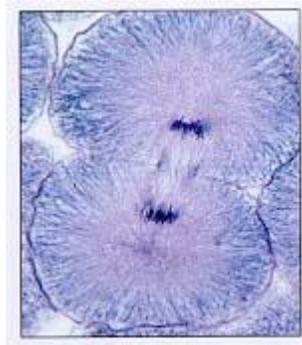
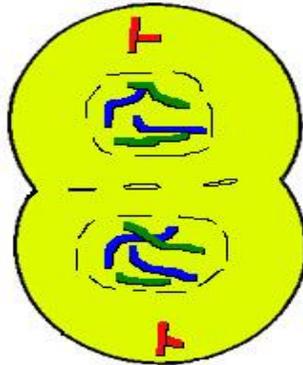
- Spindles attached to kinetochores begin to shorten.
- This exerts a force on the sister chromatids that pulls them apart.
- Spindle fibers continue to shorten, pulling chromatids to opposite poles.

This ensures that each daughter cell gets identical sets of chromosomes

Telophase

- The chromosomes de-condense
- The nuclear envelope forms

Cytokinesis reaches completion, creating two daughter cells



Cytokinesis

This is defined as the separation of the cytoplasm and the formation of two new daughter cells.

- cytoplasm and all its contents divide between the two halves of the cell.
- In animal cells an indentation of the membrane between two daughter cells forms and deepens.
- In plant cells, a new cell wall and membrane form and separate the newly formed nuclei.

Meiosis

definitions:

- **Allele** - alternate forms of the same gene
 - **Homozygous** - having two identical alleles for a given gene
 - **Heterozygous** - having two different alleles for a given gene
 - **Genotype** - genetic makeup of an organism
 - **Phenotype** - the expressed traits of an organism
-

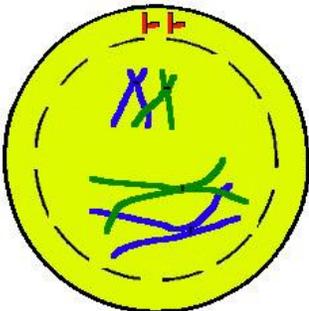
- Meiosis Is a Special Type of Cell Division That Occurs in Sexually Reproducing Organisms
 - Meiosis reduces the chromosome number by half, enabling sexual recombination to occur.
 - Meiosis of diploid cells produces haploid daughter cells, which may function as gametes.
 - Meiosis and fertilization introduce genetic variation in three ways:
 - Crossing over between homologous chromosomes at prophase I.
 - Independent assortment of homologous pairs at metaphase I:
 - Each homologous pair can orient in either of two ways at the plane of cell division.
 - The total number of possible outcomes = 2^n (n = number of haploid chromosomes).
 - Random chance fertilization between any one female gamete with any other male gamete.

The stages of meiosis can be broken down into two main stages, **Meiosis I** and **Meiosis II**

- **Meiosis I** can be broken down into four sub stages: Prophase I, Metaphase I, Anaphase I and Telophase I
 - **Meiosis II** (similar to mitosis) can be broken down into four sub stages: Prophase II, Metaphase II, Anaphase II and Telophase II
-

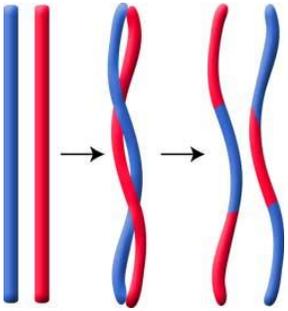
Meiosis I

Prophase I - most of the significant processes of Meiosis occur during Prophase I



- The chromosomes condense and become visible
- The centrioles form and move toward the poles
- The nuclear membrane begins to dissolve
- The homologs pair up, forming a tetrad
 - Each tetrad is comprised of four chromatids - the two homologs, each with their sister chromatid
- Homologous chromosomes will swap genetic material in a process known as **crossing over**

Crossing over serves to **increase genetic diversity** by creating four unique chromatids

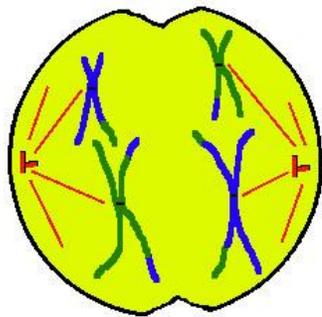
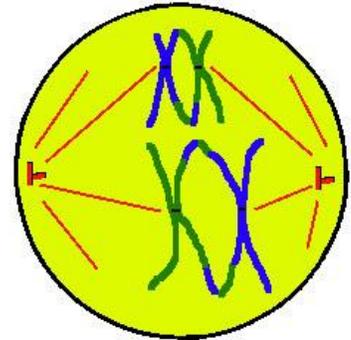


- Genetic material from the **homologous chromosomes** is randomly swapped
- This creates four unique chromatids
- Since each chromatid is unique, the overall genetic diversity of the gametes is greatly increased

Metaphase I

- Microtubules grow from the centrioles and attach to the centromeres

The tetrads line up along the cell equator



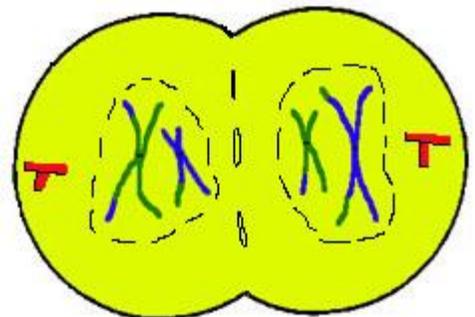
Anaphase I

- The centromeres break and **homologous chromosomes** separate (note that the **sister chromatids** are still attached)

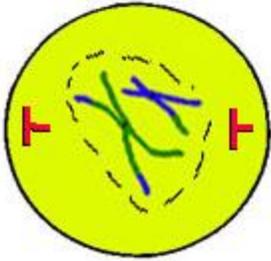
Cytokinesis begins

Telophase I

- The chromosomes may de-condense (depends on species)
- Cytokinesis reaches completion, creating **two haploid daughter cells**

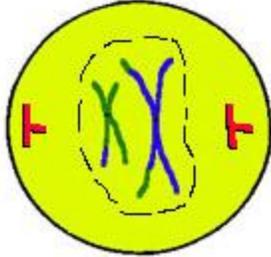


Meiosis II



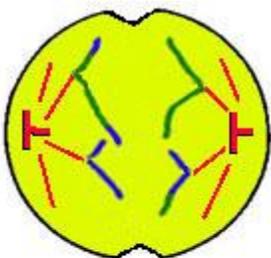
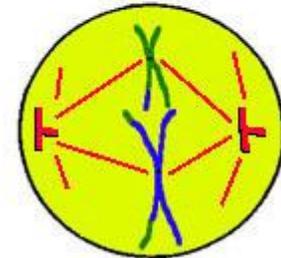
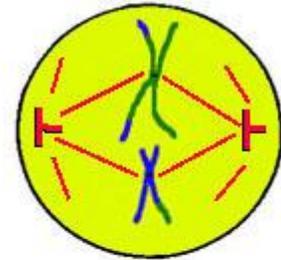
Prophase II

- Centrioles form and move toward the poles
- The nuclear membrane dissolves.



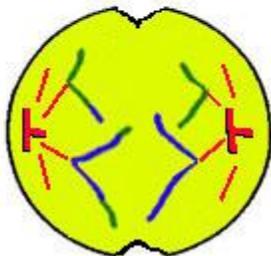
Metaphase II

- Microtubules grow from the centrioles and attach to the centromeres
- The sister chromatids line up along the cell equator



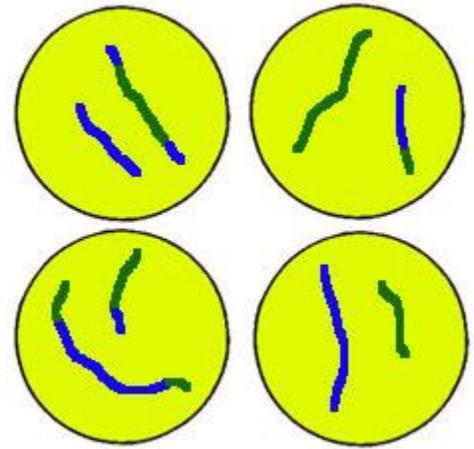
Anaphase II

- The centromeres break and **sister chromatids** separate
- Cytokinesis begins

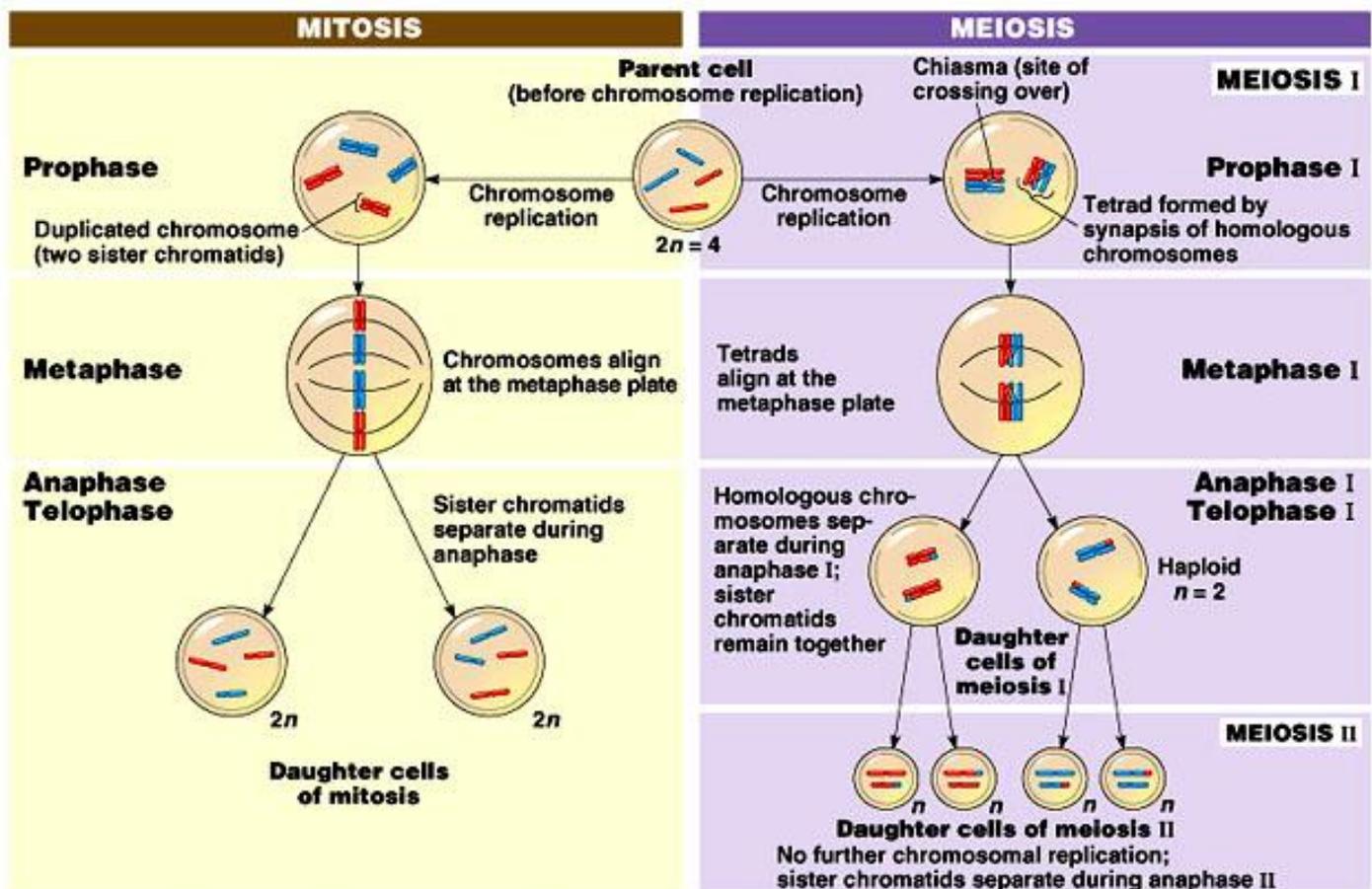


Telophase II

- The chromosomes may de-condense (depends on species)
- Cytokinesis reaches completion, creating **four haploid daughter cells**

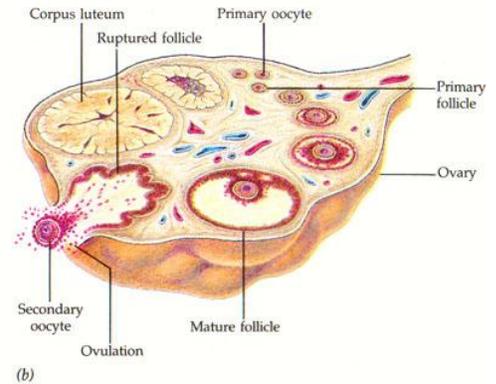
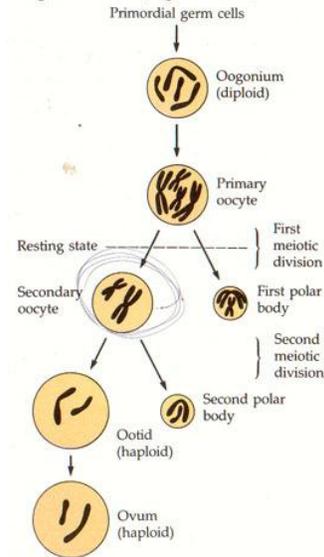


A Comparison between Mitosis and Meiosis



Oogenesis:

Oogenesis (Figure 42.14)



- occurs in the ovaries
- process begins with a diploid cell called the oogonium which enlarges and undergoes meiosis I and II.
- at the end of meiosis I the cytoplasm is not equally divided between the daughter cells
- the cell that receives most of the cytoplasm is called the primary oocyte. The other cell is called a polar body and is not a viable sex cell.
- as the primary oocyte undergoes meiosis II, the cytoplasm is again unequally divided. Only one cell becomes an egg or an ovum and contains most of the cytoplasm.
- the purpose of unequal division is to provide the ovum with sufficient nutrients to support the zygote in the first few days following fertilization.
- meiosis I begins in ovarian tissue before birth and does not continue past prophase I
- continuation of meiosis I occurs after puberty and usually in one oogonium per month
- meiosis II takes place after fertilization by a sperm cell
- production of ova (two or more egg cells) in females continues from the start of puberty until menopause which usually occurs between 40 and 50

Egg cells - contain X chromosome

Spermatogenesis

- begins at puberty
- starts with the spermatogonia, dividing mitotically to produce a small clone of diploid (46XY) cells termed spermatocytes.
- spermatocytes undergo two meiotic divisions, first division, produces two haploid cells (23X or 23Y) known as secondary spermatocytes. Almost immediately, a second meiotic division takes place in which the two chromatids that make up a single chromosome separate. These haploid cells, thus, contain 23 single half chromosomes and are called spermatids.
- Spermatids develop an acrosome (essential for fertilization) at the head and a tail for movement
- Move to the seminiferous tubule. This whole process of spermatogenesis takes approximately 74 days and about 300–600 sperm/gram of testis are produced each second. Not all survive.

Sperm cells - contain X or Y

Comparison of Sperm and Egg – See Chart on page 478

Do Core STSE # 2 - Stem cells

I. Stem cells - blank slates of the human body - undifferentiated (non-specialized) cells that can give rise to any type of cell , from a nerve cell to a white blood cell.

II. Cell transplant- transplanting stem cells to replace damaged cells (e.g. Pancreatic islet cells)

III. Cancer Treatment

Radiation and chemotherapy:

Cancer cells divide more rapidly than any other type of body cells. Therefore, anything that interferes with cell division will affect cancer cells more than healthy cells. This is the basis for radiation and chemotherapy.

Radiation therapy:

- directs radiation such as x-rays are gamma rays at the affected part of the body.
- usually treated two to three times per week
- internal radiation therapy involves placing radioactive material next to the cancerous growth
- generally radiation therapy works by damaging the chromosomes in a cell. Then it cannot divide.
- healthy cells are also damaged but many are able to repair themselves.
- goal of radiation therapy is to focus the radiation on the diseased part of the body and avoid affecting healthy tissue.
- usually used on localized cancerous tumors such as on the skin, breast , larynx , and cervix.

Chemotherapy:

- may include one or more types of drugs depending on the patient and the cancer.
- may be used in conjunction with radiation or on its own.
- some drugs attack dividing cells as they divide or prevent cells from dividing
- chemotherapy affects the entire body and is usually used to treat cancers that are spread throughout the body such as leukemia. Unfortunately , healthy cells are affected

Side effects of radiation

- skin inflammation and fatigue
- specific side effects depending on location of treatment e.g.: brain - hair loss, testicular cancer - sterility

Side effects of chemotherapy:

- hair loss , nausea , diarrhea

IV. Spinal Cord Injury

- are the results of accidents that disrupt nerve signals to the brain and peripheral nervous system. Presently, there is no successful method for curing spinal cord injuries.
- Most promising cures involve stem cells
- Immediate treatment with certain steroid class drugs can less the damage due to the inflammatory response following the injury

V. Cloning – two types : Therapeutic cloning - culturing of human cells for use in treatment of medical disorders and Reproductive cloning -the development of a cloned human embryo for the purpose of developing a cloned human being

Modes of reproduction (see handout)

Asexual -one parent cell divides by mitosis to produce 2 identical cells which are clones of the parent

- Budding - an outgrowth on the parent organism, develops into a new organism that separates from the parent., ex yeast and hydra
- Binary fission - parent DNA is copied mitotically and original cell splits into two smaller, genetically identical cells., ex bacteria
- Spore production - spores are produced mitotically and released from a single structure that is the remains of the original parent cell from which the spores came. ,ex Fungi like. Rhizopus
- Fragmentation - Piece of the parent organism breaks off and is dispersed. Each section is able to form a new organism. ex. House plants formed from cuttings
- Parthenogenesis -offspring are produced from unfertilized eggs. ex. Fleas and aphids

Sexual reproduction - new offspring are the result of the fusion of egg and sperm nuclei. The offspring resemble but are not identical to the parents.

Sexual reproduction in angiosperm flowering plants:

Flower Parts:

Pistil (carpel)- Female reproductive organ and consists of the stigma, style ovary and ovules.

Stamen- Male reproductive organ, it consists of the anther, filament and pollen.

Sepals-surround and protect the flower bud.

Petals-colourful structures that attract pollinators.

Female flower parts:

Stigma-sticky lip of the carpel that captures pollen grains.

Style- Stalk that supports the stigma

Ovary- swollen base of the carpel that contains the ovules

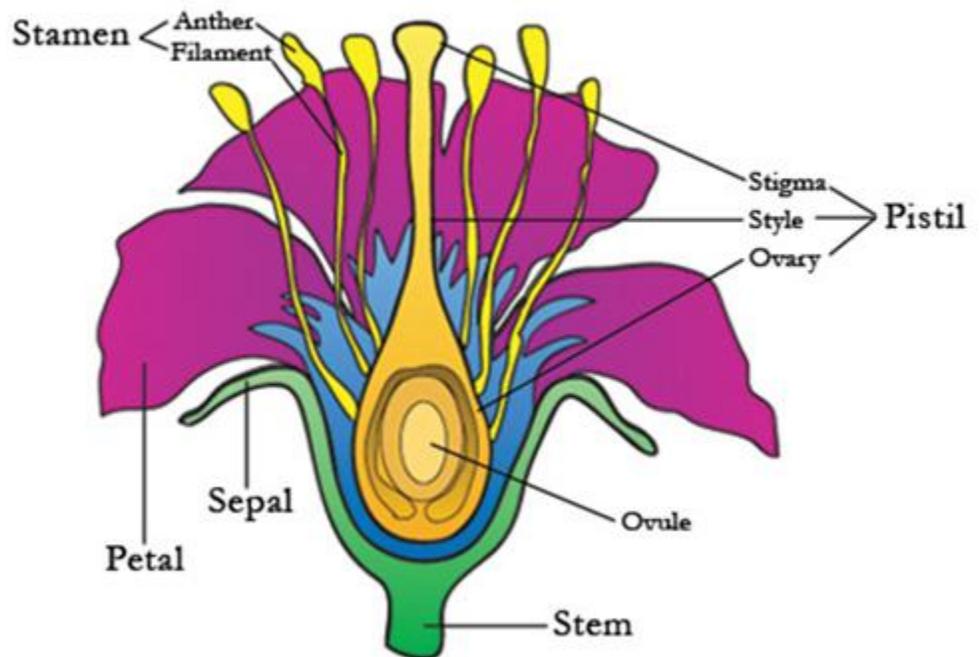
Ovules- sacs that contain female gametes.

Male Flower parts:

Anther- the place where pollen is produced and stored

Pollen- cases that contain male gametes.

Filament- stalk that supports the anther.



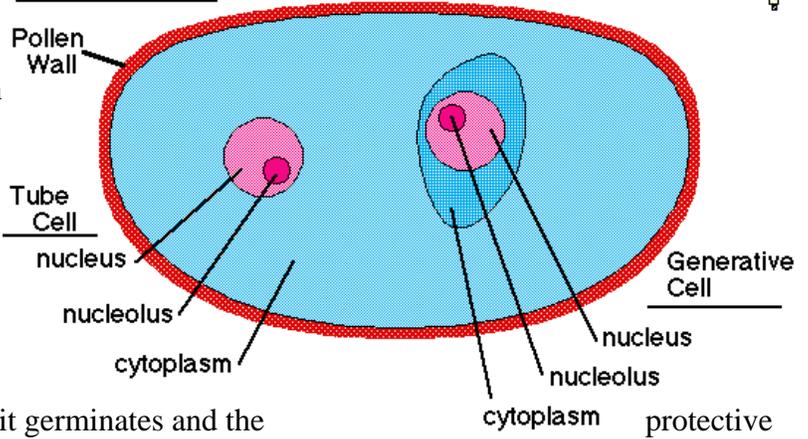
******Core Lab #4: “Reproductive Structures in Flowers”, pp. 176-177******

Fertilization in flowers

- Haploid spores are produced by meiosis within the anthers.
- Spores undergo mitosis once developed into pollen grains. Therefore two haploid cells are found inside each pollen grain. One cell is called a tube cell and the other a generative cell (which will contain two sperm nuclei)

- Every ovule in the ovary has a micropyle (small opening for the pollen tube). Also every ovule is connected to the ovary by a short stalk.
- In each ovule, meiosis of a single cell results in four haploid spores. Three of these spores die and the remaining spore undergoes mitosis three times.

Pollen Grain



Fertilization Steps

(1) Pollen grain reaches the stigma of a flower it germinates and the coat of the pollen grain breaks open.

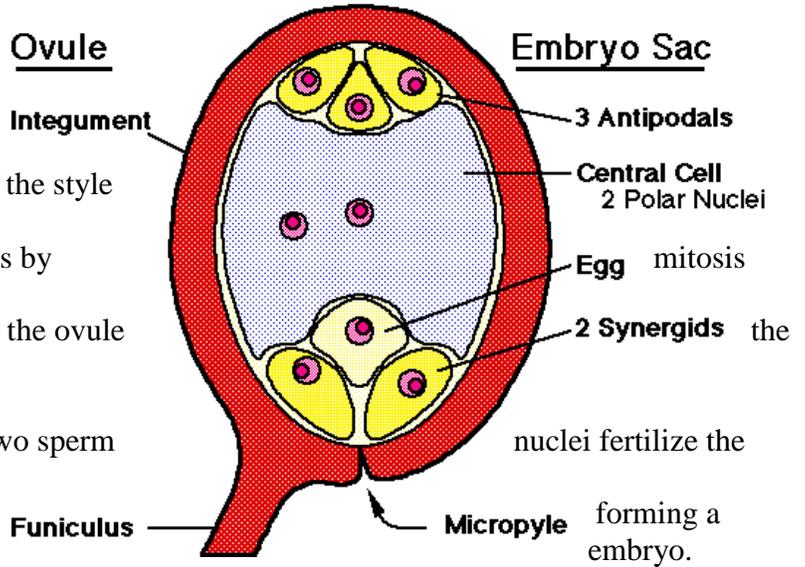
(2) Chemicals in the stigma cause an extension of the cytoplasm and becomes a structure called a pollen tube. The tube grows through the cells of the style towards the ovary.

(3) As the tube grows, the generative cell divides by forming two haploid nuclei.

(4) When the pollen tube reaches the opening to the ovule end of the tube pushes through the ovule wall and it breaks open.

(5) The tube cell nucleus disintegrates and the two sperm nuclei in the ovule.

(6) One sperm nuclei fertilizes the egg diploid zygote which will eventually form an



Male Human Reproductive System:

- Testes-produces sperm and reproductive hormones
- They hang outside the body cavity within the scrotum so that they have a cooler temperature for the formation of healthy sperm.

Scrotum-sac that contains the tests outside the body.

Seminiferous tubules-long coiled tubules where spermatogenesis occurs.

Epididymis- as sperm are formed they move to the epididymis where they mature and become motile.

Sperm duct (vas deferens) - the tube that leads upward from the testes into the abdominal cavity where it joins the urethra.

Cowper's gland and prostate gland -produce an alkaline fluid which neutralizes acids in the female reproductive tract and the urethra of male

Seminal vesicles -provide a mucus like fluid containing fructose which provides energy for the sperm.

Reproductive hormones of the human male :

(1) **FSH (follicle stimulating hormone)** - stimulates spermatogenesis from the anterior pituitary

(2) **Inhibin**- released by the somniferous tubules and forms a negative feedback loop with FSH. It acts on the hypothalamus to slow the production of releasing factors that control the release of FSH. Interaction of inhibin and FSH controls the rate of formation of sperm.

(3) **Luteinizing hormone (LH)**- also from anterior pituitary, stimulates the interstitial cells of the testes that surrounds the somniferous tubules to produce male sex hormones.

(4) **Testosterone** - the major androgen (male sex hormone) and is responsible for the development of male secondary characteristics

-enlargement of penis and testes

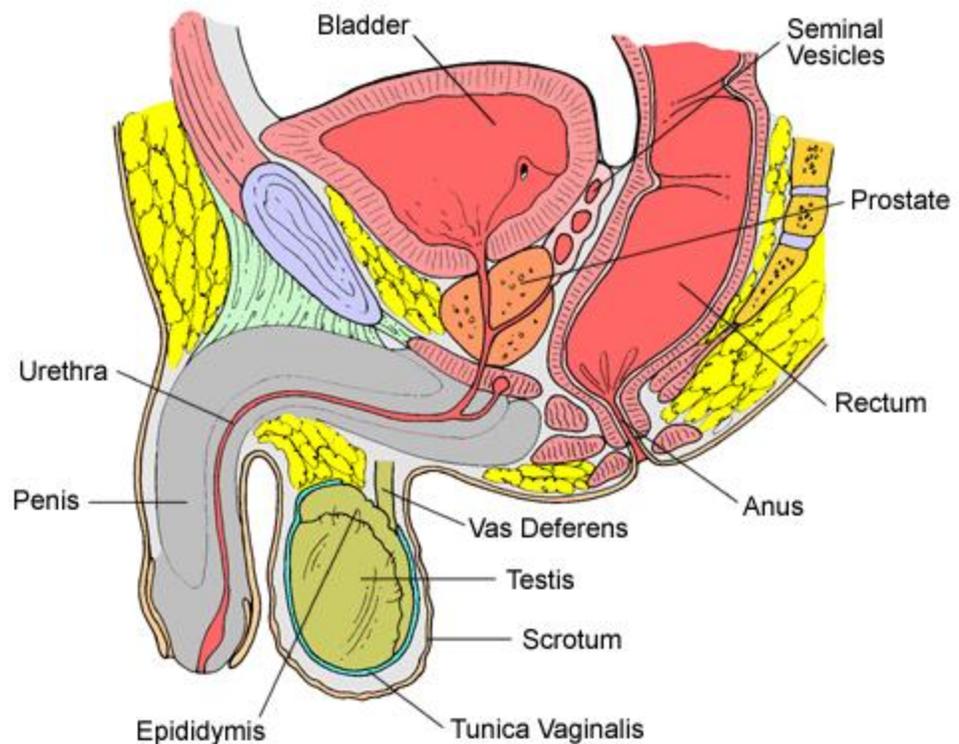
-enlargement of the larynx (Adams apple)

-inhibits fat and promotes development of muscle tissue.

-stimulates formation of the face, chest, underarms and genitals

*levels of testosterone in the blood inhibit the production of LH.

Male Reproductive Tract



Female Reproductive System:

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Female Reproductive Organs (2)

Ovary-production of female gametes (ova)

Follicles-tiny egg sac in ovary. They are composed of many groups of cells, each of which contains a single ovum.

Oviduct (Fallopian tube)

- tube which carries the egg into the uterus or womb.

The lining of each tube is ciliated to create a current that moves the egg toward the uterus.

Ova are released from different parts of the ovaries so the openings of the oviducts consist of finger like

projections called **fimbriae**

which sweep over the ovaries. They are also ciliated to sweep an ovum into an oviduct for its trip to the uterus.

Uterus -fist sized organ with thick muscular walls; receives a fertilized egg for further development (embryo implants inside the uterus)

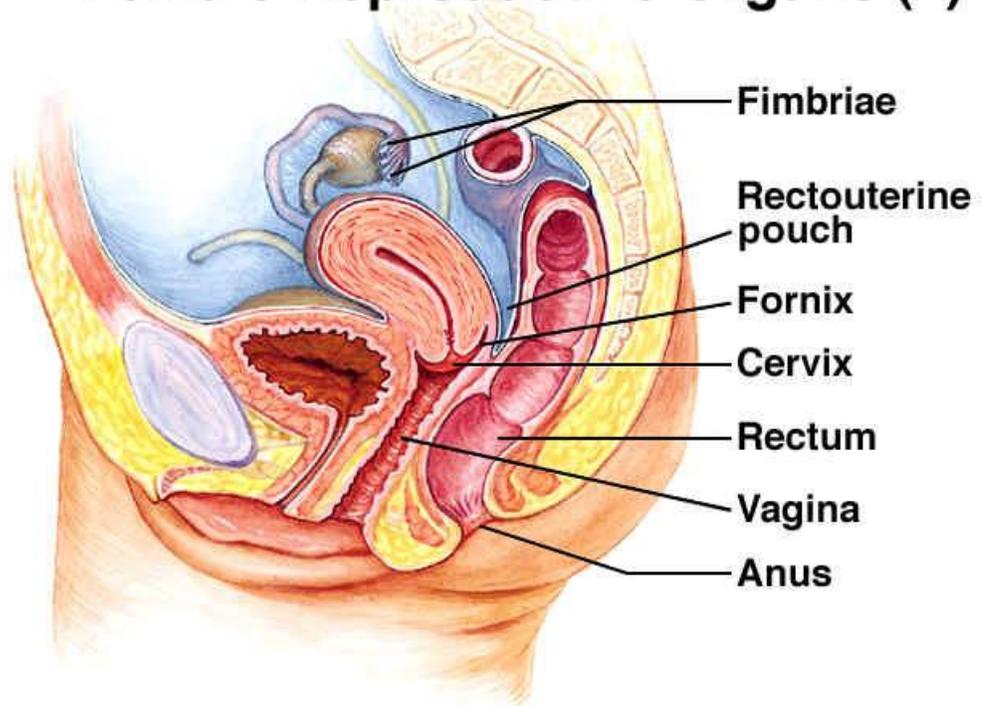
Endometrium-lining of the uterus containing many blood vessels that can nourish the developing embryo. It is affected by the changing hormone levels during menstruation.

Cervix-forms the opening or exit to the uterus.

Vagina-what the cervix extends downward into-the birth canal and leads to the outside of the female body.

Note: human female has two separate openings for urinary and reproductive function, Also the vagina has two functions:

- (1) Allows entry of sperm into female body
- (2) Exit of baby during birth



Menstrual Cycle

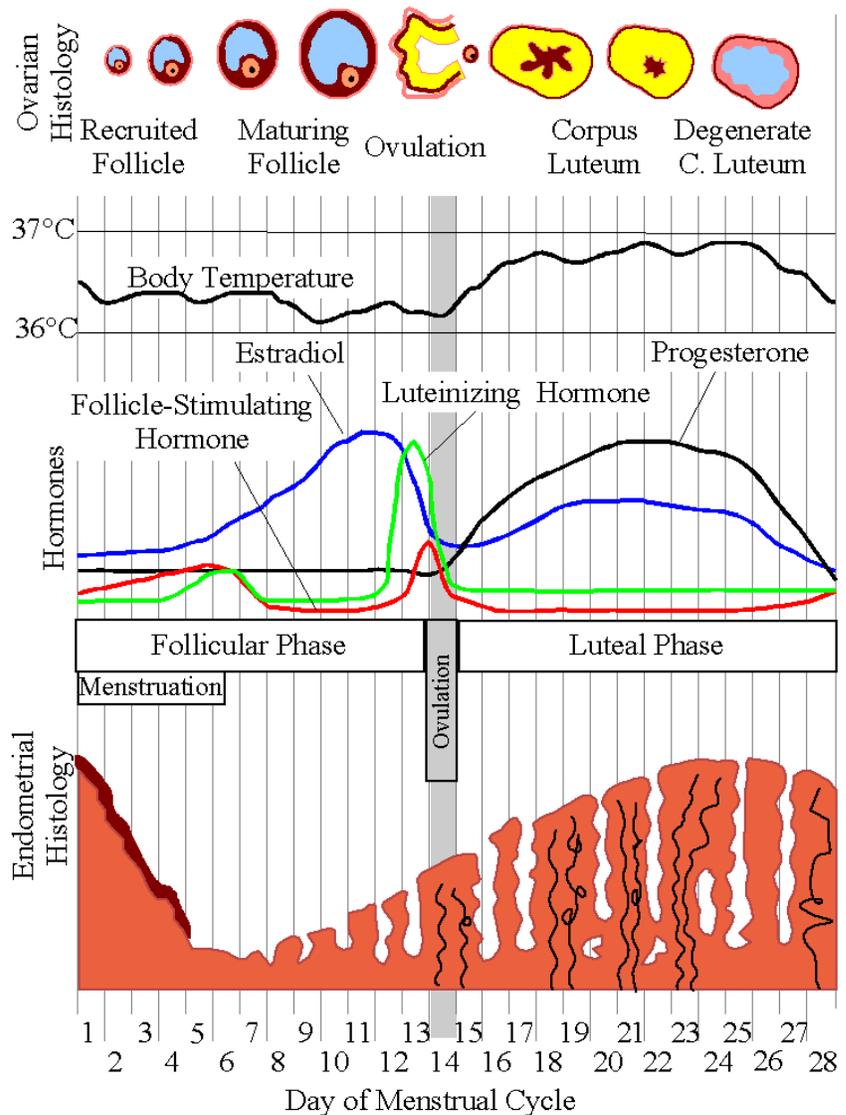
Hormones of the Menstrual Cycle

Ovaries secrete:

- Two sex hormones play a role in the control of the menstrual cycle: estrogen and progesterone:
- Estrogen peaks twice, during follicular growth and during the luteal phase.
- Progesterone remains virtually absent prior to ovulation, but becomes critical in the luteal phase and during pregnancy.
- After ovulation the corpus luteum — which develops from the ruptured follicle and remains in the ovary — secretes mostly progesterone.

Hypothalamus and pituitary secrete:

- FSH and LH
- FSH stimulates immature follicles in the ovaries to grow.
- LH triggers ovulation.



(Average values. Durations and values may differ between different females or different cycles.)

*******Do Core Lab - The Menstrual Cycle*******

Sexually Transmitted Infections

1. AIDS and HIV

- AIDS- acquired immunodeficiency syndrome
- caused by the virus HIV and attacks helper T cells of the immune system
- low helper T cells in blood leaves person susceptible to a variety of diseases and usually leads to
- sickness and death

Transmission of HIV:

- vaginal or rectal intercourse
- oral/genital contact
- sharing needles among intravenous drug users
- blood transfusions (today blood is screened)
- children of mothers who are infected with HIV may be infected before or during birth

2. Hepatitis B

- an inflammation of the liver due to the Hepatitis B virus
- Transmission results from exposure to infectious blood or body fluids containing blood.

Possible forms of transmission include (but are not limited to) unprotected sex, blood transfusions, contaminated needles and child

3. Chlamydia

- caused by bacteria
- men experience burning during urination and discharge from the penis. Women may have vaginal discharge and symptoms of urinary tract infection including pain on urination and fever
- one of the main dangers of Chlamydia is that 75% of cases are asymptomatic which means that many sufferers do not have any symptoms until irreversible damage is done
- if undetected, women may develop sores on the cervix and oviducts, the patient may develop pelvic inflammatory disease (PID) which is painful and may lead to blocked oviducts.
- if a baby comes in contact with Chlamydia during birth it can develop inflammation of the eyes or pneumonia

4. Genital herpes

- caused by herpes simplex 1 (HSV1) or herpes simplex 2 (HSV2)
- HSV 1-commonly causes cold sores and fever blisters on the mouth
- HSV 2 -likely acquired through sexual contact and may cause genital herpes

5. Syphilis

- curable STI caused by. The route of transmission of syphilis is almost always by contact
- *Primary syphilis* is typically acquired via direct sexual contact with the infectious lesions of a person with syphilis. Approximately 10-90 days after the initial exposure (average 21 days), a skin lesion may be seen on the genitalia. This lesion, called a chancre, is a firm, painless skin ulceration localized at the point of initial exposure, often on the penis, vagina, or rectum.
- If left untreated, it will cause neurological and cardiovascular complications. Eventually, death.

6. Gonorrhea

- men may have no symptoms at all, some men have some signs or symptoms that appear two to five days after infection; symptoms can take as long as 30 days to appear. Symptoms and signs include a burning sensation when urinating, or a white, yellow, or green discharge from the penis. Sometimes men with gonorrhea get painful or swollen testicles.
- most women who are infected have no symptoms. Even when a woman has symptoms, they can be so non-specific as to be mistaken for a bladder or vaginal infection. The initial symptoms and signs in

women include a painful or burning sensation when urinating, increased vaginal discharge, or vaginal bleeding between periods.

- In women, gonorrhea is a common cause of pelvic inflammatory disease (PID which causes long-lasting, chronic pelvic pain. and damage to the fallopian tubes enough to cause infertility or increase the risk of ectopic pregnancy. Ectopic pregnancy is a life-threatening condition in which a fertilized egg grows outside the uterus, usually in a fallopian tube.
- In men, gonorrhea can cause epididymis, a painful condition of the testicles that can lead to infertility if left untreated.

Causes of human infertility

Sterile- couples who are unable to have any children

Infertile- couples who have fewer children than they wish (unsuccessful after trying to get pregnant after a year or more)

Female Infertility

- (1) **Blocked oviducts** -often caused by PID which may be caused by STI's
- (2) **Failure to ovulate** - caused by hormonal imbalances that occur for a number of reasons, including being underweight and overweight
- (3) **Endometriosis**-painful condition where endometrium grows outside the uterus
- (4) **Damaged eggs**-caused by environmental factors such as exposure to chemicals

Male Infertility

- (1) **Obstruction in Vas Deferens or epididymis** -caused by complications from STI's or varicose veins in testicles
- (2) **Low Sperm Count** -overheated testicles , smoking, alcohol intake
- (3) **Abnormal sperm** - Overheated testicles , exposure to toxins, infections (STI's)

Technological Solutions to Infertility (table 15.1, page 501)

Artificial insemination (AI)

- aim is to impregnate the woman by non-sexual insertion of donor or paternal sperm into the vagina or uterus using a needle-like syringe. The cervical route is most common.

In vitro fertilization (IVF)

- a technique in which egg cells are fertilized by sperm outside the woman's womb
- process involves hormonally controlling the ovulatory process, removing ova (eggs) from the woman's ovaries and letting sperm fertilize them in a fluid medium.
- fertilized egg (zygote) is then transferred to the patient's uterus with the intent to establish a successful pregnancy.

In vitro maturation (IVM)

- technique of letting ovarian follicles mature in vitro
- If a follicle has reached the later stages of maturation, IVM can be carried out.
- IVM is still under development. There are a lot of cellular changes in the oocyte and the rest of the cells in the follicle, which makes it very susceptible.

Surrogate motherhood

- arrangement whereby a woman agrees to become pregnant for the purpose of gestating and giving birth to a child for others to raise. She may be the child's genetic mother (the more traditional form of surrogacy), or she may be implanted with someone else's fertilized egg (gestational surrogacy).

Superovulation using fertility drugs

- the woman is treated with medications that increase the number of eggs she ovulates each month. At the appropriate time, intrauterine insemination is performed.

Embryo storage (cryopreservation)

- used in infertility programs mainly to freeze and store sperm or to freeze "leftover" embryos from an in vitro fertilization cycle.

Birth Control Techniques

See Table 15.2 on page 502

Effects of birth control technology on the population demographics of developed and underdeveloped

- funding solutions to human fertility
- problems versus the funding of human population control
- the methods of population/birth control (e.g., China's one child rule per family; selection of one gender—usually male—and abortion of females in some developing countries) of various countries around the globe
- effects of these conception control population technologies on the demographics of these countries.

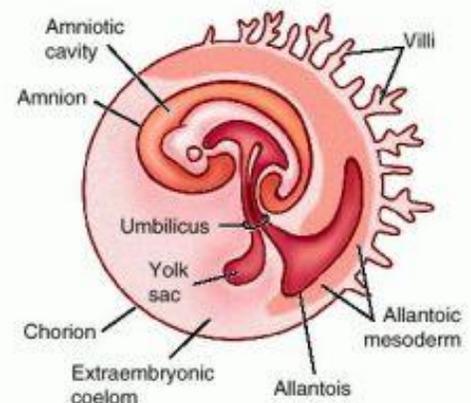
Fertilization and development

Path of sperm to the egg

- Epididymis→Vas Deferens→urethra→vagina→cervix→uterus→oviduct
- Several hundred million sperm exit the urethra during each ejaculation to survive the acidity of female reproductive tract

Fertilization Egg

- **Has 4 primary membranes that** supports, nourishes and protects the embryo
 1. **Yolk**-- humans have very little yolk but they do have a yolk sac where blood cell formation first occurs
 2. **Allantois**- the blood vessels of the umbilical cord
 3. **Amnion**-contains amniotic fluid to cushion and protect the embryo
 4. **Chorion**- develops into the placenta



Embryonic development stages

Cleavage is

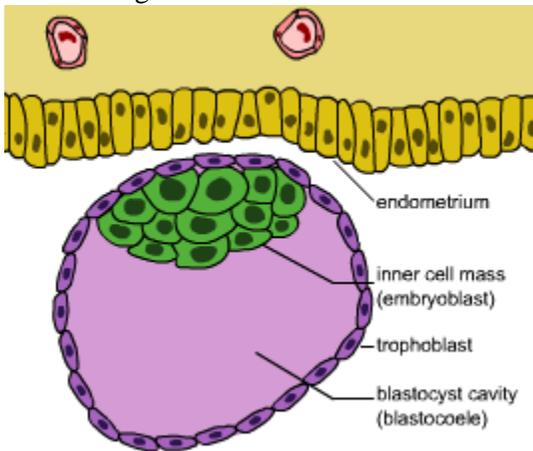
- a process that occurs in the development of ALL multicelled organisms.
- Conversion of a single-celled zygote into a multicelled embryo by mitosis. Usually, the zygotic cytoplasm is divided among the newly formed cells.

1. Morula

While the embryo is undergoing cleavage, the mass of identical cells is called a **morula**.

2. Blastocyst (blastula)

- produced by mitosis of the zygote, and is a ball of cells surrounding a fluid-filled cavity (the blastocoel).
- The decreasing size of cells increases their surface to volume ratio, allowing for more efficient oxygen exchange between cells and their environment.



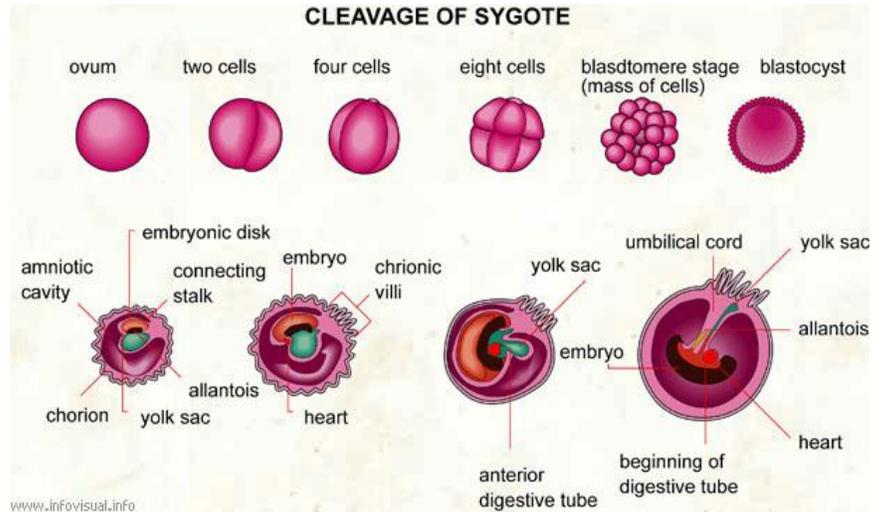
(see diagram 15.12 on page 507)

4. Gastrula

- cells become arranged into distinctive layers called germ layers. These are formed by mitotic division and migration.
- By the end of the gastrulation the embryo has three layers, the endoderm, mesoderm, and ectoderm (pg 508)

5. Neural development

- mesoderm cells that lie along what will be the back of the vertebrate come together to form a notochord
- nervous system develops from the ectoderm just above the notochord
 - cells along surface of the notochord thicken
 - folds develop on each side of a groove along this surface and these eventually fuse and form a tube
 - when fused the embryo is called a **neurula** (third week)
 - “head” end of the neural tube becomes a brain



6. Differentiation

- process in which each of the three layers of the gastrula develops into different parts of the body
- Over 38 weeks, differentiation allows a tiny clump of identical cells to develop into a human with fully formed tissues and organs such as

Placenta- a blood vessel-rich organ which is present only during pregnancy.

- begins to form from the chorion once fully implanted
- chorion develops projections which extend into the uterine wall serving as an anchor
- these projections contain blood vessels which, with the chorion form the placenta

Umbilical cord- it is a lifeline, connecting the developing embryo and fetus to the placenta

- The mother's blood and the fetus's blood never mix but the transfer of nutrients and oxygen from the mother to the fetus, and the transfer of carbon dioxide and other waste substances from the fetus to the mother take place across plasma membranes.

Teratogens

- any agent that causes a structural abnormality due to fetal exposure during pregnancy such as
 - (1) **Cigarette smoke**- may constrict fetus's blood vessels preventing the fetus from getting enough oxygen. Mothers who smoke or who are exposed to a lot of second hand smoke may have babies that are under weight. Also the babies may suffer convulsions
 - (2) **Alcohol**-can affect the fetus's brain, CNS, and physical development. Babies that are born to women who drink frequently or heavily during pregnancy are likely to have fatal alcohol syndrome (FAS)
 - (3) Prescription drugs like thalidomide --prescribed to pregnant women in the 1950's to prevent morning sickness. Thalidomide caused the babies to be born with deformed or missing limbs.

Childbirth

- Birth is triggered by sudden, dramatic changes in hormone levels, estrogen and progesterone levels drop.
- Prostaglandin's may cause the release of oxytocin which causes the uterus to contract
- Contractions signal the beginning of labour, the process that ends with the birth of an infant. The stages of labour are:
 - (1) Dilation stage
 - uterine contractions and oxytocin cause the cervix to open or dilate
 - amnion breaks and amniotic fluid is released through the vagina
 - last 2-20 hours
 - (2) Expulsion stage
 - forceful contractions push the baby through the cervix to the birth canal
 - as the baby moves through the canal, the head rotates, making it easier to pass through
 - last from 30 minutes -2 hours
 - (3) Placenta stage
 - 10-15 minutes after the baby is born, placenta and umbilical cord are expelled from the uterus
 - expelled placenta is called after birth

Hormones of Fertilization, implantation, birth and post-birth

1. progesterone - prepares the uterus for implantation, inhibits lactation during pregnancy(the fall in progesterone levels following delivery is one of the triggers for milk production).

2. estrogen - promotes the development of female secondary sex characteristics, such as breasts, and are also involved in the thickening of the endometrium and other aspects of regulating the menstrual cycle
 3. oxytocin – released upon labor contractions and after suckling reflex
 4. prolactin - stimulates the mammary glands to produce milk (lactation).
- (v) human chorionic gonadotropin (HCG) - made by the embryo soon after conception and later by one part of the placenta. Its role is to prevent the disintegration of the corpus luteum of the ovary and thereby maintain progesterone production that is critical for a pregnancy in humans. Early pregnancy testing generally is based on the detection or measurement of hCG.

Techniques used to monitor fetal development

Ultrasound:

- Sound waves beyond the level of human hearing are sent through amniotic fluid.
- waves bounce off the developing fetus and are used to create a black and white , cross-sectional image of the fetus.
- image can be studied for physical abnormalities such as a missing limb , malformed heart , or cleft palate.

Amniocentesis

- as fetus moves inside amniotic sac some of its cells are sloughed off and become suspended in amniotic fluid.
- cannot be done before the 14th week of pregnancy due to possible injury to the fetus.
- sample is taken with a long thin needle after the position of the baby is determined by ultrasound.
- sample of fluid is extracted, placed in a nutrient rich solution and allowed to multiply until there are enough fetal cells to get a good picture of all the chromosomes and create a karyotype

Fetoscopy

- direct observation of the fetus occurs because of the insertion of an endoscope into a small incision in mother's abdomen.
- enables procedures to take place inside womb such as removal of excess brain fluid and fetal blood transfusions.
- also provides a way to get blood samples to create a karyotype or to test genetic conditions such as Rh factor or sickle cell disease

Chorionic Villi Sampling (CVS)

- Chorionic villi sampling may occur after the 9th week and cells can be removed from the chorion.
- removed cells are grown in a special medium and a karyotype allows a diagnosis to be made.

The End