

## RESPIRATION

- \*The opening of the larynx is called glottis. It is also lined with mucous membrane
- \* The hilum is a triangle shaped depression of both the lungs where the blood vessels and airways pass into the lungs.
- \* There are two sets of intercostal muscles between each pair of ribs: the external intercostal and the internal intercostal
- \* In inspiration, contraction of the external intercostal and relaxation of the internal intercostal takes place
- \* Inspiration relaxation of external intercostal and contraction of the internal intercostal takes place
- \* The word scuba is an acronym for self contained underwater breathing apparatus also called aqualung. A typical aqualung contains compressed air or a mixture called Nitrox which consists of about 35% oxygen and 65% nitrogen this apparatus consists of a tank containing highly compressed air in which the pressure down to an ambient pressure so divers could breathe comfortably at any depth.
- \* Oxygen carrying capacity is sensitive to a variety of environmental conditions like rise in body temperature, drop in ph of blood and partial pressures of carbon dioxide and oxygen.
- \* Hiccups: It is the spasmodic contraction of the diaphragm while the glottis is closed, Producing a sharp respiratory sound. It is reflective and serves no known function.

\* Snoring : It is a rough, raspy noise that can occur when a sleeping person inhales through the mouth and nose. The noise usually is made by vibration of the soft palate which may occur as a result of vocal cord vibration .

\* Hemoglobin loses oxygen at a partial PO<sub>2</sub> 60mmHg

\* Myoglobin loses oxygen at partial pressure 20mmHg

## **HOMEOSTASIS**

\* The unusual higher osmotic concentration than other vertebrates of marine habitat is maintained by high levels of urea and trimethylamine oxide (TMAO) in the blood. These are organic substances called osmolytes because they increase the osmotic concentration

\* In most vertebrates the level of urea to this high concentration would damage the protein because it is a chaotropic (denaturing) agent that disrupts non covalent and ionic bonds between amino acid residues, but the presence of TMAO helps to stabilize these proteins molecules against the adverse effects of urea

\* Ammonia is highly toxic because it tends to raise the pH of body fluids and interferes with membrane transport functions

\* Humans excrete small quantities of uric acid but this is produced from the breakdown of nucleic acid and not from breakdown of proteins. Approximately 1 gram of uric acid is excreted in urine per day

\* A fibrous connective tissue layer called the fibrous capsule encloses each kidney

\* The lateral surface of each kidney is convex but its medial side is deeply concave. The resulting medial depression leads into a hollow chamber called the renal sinus. The entrance to this sinus is termed hilum (hilus), where the renal artery and nerve enter and the renal vein and the ureter exit.

\* Efferent arterioles arising from the glomerular capillaries give rise to a plexus of capillaries called the peritubular capillaries around the proximal and distal tubules.

\* Specialized part of the peritubular capillaries called vasa recta course in the medulla along with the loops of Henle and then back towards the cortex. The peritubular capillaries drain into renal vein the renal vein exits the kidney and connects to the inferior vena cava.

\* Normal urine has pH range from 4.8 to 7.5

\* In addition to the excretory and osmoregulatory role, kidneys also help to control the red blood cell formation by secreting the hormone erythropoietin and help to regulate blood pressure by secreting the enzyme renin.

\* When urine is acidic the stone is of calcium oxalate When the urine is alkaline the stones of calcium phosphate When urine is persistently acidic the stone is of uric acid type

\* The two problems are rejection and toxic effects of cyclosporine. These problems are usually treated simultaneously by adding extra doses of steroids.

\* Piloerection literally means erection of skin hair. It traps air in the erected hair which is insulator for the heat.

## **SUPPORT AND MOVEMENT**

- \* The study of bones and cartilage is called osteology
- \* The terminal broad parts are called epiphyses and the middle part along the length of bone is called diaphysis or shaft which also contains a central cavity filled by yellow bone marrow. The outer connective tissue around the bone is called periosteum and the inner region is called endosteum. The endosteum further consists of a peripheral part, called compact bone and the inner bone mass, called spongy bone. Most of the spongy bone is present in the epiphyses. The red bone marrow is found in the spaces of spongy bone.
- \* There are many small cavities distributed in the matrix of cartilage called lacunae which contain cartilage cells.
- \* Human skeleton consists of 206 bones.
- \* Head contains 29 bones which are divided into four divisions i.e. cranial bones, facial bones, ossicles and hyoid bone
  - \* Hyoid bone is a small single bone which lies at the base of skull below the tongue. It does not articulate with any other bone of head.
- \* Sacral and coccygeal vertebrae are together called pelvic vertebrae.
- \* Humerus is a long bone, the end of which has a spherical head which fits into the glenoid cavity.
- \* Femur or the thigh bone is a long bone with head which fits into the acetabulum. Patella or the knee cap is embedded in a long tendon which runs over the knee joint

\* Nucleus pulposus is an inner semi fluid which acts as a rubber ball to give a disc its elasticity and compressibility. Annulus fibrosis is the strong outer ring of fibro cartilage which holds together successive vertebrae. The disc acts as shock absorber.

\* Osteoarthritis is a progressive disease in which the articular cartilages gradually soften and disintegrate. It affects knee, hip and intervertebral joint.

\* Rheumatoid arthritis is the result of an autoimmune disorder in which synovial membrane becomes inflamed due to faulty immune system. Gouty arthritis results from metabolic disorder in which a normal amount of uric acid is retained in the blood and sodium urate crystals are deposited in joints. The most common joint affected is the joint of the big toe.

\* The study of muscles called myology

\* In smooth muscles myofilaments are not organised into sarcomeres. Consequently smooth muscle do not have a striated appearance. Smooth muscle cells contain non contractile intermediate filaments.

\* In cardiac muscles adjacent cells join together to form branching fibres by specialised cell to cell attachments called intercalated discs which have gap junctions that allow action potentials to pass from cell to cell

\* Bundles of muscle fibres are enclosed by collagen fibres and connective tissue.

\* Externally muscle is covered in a connective tissue wrapping called epimysium.

\* Each muscle is divided into discrete bundles of muscle cells called fascicles. Fascicle is surrounded by perimysium. Each muscle fibre within the fascicle is covered by a layer of connective tissue called the endomysium.

\* The entire length of thick myofilament constitute the A band because they are anisotropic that can polarized visible light. Thin myofilaments alone constitute I band is isotropic or nonpolarizing.

\* Each myosin molecule consists of six polypeptides which are arranged in such a way that each myosin molecule possesses a tail and two globular heads. Each thick filament contains about 300 myosin molecules bundled together with their tails forming the central part of the thick filament and their heads facing outward and in opposite directions at each end. The kidney shaped polypeptide subunits of actin called globular actin or G actin bear the active sites to which the myosin heads attach during contraction. G actin monomers are polymerized into long actin filaments called fibrous or F actin. The backbone of each thin filament appears to be formed by two intertwined actin filaments that look like a twisted double strand of pearls.

\* Muscle contraction is initiated by nerve impulse arriving at the neuromuscular junction. Impulse is carried through the sarcolemma to the T tubule then to sarcoplasmic reticulum (SR). The calcium gates of the SR open releasing calcium into the cytosol.

\* Bones are Attached to the bones through connective tissue called ligaments. When a muscle contracts one end normally remains stationary and the other end is drawn towards it. The end which remains stationary is called origin and that which moves is called insertion. Both are the points of attachment to the bones. Every muscle

has its own origin and insertion. Belly is the thick path between origin and insertion which contracts. Normally the bones of insertion is pulled upon when muscle contract and drawn towards origin, One bone moving one the other at the joints. Flexor muscle, when contracts, it bends the bone at joint. Extensor muscle, when contracts, it straightens the bone at joints. For the movement of the bone in two directions muscle work in pairs. When flexors contract, the extensors relax and vice versa. Such Arrangement of muscles is called antagonistic arrangement.

\* knee or tibiofemoral joint is located between the femur and tibia. It is a complex hinge joint that permits limited rolling and gliding movement in addition to flexion and extensions. The flexion is carried out by the flexor muscles. These are hamstring muscles present at the back of the upper part of the leg. The major hamstring muscle is biceps femoris. It has two origins, one from pelvic girdle and the other from the top of the femur. At its insertion the tendon divides into two portions to attach at the upper part of the tibia and fibula. The extension is carried out by the extensor muscles which are present in the front of the thigh. The main extensor muscles are quadriceps femoris. They originate at the ileum and femur, come together in a tendon surrounding the patella (kneecap) , insert at the tibia. These extend the leg at the knee joint and are important for standing, walking, and almost all activities involving the legs.

\* Bone act as the levers while joints perform as living fulcrums.

\* Rigir mortis - rigidity of death

## **NERVOUS COORDINATION**

\* The study of the structure of nervous system is called neurology

\* At the peak of the action potential the sodium gate start to close again. Sodium permeability therefore declines. The sodium potassium pump continues to work during this time, so it gradually begins to restore the original resting potential. This repolarization is shown by the falling phase of the action potential spike and results in the membrane potential returning to its original level. in fact there is a slight overshoot into a more negative potential than the original resting potential. this is called the hyperpolarization. it is due to the slight delay in closing all the potassium gates compared with sodium gates. as potassium ions continue to enter the axon their positive charge restores the normal resting potential.

\* The repolarized nerve fibre undergoes a refractory period of few milliseconds during which the original ionic distribution is restored by sodium potassium pump with active transport sodium ions out and potassium ions in. This returns the membrane to its resting potential that is -70 millivolt. Refractory period lasts for about four milliseconds so a neuron can conduct 250 impulses per second.

\* In human non myelinated fibres nerve impulses travel at 1-3 metre per second. Myelinated fibres conduct at speeds of up to 120 metres per second

\* Excitatory neurotransmitters cause increased membrane permeability to sodium ions and thus trigger nerve impulses. Acetylcholine is an excitatory neurotransmitter of peripheral nervous system Biogenic amines are important neurotransmitters in central nervous system that include epinephrine and norepinephrine, serotonin and dopamine all of which also function as hormones



Epinephrine and norepinephrine increase the heart beat rate during stress Serotonin and dopamine effects sleep mood attention and learning

\* Inhibitory neurotransmitters cause a decrease membrane permeability to sodium ions thus causing the threshold of stimulus to be raised. This action is called inhibitory because it lessens the chance that nerve impulse will be transferred to an adjoining neuron. e.g amino acids gamma-aminobutyric acid (GABA) and glycine. The endorphins are peptide that function as both neurotransmitters and hormones, decreasing our perception of pain.

\* The surface of the cerebrum is called cerebral cortex. cerebral cortex has many folds and convulsions forming ridges or gyri which are separated by grooves. A shallow groove is called a sulcus and a deep groove is called a fissure. The two hemispheres are separated by longitudinal fissure.

\* Brain is hollow structure that has cavities called ventricles. There are four ventricles in the brain

\* Grey matter is shaped like a letter H or a butterfly in spinal cord

\* Cranial nerves are largely concerned with the head, neck and facial regions of the body

\* Sympathetic division consists of only spinal nerves. These nerves arise from first thoracic segment to the second lumbar segment of the spinal cord.

\* A few cranial nerves including the vagus nerve together within the nerves that arise from the sacral portion of the spinal cord from the

parasympathetic division. It controls various autonomic functions during the state of rest.

\* The olfactory organs which contain the olfactory receptors are present in the upper part of the nasal cavity. The olfactory receptor cells are neurons. The cells are surrounded by columnar epithelial cells having cilia at the distal end. Chemicals that stimulate the olfactory receptors enter the nasal cavity as gases. They must dissolve at least partially in the watery fluids that surround the cilia before they can be detected.

\* Meissner's corpuscles and Merkel disks are touch receptors. These consist of small oval masses of flattened connective tissue cells. Two or more sensory nerve fibres branch into each corpuscle.

\* Paccinian's corpuscles are also encapsulated nerve endings present in the fatty layer deep into the skin.

\* A narcotic is a group of substances when administered diminish the perception of pain. Narcotics bind to certain pain killing sites in the brain. With constant use they build up in the brain and block the production of endorphins, the brain's natural painkilling chemicals. Their side effects are inhibition of the endocrine and autonomic nervous system etc. the narcotics are the drugs that act as agents which interact with the normal nervous activity.

\* Cerebral infarction - a portion of the tissue that is dying because of blood supply to it has been cut off.

\* Aphasia - inability to express through words

\* CT Scan - Computer Tomography Scan

## CHEMICAL COORDINATION

\* Protein and peptide hormones cannot pass through cell plasma membrane because they are water-soluble. These hormones (first messenger) bind with their receptors on the plasma membrane of target cell starting the series of events in the cell which generate second messenger. The second messenger then triggers various changes in the cell including activation of enzymes, gene activation

\* Steroid and thyroid hormones can pass through plasma membrane because they are lipid soluble. Receptors for these hormones are located inside target cells, in the cytoplasm and nucleus. Hormones bind with their receptors to form hormone receptor complex. This complex then binds with promoter region of particular gene acting as transcription factor. mRNA of that gene is formed by transcription and translated into protein. Target cell activities are modified by the altered gene expression.

\* The hypothalamus is the master control centre of the endocrine system

\* The hormones produced by the hypothalamus are either the releasing factors which stimulate secretion of pituitary hormones or inhibiting factors which inhibit secretion of pituitary hormones.

\* Infundibulum is composed of blood vessels and fibres of neurosecretory cells.

\* Adrenocorticotrophic hormone is released by the release of corticotropin-releasing factor (CRF) from hypothalamus which is controlled by steroid level in the blood and by direct nerve stimulation

of the hypothalamus as a result of stress for example cold, heat, pain, fright and infections.

\* Follicle stimulating hormone, luteinizing hormone and prolactin or luteotropic hormone are all collectively known as gonadotropic hormones.

\* Over secretion of oxytocin causes rupturing of uterine wall while under secretion of oxytocin inhibits normal labour process.

\* T4 is the major hormone, about 90% secreted by the thyroid T3 is only 10% T3 is four times more potent than T4 Action duration of T4 is four times more than T3

\* Kidney release the hormones renin, erythropoietin and calciterol

\* Renin monitors blood pressure and takes corrective action if it drops

\* Erythropoietin acts on the bone marrow to increase the production of red blood cells. stimulus such as bleeding or moving to higher altitude trigger the release of erythropoietin.

\* Calciterol Acts on the cells of the intestine to promote the absorption of calcium from the diet

\* Each adrenal gland is composed of an inner portion called the medula and outer portion the cortex

\* The over secretion of oestrogen may lead to the development of fibroids in uterus and polycystic ovaries

\* Pineal gland attached to the hypothalamus. Its primary hormone is melatonin. It influences daily rhythms called circadian rhythms.

\* The thymus reaches its largest size and is most active during childhood. Thymus produces various hormones called thymosin. Certain lymphocytes that originate in the bone marrow and then pass through the thymus are transformed into t-lymphocytes with the help of this hormone.

\* Secretin and cholecystokinin control pancreatic and liver secretions. Both are formed in the cells of duodenal wall.

\* Endorphins are produced in the brain. Endorphins bind to pain receptors and so block sensation of pain.

## **REPRODUCTION**

\* When spermatozoa are produced, they move to the seminiferous tubules and the tubular network called the rete testes for the maturation. The spermatozoa are transported out of the testes by a series of efferent ductules.

\* In interphase of meiosis the DNA in the cell is copied resulting in two identical full sets of chromosomes. Outside of the nucleus are two centrosomes each containing a pair of centrioles. During interphase microtubules extend from the centrosomes.

\* In prophase the copied chromosomes condense into X shape structures. Each chromosome is composed of two sister chromatids containing identical genetic information. The chromosomes pair up so that both copies of chromosome 1 are together both copies of chromosome 2 are together and so on. The pairs of chromosomes may then exchange bits of DNA in a process called recombination or crossing over. At the end of prophase 1 the membrane around the nucleus in the cell dissolves away. The meiotic spindle, consisting of

microtubules and other proteins extend across the cell between the centrioles

- \* Each oviduct is about 10 cm long

- \* The uterus has three portions: the fundus, the body and the cervix. The oviduct join the uterus just below the fundus at the opening of the cervix leads to the vaginal canal

- \* Cervix is a narrow entrance to the uterus from the vagina. it is normally blocked by plug of mucus.

- \* Vagina is often called the birth canal as it provides a passageway for delivery of an infant and for menstrual flow. The urethra is embedded in its interior wall.

- \* Oestrogen has negative feedback upon FSH therefore as the concentration of estrogen rises the level of FSH falls.

- \* The sperm count below 20 million per ml is called oligospermia

- \* The changes in shape of sperms are called sperm deformities

- \* In some individuals the infertility is probably due to an immune response by the male to its own sperms. antibodies are made which attack the sperm and reduce sperm count.

- \* Endometriosis is a condition where small pieces of the endometrium started growing in other places such as the ovaries. This can cause infertility because it become difficult for an egg to be released and become implanted into the uterus

## **DEVELOPMENT AND AGING**

\* Many animal eggs contain yolk. The yolk is a mixture of proteins, phospholipids and fats and serves as food for developing embryo.

\* The amount and distribution of yolk vary among different animal groups. Most invertebrates and simple chordates have eggs with relatively small amounts of yolk uniformly distributed throughout the cytoplasm. Many vertebrates have large amount of yolk concentrated at one end of the cell known as vegetal pole. The opposite pole is called the animal pole. The amount of yolk in the egg affect the pattern of cleavage. The cleavage maybe holoblastic cleavage or meroblastic cleavage.

\* In eggs with evenly distributed yolk the entire egg divides producing cells of roughly the same size. This type of cleavage is termed holoblastic for example bony fish and amphibians.

\* The eggs of reptiles, birds and some fish have a very large amount of yolk and only a small amount of cytoplasm concentrated at the animal pole. In such eggs, cell division takes place only in the blastodisc, the small disc of cytoplasm at the animal pole. This type of cleavage is termed meroblastic.

\* Gastrulation is the second major phase of embryonic development which is characterized by differentiation of embryonic germ layers. In the process the embryo is transformed from a hollow ball of cells the blastula into three layers stage called the gastrula. The three layers produced in gastrulation are embryonic tissues called ectoderm endoderm and mesoderm. The mechanism of gastrulation vary somewhat depending on the species.

\* After implantation the inner cell mass grows and splits forming two fluid filled sacs that are separated by a double layer of cells called the embryonic disc. One sac is amniotic sac which is bounded by the amnion and filled by amniotic fluid. The other sac is yolk sac but it is not contain yolk as human embryo takes nutrition from the mother's body. At this stage, The embryonic disc consists of an upper layer and lower layer. The upper is called epiblast which later on develops into ectoderm and mesoderm. The lower layer is called hypoblast which is future endoderm. The upper and lower layers split apart slightly and a slit, the primitive streak appears in the centre of the upper layer. The upper layer is now called ectoderm and inner layer is called endoderm. The cells of the ectoderm migrate to the primitive streak into the interior of the embryo forming the mesoderm.

\* If the implantation is successful the embryo begins to secrete human chorionic gonadotropin (hCG). This hormone force is the corpus luteum in the ovary to continue to secrete progesterone thereby maintaining the endometrium and inhibiting follicle stimulating hormone production. The chorion, one of the membrane that later grows and surrounds the embryo develops villi that burrows into the endometrium.

\* Pregnancy test which is readily available in hospitals and clinics is based on the fact that hCG is present in the blood and urine of a pregnant woman

\* By the end of the second week implantation of the blastocyst in the endometrium begins.



- \* During the first two to four weeks of development the embryo obtains nutrients directly from the endometrium. Meanwhile the trophoblastic grows out to form extraembryonic membranes.
- \* The amnion provides a fluid movement for the developing embryo and foetus. The yolk sac appear below the embryo. In human the yolk sac contains no yolk it is the first site of red blood cell formation. Part of this membrane becomes incorporated into the umbilical cord. The allantois contributes to the circulatory system. Chorion the outer extraembryonic membrane surrounds the embryo and mingles with the endometrium to form placenta
- \* The sensory organs are almost completely developed in second trimester and by 16th week the foetus is actively turning inside the mother. The mother may feel movements during the early part of the second trimester. By the end of the 5th month the heartbeat of the foetus can be heard through a stethoscope.
- \* The structure of the placenta consists of tissue from fetal part and maternal part. The fetal part consists of chorionic villi. These increase surface area for absorption. The maternal part consists of projections from the endometrium.
- \* The umbilical cord is physiologically and genetically part of the foetus containing two arteries and one vein. The umbilical vein supplies the foetus with oxygenated nutrient rich blood from the placenta. Conversely the fetal heart pumps deoxygenated, nutrients depleted blood through the umbilical arteries back to the placenta.
- \* Both progesterone and oestrogen secreted in progressively greater quantities throughout most of pregnancy but from the 7th month

onwards estrogen secretion becomes greater than progesterone secretion therefore called increased ratio of estrogen to progesterone. It stimulates the myometrial cells of the uterus to form abundant oxytocin receptors. As a result the myometrium become increasingly irritable, and weak, irregular uterine contractions begin to occur. These contractions are called braxton hicks contractions or false labour pains.

- \* Both oxytocin and prostaglandins are powerful uterine muscle stimulants, oxytocin causes contraction of the smooth muscles of the myometrium and prostaglandins increase the power of the contractions

- \* Following the birth of the foetus, usually within 10 to 15 minutes, the placenta separates from the uterine wall and is expelled by uterine contractions to the birth canal. This expulsion is termed the afterbirth.

- \* Premature birth is also called preterm birth. It refers to the birth of a baby of less than 7 months of pregnancy.

- \* The first secretion of the breasts following birth, is not milk, but colostrum. This has a yellow colour. It is rich in the protein globulin. It contains little fat and less lactose than the milk. It provides nutrition and contains antibodies, particularly IgA that protects the nursing baby from infections.

- \* Prolactin prepare the mammary glands for milk production. True milk production begins after a delay of 2 to 3 days of birth. Serotonin neurotransmitter is synthesized by the mammary glands. It sends feedback signals to the hypothalamus that slow down prolactin release once the mammary glands are full of milk.

\* The sucking of the baby on the breast stimulate sensory receptors around and in the nipple. Nerve impulse response from the receptors to the hypothalamus which also stimulate posterior pituitary to release oxytocin via a positive feedback mechanism. Oxytocin causes dilation of milk ducts and thus promotes ejection of milk from the mammary glands. During nursing oxytocin also stimulate the recently admitted uterus to contract helping it to return to its pre pregnant size. As long as milk is removed from breast, prolactin and oxytocin continue to be released. When nursing is discontinued the stimulus for prolactin release and milk production ends and within about one week the mammary glands lose their capacity to produce milk.

\* The immune system of a child does not reach its full length until around the age of five.

\* Approximately 50-60 % of first trimester and 20% of second trimester miscarriage due to chromosomal abnormality is within the foetus.

\* Further development of a young one after birth is called postnatal development.

\* The five life stages of postnatal development are:

1. Neonatal
2. Infancy
3. Childhood
4. Adolescence or puberty
5. Adulthood or Maturity

\* The neonatal period extends from birth to one month. Infancy begins at one month and continues to 2 years of age. Childhood begins at 2 years of age and lasts until adolescence. Adolescence begins at around 12 or 13 years of age and ends with the beginning of adulthood. Adulthood or maturity includes the years between ages 18 to 25 and old age. The process of aging is called senescence.

\* Tumors can be benign or malignant. Benign tumors aren't cancer while malignant ones are. Cells from malignant tumors can invade nearby tissues. They can also break away and spread to other parts of the body. The spread of cancer from one part of the body to another is called metastasis.

\* Older people experience a decrease in the number of melanocytes making hair grey and skin pale. In contrast some of the remaining pigment cells are larger and pigment blotches appear in skin.

## **INHERITANCE**

\* Mendel's work applies to diploid organisms and not all organisms are diploid

\* Normal trichromatic colour vision is based on three different kinds of cone in the retina, each sensitive to only one of the three primary colours, red, green or blue. Each type of cone cells has specific light absorbing proteins called opsins. The genes for red and green opsin are on x chromosome while the genes for blue opsin is present on autosome 7. Mutations in opsin gene causes colour blindness like dichromacy and monochromacy.

\* **DICHROMACY** - A dichromate can perceive two colours but is unable to perceive the one whose opsin is missing due to mutation. Protanopia

is red blindness, deuteranopia is green blindness while tritanopia is blue blindness.

\* **MONOCHROMACY** - a monochromate can perceive only one colour. Monochromacy is true colour blindness. Blue cone monochromacy is an xlinked recessive trait in which both red and green cone cells are absent. That is why it is also called red green colour blindness. It is a common hereditary disease.

\* **MUSCULAR DYSTROPHY** : As the name implies is characterized by a wasting away of the muscles. The most common form is Duchenne muscular dystrophy. It is a sex linked recessive disorder. The symptoms appear in early childhood and the child begins to have difficulty in standing up and rises to a standing position in a characteristic way. He is inevitably wheelchair bound by the age of 12. Eventually he becomes severely wasted and normal breathing becomes difficult. Death usually occurs by age of 20 therefore affected males are rarely fathers. The recessive alleles remain in the population by passage from carrier mother to carrier daughter. The gene whose mutation causes this disorder has been mapped. It codes for a protein called dystrophin which is present in the normal muscle but missing in Duchenne patients. The lack of dystrophin results in the death of muscle fibres.

## **CHROMOSOME AND DNA**

\* When cell undergoes division euchromatin is also condensed so that a uniformly chromatin fibre is established

\* Any type of organism can be identified by examination of DNA sequences unique to that species. To identify individuals forensic scientists have scanned 13 DNA regions or loci that vary from person to

person and use the data to create a DNA profile of that individual. There is an extremely small chance that another person has the same DNA profile for a particular set of 13 regions.

\* Interface is actually a period of diverse activities. The activities at interface make the next mitosis possible. Interphase generally lasts at least 12 to 24 hours in mammalian tissue. During this period the cell is constantly synthesizing RNA, producing protein and growing in size. Interface can be divided into four steps:

1. Gap 0 (G0) : There are times when a cell will leave the cycle and quit dividing. This may be a temporary resting period or maybe permanent (e.g neuron)

2. Gap 1 (G1) : Cells increase in size in gap one, produce RNA and synthesized protein

3. Gap 2 (G2) : The cell will continue to grow and produce new proteins.

4. Mitosis or M Phase : Cell growth and protein production stop at this stage in the cell cycle. The cell divides into two similar daughter cells. Mitosis is much shorter than interphase, lasting perhaps only one to two hours

. \* Each side of replication bubble is termed as replication fork

\* The primers and DNA helicase enzymes are found in the form of a complex, called primosome

\* The idea that DNA makes protein and intermediate RNA is known as the central dogma of molecular genetics. It involves two processes that is transcription and translation

- \* Transcription occurs in G<sub>0</sub>, G<sub>1</sub> and G<sub>2</sub> phases of cell cycle. It requires only one enzyme to be completed i.e. RNA polymerase.
- \* RNA Polymerase consists of four subunits: two alpha, 2 beta called the core enzymes while the sigma factors required for RNA polymerase to bind on the promoter.
- \* Once rna polymerase is attached on promoter the sigma factor is removed and the core enzyme catalyzes the remaining process. It is similar to the dna polymerase in that it also adds nucleotides to the 3' end of the growing polypeptide chain but unlike dna polymerase it does not require primer to perform polymerase activity.
- \* Splicing is catalyzed by the spliceosomes which is a large rna protein complex. Later on the spliced exon fragments are joined together with the help of rna ligase enzyme.
- \* Process of translation actually begins with the formation of initiation complex. It is formed by the combination of ribosomal subunits, messenger rna and first aminocyl transfer rna complex. First tRNA molecule carrying a chemically modified methionine (called N-formyl methionine) binds to the smaller ribosomal subunit. This binding is controlled by an enzyme called initiation factor. At the same time 5' end of messenger RNA molecule also binds to the smaller subunit of ribosome with the help of another initiation factor. Initiation complex is completed when large subunit of ribosome is also placed upon smaller subunit.
- \* In prokaryotes the initiating amino acid is modified i.e. n-formyl methionine. While in eukaryotes the initiating amino acid is methionine. It is not modified.

- \* In prokaryotes only one type of initiation factor is used while in eukaryotes more than one type of initiation factors are used.
- \* In prokaryotes two release factors are used while in eukaryotes single release factor is used.
- \* When the expression of genes is quantitatively increased by the presence of specific regulatory protein (the activator) is called positive gene regulation. Whereas when the expression of genes is diminished by the presence of specific regulatory protein (the repressor) is called negative gene regulation.
- \* Down's Syndrome is caused by autosomal nonjunction in which 21st chromosomal pair fails to segregate properly during maternal meiosis and results into the formation of an egg having 24 chromosomes.
- \* Frameshift mutations occur when one or more nucleotides are either inserted or deleted from DNA. This results in the completely new sequence of codon and a non functional protein.
- \* In sickle cell anemia the sixth amino acid that is glutamic acid in the beta chain of the normal hemoglobin is replaced by valine.
- \* Bone marrow or stem cell transplant can cure sickle cell anaemia.
- \* In healthy baby phenylalanine is converted into tyrosine by the enzyme phenylalanine hydroxylase. Due to a point mutation this enzyme becomes defective and converts phenylalanine into toxic phenyl ketone that accumulate and damage the central nervous system. It is also due to autosomal recessive gene and one can get the disease if inherited from both the parents.

## **EVOLUTION**



\* Evolutionists believed that first living being on earth belong to a group of prokaryotes the archaebacteria now known as archea. Evolutionists hypothesized that approximately more than 3.5 billion years ago the first living being originated on earth in hot water springs called hydrothermal vents through spontaneous reactions fullstop This hypothesis is called vent hypothesis.

\* In the 1830's Charles Lyell published a book principle of geology. Darwin took this book on the voyage. This book presented arguments to support the theory of geological change proposed by james hutton called theory of uniformitarianism. Lyell pointed out that the mountains, valleys, deserts, rivers, lakes and coastlines could have come through the action of existing forces and natural conditions. A river slowly carves a valley. Mountains are worn down to hills and finally plains. The slow pace of these geological processes which still occur today indicated that earth had to be much older than generally believed - A possibility that fired darwin's imagination.

\* The reappraisal of the theory of natural selection in terms of modern population genetics is sometimes called Neo Darwinism.

\* Immigration is the movement of foreign individuals into the population. Emigration is outward movement of individuals from the population.

\* In genetic drift one allele may be eliminated from the population by chance regardless of whether that allele is beneficial or harmful or of no particular advantage or disadvantage. Although genetic drift occurs in both large and small populations, a large population is expected to suffer less. When a population is small there is a greater chance that

some rare genotypes may be lost in the next generation, if few individuals fail to reproduce.

\* The two important causes of genetic drift are bottleneck effect and founder effect.

\* **BOTTLENECK EFFECT** : The reduction of population size with some specific allele and genotypes to the natural disaster is called bottleneck effect. For example events such as earthquakes, floods or fires make a large number of individuals unselectively, producing a small surviving population with different genotypic frequencies.

\* **FOUNDER EFFECT** : The founder defect is a particular example of the influence of random sampling. It is defined as: "The establishment of a new population by a few original founders (in an extreme case, by a single fertilized female) which carry only a small fraction of the total genetic variation of the parental population.

\* *Ambulocetus natans* was present in early cetacean period. It could walk as well as swim. It is a transitional fossil that shows whales have evolved from landliving mammals.

## **MAN AND HIS ENVIRONMENT**

\* When rain water falls some of the water sinks or percolates into the ground and saturates the earth to a certain level. The top of saturation zone is called water table. Whenever the earth contains basin or channels, water will appear to the level of the water table. The water within the basins is called lakes and ponds and water within the channels is called streams or rivers. Sometimes groundwater is also located in underground rivers called aquifers.

- \* Only 1% of solar energy is incorporated into the ecosystem
- \* The total amount of solar energy that is fixed by the producers during photosynthesis is called gross primary productivity GPP.
- \* The amount of energy that remains available for plant growth after subtracting the fraction that plants use for respiration is termed as net primary productivity or biomass
- \* A pyramid of biomass illustrates the total biomass at each successive trophic level. Biomass is a quantitative estimate of the total mass or amount of living material. Units of measure vary; Biomass may be represented as total volume, dry weight or live weight.
- \* Individual succession are known as seres and the development phases are called seral stages.
- \* Crustose lichen (crust like lichens) : Licanora and Rhinidona
- \* Foliose-lichens (leaf like lichens) : Parmelia and Dermatocarpom
- \* The number and structure of an animal population vary over time and the factors which cause variations are described by population dynamics. Population dynamics is concerned with the studies of long term and short term changes in population size and the factors that regulate population size such as :
  - INFLOW : births, immigration
  - OUTFLOW : culling (to pick and destroy individuals e.g seal, deer), predation, natural deaths, accidents, emigration
- \* There is a limited number of individuals that can occupy a habitat. The carrying capacity is defined as the maximum population size that a

particular environment can support. Carrying capacity is not fixed but varies over space and time with the abundance or limiting resources.

\* Nuclear power is the use of sustained nuclear fission to generate heat and electricity. Nuclear power cost about the same as coal so it's not expensive to make. It does not produce smoke or carbon dioxide so it does not contribute to the greenhouse effect. It produce huge amount of energy from small amounts of fuel. The two main problems using nuclear powers are surety of safe operation and safe disposal of the waste

## **BIOTECHNOLOGY**

\* Each restriction enzyme cleaves DNA at specific sequence of DNA called recognition sites or restriction sites. This site have palindromic sequences. A palindromic sequence is a 4 to 8 base pairs in DNA in which nucleotides are arranged symmetrically in reverse order.

\* A suitable organism that can act as a host for the recombinant factor to express is called expression system.

\* Transformation refers to the insertion of recombinant DNA into the expression system which can be performed by putting the expression system and recombinant plasmids into the same medium.

\* The types of gels most commonly used for dna electrophoresis are :

Agarose for relatively large DNA molecules ie more than 50 nucleotides

Polyacrylamide for high resolution of short DNA fragments ie less than 50 nucleotides

\* Sanger's method which is also referred to as dideoxy method or chain termination method is based on the use of dideoxy nucleosides triphosphates commonly known as dideoxynucleotide in addition to the normal nucleotides found in DNA.

\* Dideoxynucleotides are essentially the same as common nucleotides except they contain hydrogen group on the 3' carbon instead of a hydroxyl group. These modified nucleotides when integrated into a sequence prevent the addition of further nucleotides. This occurs because an OH group is required at 3' end of growing chain in order to make phosphodiester bond with next incoming nucleotide. In this way they are used to terminate replication processes.

\* In blotting, a sheet of nitrocellulose membrane is placed on top of the gel. Ion-exchange interactions bind the ssDNA to the membrane due to the negative charge of the DNA and positive charge of the membrane. The membrane is then baked in a vacuum or regular oven at 80°C for 2 hours to permanently attach the transferred DNA to the membrane. The membrane is then exposed to radioactive probes which hybridize with denatured DNA (ssDNA) fragments in all bands. Since the DNA probes are radioactive label so they can be detected by autoradiography.

\*The current techniques for paternity testing are using PCR and RFLP.

\* VNTRs or Variable number of tandem repeat polymorphisms occur in noncoding regions of DNA. This type of marker is defined by the presence of a nucleotide sequence that is repeated several times. In each case the number of times a sequence is repeated may vary.

\* Chromosome 1 has most genes (2968) Chromosome Y has least number of genes \* The function of a 50% of discovered genes are unknown

\* There are two major techniques of animal cell culture ie anchorage dependent and anchorage independent. Adherent cells are anchorage dependent and propagate as a monolayer attached to the cell culture vessel. Most cells derived from tissues are anchorage dependent. Since these cells grow for limited generation so they are called finite cell line. Suspension cells can survive and proliferate without being attached to a substratum, therefore called anchorage independent. Hematopoietic cells (derived from blood, spleen or bone marrow) as well as some transformed cell lines and cells derived from any malignant tumors can be grown in suspension. Since these cells grow for unlimited generation so there are also called continuous cell lines.

\* Some transgenic animals which also produce drugs are called transpharmer animals.

\* A carrier molecule called a vector must be used to deliver the therapeutic gene to the patients target cells. Currently the most common vector is a virus that has been genetically altered to carry normal human dna. Some of the different types of viruses used as gene therapy vectors are retroviruses, adenoviruses, herpes simplex virus.

## **BIOLOGY AND HUMAN WELFARE**

\* Tetanus (lockjaw) causes painful tightening of the muscles usually all over the body. It can lead to locking of the jaws so the victim cannot open his mouth or swallow. Tetanus leads to death in about 1 in 10 cases. Several vaccines are used to prevent tetanus among people of

varying age groups. For example DT (diphtheria tetanus) vaccine is used for children and adolescents while Td is given to the adults.

\* Helping deliver a baby calf is called calving.

\* Heterosis or hybrid vigor refers to the exhibition of superiority of the hybrid over both of its parents in one or more traits. It is based on the ability to give higher yield and disease and pest resistance. It is best suited to plants which can be vegetatively propagated for example sugarcane mango apple guava rose dahlia chrysanthemum etc. In this plants the heterohybrids retain their desirable characters in definitely since there is no chance of segregation as they are multiplied vegetatively