Biological sciences task cells biology essay

Cells are grouped to form tissues, and each of them has specialised role. Our body develops from a cell known as the zygote that is the consequences of the fusion of the female ovum (egg cell) and the spermatozoon of the male (germ cell). Single cells are very tiny and cannot be seen with the naked eye. Cell types are distinguished by their dye (colouring) and by their shape and size. Cells consist of plasma membrane within which is number of organelles.

Nucleus: it is a small electron particles composed of ribosomal RNA. The nucleus contains our body’s genetic substance that is in the form of large molecules of deoxyribonucleic acid (DNA). There are dozens of DNA molecules called chromosomes. The molecule of DNA is a series of nucleotide molecules known as proteins, and are connected by phosphate-sugar molecules. The nucleotide molecules contain one of the following materials known as bases: adenine (A), thiamine (T), guanine (G), cytosine (C). The bases are in set pattern; an in one chain is matching with T in the other and G with C. In this order of arrangement, each chain is complementary to the other. Every cell has the total match of genes needed to synthesise all the proteins, but majority of cells merely synthesise proteins that are suitable for their functions. It means enzymes can only be produced if the controlling gene is present, and when gene is missing, the linked enzyme is missing and there will be no chemical change. The RNA is responsible for the transfer of information from DNA to the cytoplasm where proteins are synthesised. Genetic information passes from DNA to RNA encouraging protein synthesis. (Anatomy and Physiology, 7th ed, 1990).

Cell membrane: it is the most important organelle; it holds and keeps the cell intact. Cell membrane is moveable, and it moves along narrow passage. It is

made up of phospholipids bilayers (two molecule layers), and has hydrophilic heads which are soluble in water and hydrophobic tails which are not soluble in water. The head has lipid molecules and a phosphate group (PO4) at the end. The apex and underneath layers of the membrane have stems that are facing each other. It also has proteins of which some are with carbohydrate. The cell membrane has 4 major functions, which are to maintain homeostasis, control the materials that can go in and out of the cell, and hold the cell together. (Cdli. ca, 2010)

Cytoplasm: it is the basic substance that fills the cell, a fluid jelly-like substance that is eight percent (8%) water and typically plain in colour. Cytoplasm is also called cytosol (cell substance). It is found within the cell membrane and surrounds the nuclear cover and the cytoplasmic organelles. It is a substance that is made up of molecules and in which all the cells organelles are suspended and held as one by a fatty membrane. Cytoplasm can only be seen through an electron microscope, and it comes into view as a three dimensional lattice protein rich strands called microtrabecular lattice (MTL). It interconnects and holds other hard (solid) structure in the cytoplasm. The cytoplasm helps to move substances and it changes shape as it moves. (sln. fi. edu, 2010).

Task 1. 2 Explain the structure and function of the main cellular organelles.

Nucleus: they are small electron particles that have ribosomal RNA. The RNA is responsible for the transfer of information from DNA to the cytoplasm where proteins are synthesised. Genetic information passes from DNA to RNA encouraging protein synthesis. (Anatomy and Physiology, 7th ed, 1990).

Cell membrane: it is a sphere-shaped structure, and it is rich in ribosomal RNA and protein. It surrounds the contents of the cell and controls the flow of materials into and out of the cell. (HUMAN BODY, 2001).

Mitochondria: it contains varieties of organelles, e. g, mitochondria and lysosomes. They are found in the cytoplasm and sometimes referred to as the power house of the cell. It produces a material known as adenosine triphosphate (ATP) which carries energy in all cells. (Anatomy and Physiology, 7th ed, 1990), (HUMAN BODY, 2001)

Endoplasmic reticulum: it contains DNA and synthesises specialised proteins, e. g., muscle protein and steroid hormones, and it is linked with detoxification (process of removing a toxic substance) of some drugs. Endoplasmic reticulum is dotted with ribosomes, which consist of RNA. It helps to transport substances through the cell. (Anatomy and Physiology, 7th ed, 1990), (HUMAN BODY, 2001)

Nucleolus: a tiny structure that is inside the nucleus. It permits the transportation of water-soluble molecules across the nucleus.

Golgi complex: a heap of compressed sacs. It receive and process protein, the proteins are made to order and then released at the cell membrane. (HUMAN BODY, 2001)

Lysosomes: potent enzymes; they mortify dangerous substances that is in the cell, and also dispose of other unwanted materials and weary organelles. (HUMAN BODY, 2001)

Ribosome: they are tiny granular structure, and they play major role in the gathering of proteins. (HUMAN BODY, 2001)

Nuclear pores: a membrane bound vesicle; plays a part in cellular digestive system.

Task 1. 3 Describe the role of nucleic acids in protein synthesis.

DNA (deoxyribonucleic acid) is the genetic substance from which chromosomes in cell’s nucleus are formed, and it controls protein synthesis and inheritance (transmission of genetically controlled characteristics). Protein synthesis begins when the DNA coils provisionally relax at exact points. In the nucleus a doubled strand of DNA temporarily partly untwists. Transcription, which is the copying of the nucleus bases on one strand of DNA, begins to happen. Free bases match with those on DNA; adenine joins with thymine, guanine with cytosine, uracil substitute’s thymine and joins with adenine. Forming a strand of messenger RNA. A completed strand of messenger RNA separates from the DNA, which twists back into place. The messenger RNA leaves the nucleus carrying the code for a protein into the cytoplasm. The messenger RNA with its series of codons (units of three nucleotides) for amino acids, attaches to a ribosome and translation starts. Translation, the sequencing of amino acids happens when free tRNA with its anticodon (units of three nucleotides) from the cytoplasm matches up and links to mRNA. When second tRNA joins, a peptide bond links the two amino acids at the ends of tRNA together, starting a peptide chain. The first tRNA separates leaving its amino acid behind. The ribosome moves along the mRNA reading the code. A third tRNA joins and the next amino acid is

connected by another peptide bond. The synthesis continues until a stop or termination codon completes the process and the assembled polypeptide or protein is released. (HUMAN BODY, 2001).

Task 2. 1 Describe the structure and function of the cell membrane.

Image of Cell membrane (lamp. tu, 2010).

Cell membrane consists of a bilayer (two layers of molecules) of phospholipid (head and two tails) that is surrounded with mobile proteins. The phosphate head of phospholipid is hydrophilic, and the fatty acid tails are hydrophobic. The membrane structure depends on fatty acids molecules (lipids) in other to spread on the water surface. It is only one end of the lipid molecule that is attracted by water and the whole hydrocarbon tail is hydrophobic. The molecules form a monomolecular film on the water surface and scatter as very small droplets (drop of liquid). Fatty acids are able to support a double lipid bilayer when it is paired. Fatty acids in membranes are paired as phospholipids and glycolipids, joining saturated and unsaturated chains. Phospholipids are plentiful in membranes and glycerol, and are usually at the main structure.

The fatty acid membrane is the storage place of the cell, it protects its content from dispersing casually, and it also permits control of the internal environment. Two lipid layers adhere to one another, in a double membrane, while it exposes water-soluble heads. Lipid molecules are free to glide in their layer. Common polar groups are ethanolamine, serine and choline.

Sphingolipids are phospholipids with serine, their saturated hydrocarbon tails are usually longer and straighter than other membrane lipids, and it allows them cluster into rafts, which floats inside the membrane.

Glycolipids are restricted to the external layer of the cell membrane. They are constructed like phospholipids, but the serine substitute’s glycerol. Polar sugar chains might extend outside from the glycolipid molecules. Cholesterol straightens membranes by reducing fluidity of lipid. Rafts in particular, are rich in cholesterol. Tiny molecules that are soluble in oils, easily pass through the lipid bilayer, and they are O2 (oxygen) and CO2 (carbon dioxide). The lipid bilayers present a solid barrier to ions and other small molecules. The larger molecules do not have any chance of passing through lipid bilayers. The larger molecules are H+ (hydrogen), Na+ (sodium), K+ (potassium), Mg+ (magnesium), Ca+ (calcium), Cl+ (chlorine) and H2O (water).

Membrane proteins has major role in determining what goes in and out of the cell. They detect and bind specified molecules, and then move them through the membrane barrier. About a half of the membrane has protein chains, the amount might be less in nerve cells because the membranes are rich in complex fatty acids. About a third of the cell’s genetic substance (DNA) codes for membrane proteins show their importance to the cell. Proteins are strings of amino acids, known as polypeptides. They fold into molecular sculptures (three dimensions), which they need in other to perform task that depend on their exact shapes and properties. Some proteins are at one side of the membrane while others go all the way through. Transmembrane protein channels transport specific molecules across the membrane. Majority of transmembrane protein have helical

sections with other portions that are exposed on whichever side of the membrane. Helical section might come together to form tunnels. The helices create a wave of contraction that moves ions from one side of the membrane to the other. Tiny ions, like potassium, calcium and sodium vigorously conduct across membranes by ATP-powered pumps. Some protein tunnels depend on gate to control the passive (inactive) flow of water and other polar molecules through the membrane bilayer. Protein chains might cross as beta sheet basket- like channels and allow larger molecules to pass. Protein chains might fasten in an electricity static state inside on leaflet, of the membrane, leaving the active domains to protrude (stick out) from the membrane. Long sugar chains (oligossacharides) attach to the external surface of the membrane proteins and glycolipids to form the glycocalyx. The glycocalyx declare the cell’s identity to the exterior. Membrane can overwhelm substances from the exterior. Endocytosis (membrane navigation) encloses large objects and drag them into the cell. Other viruses use their own membrane which can combine with the cell membrane. (John Kyrk, 2010).

Task 2. 2 Explain the differences between osmosis, diffusion, active transport and bulk transport.

Cells move water molecules, food particles, and other substances through the membranes. Things like water pass through easily, and others have to be moved through the channels. Solute; is a substance that dissolve in solvent to formulate solution, and solvent is a substance in which solute is dissolve to make a solution. Example is saltwater, in which salt is the solute, and water is the solvent.

Diffusion is the mixing of two substances by random motion of molecules. Molecules move from an area of high concentration, to an area of low concentration. When the molecules spread out equally, diffusion stops, because there is no longer a concentration of gradient (steepness). Concentration gradient, is the difference between the concentration of molecule in one area and the concentration of molecule in an adjacent (beside) area. The system has reached its equilibrium, when the concentration of solute is the same throughout a system.

Osmosis is the diffusion of water across a semipermeable (allows some types of things pass through) membrane. Water moves across membrane from a region of high concentration of water, to an area of low concentration of water.

Facilitated diffusion is a movement of particles and diffusion across the cell membranes with the help of proteins in the membranes. Particles move down the concentration gradient going from high concentration to low concentration. Facilitated diffusion increases the rate of particles that cross the cell membrane. (biologymad. com, 2010)

The process of diffusion, osmosis, and facilitated diffusion, does not need any energy to be used by the cell. The three processes are known as passive transport. The processes by which the cell uses energy to move particles across the membrane, is known as active transport.

The cell movement of things from low concentration, to high concentration, is known as active transport, because it needs energy to do so. The cell uses active transport to keep the right balance of sodium and potassium ions in

and out of the cell. This balance is vital for muscle contraction, nutrient absorption, and nerve pulse transmission.

Bulk transport is for the movement large particles in and out of the cell. During bulk transport, large particles move across cell membrane packed in membrane-bound sacs. Bulk transport is of two types; exocytosis and endocytosis. Exocytosis is to move from inside the cell, to outside the cell. Wastes and cell products are packaged by the Golgi body in sacs known as Golgi vesicles. The vesicles combine with the cell membrane and materials are secreted outside the cell. Endocytosis are materials brought into the cell. Part of the cell membrane surrounds a particle that is outside the cell. The cell pinches a part of its outer membrane to form a new vesicle. When the vesicle is within the cell, it can combine with other organelles or release its contents into cytoplasm. There are two types of endocytosis; the pinocytosis and the phagocytosis. Pinocytosis is when a cell membrane surrounds a droplet of fluid and bring into the cell. Phagocytosis is when a cell engulfs (overwhelm) a solid substance and bring into the cell. Phagocytosis engulfs (surrounds and swallow) and destroys bacteria and other invaders of the body.

Hypertonic solution; the concentration of solutes is higher than the concentration of solutes inside the cell, example is potatoes in salt water, water left the cells (diffuses out) and the potatoes became flexible.

Hypotonic solution; solutes concentration is lower than the concentration of solutes inside the cell. Water diffuses into the cell, an example, is potatoes in

distilled water, the water came into the cells, making the cell to swell and the potatoes becomes rigid

Isotonic solution; the concentration of solutes equals the concentration of solutes within the cell. (biologymad. com, 2010)

Task 2. 3 Give examples of materials exchanged by different methods with a justification in each case.

Diffusion: is a very slow process, materials exchanged, are gases oxygen and carbon dioxide. The lungs have high concentration of oxygen (O2) in the air sacs (alveoli), and a low concentration of oxygen in the blood of pulmonary capillaries. Carbon dioxide (CO2) has a low concentration in the alveoli, and a high concentration in the blood of the pulmonary capillaries. Oxygen diffuses from the air to the blood, and carbon dioxide diffuses from the blood to the air. (maexamhelp, 2010).

Osmosis: it is where the cells lining the small intestine, absorb water. The exchanged material is salt. Cells take in salts and become more salty, and then water follows the salts into the cell. This process also takes place in kidneys because of its large demand of water. (maexamhelp, 2010)

Active transport: nerves and muscle cells have sodium pump. Sodium ions (Na+) continually diffuse into the cell area of smaller concentration. Incoming sodium ions (Na+) are returned outside by the sodium pump. The nerve and muscle cells continually produce ATP to keep their sodium pump working. Another example is the assimilation of glucose and amino acids by

the cells. The cells assimilate nutrients from digested food by the use of ATP. (maexamhelp, 2010).

Filtration: blood pressure is formed by the pumping of the heart. Blood pressure force plasma and dissolve materials through the capillary membranes into the surrounding tissue spaces. This facilitates the creation of more tissue fluid and is also how cells get glucose, amino acids, and other nutrients. (Maexamhelp, 2010).

Phagocytosis and Pinocytosis: cells that are stationary (immobile) receive small molecules that are attached to their membranes. The cells of the kidney tubules reabsorb small proteins by pinocytosis. (maexamhelp, 2010).

Task 3. 1 Explain the difference between mitosis and meiosis and explain when each occurs.

Mitosis and Meiosis are both cells that have tricky division processes. Duplication of DNA occurs in both of them. The difference between mitosis and meiosis is well understood only if we know what the two cell division processes are, and they are as follows:

Mitosis is a cell division process that involves eukaryotic cell dividing the chromosomes in two identical set of two daughter nuclei inside its cell nucleus. This is followed by cytokinesis that equally divides the nuclei, cytoplasm, organelles and cell membrane, into two daughter cells. Both mitosis and cytokinesis come together and form the mitotic (M) stage of the cell cycle. This series of events are divided into different stages known as prophase, prometaphase, metaphase, anaphase and telophase. Mitosis

happens in different ways and in different species (types). Animals, for example, go through an open mitosis process which involves the breaking down of the nuclear envelope before the chromosomes separate, and the fungi and yeast go through a close mitosis process in which the chromosomes divide inside an intact cell (undamaged cell) nucleus. (buzzle. com, 2010)

Meiosis is a reduction division process that halves the number of chromosomes per cell. The DNA in the original cell is duplicated during S-phase of the cell cycle, before it starts. Meiosis separates the identical chromosomes into four haploid (a single set of unpaired chromosomes) gametes. If gametes are produced, the cells will fuse (combine) during fertilisation to produce a new diploid cell (two matched chromosomes sets). Meiosis go through fertilisation in plants. The different stages of meiosis are meiosis l, prophase l, metaphase l, anaphase l, telophase l and ll. Meiosis is needed for sexual reproduction, it occurs in all eukaryotes that reproduce sexually. It does not occur in archaea because they reproduce asexually (no fusion of male and female sex cells gametes). (buzzle. com, 2010)

The differences between mitosis and meiosis are as follows:

No.

Mitosis

Meiosis

1

Takes place inside somatic cells.

Takes place inside gamete cells.

2

A single division of the mother cell results in two daughter cells.

Two divisions of the mother cell results in four meiotic haploid gametes.

3

A mitotic mother cell can either be haploid or diploid.

A meiotic mother cell always diploid.

4

The number of chromosomes per nucleus remains the same after division.

The meiotic products contain haploid (n) number of chromosomes in contrast to the (2n) number of chromosomes in mother cell.

5

It is preceded by a S-phase in which the amount of DNA is duplicated.

In meiosis, only meiosis is preceded by an S-phase.

6

In mitosis, there is no pairing of homologous (similar) chromosomes.

During prophase l, complete pairing of all homologous chromosomes take place.

7

There is no exchange of DNA between chromosomes.

There is at least one DNA exchange per homologous pair of chromosomes.

8

The centromeres (region joining two parts of chromosome) split during anaphase.

The centromeres do separate during anaphase ll, but not during anaphase l.

9

The genotype type of the daughter cells is identical to that of the mother cells.

Meiotic products differ in their genotype from the mother cell.

10

After mitosis, each daughter cell has exactly the same DNA strands.

After meiosis, each daughter cell has only half of DNA strands.

(buzzle. com, 2010)

Task 4. 1 Explain the need for cellular specialisation in multi-cellular organism.

Each human cell has different shape and size that depend on their specialised function. Speed of cells division varies; it is very fast mostly in epithelial cells, and continually replaces itself. However, it is slow or non-existent in a structural complex cell. Specialised cells are:

Epithelial cells: they are from the skin, and cover most organ and line hollow cavities.

Photoreceptor cell: is a type of light-sensitive cell that is found in the retina of the eye. They are activated by bright light and are responsible for colour perception (interpreting information from senses). (Integrated body, 2010)

Red blood cell: a bag of oxygen-carrying haemoglobin molecules. Its biconcave shape allow for maximum oxygen absorption. (Integrated body, 2010)

Adipose (fat) cell: its main cells, adipocytes, are bulky (large) and are jam-packed with droplets of lipids (fats), which store energy in case the diet cannot meet requirements. (Integrated body, 2010)

Smooth muscle cell: this large, elongated (extended), spindle-shaped cells of smooth muscle are called muscle fibres. Its shape allow for contraction by means of sliding strands of protein within. (Integrated body, 2010)

Nerve cell: every cell consist of configuration of short extensions known as dendrites, which is to receive nerve signals, and also has a long wire called axon, which is to send signals to other cells. (Integrated body, 2010)

Sperm (egg) cell: every sperm has a head that transport the paternal (fatherly) set of genetic substances. It has a whip-like tail that propels it towards the egg. (Integrated body, 2010)

Ovum (egg) cell: they are giant cells and contain the maternal (motherly) complement of genetic material, and energy resources for the first cell divisions that shape early embryo. (Integrated body, 2010)

Task 4. 2 Describe major tissue types and their functions.

Tissues are groups of similar cells that carry out a common function. There are four groups of tissues in our body. They are epithelial, connective, muscle and nerve. Major tissue types and functions, are as follows: (Integrated body, 20100

Areola: a loose connective tissue, half-solid, allows food to pass through, inside has two other connective tissue types. They are yellow elastic and white fibrous with fibrocytes and mast cells that manufacture histamine a protective inflammation and heparin an anti-coagulant. They are mostly found in the body, connecting and supporting other tissues, such as between muscles and supporting blood vessels and nerves. They function as connection and support to other tissues.

Adipose: these are fat cells that have fat globules. They are located between muscle fibres, under skin, around kidneys and at back of eyes. Their function is to protect, insulate and act as food reserve.

Lymphoid: half (semi) solid tissue, some white fibres, lots of cells, of which majority are lymphocytes and reticular cells. They are found in lymph nodes,

thymus gland, spleen, tonsils, appendix, walls, of large intestine and glands of small intestine. They function to form lymphatic system cells and blood cells. Lymphocytes and reticular cells function to control disease.

Yellow elastic: this is elastic fibres, and very few cells. They are located in the lung tissue, bronchi and trachea, arteries, stomach, bladder and other stretchy or recoiling organs. They function as tissue enabling great expansion and recoil (shrink back).

White fibrous: it is a strongly connective tissue, but not elastic. They are mostly closely packed bundles of collagen fibres. The fibres run in same direction. They form ligaments and periosteum (material making up bones) of bone. They form outer protection of organs, for example, protection of kidneys, brain and muscle fascia. Their function is connection and protection.

Bone: it is the hardest structure of the body. It is compact outside and cancellous (not solid) inside. It has 25% water, 30% organic substance, and 45% inorganic salts. It is found in the skeleton. As compact, it functions as dense for strength, support and protection. And as cancellous, it functions as structure bearing and cellular development.

Blood: is a fluid connective tissue, it has forty five percent cells, and fifty five percent plasma. It circulates inside cardio vascular system, and cells in cell production location. Its function is to transport food and oxygen to all cells and removal of waste from them. It also fights infection and clot blood.

Cartilage: it is firm, tough, solid tissue. It has cells known as chondrocytes, and is of three types. Hyaline; is a blue and white smooth chondrocyte cells

grouped together in a solid matrix (medium) and mainly resilient (hard-wearing). It covers parts of bone that form joints. The costal cartilages, parts of larynx, trachea and bronchi. Its role is connection and protection. Yellow elastic cartilage; these are fibres running (flowing) through a solid matrix. It contains fibrocytes and chondrocytes between multi-directional fibres. They are found in the pinna, the external cartilage of the ear, epiglottis, flap which prevents food and liquid entering trachea. It is flexible function. White fibrocartilage; white fibres packed with dense masses (lump). They are tough, a bit flexible, and contain chondrocytes. It is located in intervertebral discs, semi-lunar cartilages, and hip and shoulder sockets. Its function is to absorb shock.

Task 4. 3 Analyse body systems and assess the interdependence of their functions.

The body systems are group of parts that are connected. They include organs and tissues that work together to perform particular functions. The system has separate processes inside the body, and each is dependent on the others. They work together as efficient functioning supportive system.

Skeletal system: this is the skeleton, it a solid framework that is moveable and supportive of the body. It is where the rest of the body is built. The bone has a role in the other body systems. It is where white and red blood cells grow to build up a fatty tissue called red marrow. Its essential minerals, such as calcium, are stored in the bone, and to be released when there is shortage.

Muscular system: it consist about half of the body’s bulkiness. It works with the skeleton, and its voluntary muscles allow the body to be exact in movements. The involuntary muscles, that comprise the heart muscle and the smooth muscle, are meant to provide the essential power (force) for the working (functioning) of the respiratory, cardiovascular, and the digestive systems.

Nervous system: this is the brain, and it is the site of both consciousness and creativity. The brain, through the nerves of the spinal cord and the system of nerves that branch to all other parts of the body, controls all body movement. It also communicates with the endocrine glands and influences the functions of the other body system.

Endocrine system: this is the hormones and chemicals that act (take action) on specified tissues, and then affect the body’s interior balance. It is secreted by endocrine glands and other organs. It flows in the blood and other body fluids, and also starts the changes that take place during puberty.

Cardiovascular system: its most basic function is pumping blood around the body. It supplies all organs and tissues with oxygenated nutrient blood. It can get use to changes in demand quickly. Waste products are removed during blood circulation.

Lymphatic system: it provides very important protection from infectious disease and also prevents malfunctioning of the internal tissues. (JK, 2010)

Respiratory system: it is made up of the nose (nasal cavities), which filter inward bound air. Also consists of the pharynx, the larynx, the trachea, the lungs and the air sacs. It is the site of oxygen and carbon dioxide exchange.

Digestive system: the work of the digestive system is to reduce large and complex substances to water soluble so that the cell can use them. The process is both physical and chemical. The digestive system is of two parts; the alimentary canal (mouth, anus, throat, oesophagus, stomach), and the small and large intestines.

Urinary system: its excretory organs get rid of liquid wastes. The nephrons filter the blood and remove unwanted substances as wastes, and return necessary substances and fluids to the blood. The expelling of urine waste is started by the voluntary relaxing of the sphincter. In the female, the urethra empties in the area between the clitoris and the vagina opening. And in the male, urethra, which is about twenty centimetres long, runs through the penis.

Male reproductive system: it is where sperm are produced and contained in the scrotum. The sperm and its fluid are known as semen. The semen is ejaculated into the urethra and penis, and from there, into the female’s vagina.

Female reproductive system: it is about seven to ten centimetres long, receives the sperm from the male. The sperm must reach the uterus. The cilia assist the sperm as they swim up towards the egg. A fertilised egg is formed if a sperm enters the egg, and it is called zygote. The zygote passes

through the uterus and becomes attached to its lining. The cells increases and develop into fetus (unborn offspring). (Human Anatomy, 1982).

Homeostasis: all of the human body’s systems work together to maintain equilibrium, two of the body systems are very important for the maintenance of homeostasis. They are the nervous and endocrine systems.