The structure and function in four specialised cells

The human body has numerous cells with differing functions but the same basic. The shell of the cell is the plasma membrane and is selectively permeable allowing it to control what enters and leaves, this surrounds the cytoplasm which is a jelly like substance that may appear grainy as it contains organelles. The nucleus, the largest of the organelles contains chromosomes which are made of DNA and carry the instructions for the cell. The nucleolus is a darker stained region in the nucleus that is densely packed DNA and makes ribosomal and packages it with ribosomal protein to make ribosomes. Just outside the nucleus is the rough endoplasmic reticulum (RER), which has a rough appearance due to the ribosomes that cover some endoplasmic reticulum (ER). The ribosomes translate the instructions carried on mRNA into protein (protein synthesis). Some ER lacks ribosomes, this is referred to as smooth ER and is responsible for making lipids and steroid. Golgi body collects and processes protein and lipid which bud of as vesicles and go to either the surface membrane (secretion) or to form lysosomes. Lysosomes contain powerful hydrolytic enzymes that break things down, their role is to destroy damaged organelles/cells and bacteria cells. Also within the cell are mitochondria that complete the later stages of aerobic respiration and synthesis, producing ATP (a chemical energy) for the cell.

Human cells have 23 pairs of chromosomes giving a total of 46, the exceptions to this are the reproductive cells they have only 23 single chromosomes, as fertilisation takes place the two single sets of chromosomes unite to develop a genetically unique organism (Enotes. com). The sperm cells sole function is to carry its chromosomes to the female egg cell so that this process can take place. The structure of the sperm cell is

designed specifically for this function; it has three sections, the head, the midpiece and the tail (flagellum). In the head is the nucleus which contains its 23 single chromosomes and at the tip it has acrosome which is an organelle of a cap-like structure derived from Golgi apparatus and contains enzymes to break down the egg membrane. The midpiece has a central filamentous core with many mitochondria coiled around it to produce ATP giving the sperm cell the energy it needs to travel through the female cervix to the egg cell. There is a thin layer of cytoplasm and an outer smooth membrane around the flagellum which lashes to in order to propel the sperm cell forward and helps it burrow through the egg cells membrane (national centre for biological information)

The function of the egg cell is to be fertilized by a sperm cell, if this does occur its function then becomes to provide food for the new cell. It is the largest cell in the human body and has a lot of cytoplasm, surrounded by the plasma membrane that is responsible for regulating the cell’s chemical composition. Within the cytoplasm is the nucleus which contains 23 single chromosomes that will unite with chromosomes from the sperm cell when fertilised, the cytoplasm also has droplets of lipids, which if the egg is fertilised will be used as food during the embryos early stages. The cell is encased in a glycoprotein membrane called the zona pellucida, when a sperm cell penetrates the plasma membrane it leads to the modification of the zona pellucida blocking more sperm from entering the egg. This modification happens when enzymes released into the zona pellucida by cortical granules (vesicles just under the plasma membrane) hardening the zona pellucida meaning they can’t get through the membrane therefore

stopping more than one sperm fertilising the egg (Linda J. Heffner, Danny J. Schust).

The motor neuron sends signals to the muscles for joint control, this is achieved by the ‘ upper motor neurons’ in the brain relaying signals to the ‘ lower motor neurons’ in the spinal cord, then to the muscles. It is made up of a cell body, axon and dendrite. The code for production of the neurotransmitter substances are in the nucleus and this is transported along with protein in a dense group of ribosomes and ER (Nissl granules). The axon is where rapid transmission of nerve impulses occurs; “ synapse, where two nerves join, is the slowest part of transmission, so the longer the axon, the fewer synapse, and the faster the impulses transmitted”. The axon also contains axoplasm that permits transport from the cell body to the axon. It has Schwann cells wrapped around it forming a fatty sheath called the myelin sheath which provides electrical insulation, between the Schwann cells are nodes of Ranvier which facilitates the rapid conduction of the nerve impulses. Dendrites branch out from the cell body and allow communication between neurons by connecting with the terminal branches of the axon. At the ends of the dendrites are synaptic knobs that contain many mitochondria to provide energy for active refilling of the synaptic vesicles which are used for the modification and release of chemical transmitters across the synapse (bio factsheet 1997).

The red blood cells main function is to transport oxygen from the lungs to other cells in the body, it also takes waste carbon dioxide from cells lungs. RBC’s are biconcave in shape which means they have a larger cell membrane surface enhancing the diffusion of oxygen. They are around 6-8

micrometers and are flexible; these two features allow it to pass through the minute capillary alleyways between cells in the tissues. Unlike most cells RBC’s have no nucleus or other organelles, they are passive and simply get swept along by the blood so can sustain the little energy they need by a form of anaerobic respiration therefore have no need for mitochondria. The lack of organelles also leaves more room for a substance called haemoglobin, haemoglobin is a complex molecule composed of protein and iron that is responsible for picking up the oxygen from the lungs and transporting to the other cells in the body. They also contain an enzyme called carbonic anhydrase which carries the carbon dioxide from the other cells in the body to the lungs so it can be breathed out (Erich Rosenberger M. D.)

There are many different types of cells in the human body, looking at these four specialised cells shows how the basic structure remains the same, the red blood cell might be seen as the exception, but still has a main body surrounded by a plasma membrane. Each cell differs in shape, size and the amount of organelles it has, for example the sperm cell needs lots of energy so has lots of mitochondria whereas the red blood cell is passive so needs little or no energy and has no mitochondria, therefore the structure of the cell is directly related to its function.