

# BioMedical Admissions Test (BMAT)

## Section 2: Biology Knowledge Checklist

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## B1 - Cells

Subtopics	Key points to understand	✓
Eukaryotic Cells	<ul style="list-style-type: none"> <li>• Organelles have specific functions that allow cells to carry out their functions.</li> <li>• All eukaryotic cells have some organelles in common:               <ul style="list-style-type: none"> <li>○ Nucleus</li> <li>○ Mitochondria</li> <li>○ Cytoplasm</li> <li>○ Cell membrane</li> </ul> </li> <li>• Plant cells also have:               <ul style="list-style-type: none"> <li>○ A cell wall</li> <li>○ Chloroplasts</li> <li>○ Vacuoles</li> </ul> </li> </ul>	
Prokaryotic Cells	<ul style="list-style-type: none"> <li>• Bacterial cells have:               <ul style="list-style-type: none"> <li>○ Cytoplasm</li> <li>○ Cell membrane</li> <li>○ A cell wall</li> <li>○ No true nucleus; chromosomal DNA is freely suspended in the cytoplasm</li> <li>○ Plasmid DNA</li> </ul> </li> </ul>	
Cell Organisation	<ul style="list-style-type: none"> <li>• Multicellular organisms have specialised cells which carry out a specific function.</li> <li>• The process by which these cells become specialised is called differentiation.</li> <li>• Large multicellular organisms have multiple organ systems, each serving different functions.</li> <li>• Similar cells are organised into tissues, tissues into organs, and organs are then organised into systems.</li> </ul>	

## B2 - Movement Across Membranes

Subtopics	Key points to understand	✓
Processes	<ul style="list-style-type: none"> <li>• Molecules move across the cell membrane in multiple ways:               <ul style="list-style-type: none"> <li>○ Diffusion is the passive movement of molecules from an area of high concentration to an area of low concentration.</li> <li>○ Active transport is the movement of molecules against their concentration gradient, using energy from respiration.</li> <li>○ Osmosis is the movement of water molecules across a partially permeable membranes from an area of higher water concentration to an area of lower water</li> </ul> </li> </ul>	



	concentration. <ul style="list-style-type: none"> <li>• Know examples of diffusion, osmosis and active transport in living and non-living systems</li> </ul>	
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### B3 - Cell Division and Sex Determination

Subtopics	Key points to understand	✓
Mitosis	<ul style="list-style-type: none"> <li>• DNA condenses into chromosomes before cell division (mitosis or meiosis).</li> <li>• Mitosis produces 2 identical daughter cells, which are diploid (have 23 pairs of chromosomes).</li> <li>• Mitosis is important for growth, repair and maintenance of cells, as well as asexual reproduction.</li> <li>• Mitosis occurs in most cells in the body.</li> </ul>	
Meiosis	<ul style="list-style-type: none"> <li>• Meiosis involves 2 divisions.</li> <li>• Meiosis produces 4 genetically diverse daughter cells, each with different combinations of the parental DNA.</li> <li>• Meiosis produces gametes which are haploid, meaning they have only 1 copy of each of the 23 chromosomes.</li> <li>• Meiosis occurs in the human reproductive organs (testes and ovaries).</li> </ul>	
Asexual and Sexual Reproduction	<ul style="list-style-type: none"> <li>• Asexual reproduction:               <ul style="list-style-type: none"> <li>○ Requires only one parent</li> <li>○ Gives rise to genetically identical offspring</li> </ul> </li> <li>• Sexual reproduction:               <ul style="list-style-type: none"> <li>○ Requires two parents</li> <li>○ Gives rise to genetically different offspring</li> </ul> </li> </ul>	
Sex Determination	<ul style="list-style-type: none"> <li>• Women have 2 X chromosomes (XX), while men have 1 X and 1 Y chromosome (XY).</li> <li>• A single gene on the Y chromosome makes someone a male. This gene causes the production of a protein that causes the testes to develop, and the testes go on to produce male sex hormones.</li> <li>• Females, having no Y chromosome, lack this gene and therefore develop ovaries and female sex hormones instead.</li> <li>• Know how to draw use punnett square diagrams to calculate the sex ratio of offspring.</li> </ul>	



## B4 - Inheritance

Subtopics	Key points to understand	✓
Genetic Terms	<ul style="list-style-type: none"> <li>● Understand the following terms:               <ul style="list-style-type: none"> <li>○ Gene</li> <li>○ Allele</li> <li>○ Dominant</li> <li>○ Recessive</li> <li>○ Heterozygous</li> <li>○ Homozygous</li> <li>○ Phenotype</li> <li>○ Genotype</li> <li>○ Chromosome</li> </ul> </li> </ul>	
Genetic Diagrams	<ul style="list-style-type: none"> <li>● Genetic diagrams can be used to work out the probability that two individuals' offspring will inherit a certain combination of alleles (genotype) and express a certain characteristic (phenotype).</li> <li>● Uppercase letters usually represent dominant alleles and lowercase letters represent recessive alleles.</li> <li>● Homozygous recessive for a trait means there are 2 copies of the specific recessive allele.</li> <li>● Homozygous dominant for a trait means there are 2 copies of the specific dominant allele.</li> <li>● A heterozygous individual possesses 1 copy of the recessive allele and 1 copy of the dominant allele.</li> <li>● Homozygous dominant and heterozygous individuals express the dominant characteristic, while only homozygous recessive individuals express the recessive characteristic.</li> <li>● Know how to draw and interpret genetic diagrams, including monohybrid crosses, punnett squares and family trees.</li> </ul>	
Genetic Disorders	<ul style="list-style-type: none"> <li>● Genetic disorders can be inherited from parents by a recessive or dominant allele.</li> <li>● Polydactyly is caused by a dominant allele and results in extra fingers and toes.</li> <li>● Huntington's Disease is caused by a dominant allele. Its symptoms include shakiness, poor focus, poor memory, mood swings and clumsiness. Unusually, these symptoms often appear around age 40.</li> <li>● Cystic fibrosis is caused by a recessive allele. The formation of a thick sticky mucus in membranes in the lungs and pancreas causes symptoms of breathing and digestive problems.</li> <li>● Carriers of recessive disease-causing alleles are asymptomatic.</li> </ul>	



## B5 - DNA

Subtopics	Key points to understand	✓
Structure	<ul style="list-style-type: none"> <li>Chromosomes are made of long strands of DNA and are found in the nucleus of most cells.</li> <li>DNA is made from many nucleotide units bonded together.</li> <li>Each nucleotide has 1 of 4 bases; adenine, guanine, cytosine or thymine.</li> <li>Nucleotides will only pair in certain ways:               <ul style="list-style-type: none"> <li>A pairs with T</li> <li>C pairs with G</li> <li>This pairing pattern is known as 'complementary base pairing'.</li> </ul> </li> <li>DNA tells the cell what proteins to make.</li> <li>Each triplet of nucleotides codes for a single amino acid.</li> <li>DNA is replicated prior to cell division, meaning that each daughter cell has a full set of DNA.</li> </ul>	
Gene Mutations	<ul style="list-style-type: none"> <li>A mutation is a change in the DNA sequence that can result in the formation of a new allele.</li> <li>A mutation can have a positive effect, negative effect, or no effect at all.</li> </ul>	

## B6 - Gene Technologies

Subtopics	Key points to understand	✓
Genetic Engineering	<ul style="list-style-type: none"> <li>Genetic engineering is the process of transferring genes from one organism to another organism.</li> <li>It is done in order to produce a desirable protein or drug, or to give an organism a desirable characteristic.</li> <li>For example:               <ul style="list-style-type: none"> <li>Sheep have been genetically engineered to produce drugs in their milk.</li> <li>Bacteria have been modified to produce insulin for diabetes treatment.</li> <li>Crops have been genetically altered to obtain resistance to insects and viruses.</li> </ul> </li> <li>The process of genetic engineering is as follows:               <ul style="list-style-type: none"> <li>The desired gene is cut from a chromosome using 'restriction enzymes'.</li> <li>The enzyme 'ligase' joins the sticky ends of the gene to a 'plasmid'.</li> <li>The plasmid is transferred into a new organism.</li> <li>If successful, the transgenic organism will express the desired trait.</li> </ul> </li> </ul>	



	<ul style="list-style-type: none"> <li>● Plasmids are known as 'vectors'.</li> <li>● Assaying techniques allow scientists to check the success of genetic engineering procedures before the genetically modified organism is cloned.</li> </ul>	
Stem Cells	<ul style="list-style-type: none"> <li>● Stem cells are undifferentiated cells that can become multiple other cells.</li> <li>● Embryonic stem cells can develop into any cell in the body, while adult stem cells can only differentiate into certain types of cells.</li> </ul>	
Selective Breeding	<ul style="list-style-type: none"> <li>● The process of selective breeding is as follows:           <ul style="list-style-type: none"> <li>○ Animals with desirable characteristics are selected to breed.</li> <li>○ Animals with the most desirable characteristics are selected from the offspring.</li> <li>○ These offspring animals are then bred together.</li> <li>○ This cycle is repeated over many generations.</li> <li>○ Over time the desirable characteristic increases in the population.</li> </ul> </li> <li>● Disadvantages:           <ul style="list-style-type: none"> <li>○ Reduces genetic variation.</li> <li>○ Ethical concerns that the welfare of animals is affected.</li> </ul> </li> </ul>	

## B7 - Variation

Subtopics	Key points to understand	✓
Natural Selection	<ul style="list-style-type: none"> <li>● Evolution is the process whereby organisms change over many generations.</li> <li>● Natural selection is a theory that outlines how evolution occurs:           <ul style="list-style-type: none"> <li>○ Organisms better-adapted to their environment are more likely to survive and produce offspring. Over time, this increases the proportion of individuals with those beneficial characteristics.</li> <li>○ Likewise, less-adapted organisms will be less likely to survive and breed, and the frequency of those less-adapted traits will diminish over time.</li> </ul> </li> <li>● Bacteria with a mutation that gives them antibiotic resistance will be more likely to survive in the presence of antibiotics, and thus the strain of antibiotic-resistant bacteria will grow.</li> </ul>	
Variation	<ul style="list-style-type: none"> <li>● Variation refers to the differences between organisms of the same species.</li> <li>● Variation can be genetic or environmental.</li> <li>● Genetic variation occurs due to mutations.</li> <li>● Some variation can be explained by genetics or environment</li> </ul>	



	alone (e.g. eye colour and blood group), but most variation is a result of a combination of environmental and genetic factors.	
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## B8 - Enzymes

Subtopics	Key points to understand	✓
Structure and Function	<ul style="list-style-type: none"> <li>Enzymes are biological catalysts; they increase the rate of reaction without undergoing any permanent chemical change.</li> <li>As enzymes are composed of proteins, they are sensitive to changes in temperature and pH.</li> <li>Enzymes have an active site, where substrate binds and undergoes a reaction.</li> <li>The active site of enzymes is extremely specific and therefore only catalyses a specific reaction.</li> </ul>	
Digestive Enzymes	<ul style="list-style-type: none"> <li>The role of amylase, lipase and protease in digestion.</li> </ul>	

## B9 - Animal Physiology

Subtopics	Key points to understand	✓
Respiration	<ul style="list-style-type: none"> <li>Respiration is the process of releasing energy from glucose, and it occurs in every living cell.</li> <li>It is catalysed by enzymes.</li> <li>Respiration can be aerobic and anaerobic. These two types of respiration have different equations.               <ul style="list-style-type: none"> <li>Aerobic respiration requires oxygen and releases more energy than anaerobic respiration</li> <li>Anaerobic respiration involves incomplete breakdown of glucose. It occurs when there is insufficient oxygen present, such as during vigorous exercise.</li> </ul> </li> <li>Some glucose is stored as glycogen in the liver and muscles. This can be converted back to glucose during exercise.</li> </ul>	
Nervous System	<ul style="list-style-type: none"> <li>Stimuli are changes in the environment; receptors detect these changes.</li> <li>The CNS coordinates a response, and consists of the brain and spinal cord.</li> <li>Information is transmitted via neurons as electrical impulses.</li> <li>There are 3 types of neurons, each with a slightly different structure.</li> </ul>	



	<ul style="list-style-type: none"> <li>• Each neuron has an axon, cell body and dendrites.</li> <li>• Synapses are gaps between 2 neurons.</li> <li>• Synapses are the slowest part of the neuronal pathway.</li> <li>• Impulses trigger the release of chemicals from one neuron, which diffuse across the synapse and bind to receptors on the second neuron. This causes an impulse to be carried along the second neuron.</li> </ul>	
Respiratory System	<ul style="list-style-type: none"> <li>• Gas exchange occurs in the alveoli of the lungs.</li> <li>• Oxygen is exchanged (into the blood) for carbon dioxide (out of the blood).</li> <li>• The alveoli are one cell thick, in order to maximise gas exchange.</li> <li>• Ventilation is the process of breathing in and out.</li> <li>• Understand how different muscular contractions and relaxations cause thoracic volume to increase</li> <li>• Artificial ventilators help people to breathe when they are unable to do so themselves. For example, when a person is under general anaesthetic.</li> </ul>	
Circulatory System	<ul style="list-style-type: none"> <li>• The circulatory system has 2 circuits, one for oxygenated blood and one for deoxygenated blood.</li> <li>• The heart is a muscular pump which pushes blood around the body.</li> <li>• The heart has a 4 chamber structure, with 2 atria and 2 ventricles.</li> <li>• Between the atria and ventricles, and ventricles and arteries, there are valves which prevent backflow of blood.</li> <li>• Understand the different structures and functions of the 3 types of vessels: <ul style="list-style-type: none"> <li>○ Arteries</li> <li>○ Veins</li> <li>○ Capillaries</li> </ul> </li> </ul>	
Digestive System	<ul style="list-style-type: none"> <li>• The enzymes and breakdown products for the digestion of the following: <ul style="list-style-type: none"> <li>○ Starch</li> <li>○ Proteins</li> <li>○ Lipids</li> </ul> </li> <li>• Where digestive enzymes are produced.</li> <li>• The digestive system consists of multiple organs, each with different functions.</li> </ul>	
Excretory System	<ul style="list-style-type: none"> <li>• The kidney maintains the environment of the blood by removing waste products and maintaining ion levels.</li> <li>• The kidneys filter urea out of the blood, adjust ion content and adjust water content.</li> <li>• Urea is produced as a byproduct of converting proteins to carbohydrates and fats.</li> <li>• The nephron is the unit of filtration in the kidney. Three processes occur here:</li> </ul>	



	<ul style="list-style-type: none"> <li>○ Ultrafiltration</li> <li>○ Reabsorption</li> <li>○ Release of wastes</li> <li>● You should understand what each process involves and where on the nephron it occurs.</li> </ul>	
Homeostasis	<ul style="list-style-type: none"> <li>● Homeostasis is the process of ensuring a constant internal environment is maintained.</li> <li>● Balancing things going into the body with things leaving the body ensures cells have the right environment to function properly.</li> <li>● Negative feedback is the process where a change in a condition is detected, and the brain responds to bring it back towards the normal value.</li> <li>● Homeostasis and body temperature:           <ul style="list-style-type: none"> <li>○ The thermoregulatory centre:               <ul style="list-style-type: none"> <li>■ Is in the hypothalamus</li> <li>■ Induces mechanisms to ensure body temperature is maintained around 37°C.</li> </ul> </li> <li>○ If body temperature is too high:               <ul style="list-style-type: none"> <li>■ Hairs lie flat</li> <li>■ Sweating is induced</li> <li>■ Blood vessels dilate</li> </ul> </li> <li>○ If body temperature is too low:               <ul style="list-style-type: none"> <li>■ Hairs stand up on end to trap a layer of insulating air</li> <li>■ Shivering is induced</li> <li>■ Blood vessels constrict</li> </ul> </li> </ul> </li> <li>● Homeostasis and blood glucose control:           <ul style="list-style-type: none"> <li>○ A hormone called insulin controls blood glucose levels.</li> <li>○ If blood glucose levels are too high, insulin is secreted by the pancreas and glucose is taken up by the liver. This results in a decrease in blood glucose levels.</li> </ul> </li> <li>● Homeostasis and water content           <ul style="list-style-type: none"> <li>○ Water content is controlled by a hormone called ADH.               <ul style="list-style-type: none"> <li>■ When the water content is too high, less ADH is released into the blood by the pituitary gland, and the kidneys reabsorb less water.</li> <li>■ When water content is too low, more ADH is released, and more water is reabsorbed.</li> </ul> </li> <li>○ Alcohol suppresses ADH production; ecstasy increases ADH production.</li> </ul> </li> </ul>	
Hormones	<ul style="list-style-type: none"> <li>● Hormones are chemical messengers in the blood.</li> <li>● Compared to nervous responses, hormonal effects are:           <ul style="list-style-type: none"> <li>○ Slower</li> <li>○ More general</li> <li>○ Longer lasting</li> </ul> </li> <li>● Adrenaline is a hormone which induces the 'fight or flight' response.</li> </ul>	



	<ul style="list-style-type: none"> <li>Adrenaline causes the heart rate to increase, pupils to dilate and causes dilation of vessels to direct blood to muscles</li> </ul>	
Diseases	<ul style="list-style-type: none"> <li>Communicable diseases are:               <ul style="list-style-type: none"> <li>Infectious</li> <li>Caused by pathogens</li> </ul> </li> <li>Non-communicable diseases are:               <ul style="list-style-type: none"> <li>Not infectious</li> <li>Caused by the interaction of many factors</li> </ul> </li> <li>Know about examples of communicable and non-communicable diseases</li> </ul>	

## B10 - Ecosystems

Subtopics	Key points to understand	✓
Interactions Between Organisms	<ul style="list-style-type: none"> <li>Organisms must compete for resources from the environment.</li> <li>Plants and animals compete for slightly different resources as they have different needs.</li> <li>There are different types of competition:               <ul style="list-style-type: none"> <li>Interspecific - competition between organisms of different species.</li> <li>Intraspecific - competition between organisms of the same species.</li> </ul> </li> <li>Intraspecific competition has a greater effect on population size as organisms of the same species have the same needs, making competition more rife.</li> <li>The relationships between the populations of predators and prey are cyclic:               <ul style="list-style-type: none"> <li>As prey numbers increase, predator numbers will increase.</li> <li>There is a lag between these changes in numbers as it takes some time for the populations to respond to change.</li> </ul> </li> <li>A mutualistic relationship between 2 organisms allow both organisms to benefit.</li> <li>A parasitic relationship allows one organism to benefit, whilst the host is harmed.</li> </ul>	
Environmental Change	<ul style="list-style-type: none"> <li>Changes in the environment are caused by biotic and abiotic factors:               <ul style="list-style-type: none"> <li>Biotic - disease, predators, food sources, competition</li> <li>Abiotic - temperature, rainfall, pollution</li> </ul> </li> <li>Environmental changes can lead to changes in population.</li> <li>Population can:               <ul style="list-style-type: none"> <li>Increase</li> <li>Decrease</li> </ul> </li> </ul>	



	<ul style="list-style-type: none"> <li>○ Change its distribution</li> </ul>	
Biomass Pyramids	<ul style="list-style-type: none"> <li>● We can show the mass of organic material in a food chain using a pyramid of biomass.</li> <li>● Moving up trophic levels, there is usually:             <ul style="list-style-type: none"> <li>○ Considerably less biomass.</li> <li>○ A significant decrease in the number of organisms.</li> </ul> </li> <li>● There are rarely more than 4 or 5 trophic levels in a pyramid because of the significant losses of mass and energy at each stage.</li> </ul>	
Carbon Cycle	<ul style="list-style-type: none"> <li>● Carbon is used for photosynthesis.</li> <li>● Carbon is recycled back into the environment by a number of processes:             <ul style="list-style-type: none"> <li>○ Respiration</li> <li>○ Burning of fossil fuels</li> <li>○ Burning of plant/animal matter</li> <li>○ Decay (there are stages between these main processes - refer to the diagram of the cycle in the guide).</li> </ul> </li> </ul>	
Water Cycle	<ul style="list-style-type: none"> <li>● The processes of the water cycle include the following:             <ul style="list-style-type: none"> <li>○ Transpiration</li> <li>○ Evaporation</li> <li>○ Condensation</li> <li>○ Precipitation</li> <li>○ Osmosis</li> <li>○ Excretion</li> </ul> </li> </ul>	

