**National 5 Biology**

**Learning Outcomes**

**Cell Biology**

**Unit 1**

After completing this topic you should know**:**

**Section 1 Cell structure**

**1. For plant, animal, fungal and bacteria cells, know cell ultrastructure and functions to include:**

**cell walls, mitochondria, chloroplasts, cell membrane, vacuole, nucleus, ribosomes and plasmids.**

**Section 2 Transport across cell membranes**

**2a**

**Cell Membrane**

1. **Know that the cell membrane consists of lipids and proteins.**

**2b+c**

**Diffusion and its Importance**

1. **Diffusion is the movement of molecules from an area of high concentration to an area of low concentration down a concentration gradient.**
2. **A cell membrane allows small soluble molecules to pass through but does not allow large insoluble molecules to pass through. The membrane is said to be selectively permeable.**
3. **Diffusion is passive. This means it does not require energy to take place.**
4. **Diffusion is important in cells as the mechanism of the exchange of materials e.g. glucose,**

**oxygen and amino acids into the cell and carbon dioxide and other wastes out of the cell.**

**Osmosis and its effect on cells**

**2d+e**

1. **Osmosis is the movement of water molecules from an area of high water concentration to an area of low water concentration through a selectively permeable membrane.**
2. **In solutions of different concentrations animal cells can burst, shrink or remain unchanged.**
3. **In solutions of different concentrations plant cells become turgid, plasmolysed or remain unchanged.**
4. **Solutions can be described as hypertonic, isotonic or hypotonic when compared to another solution.**
5. **Hypertonic solutions have the lower water concentration.**
6. **Isotonic solutions are of equal concentration.**
7. **Hypotonic solutions have the higher water concentration.**

**Section 2 Transport across cell membranes**

**2f**

**Active Transport**

1. **Active transport is the movement of molecules (and ions) across the cell membrane from a low to a high concentration (i.e. against the concentration gradient).**
2. **Active transport is carried out by membrane proteins.**
3. **Active transport requires energy (supplied by ATP).**
4. **Temperature, availability of oxygen and concentration of respiratory substrate (e.g. glucose) affect the rate of active transport (because the rate of respiration and energy production are affected).**
5. **Examples of active transport are a) sodium and potassium in nerve cells and b) iodine in seaweed.**

**Section 3 Producing new cells**

**Mitosis**

**3a**

1. **The sequence of events of mitosis.**
2. **Mitosis maintains the diploid chromosome complement of cells.**
3. **Diploid cells have two matching sets of chromosomes, which are replicated during mitosis.**

**Section 4** **DNA and Protein Production**

**The Structure of DNA**

**4a**

1. **DNA is a double stranded helix**
2. **DNA contains 4 types of bases**
3. **DNA bases are Guanine, Cytosine, Adenine and Thymine**
4. **DNA bases pair up in the following order;**
   * **Guanine and Cytosine (and vice-versa)**
   * **Adenine and Thymine (and vice-versa)**

**4b**

**mRNA**

1. **Messenger RNA (mRNA) is a molecule which carries a copy of the code from DNA , in the nucleus, to a ribosome.**
2. **A ribosome is a structure in the cytoplasm which ‘reads’ the mRNA and matches it to specific amino acids**
3. **Proteins are assembled from amino acids at ribosomes.**

**Section 5** **Proteins and Enzymes**

**Variety of Protein Shapes**

**5a**

1. **The variety of protein shapes and functions arises from the sequence of amino acids.**
2. **The sequence of amino acids leads to coiling and folding which determines the final shape and function**
3. **Examples of protein shapes are;**
   * **Structural Proteins**
   * **Enzymes**
   * **Hormones**
   * **Antibodies**

**5b**

**Functions of proteins**

1. **Know the functions of proteins to include: structural, enzymes, hormones and antibodies.**

**Enzymes**

**5c**

1. **Enzymes:**
   * **are biological catalysts**
   * **are made by all living cells**
   * **speed up cellular reaction**
   * **are unchanged in a reaction**
2. **The shape of the active site of the enzyme is complimentary to a specific substrate**

**Optimum conditions**

**5d**

1. **The conditions in which an enzyme will work best is called its optimum**
2. **Two conditions which must be at an optimum for an enzyme to work are temperature and pH.**
3. **If an enzyme is not at its optimum it can result in a change of shape until the enzyme is damaged**
4. **An enzyme which is damaged and unable to work is said to be denatured**

**Section 6** **Genetic Engineering**

1. **Genetic information can be transferred from one cell to another naturally or artificially**
2. **The stages of genetic information as follows;**
   * **Identifying required gene on DNA**
   * **Extracting the required gene**
   * **Extraction of bacterial plasmid**
   * **Insertion of the required gene into a plasmid**
   * **Insertion of plasmid into host cell**
   * **Growth of genetically modified organism producing required product**

**Section 7** **Photosynthesis**

**The Chemistry of Photosynthesis**

**7a**

1. **Photosynthesis is an enzyme-controlled series of reactions in green plants.**
2. **The raw materials are water and carbon dioxide**
3. **Light energy and chlorophyll are also required**
4. **The product of photosynthesis is glucose**
5. **Adenosine tri-phosphate (ATP) provides instant energy**
6. **ATP is involved in energy transfer**
7. **In the light reaction, light energy from the sun is trapped by chlorophyll and is used to form ATP from ADP + Pi and also used to spilt water into oxygen and hydrogen.**
8. **In carbon fixation, carbon dioxide and hydrogen are built into sugar (glucose) using energy in the form of ATP**

**7b**

**The Fate of Sugar**

**9. The chemical energy in sugar (glucose) can be used for respiration or can be converted into starch or cellulose**

**7c**

**Limiting factors**

1. **Limiting factors can be;**

* **Carbon dioxide concentration**
* **Light intensity**
* **Temperature**

**Section 8** **Respiration**

**The Chemistry of Respiration**

1. **The chemical energy in glucose is released in all cells through a series of enzyme-controlled reactions called respiration.**
2. **The energy released from respiration is used to generate ATP from ADP and Pi**
3. **Energy produced can be used for cellular activities including; Muscle cell contraction, cell division, protein synthesis and transmission of nerve impulses**
4. **The breakdown of each glucose molecule in the presence of oxygen produces 38 molecules of ATP**
5. **Aerobic respiration starts in the cytoplasm and is completed in the mitochondria**
6. **The by-products of respiration are carbon dioxide and water**
7. **Anaerobic respiration produces 2 molecules of ATP**
8. **In animals anaerobic respiration is reversible and produced lactic acid**
9. **In plants and yeast cells anaerobic respiration(fermentation) is irreversible and produces ethanol and carbon dioxide**
10. **Aerobic respiration can be summarised as;**

**glucose + oxygen + 38ADP + 38Pi carbon dioxide + water + 38ATP**