Biology Syllabus, Grade 11
General Objectives of Grade 11 Biology

1. To develop understanding and acquire knowledge of:
   • meaning of science and the steps of the scientific method
   • tools used in biology and their functions
   • the relevance and promise of biological science and the role of biology as a science in the fight against HIV and AIDS
   • organic molecules, their structures and functions and the property and importance of water for life
   • meaning, names, properties, and importance of enzymes and how they lower activation energy
   • the mechanism of action of enzymes, the actions of apo- and co-enzymes, co-factors and allosteric regulation and feedback control mechanism of enzyme activity
   • the cell theory, the size and functions of cells, prokaryotic and eukaryotic cells and the functions of the different parts of the cell
   • the importance and composition of a cell membrane, the models of cell membrane and the mechanisms of substance transport across a cell membrane
   • the structure of ATP and its role in cellular metabolism and the role of electron donors and acceptors
   • the structure of a mitochondrion and where the different processes of cellular respiration occur
   • the process of alcoholic fermentation and lactate production
   • the chloroplast, light dependent and independent processes of photosynthesis the products of the two processes
   • photorespiration and C_3 and C_4 plants

2. To develop skills and abilities of:
   • applying the scientific method in solving problems
   • planning and conducting scientific experiment and writing a report for scientific experiments
   • using laboratory and field tools in biology activities
   • conducting a library research and gathering information on biology topics
   • identifying biologically important compounds by conducting simple tests
   • demonstrating factors that affect enzyme activity with simple experiments
   • demonstrating osmosis and diffusion with simple experiments
   • separating photosynthetic pigments by paper chromatography
   • scientific enquiry: observing, classifying, comparing, making models, communicating, measuring, asking questions, drawing conclusions, applying concepts, interpreting photos and illustrations and relating cause and effect

3. To develop the habit and attitude of:
   • willingness to participate in community undertakings against HIV and AIDS
   • demonstrating life skills that lead to responsible sexual behaviour
   • curiosity, love, freedom, honesty, respect, co-operation, tolerance, humility, reasoning, and openness as values of learning biology as a science
# Unit 1: The science of biology (29 periods)

**Unit Outcomes:** Students will be able to:

- define science, name and demonstrate the scientific methods
- plan and conduct scientific experiment and write a report for scientific experiments
- name and classify the tools used in biology, explain their functions and demonstrate how to use some tools
- conduct a library research and gather information to explain the relevance and promise of biological science
- explain the role of biology as a science in the fight against HIV and AIDS
- express willingness to participate in community undertakings against HIV and AIDS
- demonstrate life skills that lead to responsible sexual behaviour.

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<th>Suggested activities</th>
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<tr>
<td>Students will be able to:</td>
<td><strong>1. The science of biology</strong></td>
<td>- Start the lesson by asking students to tell how they perceive the term science. Then give them the appropriate definition.</td>
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<td></td>
<td><strong>1.1 Methods of science</strong></td>
<td>- A concrete example, from scientific publications, should be shown to demonstrate scientific methods to solve problems. Students should be allowed to make simple practices of each step of the scientific method.</td>
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<tr>
<td></td>
<td><strong>(10 periods)</strong></td>
<td>- You can also use case studies from experiences of some scientists. By narrating how a given scientist discovered his findings, students can discern the Scientific Methods followed up to the discovery. For example, the scientific Methods that Alexander Fleming followed to discover penicillin could be related as a very interesting case study.</td>
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<tr>
<td></td>
<td><strong>What is science?</strong></td>
<td>- Let the students conduct a group work to identify problems from what they observe in their surroundings and show the steps they follow to solve the problem</td>
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<tr>
<td></td>
<td><strong>Steps of the scientific method</strong></td>
<td>- Present a format for writing a report for experiments. Let the students discuss on the outlined format. Let them understand that report writing skill is essential not only for experiments but also for any scientific activity conducted inside and outside the classroom. Let them practice report writing.</td>
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<td></td>
<td><strong>Scientific experiment</strong></td>
<td>- Display some of the tools available in the school laboratory. Let the students identify each tool and explain its function. Let them practice the use of some of the tools.</td>
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<td></td>
<td><strong>1.2 Basic tools of a biologist</strong></td>
<td>- If samples of some relevant tools and instruments for biological research are not available in the school laboratory pictures and charts could be used to teach about them.</td>
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<td></td>
<td><strong>(7 periods)</strong></td>
<td>- Whenever there is access to the higher education institutions students may visit biology laboratories and observe the laboratory and field tools available there.</td>
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<td></td>
<td><strong>Laboratory tools</strong></td>
<td><strong>Writing reports</strong></td>
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<td></td>
<td>(light and electron microscopes, dissecting kit, pipette, Petri-dish, etc.)</td>
<td><strong>Display some of the tools available in the school laboratory. Let the students identify each tool and explain its function. Let them practice the use of some of the tools.</strong></td>
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<tr>
<td></td>
<td><strong>Classify tools used in biology as laboratory and field equipments</strong></td>
<td><strong>If samples of some relevant tools and instruments for biological research are not available in the school laboratory pictures and charts could be used to teach about them.</strong></td>
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<tr>
<td></td>
<td><strong>Explain the functions</strong></td>
<td><strong>Whenever there is access to the higher education institutions students may visit biology laboratories and observe the laboratory and field tools available there.</strong></td>
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<tr>
<td>of some tools used in biology</td>
<td>centrifuge, balance, etc.) • Field tools (insect net, plant press, altimeter, GPS, meter, traps, etc.)</td>
<td>• Let students conduct a simple library research on relevance and promises of biology. This could also be extended to interviewing some professionals of relevant or concerned institutions. Their findings should indicate a) the relevance of biology in agriculture, medicine, nutrition and food shortage, environmental protection, control of RPG; and b) the promises of biology in the area of biotechnology and its role in the development of the country</td>
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<tr>
<td>• demonstrate the use of some tools used in biology</td>
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<tr>
<td>• explain the relevance and promise of biological science</td>
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<tr>
<td>• conduct a simple library research on relevance and promises of biology</td>
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<tr>
<td>• gather information or data through interviews</td>
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<tr>
<td>• explain the role of biology as a science in the fight against HIV and AIDS</td>
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<tr>
<td>• express willingness to participate in community undertakings against HIV and AIDS</td>
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<tr>
<td>• demonstrate life skills that lead to responsible sexual behaviour</td>
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<tr>
<td>1.3 Relevance and promises of biological science (5 periods)</td>
<td>Mainly a student project</td>
<td>• Use various participatory approaches when dealing with this content. You can plan to have guest speakers from health institutions or from among PLWHA. You can also arrange a visit to a nearby centre or NGO which is working with PLWHA. Let the students practice certain life skills through role plays, and methods like case studies, devil’s advocate, values clarification, debate and other similar methods. You can also allow members of the AIDS club to have a discussion session with your students. The AIDS club could demonstrate variety of activities that help in the development of life skills.</td>
</tr>
<tr>
<td>1.4 Biology and HIV/AIDS (7 periods)</td>
<td>Contribution of biology to the fight against AIDS • Students’ contribution to the fight against AIDS (community participation; love, care and protection of PLWHA; The fight against stigma and discrimination; etc.) • Responsible sexual behaviour • Life skills (decision making; problem solving; assertiveness; self-esteem; communication; etc.)</td>
<td></td>
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</table>
Assessment

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:
- define science, name and demonstrate the scientific methods; plan and conduct scientific experiment and write a report for scientific experiments; name and classify the tools used in biology, explain their functions and demonstrate how to use some tools; conduct a library research and gather information to explain the relevance and promise of biological science.

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.
**Unit 2: Biochemical molecules (24 periods)**

**Unit Outcomes:** Students will be able to

- group biochemical molecules as organic and inorganic
- explain the property and state the importance of water for life
- describe and show the structures and state the functions of organic molecules in living things
- identify biologically important compounds by conducting simple tests.

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<tr>
<td>Students will be able to:</td>
<td><strong>2. Biochemical molecules</strong></td>
<td></td>
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<tr>
<td>group biochemical molecules as organic and inorganic</td>
<td><strong>2.1 Inorganic molecules</strong></td>
<td>Give students a list of chemical compounds containing C and N. Let the students group the compounds as inorganic and organic. Students could also discuss in small groups on what organic and inorganic compounds are and prepare more lists of organic and inorganic compounds.</td>
</tr>
<tr>
<td>explain the property of water for life</td>
<td>(8 periods)</td>
<td>Students brainstorm in groups and develop a concept map on all properties of water. They may use reference material like chemistry books, biology books, physics books etc.</td>
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<tr>
<td>state the importance of water for life</td>
<td>• Elements in life (H, C, N, O, P, S)</td>
<td>Let students discuss in groups on some properties of water. For example they can discuss on why a bottle filled with water and plugged properly breaks when the water is completely changed into ice</td>
</tr>
<tr>
<td>describe the structures of organic molecules in living things</td>
<td>• Properties of water</td>
<td></td>
</tr>
<tr>
<td>state the functions of organic molecules in living things</td>
<td>• Importance of water</td>
<td></td>
</tr>
<tr>
<td>show the structures of biological molecules using chemical formulae</td>
<td><strong>2.2 Organic molecules</strong></td>
<td>Students brainstorm in groups and develop a list of organic compounds. They may use reference material like chemistry books, biology books etc.</td>
</tr>
<tr>
<td>identify biologically important compounds by conducting simple tests</td>
<td>(16 periods)</td>
<td>The importance of C – H bond for energy should be underlined when dealing with organic molecules.</td>
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<td></td>
<td>• Carbohydrates (structure, functional groups, isomers)</td>
<td>Students conduct simple experiments to identify carbohydrates, fats and proteins in food.</td>
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<tr>
<td></td>
<td>• Lipids, proteins and nucleic acids (structure and functional groups)</td>
<td>Students develop a table where they list resources of fats, carbohydrates and proteins. This could be documented on posters (e.g. on wallpaper) and exhibited on the classroom walls.</td>
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<td></td>
<td>• Identification of biologically important compounds, i.e., starch, sugars, cellulose, lipids, protein</td>
<td>Students list the food of their daily diet and make statements on the presence of carbohydrates, fats and proteins.</td>
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<td></td>
<td>Use diagrams and text on the chemical structures and properties of: Amino acids, peptides and proteins (including primary, secondary and tertiary structure); Lipids; and Carbohydrates</td>
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<td></td>
<td>Let the students appreciate that these organic molecules serve not only as foods but also as structural and functional molecules (e.g., protein as hair).</td>
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</tbody>
</table>
Assessment

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to: group biochemical molecules as organic and inorganic; explain the property and state the importance of water for life; describe and show the structures and state the functions of organic molecules in living things; identify biologically important compounds by conducting simple tests.

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Unit 3: Enzymes (27 periods)

Unit Outcomes: Students will be able to

- define, name, classify and explain the properties of enzymes and appreciate their importance
- explain how enzymes lower activation energy, their mechanism of action and the actions of apo- and co- enzymes
- give examples of vitamins and minerals in food that act as co-factors
- explain factors that affect enzyme activity and demonstrate that with simple experiments
- explain allosteric regulation and feedback control mechanism of enzyme activity.

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<tr>
<td>Students will be able to:</td>
<td>3. Enzymes</td>
<td>Use text with general properties of enzymes including the nomenclature (-ase) and provide tasks and questions for students.</td>
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<tr>
<td></td>
<td>3.1 Nature of enzymes (7 periods)</td>
<td>Let students list the four criteria of naming enzymes and produce a schematic representation of enzyme classification.</td>
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<td></td>
<td>• Properties of enzymes</td>
<td>Students could discuss in groups on the role of enzymes in the making of any local food (like injera) or drink (like tella) and present a report to the class.</td>
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<tr>
<td></td>
<td>• Classification of enzymes</td>
<td></td>
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<td></td>
<td>• Naming enzymes</td>
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<td></td>
<td>3.2 Functions of enzymes (9 periods)</td>
<td>Make sure that students understand the key concepts that enzymes work by lowering energy barriers; an enzyme’s structure enables it to catalyze a specific reaction; an enzyme has a limited number of active sites; and that some enzymes require co-factors and co-enzymes to function.</td>
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<tr>
<td></td>
<td>• Enzymes and activation energy</td>
<td>When learning the reduction of the activation energy of a chemical reaction students could draw the energy profile of a reaction with and without a catalyst.</td>
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<tr>
<td></td>
<td>• Mechanism of enzyme action</td>
<td>Make a list of vitamins that serve as cofactors.</td>
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<td></td>
<td>• Apoenzymes and coenzymes</td>
<td>Let students visit a nearby factory or industry that uses enzymes (if available) and write a report on practical applications of enzymes.</td>
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<td></td>
<td>• Application of enzymes</td>
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<td>• explain factors that affect enzyme activity</td>
<td>3.3 Factors affecting the functions of enzymes (11 periods)</td>
<td>• Make sure that students understand the key concepts that temperature affects the rate of enzyme catalyzed reaction; and that each enzyme has an optimal pH.</td>
</tr>
<tr>
<td>• demonstrate how temperature, pH, substrate conc. and enzyme conc. affect enzymatic activity</td>
<td>• Temperature, pH, substrate concentration, and enzyme concentration</td>
<td>• Conduct experiments on the effects of factors on enzyme activity:</td>
</tr>
<tr>
<td>• explain allosteric regulation and feedback control mechanism of enzyme activity</td>
<td>• Allosteric regulation and feedback control mechanism</td>
<td>• Enzymes and temperature</td>
</tr>
<tr>
<td>• appreciate the role of enzymes in controlling our metabolic activities</td>
<td></td>
<td>• Enzymes and pH</td>
</tr>
</tbody>
</table>

#### Assessment

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to: define, name, classify and explain the properties of enzymes and appreciate their importance; explain how enzymes lower activation energy, their mechanism of action and the actions of apo- and co-enzymes; give examples of vitamins and minerals in food that act as co-factors; explain factors that affect enzyme activity and demonstrate that with simple experiments; explain allosteric regulation and feedback control mechanism of enzyme activity.

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Unit 4: Cell biology (29 periods)

Unit Outcomes: Students will be able to
- tell the history of cell biology and describe the cell theory
- investigate the size and state the functions of cells
- state the importance and describe the composition of a cell membrane
- compare the models of cell membrane and show the arrangement of the phospholipids and proteins in the fluid mosaic model
- name and explain the function of the different parts of the cell
- explain the mechanisms of substance transport across a cell membrane and demonstrate osmosis and diffusion
- explain the difference between prokaryotic and eukaryotic cells.

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<tr>
<td>Students will be able to:</td>
<td><strong>4. Cell biology</strong></td>
<td></td>
</tr>
<tr>
<td>• tell the history of cell biology</td>
<td><strong>4.1 Cell theory</strong> (8 periods)</td>
<td>• Make sure that students understand the key concepts that the cell theory has had a long history; most cells are very small; and that microscopy reveals cell structure.</td>
</tr>
<tr>
<td>• describe the cell theory</td>
<td>• Development of the cell theory</td>
<td>• Let the students work in groups and present to the class about the contributions of the following scientists to the cell theory (stating the time they made their observations): Robert Hook, Antoine van Leeuwenhoek, Rene Dutrochet, Mathias Schleiden, Theodore Schwann, and Rudolf Virchow.</td>
</tr>
<tr>
<td>• investigate the size of cells</td>
<td>• Modern cell theory</td>
<td>• Draw four cubes with sides of 1, 2, 4 and 8 cms and let students compare:</td>
</tr>
<tr>
<td>• state the basic functions of cells</td>
<td>• Cell size and function</td>
<td>• Surface area (the surface through which materials enter the cell)</td>
</tr>
<tr>
<td>• appreciate that all life on earth originates from life</td>
<td></td>
<td>• Volume (cellular materials and functions that require input from outside)</td>
</tr>
<tr>
<td>• explain the difference between prokaryotic and eukaryotic cells</td>
<td><strong>4.2 Types of cells</strong> (4 periods)</td>
<td>• Surface area/Volume</td>
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<tr>
<td></td>
<td>• Prokaryotic and eukaryotic cells</td>
<td>Then let the students debate in group which is advantageous to the cell: high surface area to volume ratio or low.</td>
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<td></td>
<td>• Make sure that students understand the key concepts that: the two major types of cell are prokaryotic and eukaryotic; and that a eukaryotic cell is compartmentalized by its nucleus and membranous organelles</td>
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<td></td>
<td></td>
<td>• Use text and diagrams of prokaryotic and eukaryotic organisms. (If possible, use film material or other media) and let students list all features of prokaryotic and eukaryotic cells and let them draw prokaryotic and eukaryotic organisms</td>
</tr>
</tbody>
</table>
## Competencies

- state the importance of a cell membrane
- describe the composition and the arrangement of lipids and proteins in the membrane
- compare the Daveson-Daniel and the fluid mosaic models
- show the arrangement of phospholipids and proteins in the fluid mosaic model
- explain the role of glycoprotein and other components in the membrane
- name the different parts of the cell
- explain the functions of each part
- explain the mechanisms of substance transport across a cell membrane
- conduct an experiment to show movement of solvent through semi-permeable membrane
- demonstrate osmosis at a semi-permeable membrane
- explain that the size of a cell changes by osmosis because of in and outflow of water
- appreciate the fact that

## Contents

### 4.3 Parts of the cell and their functions (17 periods)

- Cell membrane
- Cell organelles
- Transport of materials in cells

## Suggested activities

- Make sure that students understand the key concepts that: cells are surrounded by plasma membrane; cells contain structures called organelles that have specialized functions; organelles themselves are membrane bound; molecules move by diffusion; membranes allow some molecules to diffuse freely while they inhibit the passage of others; proteins transport some substances across the cell membrane through facilitated diffusion; and that some molecules are actively transported against concentration gradient.
- Use diagrams and text on the Daveson-Daniel and the fluid mosaic model including time of discovery. Let the students draw the model in their exercise books. Let them compare the models and write a short paragraph on the differences.
- Demonstrate the importance of models in science; Students could discuss the question of a model and a reality and finally answer “Which is the correct model, the Daniel-Daveson or the fluid mosaic model?” (A model reflects always the evidence available on a given phenomenon)
- Use text on cell structures and functions and let students develop table on cell structures and their functions as follows:

<table>
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<tr>
<th>Cell organelle</th>
<th>Functions</th>
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</table>

- Let students prepare charts showing the passage of small molecules (oxygen, water, and carbon dioxide), and macromolecules required by the cell (amino acids, glucose, fatty acids).
- Demonstrate the processes of osmosis and diffusion by simple activities.
- Cautiously bring egg yolk (membrane must not be damaged!) into a beaker glass with a) concentrated Sodium chloride solution and b) distilled water. With this experiment you can discuss and explain Movement of water through semi-permeable membrane and osmosis (including change of size of the cell)
- Bore three potato tubers to form a U shape and add concentrated salt solution in one and distilled water in the second and physiological solution (isotonic) in the third (control).
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| osmosis is responsible for every day life phenomena | Then check whether the potatoes shrink or get turgid.  
• Let students discuss on every day life phenomena that are related to osmosis, e.g. danger of drinking sea water, turgor of plants, bursting of fruits during rain, eating food with too much salt in it, etc. |

**Assessment**

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to: tell the history of cell biology and describe the cell theory; investigate the size and state the functions of cells; state the importance and describe the composition of a cell membrane; compare the models of cell membrane and show the arrangement of the phospholipids and proteins in the fluid mosaic model; name and explain the function of the different parts of the cell; explain the mechanisms of substance transport across a cell membrane and demonstrate osmosis and diffusion; explain the difference between prokaryotic and eukaryotic cells.

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# Unit 5: Energy transformation (27 periods)

**Unit Outcomes:** Students will be able to

- describe the structure of ATP and its role in cellular metabolism and the role of electron donors and acceptors
- draw and label the structure of a mitochondrion and locate where the different processes of cellular respiration occur
- explain and demonstrate the process of alcoholic fermentation and lactate production
- draw and label a chloroplast, locate where light dependent and independent processes occur and name the products of the two processes
- explain photorespiration
- distinguish between C₃ and C₄ plants and give at least three examples for each
- separate photosynthetic pigments by paper chromatography.

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<td>Students will be able to:</td>
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<tr>
<td>• describe the structure of ATP and</td>
<td>5. Energy transformation</td>
<td>• Make sure that students understand the key concepts that: respiration produces</td>
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<tr>
<td>its role in cellular metabolism</td>
<td>5.1 Cellular respiration</td>
<td>NADH and ATP; mitochondria are the principal sites of respiration in eukaryotic cells;</td>
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<tr>
<td>• explain the role of electron</td>
<td>(14 periods)</td>
<td>the Kreb’s cycle is the core of metabolism; the electron transport system synthesizes</td>
</tr>
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<td>donors and acceptors</td>
<td>• ATP and NADH</td>
<td>ATP; many organisms obtain energy through fermentation; excess sugar can be made</td>
</tr>
<tr>
<td>• draw and label the structure of a</td>
<td>• Structure of mitochondria</td>
<td>into fatty acids; and that many compounds are catabolized into the central pathway.</td>
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<tr>
<td>mitochondrion</td>
<td>• Phases of respiration</td>
<td>• Students draw and label a mitochondrion and describe the importance of the</td>
</tr>
<tr>
<td>• locate where the different processes</td>
<td>– Glycolysis and Kreb’s cycle</td>
<td>membranes</td>
</tr>
<tr>
<td>of cellular respiration occur in the</td>
<td>– Electron transport system</td>
<td>• In a diagram/ picture of a mitochondrion are the stages of cellular respiration</td>
</tr>
<tr>
<td>cell</td>
<td>• Fermentation</td>
<td>depicted. Students write a list of the steps included and allocated to the different</td>
</tr>
<tr>
<td>• explain the process of alcoholic</td>
<td>• Conversion of sugars to fatty</td>
<td>locations. Let them prepare a chart that shows the respiratory process. They should</td>
</tr>
<tr>
<td>fermentation</td>
<td>acids</td>
<td>not be expected to memorize the steps.</td>
</tr>
<tr>
<td>• explain the process of lactate</td>
<td>• Metabolism of proteins,</td>
<td>• Prepare a generalized schematic drawing of the respiratory process to show which</td>
</tr>
<tr>
<td>production</td>
<td>polysaccharides and lipids</td>
<td>steps constitute glycolysis, Kreb’s cycle and ETS. Show also at which step</td>
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<tr>
<td>• appreciate the importance of</td>
<td></td>
<td>fermentation starts and give example of fermentation reactions.</td>
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<td>lactate production</td>
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<td>• Let students conduct a fermentation activity to produce an alcoholic beverage or</td>
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<td>bread/injera. They describe all steps of the process and note it in their exercise</td>
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<td>• Use a chart to show how proteins and lipids are metabolized through the central</td>
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<td>Competencies</td>
<td>Contents</td>
<td>Suggested activities</td>
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<td>during running and other sports</td>
<td><strong>5.2 Photosynthesis</strong> <em>(13 periods)</em>&lt;br&gt;- Structure of chloroplast&lt;br&gt;- Photosynthetic pigments&lt;br&gt;- Light-dependent and light–independent reactions&lt;br&gt;- Photorespiration&lt;br&gt;- <strong>C</strong>&lt;sub&gt;3&lt;/sub&gt; and <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt; plants&lt;br&gt;</td>
<td>Make sure that students understand the key concepts that: photosynthesis in eukaryotes occurs in chloroplasts; molecules absorb light through activation of their electrons; chlorophylls are the major pigments used in photosynthesis; two photosystems cooperate in plant photosynthesis; cyclic photophosphorylation creates only ATP; non-cyclic photophosphorylation creates NADH; CO&lt;sub&gt;2&lt;/sub&gt; is reduced to organic compounds in the Calvin cycle; and that some plants use an alternative pathway for CO&lt;sub&gt;2&lt;/sub&gt; fixation.&lt;br&gt;Let students draw the structure of a chloroplast and label them. Let them indicate light-dependent reactions in the thylakoids and light-independent reactions in the stroma.&lt;br&gt;Let students discuss in groups and illustrate the function of the light harvesting complex and let them identify products of both light-dependent and light-independent processes and develop a summary of both processes. Let them give a group presentation on: light-dependent and light-independent reactions; photorespiration; and on <strong>C</strong>&lt;sub&gt;3&lt;/sub&gt; and <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt; plants.&lt;br&gt;Prepare a chart showing the fate of an electron during PS1 and PS2 and show non-cyclic and cyclic photophosphorylation.&lt;br&gt;Draw a chart to show the calvin cycle and indicate where it occurs in <strong>C</strong>&lt;sub&gt;3&lt;/sub&gt; and <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt; plants&lt;br&gt;Let students list <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt;-plants in Ethiopia and other countries by using literature like the schoolbook and other sources from the library.&lt;br&gt;Let the students conduct an activity to separate photosynthetic pigments by paper chromatography.</td>
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<td>• summarize the metabolism of proteins, polysaccharides and lipids</td>
<td>• draw and label a chloroplast&lt;br&gt; • locate where light dependent and independent processes occur in the chloroplast&lt;br&gt; • name the products of the light independent and dependent processes&lt;br&gt; • explain photorespiration and how it is related to higher temperatures&lt;br&gt; • distinguish between <strong>C</strong>&lt;sub&gt;3&lt;/sub&gt; and <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt; plants&lt;br&gt; • give at least three examples of <strong>C</strong>&lt;sub&gt;3&lt;/sub&gt; and <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt; plants&lt;br&gt; • appreciate the importance of <strong>C</strong>&lt;sub&gt;4&lt;/sub&gt; plants in Ethiopia&lt;br&gt; • separate photosynthetic pigments by paper chromatography</td>
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Assessment

The teacher should assess each student’s work continuously over the whole unit and compare it with the following description, based on the Competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to: describe the structure of ATP and its role in cellular metabolism and the role of electron donors and acceptors; draw and label the structure of a mitochondrion and locate where the different processes of cellular respiration occur; explain and demonstrate the process of alcoholic fermentation and lactate production; draw and label a chloroplast, locate where light dependent and independent processes occur and name the products of the two processes; explain photorespiration; distinguish between C₃ and C₄ plants and give at least three examples for each; separate photosynthetic pigments by paper chromatography.

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during breaks or at the end of the day.