**Course Description:**

Students gain knowledge and skill in genetic principles and mechanisms of heredity. Students perform applications using knowledge of DNA and chromosome structure, transcription and gene regulation; replication and cell division; patterns of inheritance; and genetic recombination mutations and their repair. Learners will apply molecular principles to food, plant and animal research and present findings through various forms of communication.

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome: 1.12. Site and Personal Safety Procedures**

Follow site and personal safety procedures in specific situations with specialized tools and equipment, evaluate the situation and take corrective action.

**Competencies**

1.12.2. Interpret safety signs and symbols.

1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.

1.12.8. Identify safety hazards and take corrective measures.

1.12.9. Identify, inspect and use safety equipment appropriate for the task.

1.12.10. Follow established procedures for the administration of first aid and contact emergency medical personnel when necessary.

*An “X” indicates that the pathway applies to the outcome.*

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management | X | Bioscience | |  | Horticulture |
|  | Natural Resource Management |  | Power Technology | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | |  | Does not apply | | |

**Strand 3. Biotechnology**

Learners apply the skills and knowledge of interpreting laboratory requests, using protective clothing and hazardous material containment, specimen collection procedures, a variety of laboratory testing and techniques, and maintenance of laboratory equipment and supplies.

**Outcome: 3.2. Foundations of Chemistry**

Perform a systematic and methodical application of general and organic chemistry principles to examine structures, their functions, their binding to other molecules and the methodologies for their purity and characterization.

**Competencies**

3.2.3. Differentiate between organic and inorganic compounds.

3.2.6. Prepare solutions based on molarity, normality, percent weight per volume (w/v) and percent volume per volume (v/v).

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| **Pathways** |  | Agribusiness and Production Systems |  | Animal Science and Management | X | Bioscience | | |  | Horticulture |
|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**Outcome: 3.3. Microbiology Testing and Technology**

Describe the morphologies and processes of the reproduction of microorganisms.

**Competencies**

3.3.2. Compare and contrast cellular structure and functions of prokaryotic and eukaryotic cells.

3.3.3. Transform deoxyribonucleic acid (DNA) to alter bacterial metabolism, reproduction, cell structures and their functions.

3.3.12. Perform an enzyme-linked immunosorbent assay (ELISA) and interpret the results.

3.3.13. Perform biochemical assays of proteins, lipids, carbohydrates, nucleic acids and enzymes.

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**Outcome: 3.4. Molecular-Genetics Technology**

Apply knowledge of nucleic acid structure and function, deoxyribonucleic acid (DNA) replication, transcription, translation, chromosome structure and remodeling and regulation of gene expression in prokaryotes and eukaryotes.

**Competencies**

3.4.1. Use a Punnet square to predict and explain Mendel’s Laws, genotype and phenotype.

3.4.2. Explain alternative forms of transmission (e.g., non-Mendelian inheritance).

3.4.3. Model, predict and diagram the three-dimensional shape, types of bonds (covalent and hydrogen bonds) and antiparallel nature of DNA.

3.4.4. Model the Central Dogma Theory (e.g., replication, transcription, translation).

3.4.5. Follow regulations for genetic modification (e.g., histone acetylation, ribonucleic acid [RNA] stability, co- and post-translational modifications).

3.4.6. Identify alternative types of gene expression (e.g., sex-limited, sex-linked, partial dominance, epistatic, pleiotropic).

3.4.7. Identify, isolate and manipulate peptides and proteins (i.e., primary, secondary, tertiary, quaternary).

3.4.9. Isolate and purify nucleic acids, including chromosomal and extra-chromosomal DNA molecules.

3.4.10. Compare nucleic acids, chromosomal DNA molecules and proteins using a sequence database (e.g., National Center for Biotechnology Information, Europeon Bioninformatics Institute).

3.4.11. Perform a restrictive enzyme digest and analyze the results.

3.4.12. Apply concepts of screening genetic expression, expression vectors and genetic libraries.

3.4.13. Apply the principles of nucleic acid blotting (e.g., colony transfer, Southern and Northern Blot Analysis).

3.4.14. Perform and interpret the results of a polymerase chain reaction (PCR).

3.4.15. Explain applications of Southern and Northern Blot Analysis.

3.4.21. Identify the role of RNA in gene expression.

3.4.22. Explain results from genome sequencing projects and explain how gene sequencing is performed.

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**Outcome: 3.5. Laboratory Standard Operational Procedures**

Perform methods and techniques using protocols to conduct an experiment.

**Competencies**

3.5.1. Use an aseptic technique to collect, prepare and test samples.

3.5.2. Prepare and dispense stock reagents, buffers, media and solutions by calculating concentrations, adjusting factors such as pH and selecting purification techniques and containers.

3.5.3. Test and maintain the integrity of stains, reagents, chemicals and mounts.

3.5.4. Select and apply sterilization methods for reagents, buffers, media and solutions.

3.5.5. Perform laboratory measures by calculating and preparing a serial dilution, calculating quantities needed to perform a test analysis and calculating unit conversions and concentrations (graphing results).

3.5.6. Monitor physical properties of reagents, buffers, media and solutions for conductivity and resistivity, pH and turbidity and explain the significance of each.

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**Outcome: 3.8. Research and Experiments**

Conduct a problem-based study, applying scientific methodology and using descriptive statistics to communicate and support predictions and conclusions.

**Competencies**

3.8.1. Identify research problems and structure a statistical experiment, simulation or study related to the problem.

3.8.2. Design a research plan, including the significance of the problem, purpose, variables, hypotheses, objectives, methods of study and a list of materials.

3.8.3. Distinguish between dependent, independent and control variables in an experiment.

3.8.4. Establish and implement procedures for systematic collection, organization and use of data.

3.8.5. Select and apply sampling methods that appropriately represent the population to be studied.

3.8.6. Define the concepts of confidence limit and significant figures.

3.8.7. Document results of the experiment in a laboratory notebook, including a statement of purpose, experimental designs, observations, results, conclusions and next steps.

3.8.8. Compute measures of central tendency and dispersion to interpret results and draw conclusions.

3.8.9. Describe the relationships among variables using correlations and draw conclusions.

3.8.10. Create, interpret and use tabular and graphical displays and describe the data.

3.8.11. Draw conclusions based on observations and data analyses, recognizing that experimental results must be open to the scrutiny of others.

3.8.12. Prepare and present findings using scientific reports.

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|  | Natural Resource Management |  | Power Technology | | |  |  | | |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |