**Course Description:**

Learners in this course will apply knowledge of bioinformatics, plant and animal microbiology, and chemistry to data mining and laboratory techniques. Students will perform procedures of developing bio-products to solve issues facing agriculture. In this course, students will also be introduced to bioinformatics related to genome analysis for research and present their overall findings.

**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: 1.1. Employability Skills**

Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.1. Identify the knowledge, skills and abilities necessary to succeed in careers.

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure and experience.

1.1.3. Develop a career plan that reflects career interests, pathways and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations and organized labor and use networking techniques to develop and maintain professional relationships.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, resumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability and responsibility and demonstrate associated behaviors in fulfilling personal, community and workplace roles.

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

1.1.8. Identify the correlation between emotions, behavior and appearance and manage those to establish and maintain professionalism.

1.1.9. Give and receive constructive feedback to improve work habits.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 1.2. Leadership and Communications**

Process, maintain, evaluate and disseminate information in a business. Develop leadership and team building to promote collaboration.

**Competencies**

1.2.1. Extract relevant, valid information from materials and cite sources of information.

1.2.12. Use technical writing skills to complete forms and create reports.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 1.4. Knowledge Management and Information Technology**

Demonstrate current and emerging strategies and technologies used to collect, analyze, record and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).

1.4.2. Select and use software applications to locate, record, analyze and present information (e.g., word processing, e-mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to the industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure and monitor business records.

1.4.6. Use an electronic database to access and create business and technical information.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.1. Handling, Preparation, Transportation, Storage and Disposal**

Handle, prepare, transport, store and dispose of specimens using procedures that minimize disturbance to the test specimen. Monitor, record and maintain the integrity of equipment and instrumentation, environmental conditions of the facility and the inventory.

**Competencies**

3.1.1. Prepare and interpret labels for chemicals, supplies and equipment.

3.1.3. Neutralize acids, bases or caustic solutions for handling and disposal.

3.1.4. Sample, monitor and record the environmental conditions of the facility (e.g., air quality,

temperature, microbial contaminations).

3.1.7. Select personal protective attire for various laboratory protocols.

3.1.9. Use laboratory biosafety level criteria, based on established standard operating procedures.

3.1.11. Adjust, calibrate and perform systems diagnostics on laboratory equipment.

3.1.15. Maintain an inventory system for products.

3.1.17. Maintain separate in-processing, quarantine and release areas.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.2. 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**

3.2.1 Illustrate electron configurations of elements, compounds and mixtures.

3.2.2. Use the periodic table to describe atomic structure and to characterize molecules based on functional groups.

3.2.3. Differentiate between organic and inorganic compounds.

3.2.4. Use common and chemical nomenclature for organic and inorganic materials.

3.2.5. Write names and formulas for common compounds.

3.2.10. Identify materials that can be used as a catalyst.

3.2.12. Use naming systems, including common and International Union of Pure and Applied Chemistry (IUPAC) conventions.

3.2.15. Calculate errors in various measurements, based on data acquired using common laboratory equipment.

3.2.16. Apply standard rules for determining the number of significant figures in measurements and in the answers to corresponding calculations.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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**

3.3.10. Explain how chemical energy operates major cell processes (e.g., biosynthesis, movement, transport, growth).

3.3.11. Identify factors that affect and optimize rates of enzyme assay reactions.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.4. 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**

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

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

3.4.8. Perform the steps in creating a recombinant DNA molecule.

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).

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

3.4.19. Evaluate genomes in relation to food, plant, animals and natural resources.

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

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.5. 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.

3.5.3. 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.

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

3.5.7. Perform separation techniques, including chemical separations, chromatography, centrifugation, distillation and filtration and interpret the results.

3.5.12. Comply with industry-based and required regulatory quality-assurance practices (e.g., quality

control [QC], Good Laboratory Practice [GLP], Good Manufacturing Practice [GMP]) for documentation.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.6. Culturing**

Perform experimental techniques used in microbial biology to study cell growth, manipulation and evaluation.

**Competencies**

3.6.4. Operate centrifuge, microscope, compound microscope, spectrophotometer, incubator, colony counter, pipettes and other basic microbiology and analytical equipment to examine biological specimens.

3.6.6. Prepare, incubate and identify colonies microscopically and macroscopically (e.g., colonial morphology, staining procedures, biochemical).

3.6.7. Isolate, propagate, maintain and harvest pure cell lines.

3.6.8. Verify culture cell lines and determine the cause or causes of culture failures.

3.6.11. Correlate bacterial binary fission with generation time.

3.6.13. Conduct a shelf-life study to determine physical change and biological growth.

3.6.14. Conduct a thermal death time study on an organism.

3.6.15. Calculate values of cell concentration for both batch and continuous cultivation.

3.6.16. Identify hormones used to stimulate cell growth and test for antibiotic susceptibility.

3.6.18. Demonstrate cryopreservation techniques by freezing and thawing cells.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.7. Bioreactor Technologies**

Describe and perform bioreactor and fermentation procedures (e.g., sterilization, microfiltration).

**Competencies**

3.7.12. Perform applications using benchtop fermentor and bioreactor systems.

3.7.13. Monitor microorganism growth and determine the viability of cells.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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: 3.8. 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.

3.8.6. 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.

3.8.10. 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.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 7. Food Science**

Learners apply principles of biology, chemistry and physics to the research, development, production, processing and distribution of food products meeting quality assurance standards in a system that is safe and secure.

**Outcome: 7.5. Food Product Development**

Apply principles of nutrition and human behavior to create a new food prototype that meets a specific dietary need or demand for consumption, design packaging and seek label approval.

**Competencies**

7.5.3. Manipulate ingredients to meet a desired product goal.

7.5.7. Estimate the shelf life and potential changes in attributes over time.

7.5.10. Describe regulatory and patent requirements.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | | |