**Course Description:**

This course introduces biochemical methods, analysis, and techniques used in the bioscience research and development industry. Students will learn the chemistry of organic macromolecules, intermediary metabolism and the relationships to the human body. Topics also include structures, properties, functions, reactivity, and synthesis of simple organic molecules. Students will monitor, record, and maintain integrity of equipment and instrumentations; environmental conditions of the facility; and inventory.

**Strand 5. Bioscience Research and Development**

Learners will demonstrate 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: 5.1. Handling, Preparation, Storage and Disposal**

Follow standard operating protocols for handling, preparing, storing and disposing of specimens, supplies and equipment.

**Competencies**

5.1.1. Use standard operating procedures for the safe use of instruments, equipment and gas

cylinders.

5.1.2. Locate and use safety data sheets to prepare and interpret labels for chemicals, supplies,

and to identify hazards associated with handling and storing chemical materials.

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

5.1.4. Recognize clean room integrity using Standard Operating Procedures (SOPs).

5.1.5. Sample, monitor and record the environmental conditions of the facility (e.g. air quality, humidity, temperature, microbial contaminations).

5.1.6. Adjust, calibrate, maintain and perform systems diagnostics on laboratory equipment per standard operating procedure (SOP) and equipment specifications.

5.1.7. Maintain equipment logs and determine when to perform, implement, or schedule

preventive maintenance and/or systems updates.

5.1.8. Verify expiration dates and lot numbers.

5.1.9. Implement a chemical inventory system that includes all pertinent information regarding stability, hazards and sensitivity per standard operating procedure (SOP).

5.1.10. Maintain an inventory system for manufactured products per standard operating procedure (SOP).

5.1.11. Maintain separate in‐processing, quarantine and release areas.

5.1.12. Monitor and maintain animal behavior, welfare and husbandry per standard operating procedure (SOP).

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pathways** |  | Health Information Management | X | Medical Bioscience | X | Allied Health and Nursing | |  | Exercise Science and Sports Medicine |
| **Green Practices** |  | Green-specific |  | Context-dependent | | X | Does not apply | | |

**Outcome: 5.2. Foundations of Chemistry**

Use standard operating procedure (SOP) when performing systematic and methodical application of general and organic chemistry principles to examine the structures, their functions, their binding to other molecules and the methodologies for their purification and characterization.

**Competencies**

5.2.1. Draw electronic configurations of elements, compounds and mixtures.

5.2.2. Use the periodic table to describe atomic structure and to characterize elements based on the

functional group.

5.2.3. Differentiate between organic and inorganic compounds.

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

5.2.5. Write names and formulas for common compounds.

5.2.6. Calculate mole, molarity, normality, percent weight per volume (w/v) and percent volume per volume (v/v).

5.2.7. Describe the chemical bonding and bond types, including ionic and covalent and the

relationships that they have with physical state of materials.

5.2.8. Apply the concepts of stoichiometry and the laws of thermodynamics to chemical reactions.

5.2.9. Perform spectroscopy of biological materials explaining the principles behind the procedures, the purpose of a blank and determine the concentration of biomolecular samples.

5.2.10. Calculate the volume, temperature and pressure of gases using the ideal gas law, Charles Law, Boyles Law and Beer's Law.

5.2.11. Balance chemical reactions.

5.2.12. Define catalyst and identify materials used as catalysts, including enzymes.

5.2.13. Predict endothermic and exothermic characteristics of a chemical reaction.

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

5.2.15. Describe, use and calibrate precision weighing and measuring techniques (e.g., analytical balance, micropipette) that are based on the metric system.

5.2.16. Calculate errors in measurements based on data acquired using common laboratory equipment.

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

5.2.18. Convert units of measure from English to metric and vice versa.

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

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pathways** |  | Health Information Management | X | Medical Bioscience |  | Allied Health and Nursing | | |  | Exercise Science and Sports Medicine |
| **Green Practices** |  | Green-specific |  | Context-dependent | | |  | Does not apply | | |

**Outcome: 5.5. Laboratory Standard Operational Procedures**

Perform methods and techniques using protocols in order to conduct an experiment.

**Competencies**

5.5.1. Follow standard operating procedure (SOP) to aseptically collect and prepare dry and wet samples for analysis.

5.5.2. Prepare and dispense stock reagents, buffers, media and solutions by calculating

concentrations, adjusting factors such as pH and selecting purification techniques and

containers.

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

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

5.5.5. Explain the principles of microscopy and process a specimen for light microscopy.

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

5.5.7. Perform separation techniques, including chemical separations (chromatography),

centrifugation, distillation and filtration and describe their principles and interpret the results.

5.5.8. Titrate liquids.

5.5.9. Transfer gases, liquids and solids from storage containers to equipment used in the

laboratory.

5.5.10. Use aseptic laboratory techniques while working.

5.5.11. Perform a chromatography separation of a given mixture of substances.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pathways** |  | Health Information Management | X | Medical Bioscience | X | Allied Health and Nursing | |  | Exercise Science and Sports Medicine |
| **Green Practices** |  | Green-specific |  | Context-dependent | | X | Does not apply | | |

**Outcome: 5.8. Biotechnology Research and Experiments**

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

**Competencies**

5.8.1. Identify research problems and structure a statistical experiment, simulation, or study related

to the problem.

5.8.2. Design a research plan, including the significance of the problem, purpose, variables,

hypotheses, objectives, methods of study and a list of materials.

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

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

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

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

5.8.7. Document results of the experiment in a laboratory notebook, adhering to professional protocol.

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

conclusions.

5.8.9. Describe the relationships between variables using correlations and draw conclusions.

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

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

5.8.12. Prepare and present findings using scientific reports.

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

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Pathways** |  | Health Information Management | X | Medical Bioscience | X | Allied Health and Nursing | |  | Exercise Science and Sports Medicine |
| **Green Practices** |  | Green-specific |  | Context-dependent | | X | Does not apply | | |