# Biotechnology Essentials Course No. 21014 Credit: 1.0

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| **Student name:** |  | **Graduation Date:** |  |

Pathways and CIP Codes:Biotechnology

Course Description: **Technical Level: Biotechnology Essentials** is a course that enable students to develop and expand their knowledge and skills and applications in biology, biotechnology, and mathematics. Course content may vary widely, drawing upon diverse fields such as biomedical engineering, biomolecular genetics, bioprocess engineering, agricultural biology, or environmental engineering. Students may engage in problems related to genomics, proteomics, genetic engineering, Biomedical manufacturing, agricultural biotechnology, forensics, and bioethics.

Directions:The following competencies are required for full approval of this course. Check the appropriate number to indicate the level of competency reached for learner evaluation.

**RATING SCALE:**

4. Exemplary Achievement: Student possesses outstanding knowledge, skills or professional attitude.

3. Proficient Achievement:Student demonstrates good knowledge, skills or professional attitude. Requires limited supervision.

2. Limited Achievement:Student demonstrates fragmented knowledge, skills or professional attitude. Requires close supervision.

1. Inadequate Achievement:Student lacks knowledge, skills or professional attitude.

0. No Instruction/Training:Student has not received instruction or training in this area.

## Benchmark 1: Effective Communication and Laboratory Safety

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 1.1 | Demonstrates effective and essential vocabulary through written and oral communication skills for reports, presentations, procedures and conclusions. |  |
| 1.2 | Demonstrate ability to evaluate proper sources used in research. |  |
| 1.3 | Demonstrate knowledge and understanding of common laboratory hazards, symbols and signs. |  |
| 1.4 | Demonstrates consistently the ability to maintain a safe, clean and organized work environment. |  |
| 1.5 | Effectively and consistently uses appropriate Personal Protective Equipment (PPE). |  |
| 1.6 | Recognize OSHA, EPA and local regulations practiced in the Science Lab and workplace. |  |

## Benchmark 2: Identification and manufacture of a biomedical product

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 2.1 | Identify major sectors in biotechnology and the products manufactured. |  |
| 2.2 | Identify and explain the steps involved in bringing a biotechnology product to market from development to market. |  |
| 2.3 | Identify and explain the roles of the FDA, EPA and USDA in Biotechnology product development. |  |
| 2.4 | Describe the roles of QA, QC of a biotechnology company in the manufacture of a biotechnology product. |  |
| 2.5 | Analyze policies and procedures for Good Manufacturing Practices (GMP), Standard Operating Procedures (SOP), and International Organization for Standardization (ISO). |  |
| 2.6 | Investigate the relationship between financial markets and scientific research. |  |
| 2.7 | Explain the concepts of product liability, product reliability, product reusability and product failure. |  |

## Benchmark 3: Biotechnology Lab Skills

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 3.1 | Demonstrate Aseptic Technique. |  |
| 3.2 | Demonstrate and use of appropriate tool for measurement of solid and liquid reagents. |  |
| 3.3 | Demonstrate proper use and calibration of a pH meter. |  |
| 3.4 | Demonstrate proper use and selection of a variable Volume micropipette. |  |
| 3.5 | Demonstrate proper use of Gel electrophoresis. |  |
| 3.6 | Calculate and prepare solutions based on mass/vol, molarity, and % mass/volume. |  |
| 3.7 | Calculate and prepare serial dilution. |  |
| 3.8 | Identify microorganisms by preforming staining methods such as gram stain, methylene blue and acid-fast staining. |  |
| 3.9 | Keep, maintain, and demonstrate proper lab documentation in a lab notebook. |  |
| 3.10 | Demonstrate writing and importance the of a Standard Operating procedure (SOP) related to lab protocol. |  |

## Benchmark 4: Nucleic Acids in Biotechnology

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 4.1 | Compare and Contrast DNA and RNA based on their structure and function. |  |
| 4.2 | Describe the Central Dogma of Molecular Biology. |  |
| 4.3 | Describe the antiparallel Structure of DNA and how DNA replicates through semiconservative replication. |  |
| 4.4 | Demonstrate the process of DNA extraction and isolation. |  |
| 4.5 | Explain the process of restriction digestion of DNA. |  |
| 4.6 | Identify two different types of restriction enzymes and explain their differences. |  |
| 4.7 | Explain how to amplify DNA using Polymerase Chain Reaction. |  |
| 4.8 | Analyze DNA fragments resulting from Gel Electrophoresis. |  |
| 4.9 | Describe the process of bacterial transformation and the role of plasmid in the process. |  |
| 4.10 | Describe perform and analyze the results of Restriction analysis of DNA. |  |
| 4.11 | Perform Polymerase Chain Reaction to amplify DNA followed by analysis with Gel electrophoresis. |  |
| 4.12 | Demonstrate the proper use of a thermal cycler. |  |

## Benchmark 5: Proteins and Biotechnology

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 5.1 | Describe the process of protein synthesis. |  |
| 5.2 | Describe how proteins achieve different levels of 3-D shape and how shape dictates function. |  |
| 5.3 | Identify different types of naturally produced proteins and their function in humans or animals. |  |
| 5.4 | Describe the relationship and specificity between enzymes and substrates. |  |
| 5.5 | Describe and perform Enzyme-linked Immunosorbent Assay (ELISA) . |  |
| 5.6 | Explain how antibodies are used in Biotechnology. |  |
| 5.7 | Analyze proteins used in sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS Page). |  |
| 5.8 | Isolate protein using chromatography. |  |
| 5.9 | Explain various ways to isolate a protein. |  |
| 5.10 | Explain how the process of CRISPR works and its use in Biotechnology and treatment of disease in public health. |  |

## Benchmark 6: Research and the Experimental Process in Biotechnology

### Competencies

| **#** | **DESCRIPTION** | **RATING** |
| --- | --- | --- |
| 6.1 | Research career opportunities in Biotechnology. |  |
| 6.2 | Research historical milestones and contributions of scientists in Biotechnology. |  |
| 6.3 | Distinguish between scientific hypotheses and theory. |  |
| 6.4 | Plan and implement investigative procedures including asking questions, formulating hypotheses, collecting data, and analyzing data. |  |
| 6.5 | Collect data individually or collaboratively, make measurements with precision and accuracy, record values with appropriate units and calculate statistically relevant quantities to describe data including mean, median and range. |  |
| 6.6 | Distinguish between reputable sources if information from sources of disinformation. |  |

I certify that the student has received training in the areas indicated.

Instructor Signature:

For more information, contact:

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