Health Science

Pathway: Biotechnology Research and Development

Code	Topic	Course	Knowledge and Skill	Performance Element	Measurement Criteria
HLPE01.01	Contributions of Biotechnology to Health and the Human Condition	#5: Health Science IV: Introduction to Biotechnology Research and Development	Biotechnology R&D professionals will understand that the goal of biotechnology products is to improve the quality of life within legal and ethical protocols.	Identify contributions to quality of life.	Propose an individual life or industrial enzyme that could be used for treating disease and contribute to the quality of life.
					Generate a list of environmental diseases or chronic conditions that have been or could be treated with biotechnology products.
				Assess Legal and Ethical Considerations.	Assess a current biotechnology-related ethical issue in the “news,” and list the basic ethical considerations and how the issue may affect the quality of life.
HLPE02.01	Academic Foundations	#1: Health Science I: Introduction to Health Science #3: Health Science II: Health, Safety and Ethics in the Health Environment #5: Health Science IV: Introduction to Biotechnology Research and Development (Knowledge and Skills also found in various academic courses.)	Biotechnology R&D professionals will be knowledgeable in the fundamentals of biochemistry, cell biology, genetics, mathematical concepts, microbiology, molecular biology, organic chemistry, and statistics.	Apply Mathematical concepts.	Illustrate the concepts of percentages and ratios using a biotechnology application.
					Contract weight-to-weight and weight-to-volume calculations for solutions.
					Explain scientific notation.
				Use Statistical data.	Compare the standard deviation and the mean of data results from testing effectiveness of two biotechnology products.
					Graphically illustrate a set of biotech data such that a layman would understand it.

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			(CONTINUED)	Understand Genetics.	Describe the basic structure of a chromosome.
					Construct a karyotype with human chromosomes.
					Differentiate the genetic inheritance of a dominant homozygous trait (e.g. dwarfism) from a heterozygous disease (e.g., sickle cell anemia).
				Apply principles of organic chemistry.	Construct a molecule of a compound with three or more carbon atoms.
					Create an equation of two organic substrates leading to a product.
					Describe atomic number, atomic mass and orbitals.
					Contrast covalent, ionic and hydrogen bonding.
				Apply principles of biochemistry.	Diagram six chemical side groups that could be in a biotechnology product.
					Categorize all amino acids into essential and non-essential.
					Describe the relationship between biochemistry and biotechnology product development.
					Compare the underlying reasons why some molecules are hydrophilic and some are hydrophobic.
				Apply principles of cell biology.	Describe the basic structures and functions of cells and how this knowledge is used in biotechnology.
					Select cellular barriers to be overcome for a biotechnology product to work inside a cell.

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			(CONTINUED)	Apply principles of molecular biology.	Diagram the structure of the nucleic acid DNA.
					Demonstrate DNA replication graphically and its importance to biotechnology product development.
					Describe the central dogma of molecular biology and how understanding this process impacts biotechnology research and development.
				Apply principles of microbiology.	Analyze how microorganisms are used in mass producing recombinant proteins.
					Compare and contrast bacterial, fungal, and animal cells and how these similarities and differences affect biotechnology product development and production decisions.
					Compare and contrast the use of plasmids in bacterial transformation and the process of plasmid DNA isolation.
HLPE03.01	Understand Biotechnology Knowledge Areas and Techniques	#6: Health Science V: Biotechnology Research and Development Preparation	Biotechnology R&D professionals will be introduced to recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics.	Identify techniques used in biotechnolgy.	Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation and purification of biotechnology products and bioprocessing.
				Identify trends in the field of biotechnology.	Predict how nanotechnology, bioinformatics, proteomics, genomics and transcriptomics will create new career opportunities.

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HLPE04.01	Laboratory Protocols and Procedures	#6: Health Science V: Biotechnology Research and Development Preparation	Biotechnology R&D professionals will understand the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments. They will maintain a safe laboratory environment using biosafety protocols.	Use Procedures.	Describe how molarity relates to solution preparation.
					Calculate the molarity of a given solution and measure the pH of this solution.
					Prepare a serial dilution of a microbial culture starting with 10-3 going to 10-8 and plate on to nutrient agar petri dishes. Determine the original concentration of the microbial culture.
				Apply protocols.	Describe the criticality of the requirements of sterile techniques.
					Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team.
HLPE05.01	Product Development and Regulation	#6: Health Science V: Biotechnology Research and Development Preparation	Biotechnology R&D professionals will know the process for product design and production and how their work contributes to the result.	Understand product development.	Diagram the process involved in making one biotech product in an industrial setting.
					Analyze the role of pre-clinical and clinical trials in biotechnology product development.
				Understand regulation.	Examine the role of a Quality Assurance person in this process.
					Define cGMP and why it is important in biotech production.

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HLPE06.01	Apply Principles of Bioethical Conduct	#6: Health Science V: Biotechnology Research and Development Preparation	Biotechnology R&D professionals will understand the larger ethical, moral and legal issues related to biotech research, product development and use in society.	Understand biotechnological implications on society.	Differentiate between morality and ethics and the relationship of each to biotechnology health care product development.
					Discuss bioethical issues related to biogenetic products.
					Contrast personal, professional and organizational ethics.
				Apply institutional protocols.	Comply with policies and requirements for documentation and record keeping.
					Comply with institutional ethical policies and procedures.