Oregon CTE

Health Sciences: Biotechnology Research & Development Focus Area

Summarize the goals of biotechnology research and development within legal and ethical protocols. HLBR01

1. **Identify biotechnology's contributions to quality of life.** HLBR01.01.01
2. **Propose a biological or industrial enzyme that could be used for treating disease and contribute to the quality of life.** HLBR01.01.02
3. **Develop a list of environmental diseases or chronic conditions that have been or could be treated with biotechnology products.** HLBR01.01.03
4. **Assess legal and ethical considerations associated with using biotechnology.** HLBR01.02.01
5. **Assess a current biotechnology-related ethical issue in the news.** HLBR01.02.02
6. **Discuss how a current biotechnology-related ethical issue may affect the quality of life.** HLBR01.02.03

Apply the fundamentals of biochemistry, cell biology, genetics, mathematical concepts, microbiology, molecular biology, organic chemistry and statistics to conduct effective biotechnology research and development of products. HLBR01

1. **Apply mathematical concepts to the field of biotechnology.** HLBR02.01.01
2. **Illustrate the concepts of percentages and ratios using a biotechnology application.** HLBR02.01.02
3. **Contrast weight-to-weight and weight-to-volume calculations for solutions.** HLBR02.01.03
4. **Explain scientific notation.** HLBR02.01.04
5. **Use statistical data when conducting biotechnology research and development.** HLBR02.02.01.01
6. **Compare the standard deviation and the mean of data results from testing effectiveness of two biotechnology products.** HLBR02.02.01.02
7. **Graphically illustrate a set of biotech data such that a layman would understand it.** HLBR02.02.01.03
8. **Apply genetic principles to biotechnology.** HLBR02.03.01

9 **Describe the basic structure of a chromosome.** HLBR02.03.02

10 **Construct a karyotype with human chromosomes.** HLBR02.03.03

11 **Differentiate the genetic inheritance of a dominant homozygous trait (e.g. dwarfism) from a heterozygous disease (e.g., sickle cell anemia).** HLBR02.03.04

12 **Apply principles of organic chemistry to biotechnology.** HLBR02.04.01

13 **Construct a molecule of a compound with three or more carbon atoms.** HLBR02.04.02

14 **Create an equation of two organic substrates leading to a product.** HLBR02.04.03

15 **Describe atomic number, atomic mass, and orbitals.** HLBR02.04.04

16 **Contrast covalent, ionic, and hydrogen bonding.** HLBR02.04.05

17 **Apply principles of biochemistry to biotechnology.** HLBR02.05.01

18 **Diagram six chemical side groups that could be in a biotechnology product.** HLBR02.05.02

19 **Categorize all amino acids into essential and non-essential.** HLBR02.05.03

20 **Describe the relationship between biochemistry and biotechnology product development.** HLBR02.05.04

21 **Compare the underlying reasons why some molecules are hydrophilic and some are hydrophobic.** HLBR02.05.05

22 **Apply principles of cell biology to biotechnology.** HLBR02.06.01

23 **Describe the basic structures and functions of cells and how this knowledge is used in biotechnology.** HLBR02.06.02

24 **Select cellular barriers to be overcome for a biotechnology product to work inside a cell.** HLBR02.06.03

25 **Apply principles of molecular biology to biotechnology.** HLBR02.07.01

26 **Diagram the structure of the nucleic acid DNA.** HLBR02.07.02

27 **Demonstrate DNA replication graphically and its importance to biotechnology product development.** HLBR02.07.03

28 **Describe the central dogma of molecular biology and how understanding this process impacts biotechnology research and development.** HLBR02.07.04

29 **Apply principles of microbiology to biotechnology.** HLBR02.08.01

	30 Analyze how microorganisms are used in mass producing recombinant proteins. HLBR02.08.02
	31 Compare and contrast bacterial, fungal, and animal cells and how these similarities and differences affect biotechnology product development and production decisions. HLBR02.08.03
	32 Compare and contrast the use of plasmids in bacterial transformation and the process of plasmid DNA isolation. HLBR02.08.04
Demonstrate basic knowledge of recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics to conduct biotechnology research and development. HLBR03	1 Identify techniques used in biotechnology. HLBR03.01.01
	2 Describe the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation, and purification of biotechnology products and bioprocessing. HLBR03.01.02
	3 Identify uses of the following techniques: recombinant DNA, genetic engineering, monoclonal antibody production, separation, and purification of biotechnology products and bioprocessing. HLBR03.01.03
	4 Identify trends in the field of biotechnology. HLBR03.02.01
	5 Predict how nanotechnology, bioinformatics, proteomics, genomics, and transcriptomics will create new career opportunities. HLBR03.02.02
	6 Identify how the above career opportunities will impact health care environments. HLBR03.02.03
Demonstrate the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments used in biotechnology research. HLBR04	1 Use laboratory procedures to prepare solutions, sterilize, control contamination, use measurement instruments, and calibrate instruments. HLBR04.01.01
	2 Describe how molarity relates to solution preparation. HLBR04.01.02
	3 Calculate the molarity of a given solution and measure the pH of this solution. HLBR04.01.03
	4 Apply biosafety protocols in the laboratory environment. HLBR04.02.01
	5 Maintain a safe laboratory environment using biosafety protocols. HLBR04.02.02
	6 Describe the criticality of the requirements of sterile techniques. HLBR04.02.03
	7 Respond to a hypothetical laboratory accident appropriately as a member of a laboratory team. HLBR04.02.04
Determine processes for product design and production and how that work contributes to	1 Explain biotechnology product development processes. HLBR05.01.01

an understanding of the biotechnology product development process. HLBR05	2 **Diagram the process involved in making one biotech product in an industrial setting.** HLBR05.01.02
	3 **Analyze the role of pre-clinical and clinical trials in biotechnology product development.** HLBR05.01.03
	4 **Explain regulations affecting the processes for biotechnology product development.** HLBR05.02.01
	5 **Examine the role of a Quality Assurance person in this process.** HLBR05.02.02
	6 **Define Current Good Manufacturing Practices (CGMP) and why it is important in biotech production.** HLBR05.02.03
Summarize and explain the larger ethical, moral and legal issues related to biotechnology research, product development and use in society. HLBR06	1 **Explain biotechnological implications on society.** HLBR06.01.01
	2 **Differentiate between morality and ethics and the relationship of each to biotechnology health care product development.** HLBR06.01.02
	3 **Discuss bioethical issues related to biogenetic products.** HLBR06.01.03
	4 **Contrast personal, professional, and organizational ethics.** HLBR06.01.04
	5 **Apply institutional protocols to biotech research and product development.** HLBR06.02.01
	6 **Identify and comply with policies and requirements for documentation and record keeping.** HLBR06.02.02
	7 **Identify and comply with institutional ethical policies and procedures.** HLBR06.02.03