

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**

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- 9 Describe the basic structure of a chromosome.** HLBR02.03.02
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- 10 Construct a karyotype with human chromosomes.** HLBR02.03.03
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- 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
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- 12 Apply principles of organic chemistry to biotechnology.** HLBR02.04.01
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- 13 Construct a molecule of a compound with three or more carbon atoms.** HLBR02.04.02
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- 14 Create an equation of two organic substrates leading to a product.** HLBR02.04.03
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- 15 Describe atomic number, atomic mass, and orbitals.** HLBR02.04.04
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- 16 Contrast covalent, ionic, and hydrogen bonding.** HLBR02.04.05
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- 17 Apply principles of biochemistry to biotechnology.** HLBR02.05.01
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- 18 Diagram six chemical side groups that could be in a biotechnology product.** HLBR02.05.02
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- 19 Categorize all amino acids into essential and non-essential.** HLBR02.05.03
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- 20 Describe the relationship between biochemistry and biotechnology product development.** HLBR02.05.04
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- 21 Compare the underlying reasons why some molecules are hydrophilic and some are hydrophobic.** HLBR02.05.05
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- 22 Apply principles of cell biology to biotechnology.** HLBR02.06.01
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- 23 Describe the basic structures and functions of cells and how this knowledge is used in biotechnology.** HLBR02.06.02
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- 24 Select cellular barriers to be overcome for a biotechnology product to work inside a cell.** HLBR02.06.03
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- 25 Apply principles of molecular biology to biotechnology.** HLBR02.07.01
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- 26 Diagram the structure of the nucleic acid DNA.** HLBR02.07.02
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- 27 Demonstrate DNA replication graphically and its importance to biotechnology product development.** HLBR02.07.03
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- 28 Describe the central dogma of molecular biology and how understanding this process impacts biotechnology research and development.** HLBR02.07.04
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- 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](#)

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- 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](#)
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Summarize and explain the larger ethical, moral and legal issues related to biotechnology research, product development and use in society. [HLBR06](#)

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- 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](#)
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