

180-Hour, Skill Development Lab-based, Concept-Supported Medical Biotechnology Course Plan

Suggested Lesson Planning Guide

36 weeks, 5 hours of lab and lecture/discussion meetings/week

Activities may require adjustment to meet time limitations.

Biotech Online Activities, additional Biotech Live and Bioethics Activities, and skills testing may be added as needed.

Week	Lab(s)	Lab/Activity Lesson Focus	Text Section Support and Lecture Discussion Focus	Key Lab/Activity Skill Objectives Students will:
1	1a 1b - -	Scientific Notebook Laboratory Safety Biotech Hubs Activity (www.BiotechEd.com) Biotech Company Stock Project (www.BiotechEd.com)	1.1 Defining Biotechnology 1.2 Biotechnology Products 1.3 Selecting Potential Products	- Start and maintain a legal scientific notebook - Learn emergency procedures and the location of safety hazards and emergency equipment - Setting up and stocking the biotech lab - Inventory Log (Biotech Live Activities 3.1 and 3.3) - Ongoing project – 1 st semester > presentations during Finals = 2weeks -
2	1c - -	Cheese Production Chapter 1 Bioethics Activity Biotech e-Career Project –begin (www.BiotechEd.com)	1.4 Scientific Methodology 1.5 Biotech Careers 1.6 Bioethics	- Conduct a controlled experiment, analyze and report data - View interviews with biotech employees - Analyze a bioethical dilemma based on animal use
3	- 2c	Intro to Medical Biotechnology Microscopy	12.1 Drug Discovery and Medical Biotechnology 2.1 Organisms and their Parts 2.2 Cellular Organization	- Give examples of medical biotechnology and its products - Biotech Online p.327: Penicillin - Learn microscope use for prepared and wet mount slides
4	2d 2e	Microscopic Measurement Properties of Carbohydrates	2.2 Cellular Organization 2.3 Molecules of Cells	- Learn to estimate the size of microscopic specimen. - Study the structure and characteristics of different carbohydrates and other biomolecules
5	3a 3b	Pipeting Micropipeting	3.1 Measuring Volumes	- Demonstrate skill using pipets and pipet pumps - Demonstrate skill using micropipets

6	- 3c	Pipet Skills Quiz Mass Measurement	3.2 Making Solutions and Solutions in Medicine	<ul style="list-style-type: none"> - Demonstrate skill using pipets and micropipets - Demonstrate skill using balances and mixing solutes and solvents
7	7a 7b	Using the Spec Using the Spec to Study Molecules	7.1 Using the Spectrophotometer	<ul style="list-style-type: none"> - Learn how to operate a spectrophotometer and how light corresponds to colors of the visible spectrum - Use a VIS-spec to determine the absorption spectra and λ_{max} for three colored solutions
8	3e 3f	Mass/Volume Solutions Percent Mass/ Volume Solutions	3.3 Mass/Volume Solutions 3.4 Percent Mass/ Volume Solutions	<ul style="list-style-type: none"> - Prepare various mass/volume solutions and check through spectrophotometry - Prepare various percent mass/volume solutions
9	3g 3h	Molar Solutions Dilutions	3.5 Molar Solutions 3.6 Dilutions	<ul style="list-style-type: none"> - Prepare various molar solutions - Prepare dilutions of solutions - Solution Preparation Skills Quiz
10	7c 7d	Measuring pH Making Buffer	7.2 Introduction to pH 7.3 Buffers	<ul style="list-style-type: none"> - Learn to use pH paper and a pH meter - Prepare a buffer to use in making a protein solution - Prepare buffers and test their ability to resist changes in pH
11	4a 4b	DNA Solutions DNA Spooling	4.1 DNA Structure &Function	<ul style="list-style-type: none"> - Prepare buffers and reagents for DNA isolation - Conduct alcohol precipitation of pure DNA sample
12	4e 4f	Media Prep Sterile Technique	4.2 Sources of DNA	<ul style="list-style-type: none"> - Prepare LB agar and LB broth - Pour sterile LB agar Petri plates - Discuss medical applications of sterile technique
13	4g 4h	Bacteria Cell Culture Bacteria DNA Extraction	4.2 Sources of DNA 4.3 Isolating and Manipulating DNA	<ul style="list-style-type: none"> - Streak isolated colonies and start broth cultures - Isolate genomic DNA from bacteria
14	4i 4j	Agarose Gel Prep DNA Gel Electrophoresis	2.4 The "New" Biotechnology (rDNA and Genetic Engineering) 4.4 Gel Electrophoresis	<ul style="list-style-type: none"> - Prepare an agarose gel - Load, run, stain and analyze DNA on a gel
15	13f 13g	Human DNA Extraction Alu PCR Genotyping	13.1 DNA Synthesis in the Lab 13.3 Polymerase Chain Reaction 13.4 Applications of PCR Technology	<ul style="list-style-type: none"> - Isolate DNA from cheek cells for PCR - Perform a PCR reaction - Use PCR to test DNA for a specific genotype.

16	- -	Biotech Online p. 370 – Growing Up Too Fast Ch 14 Bioethics Activity	14.1 DNA Sequencing 14.2 Genomics/Human Genome Project	- Describe how DNA sequencing is done and how it has impacted genome studies. - Explain how the Humans Genome Project will impact medicine and personal medical decision-making.
17	-	Stock Project Summary and Presentations		- Oral and PPT presentation of stock investment results.
18	-	Biotech Notebook Final		- Demonstrate the ability to retrieve accurate data and reference information from a legal, scientific notebook in a timely manner.
19	5a -	Antibody Function Biotech Immunology, Biotech Online p.337 Getting Sick	5.1 Structure and Function of Proteins 12.4 Creating Pharmaceuticals by Protein Engineering	- Antibody-antigen testing - Describe immunology and the immune response - Explain how engineered proteins are used as pharmaceuticals.
20	5b or 5c 5g	Enzyme Function PAGE (pre-lab)	5.3 Enzymes: Protein Catalysts 5.4 Studying Proteins Using PAGE	- Test enzyme activity at different concentrations - Prepare animal muscle tissue samples to characterize proteins on a PAGE gel
21	5g	Identifying Muscle Proteins using PAGE	5.4 Studying Proteins 5.5 Applications of Protein Analysis	- Load and run animal muscle tissue samples on vertical gels to study differences in protein composition. - Describe the value of protein PAGE in medical biotech
22	6c	Amylase Assay Biotech Online p.328-Pancreatitis Career Exploration Project	6.1 Sources of Potential Biotech Products 6.2 The Use of Assays	- Conduct aldose and starch indicator tests - Test saliva for alpha-amylase activity - Describe how assays are used in medical diagnosis - Career Presentations during Finals = 2weeks
23	7f 7g	Spec Amylase Study Determining Amylase Concentration	7.4 Determining Protein Concentration	- Determine the absorbance spectrum for amylase-Bradford reagent to learn λ_{max} - Use a best-fit standard curve to determine the concentrations of unknown amylase solutions
24	7i	UV Spec to Study Proteins	7.4 Determining Protein Concentration	- Use a UV-VIS spec to determine the λ_{max} for a sample of colorless protein or medicinal compound

25	14a	ELISA	14.3 Advanced Protein Studies	- Conduct a qualitative ELISA (antibody assay) of amylase
26	8b	Restriction Digestion of pAmylase	8.1 Overview of Genetic Engineering	- Conduct a restriction digestion of the pAmylase to confirm prior to transformation of <i>E. coli</i> cells
27	8c -	Transformation Biotech Online p.256 Medicinal Biotech Products in the Pipeline	8.2 Transforming Cells	- Transfer plasmids into <i>E. coli</i> and select transformants - Give several examples of pharmaceutical biotechnology products and their applications
28	8e -	Scaling-up Transformed Cells Activity 9.1 Protein Manufacturing	8.3 After Transformation 8.4 Fermentation, Manufacturing, and GMP	- Select colonies and scale them up from a selection plate to selection broth media. - Discuss the major steps in manufacturing rDNA/protein pharmaceuticals
29	9a 9b	Harvesting Amylase Dialysis of Protein Buffers	9.1 Harvesting a Protein Product 9.2 Using Chromatography to Study and Separate Molecules	- Separate transformed cells from broth and test the broth for amylase activity - Use dialysis tubing to conduct a buffer exchange prior to column chromatography
30	9c	Using Ion-Exchange Chromatography	9.3 Column Chromatography	- Separate lysozyme from albumin on an ion-exchange column
31	9d	Ion-Exchange Purification of Amylase	9.4 Product Quality Control 9.5 Marketing and Sales	- Use an ion-exchange column to determine the overall charge of amylase at pH7.2 and isolate amylase from a broth culture.
32	12a 12b	UV Spec to Study Caffeine MSDS to Recognize Compounds	12.1 Drug Discovery	- Discuss the use of spectrophotometry in medical biotech - Access MSDS data to learn the characteristics of compounds
33	12c	Synthesis of Aspirin	12.2 Creating Pharmaceuticals by Combinatorial Chemistry	- Synthesize acetylsalicylic acid through combinatorial chemistry
34	12d	Melting Point Determinations for Quality Control	12.3 Creating Pharmaceuticals by Peptide and DNA synthesis 12.4 Pharmaceuticals by Protein Engineering	- Conduct melting point determinations the product of their acetylsalicylic acid production
35	-	Career Project Presentations		- Oral and PPT presentation of career project investigations.
36	-	Lab Practical Final		- Demonstrate the ability to set-up a valid, controlled experiment to collect data similar to that in a biotechnology R&D, manufacturing, or quality control facility and analyze it in a timely manner.