

540-Hour, Skill Development Lab-based, Concept-Supported Course Plan

Suggested Lesson Planning Guide

36 weeks, 15 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/Computer Lesson Focus	Text Section Support and Lecture Discussion Focus	Key Lab Skill Objectives/Activities Students will:
1	1a 1b	Scientific Notebook Laboratory Safety Biotech Company Stock Project (www.BiotechEd.com)	1.1 Defining Biotechnology (Biotech Live Activities 1.1, 1.2, 1.4) 1.2 Biotechnology Products 1.3 Selecting Potential Products	<ul style="list-style-type: none"> - 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)
2	1c	Cheese Production	1.4 Scientific Methodology 1.5 Biotech Careers 1.6 Bioethics	<ul style="list-style-type: none"> - Conduct a controlled experiment, analyze and report data, Excel®, WORD®, conclusions - Animal Use Bioethics (Ch 1) - Continue Stock Project set up (check week from here forward)
3	2a 2b 2c	“Cell” Dissection Model Organisms Microscopy	2.1 Organisms and their Parts 2.2 Cellular Organization	<ul style="list-style-type: none"> - Indicator test of “cell” parts for the presence of macromolecules (Biotech Live Activity 2.2) - Grow, maintain, and monitor bacteria and fungi (Biotech Live Activity 2.1) - Stem Cell Bioethics Activity (Ch 2) - 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	<ul style="list-style-type: none"> - Learn to estimate the size of microscopic specimen. - Study the structure and characteristics of different carbohydrates

5	3a 3b 3d	Pipeting Micropipeting Checking Micropipets	3.1 Measuring Volumes	<ul style="list-style-type: none"> - Demonstrate skill using pipets and pipet pumps (Biotech Live Activity 3.5) - Demonstrate skill using micropipets - Pipeting/Micropipeting Skills Quizzes - Honesty Bioethics Activity (Ch 3)
6	3c 3e	Mass Measurement Mass/Volume Solutions	3.2 Making Solutions 3.3 Mass/Volume Solutions	<ul style="list-style-type: none"> - Demonstrate skill using balances - Prepare various mass/volume solutions (Biotech Live Activity 3.8) - Practice Worksheets from EMCP.com Internet Resource Center (IRC)
7	3f 3g	Percent Mass/ Volume Solutions Molar Solutions	3.4 Percent Mass/ Volume Solutions 3.5 Molar Solutions	<ul style="list-style-type: none"> - Prepare various percent mass/volume solutions - Prepare various molar solutions (Biotech Live Activity 3.4) - Practice Worksheets from EMCP.com Internet Resource Center (IRC)
8	3h 4a 4b	Dilutions DNA Isolation Solutions DNA Spooling	3.6 Dilutions 4.1 DNA Structure and Function	<ul style="list-style-type: none"> - Prepare dilutions of solutions - Practice Worksheets from EMCP.com Internet Resource Center (IRC) - Prepare buffers and reagents for DNA isolation - DNA Model (Activity 4.1) - Conduct alcohol precipitation of pure DNA sample
9	4d 4e 4f	EtBr DNA Sample testing Media Prep Sterile Technique	4.2 Sources of DNA Biotech Live Activities 4.2, 4.3, 4.4	<ul style="list-style-type: none"> - Let samples sit over the weekend and test starting Monday - Prepare LB agar and LB broth - Pour sterile LB agar Petri plates (Biotech Live Activity 4.5) - 8-week Stock Project Check ☺ - Field Trip to Biotech Facility
10	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 - Gene Therapy Bioethics Activity (Ch 4)
11	4i 4j	Agarose Gel Prep Agarose Gel Electrophoresis	2.4 The “New” Biotechnology 4.4 Gel Electrophoresis	<ul style="list-style-type: none"> - Prepare an agarose gel - Load, run, stain and analyze DNA on a gel

12	13e	Lambda PCR	13.1 Making DNA 13.2 DNA Synthesis Products 13.3 Polymerase Chain Reaction	<ul style="list-style-type: none"> - Perform a PCR reaction - Biotech Live Activity 13.1 - Biotech Online (p.361) – CSI: Your Town - Biotech Live Activity 13.2
13	13f 13g	Human DNA Extraction Alu PCR Genotyping	13.4 Applications of PCR Technology	<ul style="list-style-type: none"> - Isolate DNA from cheek cells for PCR - Use PCR to test DNA for a specific genotype. - Biotech Live Activity 13.3 - Designer Babies Bioethics Activity (Ch 13)
14	5a 5b 5c	Antibody Function Enzyme Function Protease Assay (3 days)	5.1 Structure and Function of Proteins 5.3 Enzymes: Protein Catalysts	<ul style="list-style-type: none"> - Biotech Live Activity 5.1 - Simulate antibody-antigen testing - Test enzyme activity at different concentrations - Experimental design
15	5f	PAGE	5.4 Studying Proteins	<ul style="list-style-type: none"> - Biotech Live Activity 5.2 - Prepare protein samples and load, run, stain and characterize proteins on a PAGE gel
16	5g	Identifying Proteins	5.5 Applications of Protein Analysis	<ul style="list-style-type: none"> - Prepare animal muscle tissue samples and run gels to study differences in protein composition - Protein Patents Bioethics Activity (Ch 5) - Guest Speaker: Forensics or Pharmaceuticals
17	6b 6c	Starch and Sugar Assays Amylase Assay	6.1 Sources of Potential Products 6.2 The Use of Assays	<ul style="list-style-type: none"> - Conduct aldose and starch indicator tests - Test saliva for alpha-amylase activity - Finish up Stock Project - PowerPoint® Instruction and work on PPT of Stock Investment - Prepare for Final
18	Finals			<ul style="list-style-type: none"> - Timed NB Final and Stock Investment PPT presentations
19	10a 10b 10c	Flower Dissection Seed Dissection Germination Study	10.1 Intro to Plant Propagation 10.2 Plant Anatomy 10.3 Plant Growth	<ul style="list-style-type: none"> - Study of plant anatomy of reproductive structures - Biotech Live Activity 10.1, 10.2 - Comparative study of seed germination

20	10d 10e	WFP Breeding Breeding Statistical Analysis	10.4 Intro to Plant Breeding	<ul style="list-style-type: none"> - Dihybrid, heterozygous cross of selected WFP - Chi-Square analysis of breeding experiment data - Biotech Live Activity 10.4, 10.3, 11.4
21	11c 11d	Hormone Concentration Study African Violet Cloning	11.1 Cloning Plants 11.2 Plant Tissue Culture	<ul style="list-style-type: none"> - Testing how hormone concentration affects rooting - African Violet Tissue Culture - Biotech Live Activity 10.5, 11.1, 11.5 - Monarch Butterfly Bioethics Activity (Ch 10) - Field Trip to a Plant Biotech Facility
22	6d 6f	Testing Plants Substances Peroxidase Assay	6.3 Products from Nature 6.4 Plant Proteins as Products	<ul style="list-style-type: none"> - Extract compounds from plants and test the extracts' antimicrobial activity on the growth of <i>E. coli</i> - Biotech Live Activity 6.2 - Qualitative test for peroxidase activity
23	6g 6h	Extracting HRP Assay for HRP with TMB		<ul style="list-style-type: none"> - Isolate a plant enzyme - Colorimetric assay for peroxidase activity - Prepare for ELISA
24	14a 6e 7a	ELISA Searching for Native Amylase Using the Spectrophotometer	14.3 Advanced Protein Studies 6.5 Producing Recombinant DNA Protein Products 7.1 Using the Spectrophotometer	<ul style="list-style-type: none"> - Conduct a qualitative ELISA (antibody assay) - Predict where amylase-producing bacteria might be found in nature and attempt to isolate colonies - Biotech Live Activity 6.4 Product Pipeline Study - Learn how to operate a spectrophotometer and how light corresponds to colors of the visible spectrum
25	7b 7c	Using the Spec to Study Molecules Measuring pH	7.1 Using the Spectrophotometer 7.2 Introduction to pH	<ul style="list-style-type: none"> - Use a VIS-spec to determine the absorption spectra and λ_{max} for three colored solutions - Biotech Live Activity 7.1 - Learn to use pH paper and a pH meter - Biotech Live Activity 7.2
26	7d 7e	Making Buffer Demonstrating Buffer Efficacy	7.3 Buffers	<ul style="list-style-type: none"> - Prepare a buffer to use in making a protein solution - Prepare buffers and test their ability to resist changes in pH

27	7f 7g	Spec Amylase Study Determining Amylase Concentration	7.4 Determining Protein Concentration	<ul style="list-style-type: none"> - 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 - Preparation for Job Shadow (review of opportunities and sign ups begin communication with Job Shadow host, review of annual report (Activity 9.2), products, pipeline study.
28	7i 8b	UV Spec to Study Proteins Restriction Digestion of pAmylase	7.4 Determining Protein Concentration 8.1 Overview of Genetic Engineering	<ul style="list-style-type: none"> - Use a UV-VIS spec to determine the λ_{max} for a sample of colorless protein - Conduct a restriction digestion of the pAmylase to confirm prior to transformation of <i>E. coli</i> cells - Biotech Live Activity 8.2, 8.3, 8.4
29	-	Job Shadow Activity (www. BiotechEd.com)		<ul style="list-style-type: none"> - Job Shadows 15 hours/journaling
30	-	Job Shadow Activity (www. BiotechEd.com)		<ul style="list-style-type: none"> - Job Shadows – second 15 hours/ journaling
31	8c	Transformation	8.2 Transforming Cells	<ul style="list-style-type: none"> - Transfer plasmids into <i>E. coli</i> and select transformants - Preparation of Job Shadowing Presentations (PPT)
32	8e	Scaling-up Transformed Cells	8.3 After Transformation 8.4 Fermentation, Manufacturing, and GMP	<ul style="list-style-type: none"> - Select colonies and scale them up from a selection plate to selection broth media. - NSF Funding Bioethics Activity (Ch 8)
33	9a 9b	Harvesting Amylase Dialysis of Protein Buffers	9.1 Harvesting a Protein Product 9.2 Using Chromatography to Study and Separate Molecules	<ul style="list-style-type: none"> - Separate transformed cells from broth and test the broth for amylase activity - Use dialysis tubing to conduct a buffer exchange prior to column chromatography
34	9c	Using Ion-Exchange Chromatography	9.3 Column Chromatography	<ul style="list-style-type: none"> - Separate lysozyme from albumin on an ion-exchange column - Activity 9.1 Protein Manufacturing Poster (due Week 35)

35	9d	Ion-Exchange Purification of Amylase	9.4 Product Quality Control 9.5 Marketing and Sales	<ul style="list-style-type: none"> - Use an ion-exchange column to determine the overall charge of amylase at pH7.2 and isolate amylase from a broth culture. - Biotech Live Activity 6.3 Nasty New Diseases - Limited Medications Bioethics Activity (Ch 6)
36	Finals			<ul style="list-style-type: none"> - Timed NB Final and Job Shadow Presentations