

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

Suggested Lesson Planning Guide

Either 72 weeks (4 semesters), 5 hours of lab and lecture/discussion meetings/week or 36 weeks (2 semesters), 10 hours of lab and lecture/discussion meetings/week (use 2 weeks of the Planning Guide/week for a 36-week course).

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 - Continue Stock Project set up (check each week from here forward) - Conduct a controlled experiment, analyze and report data, Excel®, WORD®, conclusions - Animal Use Bioethics (Ch 1) - Animal Technician Career Exploration
3	2c 2d	Microscopy Microscopic Measurement	2.2 Cellular Organization	<ul style="list-style-type: none"> - Learn microscope use for prepared and wet mount slides - Learn to estimate the size of microscopic specimen. - Stem Cell Bioethics Activity (Ch 2) - Cell Biologist Career Exploration
4	3a	Pipeting	3.1 Measuring Volumes	<ul style="list-style-type: none"> - Demonstrate skill using pipets and pipet pumps

	3b	Micropipeting		(Biotech Live Activity 3.5) <ul style="list-style-type: none"> - Demonstrate skill using micropipets - Pipeting/Micropipeting Skills Quizzes - Honesty Bioethics Activity (Ch 3)
5	3c 7a	Mass Measurement Using the Spectrophotometer	3.2 Making Solutions 7.1 Using the Spectrophotometer	<ul style="list-style-type: none"> - Pipeting/Micropipeting Skills Quizzes - Learn how to operate a spectrophotometer and how light corresponds to colors of the visible spectrum in preparation to judge solution preparations
6	7b	Using the Spec to Study Molecules	7.1 Using the Spectrophotometer	<ul style="list-style-type: none"> - Use a VIS-spec to determine the absorption spectra and λ_{max} for three colored solutions
7	3e	Mass/Volume Solutions	3.3 Mass/Volume Solutions	<ul style="list-style-type: none"> - Prepare various mass/volume solutions (Biotech Live Activity 3.8) - Practice Worksheets from EMCP.com Internet Resource Center (IRC)
8	3f	Percent Mass/ Volume Solutions	3.4 Percent Mass/ Volume Solutions	<ul style="list-style-type: none"> - Prepare various percent mass/volume solutions - Practice Worksheets from EMCP.com Internet Resource Center (IRC)
9	3g	Molar Solutions	3.5 Molar Solutions	<ul style="list-style-type: none"> - Prepare various molar solutions (Biotech Live Activity 3.4) - Practice Worksheets from EMCP.com Internet Resource Center (IRC)
10	3h 4a	Dilutions DNA Isolation Solutions	3.6 Dilutions	<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 - Biochemist Career Exploration
11	4b	DNA Spooling	4.1 DNA Structure and Function	<ul style="list-style-type: none"> - DNA Model (Activity 4.1) - Conduct alcohol precipitation of pure DNA sample
12	4d 4e	EtBr DNA Sample testing Media Prep	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 (Biotech Live Activity 4.5)
13	4e	Media Prep (cont.)	4.2 Sources of DNA	<ul style="list-style-type: none"> - Pour sterile LB agar Petri plates

	4f	Sterile Technique	Biotech Live Activities 4.2, 4.3, 4.4	(Biotech Live Activity 4.5) - 8-week Stock Project Check ☺ - Field Trip to Biotech Facility
14	4g	Bacteria Cell Culture	4.3 Isolating and Manipulating DNA	- Streak isolated colonies and start broth cultures - Microbiologist Career Exploration
15	4h	Bacteria DNA Extraction	4.3 Isolating and Manipulating DNA	- Isolate genomic DNA from bacteria - Gene Therapy Bioethics Activity (Ch 4) - EtBr Dot Test of samples
16	4i 4j	Agarose Gel Prep Agarose Gel Electrophoresis (pre-lab)	2.4 The “New” Biotechnology 4.4 Gel Electrophoresis	- Prepare an agarose gel - Compare and contrast horizontal vs vertical gel electrophoresis - Prepare samples for an agarose gel
17	4j	Agarose Gel Electrophoresis (lab)	4.4 Gel Electrophoresis	- Load, run, stain and analyze DNA on a gel
18	Finals	Timed Notebook Final Lab Practical Final		- Notebooks turned in for final evaluation
19	5a	Antibody Function	5.1 Structure and Function of Proteins	- Biotech Live Activity 5.1 - Simulate antibody-antigen testing
20	5b 5c	Enzyme Function Protease Assay (3 days)	5.3 Enzymes: Protein Catalysts	- Test enzyme activity at different concentrations - Experimental design - Protein Chemist Career Exploration
21	5b	Enzyme Function	5.3 Enzymes: Protein Catalysts	- Test enzyme activity at different concentrations
22	5c	Protease Assay (3 days)	5.3 Enzymes: Protein Catalysts	- Experimental design
23		Insulin Structure	5.2 Protein Structure	- Biotech Live Activity 5.2
24	5f	PAGE	5.4 Studying Proteins	- Prepare protein samples and load, run, stain and characterize proteins on a PAGE gel
25	5g	Identifying Proteins (Pre-lab)	5.5 Applications of Protein Analysis	- Prepare animal muscle tissue samples to run gels to study differences in protein composition

				<ul style="list-style-type: none"> - Protein Patents Bioethics Activity (Ch 5) - Pharmaceuticals Clinical Research Career Exploration
26	5g	Identifying Proteins	5.5 Applications of Protein Analysis	<ul style="list-style-type: none"> - Run animal muscle tissue samples on gels to study differences in protein composition - Pharmaceuticals Clinical Research Career Exploration
27	6b	Starch and Sugar Assays	6.1 Sources of Potential Products	<ul style="list-style-type: none"> - Conduct aldose and starch indicator tests - Finish up Stock Project
28	6c	Amylase Assay	6.2 The Use of Assays	<ul style="list-style-type: none"> - Test saliva for alpha-amylase activity - PowerPoint® Instruction and work on PPT of Stock Investment
29	6e 7c	Searching for Native Amylase Measuring pH	6.5 Producing Recombinant DNA Protein Products 7.2 Introduction to pH	<ul style="list-style-type: none"> - Predict where amylase-producing bacteria might be found in nature and attempt to isolate colonies - Biotech Live Activity 7.1 - Learn to use pH paper and a pH meter - Biotech Live Activity 7.2
30	7d 7f	Making Buffer Spec Amylase Study	7.3 Buffers 7.4 Determining Protein Concentration	<ul style="list-style-type: none"> - Prepare a buffer to use in making a protein solution - Determine the absorbance spectrum for amylase-Bradford reagent to learn λ_{max}
31	7g	Determining Amylase Concentration	7.4 Determining Protein Concentration	<ul style="list-style-type: none"> - 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.
32	7i	UV Spec to Study Proteins	7.4 Determining Protein Concentration	<ul style="list-style-type: none"> - Use a UV-VIS spec to determine the λ_{max} for a sample of colorless protein
33	8a	Restriction Digestion of Lambda Phage	8.1 Overview of Genetic Engineering	<ul style="list-style-type: none"> - Conduct a restriction digestion of the Lambda DNA to learn about restriction enzymes - Conduct a restriction digestion of the pAmylase to confirm prior to transformation of <i>E. coli</i> cells - Biotech Live Activity 8.2
34	8b	Restriction Digestion	8.1 Overview of Genetic	<ul style="list-style-type: none"> - Conduct a restriction digestion of the pAmylase to

	8c	of pAmylase Transformation (pre-lab)	Engineering	confirm prior to transformation of <i>E. coli</i> cells - Prepare reagents/media for transformation (Lab 8c) - Biotech Live Activity 8.3 8.4
35	8c	Transformation lab)	8.2 Transforming Cells	- - Transfer plasmids into <i>E. coli</i> and select transformants
36	Finals			- Timed NB Final and Stock Investment PPT presentations
37	10a	Flower Dissection	10.1 Intro to Plant Propagation 10.2 Plant Anatomy	- Study of plant anatomy of reproductive structures - Biotech Live Activity 10.1, 10.2
38	10b 10c	Seed Dissection Germination Study	10.2 Plant Anatomy 10.3 Plant Growth	- Comparative study of seed germination
39	10e	WFP Breeding	10.4 Intro to Plant Breeding	- Dihybrid, heterozygous cross of selected WFP - Biotech Live Activity 10.4, 10.3, 11.4
40	11a	Asexual Plant Propagation	11.1 Cloning Plants	- Testing how media and plant organs affects rooting
41	11c	Hormone Concentration Study	11.1 Cloning Plants	- Testing how hormone concentration affects rooting - Biotech Live Activity 10.5
42	11d	African Violet Cloning	11.2 Plant Tissue Culture	- African Violet Tissue Culture - Biotech Live Activity 11.1, 11.5 - Monarch Butterfly Bioethics Activity (Ch 10) - Plant Biologist Career Exploration
43	6d	Testing Plants Substances (pre-lab)	6.3 Products from Nature	- Extract compounds from plants and test the extracts' antimicrobial activity on the growth of <i>E. coli</i>
44	6d	Testing Plants Substances (lab)	6.3 Products from Nature	- Test the extracts' antimicrobial activity on the growth of <i>E. coli</i>
45	6d	Peroxidase Assay	6.4 Plant Proteins as Products	- Qualitative test for peroxidase activity - Biotech Live Activity 6.2
46	6g 6h	Extracting HRP Assay for HRP with TMB	6.4 Plant Proteins as Products	- Isolate a plant enzyme - Colorimetric assay for peroxidase activity - Prepare for ELISA
47	14a	ELISA (pre-lab)	14.3 Advanced Protein Studies	- Conduct a qualitative ELISA (antibody assay)
48	14a	ELISA (lab)	14.3 Advanced Protein Studies	- Conduct a qualitative ELISA (antibody assay)
49	10e	Breeding Statistical	10.4 Intro to Plant Breeding	- Dihybrid, heterozygous cross of selected WFP

		Analysis		- Chi-Square analysis of breeding experiment data
50		Bioengineered Product Pipeline	Bioengineered Product Pipeline	- Biotech Live Activity 6.4 Product Pipeline Study
51	8e	Scaling-up Transformed Cells	8.3 After Transformation 8.4 Fermentation, Manufacturing, and GMP	- Select colonies and scale them up from a selection plate to selection broth media. - NSF Funding Bioethics Activity (Ch 8)
52	9a	Harvesting Amylase	9.1 Harvesting a Protein Product	- Separate transformed cells from broth and test the broth for amylase activity
	9b	Dialysis of Protein Buffers	9.2 Using Chromatography to Study and Separate Molecules	- Use dialysis tubing to conduct a buffer exchange prior to column chromatography
53	9c	Using Ion-Exchange Chromatography	9.3 Column Chromatography	- Separate lysozyme from albumin on an ion-exchange column - Activity 9.1 Protein Manufacturing Poster (Final Week)
54	Finals			- Timed NB Final and finish up all plant propagations
55	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. - Biotech Live Activity 6.3 Nasty New Diseases - Limited Medications Bioethics Activity (Ch 6)
56	13a-13d	DNA Synthesis (pre-lab)	13.1 DNA Replication 13.2 DNA Synthesis products	- Replicate a strand of DNA from a template, use Southern Blot, Colormetric Visualization
57	13a-13d	DNA Synthesis (lab)	13.1 DNA Replication 13.2 DNA Synthesis products	- Replicate a strand of DNA from a template, use Southern Blot, Colormetric Visualization
58	13a-13d	DNA Synthesis (analysis)	13.1 DNA Replication 13.2 DNA Synthesis products	- Replicate a strand of DNA from a template, use Southern Blot, Colormetric Visualization
59	13e	Electrophoresis Intro to PCR Lambda PCR	13.1 Making DNA 13.2 DNA Synthesis Products 13.3 Polymerase Chain Reaction	- Perform a PCR reaction - Biotech Live Activity 13.1 - Biotech Online (p.361) – CSI: Your Town - Biotech Live Activity 13.2
60	13f	Human DNA Extraction	13.4 Applications of PCR Technology	- Isolate DNA from cheek cells for PCR - Biotech Live Activity 13.3
	13g	Alu PCR		- Designer Babies Bioethics Activity (Ch 13)

		Genotyping (pre-lab)		
61	13g	Alu PCR Genotyping	13.4 Applications of PCR Technology	- Use PCR to test DNA for a specific genotype.
62	Ch 13	Bioinformatics	DNA Learning Center Website	- Hardy Weinberg Equilibrium - Bioinformatics
63	Ch 13	GMO PCR	BABEC materials or other	- Pre-lab/lab
64	Ch 13	GMO PCR	BABEC materials or other	- Pre-lab/lab/analysis
65	Ch 13	PCR Optimization	BABEC materials or other	- Pre-lab calculation
66	Ch 13	PCR Optimization	BABEC materials or other	- Lab/analysis
67	Ch 14	DNA Sequencing/Genomi cs		- As determined by instructor
68	Ch 14	Proteonomics		- As determined by instructor
69	Ch 14	Special Projects/Topics	ie. Bioremediation, Biotech Environmental Studies	- As determined by instructor
70	Ch 14	Special Projects/Topics	ie. Bioremediation, Biotech Environmental Studies	- As determined by instructor
71		Protein Manufacturing Posters		- Poster Presentations
72	Finals			- Timed NB Final and Poster Presentations