

BS4NM 2017 1 Year Biotechnology Course - The rAmylase Project Theme

Suggested Lesson Planning Guide Scope and Sequence

Four semesters of daily 55-minute periods (or 4.5 hrs/week) of lab and lecture/discussion meetings.

Activities may require adjustment to meet unexpected changes in time, supplies, or student and teacher experience.

Adjustment in Biotech Online (BO), Biotech Live (BL) and Bioethics (BE) activities and testing may be made as necessary.

* = G-Biosciences' "The rAmylase Project" Kit is available.

Week	Lab	Lab/Computer/Activities Lesson/Focus	Text Section Support, Lecture Discussion Focus, Activities	Key Skill Objectives/Activities
1	1a 1b	Scientific Notebook Laboratory Safety	1.1 Introduction to Biotech, BL# 1.1 What is Biotech? BL# 1.5 Staying Current in Biotech Inventory Logs BL# 3.1 Maintaining Stock Areas BL# 3.3 Hazardous Chemicals	<ul style="list-style-type: none"> - Start and maintain a legal scientific notebook - Explore Who/What/Where/How of Biotech - Understand the breadth of biotech domains - Learn emergency procedures and the location of safety hazards and emergency equipment - Setting up and stocking the biotech lab - Inventory Log
2	1c	Cheese Production	1.4 Scientific Methodology, Data Processing/Reporting 1.2 Biotech Products BL# 1.4 How Biotech Improves Life	<ul style="list-style-type: none"> - Conduct a controlled experiment, analyze and report data, Excel®, WORD®, conclusions - Conduct a controlled experiment, analyze and report data, Excel®, WORD®, conclusions - Explore Biotech Companies and their Products
3		Biotech Company Stock Project	1.3 How Companies Select Products BL# 1.2 Business Side of Biotech BL# 1.3 Investing in Biotech	<ul style="list-style-type: none"> - Stock Project set up and monitoring (check each week)
4		Biotech Career Exploration	1.5 Biotech Careers BO: Finding Hot Jobs 1.6 Bioethics, Bioethical Dilemmas BE: Use of Animals in Science	<ul style="list-style-type: none"> - Career Exploration Using Chapters' Biotech Career Focus and BO: Finding Hot Jobs - Animal Use Values Clarification
5	2b 2c	Model Organism Growth Microscopy	2.1 Organisms and their Components BL# 2.1 Biohazards 2.2 Cellular Organization BO: Cell Picture Show	<ul style="list-style-type: none"> - Recognize Levels of Biological Organization - Understand how to deal with biohazards - Learn microscope use for prepared and wet mount slides - Compare and contrast prokaryotic vs. eukaryotic cells
6	2d 2f	Microscopic Measurement Microscope Skills Quiz Carbohydrate Molecular Variety	BE: Stem Cells BL# 2.2 ATCC 2.3 The Molecules of Cells BO: Computer Molecular Models	<ul style="list-style-type: none"> - Learn to estimate the size of microscopic specimen. - Demonstrate competence in microscope use - Stem Cell Use Values Clarification - Review macromolecules using molecular model application - Demonstrate the impact of slight molecular variations
7	3a 3b	Pipeting Micropipeting Micropipeting Skills Quiz	3.1 Measuring Volumes BL# 3.5 Writing a SOP	<ul style="list-style-type: none"> - Demonstrate skill using pipets and pipet pumps - Demonstrate skill using micropipets and microcentrifuge - Demonstrate competence in pipeting

			BE: Honesty – The Best Policy?	- Scientific Integrity Values Clarification
8	3c 7a 7b	Mass Measurement Using the Spectrophotometer (as demo) Using the Spec to Study Molecules (into Week 9)	3.2 Making Solutions 7.1 Using the Spectrophotometer BO: Visual Spectrophotometry Virtually	- Use a balance to measure solutes for solution. - Learn how to operate a spectrophotometer and how light corresponds to colors of the visible spectrum in preparation to judge solution preparations - Use a VIS-spec to determine the absorption spectra and λ_{max} for three colored solutions and check solution prep
9	3d	Mass/Volume Solutions	3.3 Making Solutions from Scratch	- Prepare various mass/volume solutions and check preparation - Best-fit straight line graph and linear regression to check data
10	3e 3f	Percent Mass/ Volume Solutions Molar Solutions	BL# 3.4 Molecular Weights	- Prepare various percent mass/volume solutions and check preparation - Review of molecular weight determinations - Prepare various molar solutions
11	3g 3h 3i	Measuring pH Effect of pH on Protein Structure Buffer Efficacy	3.4 pH BL# 3.7 “pHun” at home with pH 3.5 Buffers BO: Blood Buffer System	- Use pH meter and pH paper to check and adjust solutions - Demonstrate how proteins change in changing pH and the importance of protein buffers - Compare the buffering of different buffers
12	3j	Dilutions Solution Prep Skills Quiz	3.6 Dilutions	- Prepare dilutions of solutions and check preparation - Demonstrate competence in solution preparation
13	4a 4b 4d	DNA Isolation Solutions DNA Spooling EtBr DNA Sample testing (optional/teacher demo)	4.1 DNA Structure and Function BL# 4.1 DNA Models BL# 4.5 DNA Computer Model 4.2 Sources of DNA BL# 4.2 <i>E.coli</i> as a Model Organism	- Understand how DNA structure impacts function and isolation. - Prepare buffers and reagents for DNA isolation - Conduct alcohol precipitation of pure DNA sample - Confirmation of DNA in precipitated samples
14	4e 4f 4g	Media Prep Sterile Technique Bacteria Cell Culture	4.3 Isolating and Manipulating DNA BL# 4.3 Bacteria Growth Curve	- Prepare LB agar and LB broth - Pour sterile LB agar Petri plates - Streak isolated <i>E.coli</i> colonies and monitor colony growth
15	4g 4h	Bacteria Cell Culture Bacteria DNA Extraction	BL# 4.4 NCBI and Bioinformatics BO: Know Your Genome BE: GeneTherapy	- Start broth cultures - Learn how to access public DNA data - Isolate and confirm genomic DNA isolation from bacteria - Manipulating the Humane Genome Values Clarification
16	4i 4j	Agarose Gel Prep Agarose Gel Electrophoresis (pre-lab)	2.4 The “New” Biotechnology BO: Recombinant Pharmaceuticals 4.4 Gel Electrophoresis	- Prepare an agarose gel - Compare and contrast horizontal vs vertical gel electrophoresis - Prepare samples for an agarose gel
17	4j Final	Agarose Gel Electrophoresis (lab) Timed Notebook Final	BO: Chop and Go Electrophoresis	- Load, run, stain and analyze DNA on a gel - Semester Final (Written)
18	Final	Lab Practical Final = Lab 4c Yeast DNA Extraction & Gel Confirmation		- Semester Final (Lab Practical) - Notebooks turned in for final evaluation

19		BL#5.1 Protein Structure/Function “Mini-Poster” BL#5.2 Insulin Amino Acid Sequence/Structure	5.1 Structure and Function of Proteins 5.2 Production of Proteins	<ul style="list-style-type: none"> - Set up new NB - Distinguish between 9 protein groups based on their function - Create a 3-D paper model of pro-insulin, then insulin.
20	5a 5b	Antibody Function Enzyme Function	BO: Antibody-Producing Companies 5.3 Enzymes: Protein Catalysts BO: Enzymes: Catalysts for Better Health	<ul style="list-style-type: none"> - Antibody-antigen interactions, testing, use, applications - Review of enzyme structure and function - Test the activity of different enzymes on juice production
21	5d 5e	Protein Indicators Buffer Prep for PAGE	5.4 Studying Proteins	<ul style="list-style-type: none"> - Protein Indicators, Spectrophotometry, and Standard Curves - Prepare buffers, loading dyes and samples for analysis on SDS_PAGE gels.
22	5f* or 6a*	Protein Characterization by PAGE	Online comparison of vertical and horizontal gel electrophoresis > factsheet	<ul style="list-style-type: none"> - Load, run, stain, and analyze proteins on a PAGE gel proteins to learn how to characterize them for future studies
23	5g	Muscle Tissue Protein Study	5.5 Applications of Protein Analysis BE: How Owns your Genetic Code	<ul style="list-style-type: none"> - Prepare and run animal muscle tissue samples to run PAGE gels to study differences in tissue protein composition - Genetic Information and Privacy Values Clarification
24	6a 6c	Searching for Native Amylase Starch and Sugar Assays	6.1 Sources of Potential Products and Unit 2 Intro = The rAmylase Project, use text Figure 1.21 BL #6.1 Exploring Potential Products 6.2 The Use of Assays	<ul style="list-style-type: none"> - Review of how a recombinant protein, such as amylase, might be made for market - Search and evaluation of a potential commercially-interesting amylase in nature - Conduct positive and negative control aldose and starch indicator tests
25	6d*	Amylase Assay BL# 6.3 Latest in ELISA and Western Blots	BL #6.2 Amylase Three-Dimensionally 6.3 ELISA	<ul style="list-style-type: none"> - Quantify alpha-amylase activity from different samples - Describe how ELISA and Western blots utilize antibody and enzyme technology to quantify protein in samples.
26	6e*	Amylase ELISA BL #6.5 Product Pipeline Study	BO: ELISA Diagnostic Kits 6.6 Producing Recombinant DNA Protein Products	<ul style="list-style-type: none"> - Conduct an ELISA to determine the concentration of 2 unknown amylase samples - Demonstrate an understanding of all the major steps in bringing a recombinant protein product from conception to market.
27	6f*	Western Blot of Amylase BL #6.5 Product Pipeline Presentations	6.4 Western Blots	<ul style="list-style-type: none"> - Conduct a Western Blot to confirm the presence of low concentrations of amylase in samples - In oral presentations, summarize the major steps in research, development, manufacturing, and marketing
28	7c 7d*	Use Spectrophotometer to Study Amylase Determining Amylase Concentration	7.2 Spec to Measure Protein Concentration BO: Which Indicator is Indicated?	<ul style="list-style-type: none"> - Determine the absorbance spectrum for amylase-Bradford reagent to learn λ_{max} - Use a best-fit standard curve and protein indicators to determine the concentrations of unknown amylase solutions
29	7g	UV Spec to Study Proteins BL#7.3 Diagnostic Spectrophotometry Spec Skills Quiz	7.4 Other Spectrophotometers BO: Spectrometer vs. Spectrophotometer 7.5 Applications of Spectrophotometry	<ul style="list-style-type: none"> - Use a UV spec to determine the λ_{max} for a sample of colorless protein - Demonstrate competence using the spectrophotometer

30	8a	Restriction Digestion of Lambda Phage	8.1 Overview of Genetic Engineering BO: Endonucleases: Real “Cut-ups”	<ul style="list-style-type: none"> - Conduct a restriction digestion of the Lambda DNA to learn about restriction enzymes and their role in DNA fingerprinting
31	8b* 8c*	Restriction Digestion of pAmylase2014 Transformation (pre-lab)	8.2 Using Recombinant DNA for Transformation BL #8.2 Restriction Enzymes: Protein Scissors	<ul style="list-style-type: none"> - Conduct a restriction digestion of the pAmylase to confirm its presence prior to transformation of <i>E. coli</i> cells in Lab 8c - Prepare reagents/media for Lab 8c transformation
32	8c*	Transformation of <i>E. coli</i> by pAmylase 2014	8.3 Transforming Cells using rDNA BO: A Glow in the Dark Cat?	<ul style="list-style-type: none"> - Use competency and hot and cold shock to transfer plasmids into <i>E. coli</i>, then select transformants on selection media - Research about genetic engineering in other organisms.
33	8e 8g* 6d	(modified) Scale-up of Transformed Cultures Mini-Prep of pAmylase2014 (modified) Amylase Assays on Transformed BrothCultures	8.4 After Transformation 8.6 Retrieving Plasmids BE: Designer Babies:Using New Technologies	<ul style="list-style-type: none"> - Grow transformed cells in broth to a high enough concentration to extract the transforming plasmid back out of the transformed cells. - Use mini-prep kit to isolate pAmylase 2014 from transformed cells - Test for Amylase production in transformed cells broth cultures
34	9c*	Ion Exchange Chromatography BO: Products in the Pipeline	9.1 Intro to Biomanufacturing 9.2 Using Chromatography to Separate Proteins 9.4 Product Quality Control	<ul style="list-style-type: none"> - Summarize the major steps to scale up transformed cells to marketable amounts - Conduct an ion-exchange chromatography to demonstrate that amylase can be purified from other proteins
35	13g	Amylase Gene PCR Stock Investment PPT Presentations Timed NB Final	13.3 PCR 13.4 Applications of PCR	<ul style="list-style-type: none"> - Use PCR to confirm the presence of the Amylase gene in a DNA sample - Final data analysis and oral PPT presentations of investment projects
36	Final	Hemoglobin Concentration Lab Practical Final Lab Clean up		<ul style="list-style-type: none"> - Semester Final (Written) - Semester Final (Practical) - Notebooks turned in for final evaluation