### 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.

<table>
<thead>
<tr>
<th>Week</th>
<th>Lab(s)</th>
<th>Lab/Computer Lesson Focus</th>
<th>Text Section Support and Lecture Discussion Focus</th>
<th>Key Lab Skill Objectives/Activities Students will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1a</td>
<td>Scientific Notebook</td>
<td>1.1 Defining Biotechnology</td>
<td>- Start and maintain a legal scientific notebook</td>
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<tr>
<td></td>
<td>1b</td>
<td>Laboratory Safety</td>
<td>(Biotech Live Activities 1.1, 1.2, 1.4)</td>
<td>- Learn emergency procedures and the location of safety hazards and emergency equipment</td>
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<td></td>
<td></td>
<td>Biotech Company Stock</td>
<td>1.2 Biotechnology Products</td>
<td>- Setting up and stocking the biotech lab - Inventory Log (Biotech Live Activities 3.1 and 3.3)</td>
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<tr>
<td></td>
<td></td>
<td>Project (<a href="http://www.BiotechEd.com">www.BiotechEd.com</a>)</td>
<td>1.3 Selecting Potential Products</td>
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<tr>
<td>2</td>
<td>1c</td>
<td>Cheese Production</td>
<td>1.4 Scientific Methodology</td>
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<td>1.5 Biotech Careers</td>
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<td>1.6 Bioethics</td>
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<tr>
<td>3</td>
<td>2a</td>
<td>“Cell” Dissection</td>
<td>2.1 Organisms and their Parts</td>
<td>- Indicator test of “cell” parts for the presence of macromolecules (Biotech Live Activity 2.2)</td>
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<td></td>
<td>2b</td>
<td>Model Organisms</td>
<td>2.2 Cellular Organization</td>
<td>- Grow, maintain, and monitor bacteria and fungi (Biotech Live Activity 2.1)</td>
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<tr>
<td></td>
<td>2c</td>
<td>Microscopy</td>
<td></td>
<td>- Stem Cell Bioethics Activity (Ch 2)</td>
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<tr>
<td>4</td>
<td>2d</td>
<td>Microscopic Measurement</td>
<td>2.2 Cellular Organization</td>
<td>- Learn to estimate the size of microscopic specimen.</td>
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<tr>
<td></td>
<td>2e</td>
<td>Properties of Carbohydrates</td>
<td></td>
<td>- Study the structure and characteristics of different carbohydrates</td>
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<td></td>
<td></td>
<td></td>
<td>2.3 Molecules of Cells</td>
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</tr>
</tbody>
</table>
| 5 | 3a | Pipetting  
 3b | Micropipeting  
 3c | Checking  
 3d | Micropipets  
 3e | 3.1 Measuring Volumes  
 3f | - Demonstrate skill using pipets and pipet pumps  
 3g | (Biotech Live Activity 3.5)  
 3h | - Demonstrate skill using micropipets  
 3i | - Pipeting/Micropipeting Skills Quizzes  
 3j | - Honesty Bioethics Activity (Ch 3)  
 4a |  
 4b |  
 4c |  
 4d |  
 4e |  
 4f |  
 4g |  
 4h |  
 4i |  
 4j |  
 4k |  
 4l |  
 4m |  
 4n |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 3c | Mass Measurement  
 3d |  
 3e | Mass/Volume Solutions  
 3f |  
 3g | 3.2 Making Solutions  
 3h | - Demonstrate skill using balances  
 3i | - Prepare various mass/volume solutions  
 3j | (Biotech Live Activity 3.8)  
 3k | - Practice Worksheets from EMCP.com Internet Resource Center (IRC)  
 4a |  
 4b |  
 4c |  
 4d |  
 4e |  
 4f |  
 4g |  
 4h |  
 4i |  
 4j |  
 4k |  
 4l |  
 4m |  
 4n |  |  |  |
| 7 | 3f | Percent Mass/Volume Solutions  
 3g | Molar Solutions  
 3h | 3.3 Mass/Volume Solutions  
 3i | - Prepare various percent mass/volume solutions  
 3j | - Prepare various molar solutions (Biotech Live Activity 3.4)  
 3k | - Practice Worksheets from EMCP.com Internet Resource Center (IRC)  
 4a |  
 4b |  
 4c |  
 4d |  
 4e |  
 4f |  
 4g |  
 4h |  
 4i |  
 4j |  
 4k |  
 4l |  
 4m |  
 4n |  |  |  |
| 8 | 3h | Dilutions  
 3i | DNA Isolation Solutions  
 3j | DNA Spooling  
 3k | 3.4 Percent Mass/Volume Solutions  
 3l | 3.5 Molar Solutions  
 3m | - Prepare dilutions of solutions  
 3n | - Practice Worksheets from EMCP.com Internet Resource Center (IRC)  
 3o | - Prepare buffers and reagents for DNA isolation  
 3p | - DNA Model (Activity 4.1)  
 3q | - Conduct alcohol precipitation of pure DNA sample  
 4a |  
 4b |  
 4c |  
 4d |  
 4e |  
 4f |  
 4g |  
 4h |  
 4i |  
 4j |  
 4k |  
 4l |  
 4m |  
 4n |  |  |  |
| 9 | 4a | EtBr DNA Sample testing  
 4b | Media Prep  
 4c | Sterile Technique  
 4d | 4.2 Sources of DNA  
 4e | Biotech Live Activities 4.2, 4.3, 4.4  
 4f | - Let samples sit over the weekend and test starting Monday  
 4g | - Prepare LB agar and LB broth  
 4h | - Pour sterile LB agar Petri plates  
 4i | (Biotech Live Activity 4.5)  
 4j | - 8-week Stock Project Check ☺  
 4k | - **Field Trip to Biotech Facility**  
 4l |  
 4m |  
 4n |  |  |  |
| 10 | 4a | Bacteria Cell Culture  
 4b | Bacteria DNA Extraction  
 4c | 4.2 Sources of DNA  
 4d | 4.3 Isolating and Manipulating DNA  
 4e | - Streak isolated colonies and start broth cultures  
 4f | - Isolate genomic DNA from bacteria  
 4g | - Gene Therapy Bioethics Activity (Ch 4)  
 4h | - Prepare an agarose gel  
 4i | - Load, run, stain and analyze DNA on a gel  
 4j |  
 4k |  
 4l |  
 4m |  
 4n |  |  |  |
| 11 | 4a | Agarose Gel Prep  
 4b | Agarose Gel Electrophoresis  
 4c | 2.4 The “New” Biotechnology  
 4d | 4.4 Gel Electrophoresis  
 4e |  
 4f |  
 4g |  
 4h |  
 4i |  
 4j |  
 4k |  
 4l |  
 4m |  
 4n |  |  |  |
| 12 | 13e | 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 |
|---|---|---|---|
| 13 | 13f | Human DNA Extraction  
Alu PCR Genotyping | 13.4 Applications of PCR Technology | - 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) |
| 13 | 13g | | |
| 14 | 5a | Antibody Function  
Enzyme Function  
Protease Assay (3 days) | 5.1 Structure and Function of Proteins  
5.3 Enzymes: Protein Catalysts | - Biotech Live Activity 5.1  
- Simulate antibody-antigen testing  
- Test enzyme activity at different concentrations  
- Experimental design |
| 14 | 5b | | |
| 14 | 5c | | |
| 15 | 5f | PAGE | 5.4 Studying Proteins | - 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 | - 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 | Starch and Sugar Assays  
Amylase Assay | 6.1 Sources of Potential Products  
6.2 The Use of Assays | - 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 |
| 17 | 6c | | |
| 18 | | Finals | | - Timed NB Final and Stock Investment PPT presentations |
| 19 | 10a | Flower Dissection  
Seed Dissection Germination Study | 10.1 Intro to Plant Propagation  
10.2 Plant Anatomy  
10.3 Plant Growth | - Study of plant anatomy of reproductive structures  
- Biotech Live Activity 10.1, 10.2  
- Comparative study of seed germination |
| 20 | 10d | WFP Breeding Breeding Statistical Analysis | 10.4 Intro to Plant Breeding | - Dihybrid, heterozygous cross of selected WFP  
- Chi-Square analysis of breeding experiment data  
- Biotech Live Activity 10.4, 10.3, 11.4 |
| 21 | 11c | Hormone Concentration Study African Violet Cloning | 11.1 Cloning Plants | - 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** |
| 21 | 11d |  | 11.2 Plant Tissue Culture | |
| 22 | 6d | Testing Plants Substances Peroxidase Assay | 6.3 Products from Nature  
6.4 Plant Proteins as Products | - Extract compounds from plants and test the extracts’ antimicrobial activity on the growth of *E. coli*  
- Biotech Live Activity 6.2  
- Qualitative test for peroxidase activity |
| 22 | 6f |  |  | |
| 23 | 6g | Extracting HRP Assay for HRP with TMB |  | - Isolate a plant enzyme  
- Colorimetric assay for peroxidase activity  
- Prepare for ELISA |
| 24 | 14a | 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 | - 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 |
| 24 | 6e |  |  | |
| 24 | 7a |  |  | |
| 25 | 7b | Using the Spec to Study Molecules Measuring pH | 7.1 Using the Spectrophotometer  
7.2 Introduction to pH | - Use a VIS-spec to determine the absorption spectra and Lambda<sub>max</sub> for three colored solutions  
- Biotech Live Activity 7.1  
- Learn to use pH paper and a pH meter  
- Biotech Live Activity 7.2 |
| 25 | 7c |  |  | |
| 26 | 7d | Making Buffer Demonstrating Buffer Efficacy | 7.3 Buffers | - Prepare a buffer to use in making a protein solution  
- Prepare buffers and test their ability to resist changes in pH |
<table>
<thead>
<tr>
<th>Week</th>
<th>Day</th>
<th>Task Title</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>7f</td>
<td>Spec Amylase Study</td>
<td>Determine the absorbance spectrum for amylase-Bradford reagent to learn ( \lambda_{\text{max}} ) and 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).</td>
</tr>
<tr>
<td>28</td>
<td>7i</td>
<td>UV Spec to Study Proteins</td>
<td>Use a UV-VIS spec to determine the ( \lambda_{\text{max}} ) for a sample of colorless protein. Conduct a restriction digestion of the pAmylase to confirm prior to transformation of ( E. \text{coli} ) cells. Biotech Live Activity 8.2, 8.3, 8.4.</td>
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<tr>
<td>29</td>
<td>-</td>
<td>Job Shadow Activity</td>
<td>Job Shadows 15 hours/journaling.</td>
</tr>
<tr>
<td>30</td>
<td>-</td>
<td>Job Shadow Activity</td>
<td>Job Shadows – second 15 hours/ journaling.</td>
</tr>
<tr>
<td>31</td>
<td>8c</td>
<td>Transformation</td>
<td>- Transfer plasmids into ( E. \text{coli} ) and select transformants. - Preparation of Job Shadowing Presentations (PPT).</td>
</tr>
<tr>
<td>32</td>
<td>8e</td>
<td>Scaling-up Transformed Cells</td>
<td>- Select colonies and scale them up from a selection plate to selection broth media. - NSF Funding Bioethics Activity (Ch 8).</td>
</tr>
<tr>
<td>33</td>
<td>9a</td>
<td>Harvesting Amylase</td>
<td>- Separate transformed cells from broth and test the broth for amylase activity. - Use dialysis tubing to conduct a buffer exchange prior to column chromatography.</td>
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<tr>
<td>34</td>
<td>9c</td>
<td>Using Ion-Exchange Chromatography</td>
<td>- Separate lysozyme from albumin on an ion-exchange column. - Activity 9.1 Protein Manufacturing Poster (due Week 35).</td>
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<td><strong>Ion-Exchange Purification of Amylase</strong></td>
<td><strong>9.4 Product Quality Control</strong></td>
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| 35 | 9d | - 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 | - Timed NB Final and Job Shadow Presentations |