Scope and Sequence



BioTechBuilder FOUNDATIONS

TOPIC: ANALYZING DNA
TOPIC: ANALYZING PROTEINS

This module uses a molecular framework to introduce techniques in DNA and protein analysis.



TOPIC: ANALYZING DNA

This topic introduces students to DNA techniques used in modern biotechnology including DNA isolation, PCR, restriction digest analysis, gel electrophoresis, and sequencing. This topic reinforces solution preparation and lab math, micropipetting, and documentation.

LESSON	LAB ACTIVITY	ADDITIONAL RESOURCES
1. DNA Foundations Overview	Streaking BB1 for Single Colonies	Slides, Overview Activity
Students streak a transformed *E. coli* strain for single colonies while learning why it is necessary to verify DNA.		
2. Calibrating Pipettes	Pipette Calibration	Slides, Pre-lab Quiz, Homework
Students revisit micropipetting and calibrate their instruments to ensure consistent and accurate measurements.		
3. Making Miniprep Solutions	Solution Preparation	Slides
Students prepare plasmid DNA isolation buffers while learning about the process of DNA isolation by miniprep.		
4. Isolating DNA I	Plasmid Isolation, Day 1	Slides
Students learn to safely operate a centrifuge as they begin extracting DNA from their bacterial cultures using miniprep protocol.		
5. Isolating DNA II	Plasmid Isolation, Day 2	Slides, Homework
Students map the recombinant DNA components of the engineered strain and complete the plasmid isolation.		

TOPIC: ANALYZING DNA

LESSON	LAB ACTIVITY	ADDITIONAL RESOURCES
6. Amplifying DNA I	Write a PCR protocol	Slides, Pre-lab Quiz
Students learn how the polymerase chain reaction can be used to amplify and verify DNA segments.		
7. Amplifying DNA II	PCR Verification of pBTB1	Slides, Quiz Review
Students evaluate their PCR protocol then amplify the DNA they isolated from their bacterial cultures.		
8. Quiz I	Assessment	Slides, Answer Key
Students design primers, calculate reagent volumes, and predict the length of a PCR product.		
9. Digesting DNA	Restriction Digest of PCR Product	Slides, Pre-lab Quiz, Homework
Students learn about restriction enzymes and apply their understanding to verify and analyze their PCR products.		
10. Visualizing DNA I	Pouring an Agarose Gel	Slides
Students learn the principles of gel electrophoresis and pour gels to analyze their digested PCR DNA.		
11. Visualizing DNA II	Gel Loading Practice	Slides, Pre-lab Quiz, Homework
Students learn features of an agarose gel then practice loading and interpreting gels.		
12. Visualizing DNA III	Gel Electrophoresis	Slides, Quiz Review
Students analyze their PCR and digested DNA by gel electrophoresis.		
13. Quiz II	Assessment	Slides, Answer Key
Students select enzymes, calculate the length of the DNA digestion products, and predict the results of agarose electrophoresis.		
14. Lab Practical I	Assessment	Slides, Set-Up, Answer Key
Students demonstrate gel electrophoresis competency by pouring, loading, running, and analyzing agarose gel.		
15. Sequencing DNA	Analyzing Sequencing Data	Slides, Quiz Review
Students learn how DNA sequencing works and how to read and interpret DNA sequencing results of sample DNA.		
16. Quiz III	Assessment	Slides, Homework, Answer Key
Students demonstrate techniques used to verify DNA by answering fundamental and situational questions.		
17. Lab Practical II	Assessment	Slides, Set-Up, Answer Key
Students use different DNA verification techniques to solve a forensic mystery.		

TOPIC: ANALYZING PROTEINS

This topic teaches students to express and analyze a protein of interest. Hands-on experiments unify and apply content related to gene expression, protein induction, enzyme activity, protein concentration measurements, and separation techniques including column chromatography and SDS-PAGE.

LESSON	LAB ACTIVITY	ADDITIONAL RESOURCES
1. Protein Foundations Overview	Streaking for Colony Isolation	Slides, Overview Activity
Students review central dogma, inducible gene expression (lac operon), and streaking for single cells.		
2. Bacterial Growth Curves	Overnight Induced Culture	Slides, Pre-lab Quiz
Students learn about bacterial growth curves and transfer a strain from solid to liquid media.		
3. Protein Induction	Measuring Cell Density	Slides, Pre-lab Quiz, Homework
Students learn how a chemical can induce bioproduction of an enzyme then induce the cells they have grown.		
4. Cell Viability I	Assay, day 1	Slides, Homework
Students use spectrophotometry and serial dilution to evaluate growth and viability of their induced bacterial strain.		
5. Cell Viability II	Assay, day 2	Slides
Students assess cell growth data, calculate viability, and analyze the impact of enzyme overproduction on cellular fitness.		
6. Lab Practical I, part 1	Assessment	Slides, Rubric
Students repeat the viability assay to assess the impact of cold storage on the induced bacterial strain.		
7. Lab Practical I, part 2	Assessment	Slides, Homework
Students analyze the viability assay plates and summarize the impact of cold storage on induced bacterial strain, then learn about enzymes as catalysts.		
8. Solution Preparation	Making Solutions for Assay	Slides
Students prepare reagents necessary for enzyme activity measurement.		

TOPIC: ANALYZING PROTEINS

LESSON	LAB ACTIVITY	ADDITIONAL RESOURCES
9. Enzyme Activity Measurement	b-gal Activity Assay	Slides, Quiz Review
Students learn how colorimetric enzyme assays work, and then measure enzyme activity in their uninduced and induced bacterial cells to calculate enzyme activity.		
10. Quiz I	Assessment	Slides, Answer Key
Students are evaluated on their understanding of cell growth, induction, viability, and activity calculation.		
11. Standard Curve	Cell Lysis	Slides, Homework
Students learn about the linear relationship between concentration and absorbance, and then serially dilute a known protein to prepare a standard curve.		
12. Protein Concentration	Bradford Assay	Slides
Students plot absorbance vs concentration and use that standard curve to determine the protein concentration in their induced and uninduced bacterial cells.		
13. Protein Purification I	Nickel Resin, day 1	Slides, Homework
Students study affinity-based purification methods and prepare nickel resin for subsequent lesson.		
14. Protein Purification II	Nickel Resin, day 2	Slides, Homework
Students use affinity chromatography to purify the overproduced enzyme.		
15. Visualizing Protein I	SDS-PAGE, day 1	Slides, Pre-lab Quiz
Students learn how denaturing gel electrophoresis separates proteins by size, then prepare select fractions for SDS-PAGE.		
16. Visualizing Protein II	SDS-PAGE, day 2	Slides, Homework
Students load samples onto SDS-PAGE and use Coomassie to stain the gel.		
17. Visualizing Protein III	SDS-PAGE, day 3	Slides, Quiz Review
Students destain gels to compare their data to their documented predictions.		
18. Quiz II	Assessment	Slides, Answer Key
Students demonstrate their knowledge of standard curves, affinity-based purification, and protein gel electrophoresis.		
19. Lab Practical II	Assessment	Slides, Answer Key
Students will be assessed on their ability to generate a standard curve and use that curve to measure the concentration of an unknown solution		