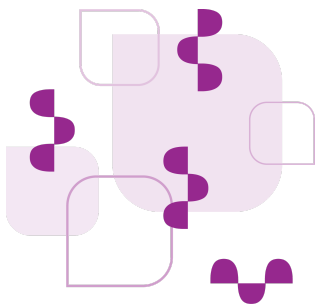




# OVERVIEW



## **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 overview	Streaking BB1 for Single Colonies	Slides, Overview Activity
Students streak a transformed <i>E. coli</i> 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 1	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 2	Plasmid Isolation, Day 2	Slides, Wrap Up
Students demonstrate their understanding of lab safety, safe handling of hazardous chemicals, and keeping of a lab notebook.		

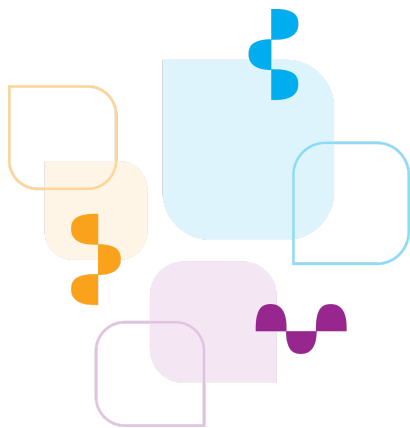




# TOPIC: ANALYZING DNA (CONTINUED)



LESSON	LAB ACTIVITY	ADDITIONAL RESOURCES
6. Amplifying DNA 1	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 2	PCR Verification of pBTB1	Slides, Homework
Students use their own PCR protocol to 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 1	Pouring an Agarose Gel	Slides
Students pour gels for electrophoresis of their digested PCR DNA.		
11. Visualizing DNA 2	Gel Loading Practice	Slides, Pre-lab Quiz, Homework
Students practice loading gels.		
12. Visualizing DNA 3	Gel Electrophoresis	Slides, Homework
Students analyze their PCR 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, Key
Students demonstrate gel electrophoresis competency by pouring, loading, running, and analyzing agarose gel.		
15. Sequencing DNA	Analyzing Sequencing Data	Slides, Homework
Students learn how DNA sequencing works and how to read and interpret DNA sequencing results of their plasmid DNA.		
16. Quiz III	Assessment	Slides, Homework
Students demonstrate their knowledge of techniques used to verify DNA by answering fundamental and situational questions.		
17. Lab Practical II	Assessment	Slides, Set-Up, 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 Overview	Streaking for Colony Isolation	Slides, Homework
Students pour agar plates while learning the fundamentals of bacterial cell structure and growth.		
2. Bacterial Growth Curves	Overnight Induced Culture	Slides, Pre-lab Quiz
Students streak for single colonies from a bacterial slant while learning about selective media.		
3. Protein Induction	Measuring Cell Density	Slides, Pre-lab Quiz, Homework
Students use aseptic technique to prepare liquid selective media and transfer a signal colony for growth overnight.		
4. Cell Viability 1	Assay, day 1	Slides, Homework
Students measure OD600 of their overnight culture and prepare a serial dilution of for viability assay plating.		
5. Cell Viability 2	Assay, day 2	Slides
Students learn how cell concentration and viable cells differ, then count the colonies on their plates to calculate the viability of their bacterial cells. Each student repeats the viability assay experiment for skills assessment.		
6. Lab Practical I, part 1	Assessment	Slides, Rubric
Students repeat the analysis and calculation of the bacterial cell viability using their plates from Lab Practical I, and submit their lab notebook for assessment.		
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 follow an SOP to prepare reagents necessary for enzyme activity measurement.		



# TOPIC: ANALYZING PROTEIN (CONTINUED)



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, 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 bacterial cells.		
13. Protein Purification I	Nickel Resin, day 1	Slides, Homework
Students survey techniques for disrupting cells, then use chemicals to prepare protein lysates from induced cells.		
14. Protein Purification II	Nickel Resin, day 2	Slides, Homework
Students survey protein separation techniques, then 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 load select fractions from their protein purification onto SDS-PAGE.		
16. Visualizing Protein II	SDS-PAGE, day 2	Slides, Homework
Students learn how proteins are visualized and how their size is determined, then document predictions for their experiment and use Coomassie to stain the gel.		
17. Visualizing Protein III	SDS-PAGE, day 3	Slides, Quiz Review
Students will compare their documented predictions of the gel to their data, then review the various protein analysis techniques they explored in the lessons.		
18. Quiz II	Assessment	Slides, Answer Key
Students demonstrate their knowledge of spectrophotometry, cell lysate preparation techniques, and protein gel electrophoresis		
19. Lab Practical II	Assessment	Slides, Data, 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		