NYS Performance Indicators	Objectives Essential Questions	Resources (Suggested Activities)	Cross-Curriculum Connections	Assessment Items
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	What is Biotechnology? Students will be able to: - Identify product domains - Outline steps in producing and delivering product - Give examples of careers - Describe scientific methods used to experiment and develop product - Make bioethical assessments	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 1 *Lab Activity:* Making Cheese – Quality Control and Technique (Found in "Biotechnology: Science for the New Millenium Lab Manual" Gummy Bear Lab Meeting	Engineering: Developing an understanding of problem-solving methods Math: Calculations and measurements connected to experimentation	*Formative:* Chapter 1 Activity 1.1 – Use the internet to research biotechnology industry companies and products. Activity 1.5 – Summary of current article connected to biotechnology Bioethics – Using Animals in Science and Industry Assignment *Summative:* Unit 1 Test (multiple choice and short answer)
HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative	What are the raw materials of biotechnology? Students will be able to: - Explain the relationships between levels of biological organization - Describe cell structure - Differentiate between prokaryotes and eukaryotes - Identify classes of macromolecules - Define genetic engineering - Explain the Central Dogma	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 2 Biotechnology: Laboratory Manual Chap 2 *Lab Activities:* "Biotechnology: Science for the New Millenium Lab Manual" Studying the Plasma Membrane Egg/Vinegar Experiment Testing for Molecules Studying Cells with Microscopes Writing a Lab Report Lesson: Diagrams	*Math:* Calculations in experiments *Health:* Food macromolecules	*Formative:* Chapter 2 – "Thinking like a Biotechnician" review questions Eukaryotic and Prokaryotic Jigsaw – bio roots Bioethics – Research on embryonic stem cells and medical therapies *Summative:* Unit 1 Test

criteria and constraints for solutions that account for societal needs and wants.		Stem cell lab The Effect of Alcohol on Cell Membranes		
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.	What are the basic skills of the Biotechnology Workplace? Students will be able to: - Determine appropriate measurement tools for specific situations - Use micropipettes - Convert units - Describe pH and why it is important	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 3 *Lab Activities:* Pipetting By Numbers: STEAM Pipetting Practice Micropipette "Secret Code" Measurement Olympics pH Lab Buffer Lab Writing a Lab Report Lesson: Procedure Ion Exchange Chromotography	*Math:* Unit conversions *Chemistry:* pH, ion exchange, and Buffers	*Formative:* Measurement Practice Worksheet Lab analysis questions Activity 3.5 – Writing a Standard Operating Procedure (SOP) *Summative:* Measurement Quiz
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.	What is the structure and function of DNA? Students will be able to: - Describe the structure and function of DNA and how it encodes for protein	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 4 *Labs:* Strawberry DNA isolation	*Math:* Lab calculations and measurements *ELA:* Writing for Science	*Formative:* Lab Analysis Questions Lab Report Practice Questions

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	- Discuss the characteristics of viruses and their importance in genetic engineering - Explain the process of genetic engineering - Describe and carry out the process of gel electrophoresis	Writing a Lab Report Lesson: Introduction Central Dogma Lab Linking Food Science to Biotechnology: Unlock the Color of Candies Writing a Lab Report Lesson: Conclusion Electrophoresis Lab: Outbreak Antibody / Antigen Interaction: Immunodetective Investigation What is the Source of the Ground Meat		Electrophoresis Practice Questions Exit Ticket for Labs *Summative:* Unit Test 2 Multiple Choice & Matching
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a	What are Proteins? Students will be able to: - Describe the structure and function of proteins, amino acid R-groups, 3D structures - Explain steps of transcription and translation - Differentiate different protein functions - Examine enzyme activity - Analyze proteins in relation to evolutionary connections	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 5 *Labs:* Protein Synthesis Race Nova Lab Protein Synthesis Create a protein using a 3-D printer From Fossils to Phylogenies – Mass Spec Activity From Fossils to Phylogenies – BLAST Activity	*Technology:* Coding 3-D Printing	*Formative:* Protein Synthesis Activity Results "Thinking like a Biotechnician" questions p. 159 3-D Printing Rubric Fossils to Phylogenies – Questions *Summative:* Unit 3 Quiz

complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.				
HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	What are Potential Biotechnology Products? Students will be able to: - Give examples of plant and animal derived products - Describe and conduct ELISA - Design ELISA protocol	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 6 *Labs:* ELISA Model Quantitative ELISA Alzheimer's ELISA Bio Rad: Giant Panda Problem (Immunodetection, Design ELISA protocol, Qualitative, Quantitative Measurements, Genuine Antibody and Hormone detection)	*Math:* Measurements Lab Calculations	*Formative:* Lab Analysis Questions Panda Activity Rubric Scoring Activity 6.2 – PowerPoint created to share ELISA and Western Blot descriptions (rubric) Activity 6.3 – Informational Sheet on herbal remedy Activity 4.6 – Transcription Factors and Protection from Alzheimer's Disease *Summative:* Unit 3 Test Multiple Choice & Short Answer
HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior	What are Spectrophotometers? - Describe how spectrophotometers work	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 7	*Chemistry:* Beers Law	*Formative:* Analysis of diagrams, and graphing assignments

and wave interactions with matter to transmit and capture information and energy. * HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	- Determine the uses for different types	*Labs:* Beers Law Virtual Lab Virtual Spectrophotometry Compare/Contrast Spectrophotometers Writing a Lab Report Lesson: Graphing		p. 218 – "Thinking like a Biotechnician" Questions *Summative:* Unit 4 Test
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	How are recombinant biotechnology products produced? Students will be able to: - Outline steps in genetic engineering procedures and give examples of products - Describe mechanism of action and use of restriction enzymes - Explain bacterial transformation	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 8 *Labs:* Bacterial Transformation – Paper Simulation CRISPR Model How does Genetic Engineering produce human growth hormone?	*Math:* Lab calculations *Art:* Constructing Models	*Formative:* Diagram analyzed with rubric Lab questions *Summative:* Unit 4 Test
HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative	How do you bring biotechnology products to market? Students will be able to: - Outline steps on brining genetically engineered procures to market	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 9 *Labs:* Plant Chromatography	*Math:* Lab calculations Statistical Analysis	*Formative:* Lab analysis questions Lab Reports analyzed with rubric Activity 9.2 Setting the Standard in Biomanufacturing

criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	- Define chromatography and distinguish between the different types - Explain how product quality is maintained for key types of biomedical and pharmaceutical products - Describe clinical testing procedures and marketing and sales considerations	Affinity Chromatography of Glucose Binding Proteins Use of Animals for Medical Testing Clinical Trial Simulation		*Summative:* Unit 5 Test
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	What is bioinformatics and how is it useful? Students will be able to: - Use the tools of BLAST and Cn3D - Understand how bioinformatics can help solve medical issues - Connect bioinformatic skills with career options	*Text:* Northwest Association for Biomedical Research Introductory Bioinformatics https://www.edvotek.com/342 Learn to Code - Introduction to Python for Detecting Disease	*Technology:* Coding Database analysis	*Formative:* Lab Reports analyzed with rubric *Summative:* Unit 5 Test
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	What is the scope and role of biotechnology? Students will be able to: - Describe the function of drugs and how they may be created - Detail multiple uses of antibodies and vaccines	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 12 *Labs:* Digestion Connection	*Math:* Lab calculations and measurements *Chemistry:* Chemical interactions and reactions	*Formative:* Activity 12.1 – Antibiotic Resistance Lab Analysis Questions

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts	- Give examples of recent advances in medical biotech and expected new applications	Developing a Flu Prevention Drug Medical Mystery Case Study Antibiotics Resistance Case Study Agricultural Monitoring Lab: Antibiotic Resistance		"Thinking like a Biotechnician" p. 361 *Summative:* Unit 6 Quiz
HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	What are current DNA Technologies? Students will be able to: - Describe the process of DNA replication in both cells and in the lab - Explain the steps of PCR and the function of a thermocycler - Discuss the benefits and implications of knowing DNA sequences of humans and other organisms	*Text:* "Biotechnology: Science for the New Millenium" E.Daugherty Chapter 13 *Labs:* Golden Bread PCR	*Math:* Lab measurements and calculations	*Formative:* Lab Analysis Questions Lab Report Rubric Thinking Like a Biotechnician p. 390 *Summative:* Unit 7 Quiz
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable	What is currently happening in Biotechnology Research and Applications? Students will be able to: - Describe how bioinformatics and microarray technology are speeding genetic studies and the search for novel pharmaceuticals	*Labs/Activities:* Current Event Research PowerPoint presentation Biotechnology Review – Stations Biotechnology – "Gram" Review Activity	*Math:* Experimental Connections *CFM:* Career Analysis	*Formative:* Station Questions Biotechnology Career Summary *Summative:* Final Exam

problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.	- Give examples of RNA technologies, the field of proteomics, and advances in stem cells. - Summarize the main topics and lab techniques covered in this course			