Milpitas Unified School District
Course Presentation
Title of Course: *Biotechnology 1*

Course Duration: *1 School Year*
Credits:
Grade Level: *10-12*
Department: Science
Submitted by: *Christopher O'Connor*
Date: March 14, 2017

Prerequisites: Algebra 1, Biology [both C or better]
Sequence:
Magnet:
Academy:
UC/A-G Not yet submitted
Course Catalog Information: See Course Description

Course Description

Biotechnology-1 is a two-semester course designed to give students an introduction to the concepts and techniques of the field of biotechnology. Students will develop laboratory technique, and the critical thinking, and communication skills currently used in the biotechnology industry and academic research lab. The student will develop a set of skills that will prove to be valuable to the academic research lab in college or the biotechnology lab in industry.

Total Number of Students Per Year
1 @ 32/1

Goals of the Class
*This class will prepare students to...*enter the Biotechnology field as an intern or research assistant

Course Objectives

This course introduces students to the fundamental scientific principles of biotechnology, bioethics, the variety of careers in biosciences, as well as the commercial and regulatory characteristics of the biosciences. This Biotechnology course emphasizes how key concepts from biology and chemistry apply to modern applications within the biological sciences. The knowledge and skills gained in this course provide students with a broad understanding of biotechnology and the impact it makes on society. As students work to master the content, they mirror what scientists and technicians are doing in scientific laboratories. A significant part of the course involves actual and simulated research being done in actual laboratories world-wide, which gives students the unique opportunity to carry out the world changing experiments about which they are learning. To accomplish this goal, the course is especially laboratory intensive, and students spend approximately 50% of class time carrying out actual experiments. This focus on working knowledge allows students to learn and practice the skills that they would actually use in the field of biotechnology and build up the practical skill set of each student. Ultimately, the content and skills covered offers all students the opportunity to acquire basic competencies required for an entry-level position in any biotechnology company. The target audience includes all students interested in attending any college or technical schools by providing foundational concepts and established laboratory procedures in a broad spectrum of disciplines such as biology, chemistry, biochemistry, molecular biology, microbiology, genetics, and immunology.

Class Objectives are:

- **Prepare students for an entry level position in the Biotechnology field**
- **Energize students as to their capacity to contribute to scientific research**

Major Units of Study

Unit 1: Intro to Biotechnology

Chapter 1: What is Biotechnology?

- Describe the science of biotechnology and identify its product domains.
- Give examples of careers and job responsibilities associated with biotechnology.
- Outline the steps in producing and delivering a product made through recombinant DNA technology.
- Describe how scientific methodologies are used to conduct experiments and develop products.
- Apply the strategy for values clarification to bioethical issues.
- Setting up and maintaining a legal scientific notebook.
- Understanding safety concerns, precautions, equipment, and rules for the typical biotechnology facility.
- Setting up experiments, documenting conditions, analyzing data, and reporting results.

Labs and Activities

- Activity 1.1 - What is Biotechnology? Computer research into biotechnology companies and products.

- Activity 1.2 -The Business Side of Biotechnology. Computer research into companies and revenues.
- Activity - Lab 1a – Setting up a legal and scientific notebook.
- Lab 1b – Safety in the biotech laboratory. – Diagraming and identifying safety hazards in the laboratory.
- Lab 1c – Biotech Cheese Production - Producing cheese with enzyme producing bacteria.
- Bioethics dilemma – Using Animals in Science and Industry – Students will explore the use of animals in science and industry.

Key Assignments:
The key assignments that will help students master the above skills are:

1. "Using Enzymes to Make Cheese" is an introductory lab activity in which students will conduct a scientific experiment/activity in order to learn the basics of the scientific method, communication of data and conclusions, and standard laboratory operating procedures.
2. "Biotechnology Company Stock Project" is a semester-long project in which students track the progress of a biotechnology company's stock. Stocks are tracked weekly, trends are identified and analyzed, and results and reasoning is communicated through PowerPoint presentations.
3. "Bioethical Decision Making Model" is a reading and writing exercise in which students learn the basics of bioethical decision making through a step-by-step model. A current bioethical issue, taken from "Taking Sides" is used in the activity: Should Animal Experimentation Be Permitted?

Scope of Key Assignment #3:
Students will evaluate bioethical decision making by decoding a scientific text and processing pro and con arguments. Students will collaborate on articulating the pro/con arguments and a class discussion will be held to encourage critical thinking. Students will then submit a written report that highlights one side of the debate with evidence from the text. Students will justify their argument with scientific reasoning developed through the in-class debate.

Unit 2: Biotech in Biology
Chapter 2: The Raw Materials of Biotechnology

- Identify the levels of biological organization and explain their relationships.
- Describe cell structure and its significance in biotechnology research and product development.
- Discuss the types of organisms researched and the types of cells grown and studied in biotechnology facilities.
- Distinguish between prokaryotic and eukaryotic cells.
- Describe the structure and function of the four main classes of macromolecules.
- Define genetic engineering and identify products created with this technology.

- Describe the central dogma of biology.
- Be able to use indicator solutions and standards to test for the presence of biologically important molecules, such as: carbohydrates, proteins, and nucleic acids.
- Be able to grow and monitor cell cultures.
- Be able to use a microscope to measure and study cell structures and processes.
- Be able to explain how the structure of molecules affects the cell functions.
- Be able to explain how a change in the environment can alter molecular structure and cell function.

Labs and Activities

- Lab 2a – Dissecting a "Cell" and Examining Its Components – Students will use indicator tests on parts of an egg to test for proteins, carbohydrates, and/or fats.
- Lab 2b – Model Organism Growth – Students will grow and maintain different bacteria cultures.
- Activity 2.1 – Biohazards – Students will use the internet to find out about biohazards and ways to deal with them.
- Lab 2c and 2d – Using a Compound Microscope to Study Cells and Make Microscopic Measurements.
- Activity 2.2 – What is the American Type Culture Collection(ATCC)? - Students will use the internet to learn about samples and services available from ATCC.
- Bioethics dilemma – Stop You Cannot Use Those Cells – Students will evaluate the benefits and risks of using embryonic stem cells.

Key Assignments and Mastery:

The key assignments that will help students master the above skills are:

1. "Measuring Volumes and Making Solutions" is a series of laboratory skill activities in which students use "Kool-Aid" or cupric sulfate to measure volumes, make solutions and dilute solutions. Mastery of the techniques of these activities is essential in understanding the basics of standard lab operating procedures and for the laboratory work in the inquiry lab "Detecting the Presence of Amylase." In addition, students will utilize these skills throughout the rest of the course as they prepare solutions for a variety of laboratory work and activities.
2. Inquiry Lab: "Detecting the Presence of Amylase" is an inquiry-based laboratory in which students are asked to design and conduct an experiment to identify an unknown solution for the presence of amylase. This lab reinforces the understanding of macromolecules, the use of indicators, and the proper use of scientific instrumentation and calculations of solutions presented in this unit. It furthermore has students learn science by doing science through an inquiry approach.
3. "Reading and Critiquing Scientific Journal Articles Part 1: Methods and Results" is an activity in which students read and critique different scientific journal articles, focusing on the materials and methods of the experiment done. Students conduct the steps of summarizing and critiquing journal articles and experience what "good science" versus "bad science" is by comparison of articles with their peers in small groups. Students will master the technique of reading and critiquing scientific work by the end of the course.

This activity begins this process of critical analysis by focusing on materials and methods, and presentation of data.

Scope of Key Assignment #2:
Students apply fundamental knowledge of solutions to plan and carry out an investigation (detecting amylase). Using their learning of macromolecules and laboratory techniques, students will analyze and interpret data to effectively communicate an evidence-based conclusion in a submitted laboratory report.

Unit 3: Biotech Chemistry
Chapter 3: The Raw Materials of Biotechnology

- Determine the most appropriate tools for measuring specific volumes or masses.
    - Describe how to select, set, and use a variety of micropipets within their designated ranges to accurately measure small volumes.
    - Convert between units of measurement using appropriate conversion factors.
    - Recognize the different expressions for units of concentration measurements and their corresponding equations to calculate the amount of solute needed to make a specified solution or make a dilution.
    - Describe what pH is and why it is important in solution preparation.
    - Be able to measure liquid volume using graduated cylinders, pipets, and micropipets.
    - Be able to measure solids using tabletop and analytical balances.
    - Be able to perform calculations that determine the amount of solids or liquids needed in a solution.
    - Be able to prepare solutions of varying concentrations of solute and solvent.
    - Be able to measure and adjust the pH of a solution.
    - Be able to prepare dilutions of concentrated solutions.

Labs and Activities

- Activity 3.3 – Hazardous Chemicals: Knowing When You Have One – Students will gather safety information about some chemicals used regularly in the biotechnology laboratory through material safety data sheets.
- Lab 3a and 3b – Measuring Small Volumes in a Biotechnology Lab – Students will use serological pipets and micropipets to measure minute volumes.
- Lab 3c – Measuring Mass Lab – Students will use tabletop and analytical balances to perform mass measurements.
- Activity 3.4 – Finding Molecular Weights of the Solutes Used in Common Solutions – Students will use find the molecular formula and mass of some common solutes using the periodic table.
- Lab 3e, 3g, and 3h – Solution and Dilution Preparation Lab – Students will make solutions with different mass/volume concentrations and different molarities.
- Bioethics dilemma – Is Honesty Always the Best Policy? – Students will decide steps to be taken when they are presented with scientific dishonesty.

Key Assignments and Mastery: (These are continued from Unit 2)
The key assignments that will help students master the above skills are:

1. “Measuring Volumes and Making Solutions” is a series of laboratory skill activities in which students use “Kool-Aid” or cupric sulfate to measure volumes, make solutions and dilute solutions. Mastery of the techniques of these activities is essential in understanding the basics of standard lab operating procedures and for the laboratory work in the inquiry lab “Detecting the Presence of Amylase.” In addition, students will utilize these skills throughout the rest of the course as they prepare solutions for a variety of laboratory work and activities.
2. Inquiry Lab: “Detecting the Presence of Amylase” is an inquiry-based laboratory in which students are asked to design and conduct an experiment to identify an unknown solution for the presence of amylase. This lab reinforces the understanding of macromolecules, the use of indicators, and the proper use of scientific instrumentation and calculations of solutions presented in this unit. It furthermore has students learn science by doing science through and inquiry approach.
3. “Reading and Critiquing Scientific Journal Articles Part 1: Methods and Results” is an activity in which students read and critique different scientific journal articles, focusing on the materials and methods of the experiment done. Students conduct the steps of summarizing and critiquing journal articles and experience what “good science” versus “bad science” is by comparison of articles with their peers in small groups. Students will master the technique of reading and critiquing scientific work by the end of the course. This activity begins this process of critical analysis by focusing on materials and methods, and presentation of data.

Scope of Key Assignment #3:
Students collaborate with partners to diagnose “good” and “bad” scientific arguments. Understanding is demonstrated through a graphic organizer separates the two types and provides room for an explanation as to why a particular thought was put into the “good” or “bad” category. Based on collected evidence, students submit a paragraph that summarizes characteristics of “good” and “bad” scientific arguments. A successful student submission highlights the importance of evidence and clear explanation of how evidence works with argument.

Unit 4: DNA Studies
Chapter 4: Introduction to Studying DNA

- Describe the structure and function of DNA and explain the process by which it encodes for protein.
- Differentiate between eukaryotic and prokaryotic chromosomal structure and explain how this difference impacts gene regulation in the two cell types.
- Differentiate between bacterial cultures grown in liquid and solid media and explain how to prepare each media type using sterile technique.
- Discuss the characteristics of viruses and their importance in genetic engineering.

- Describe the process of gel electrophoresis and discuss how characteristics of molecules affect their migration through a gel.
- Be able to identify and use sterile lab techniques.
- Be able to prepare cell culture media.
- Be able to use complete cell lysis.
- Be able to separate or precipitate DNA onto spooling rods.
- Be able to complete DNA analysis by horizontal gel electrophoresis.

Labs and Activities

- Biotech Online – Know Your Genome – Students will use the internet to learn about and describe the impacts of the Human Genome Project.
- Lab 4b – Pulling DNA out of Solution - Students will spool DNA out of a solution and record observations about the DNA.
- Lab 4e – Making Media for Bacteria Cell Culture – Students will prepare agar media for growing bacteria cultures.
- Activity 4.2 – coli : Model Organism for Geneticists and Biotechnologists – Students will use the internet to find out why E. coli is useful to scientists and how it is used in current scientific experiments.
- Lab 4f and 4g – Sterile Technique and Bacterial Cell Culture Lab – Students will learn and apply sterile techniques for pouring Petri plates and streak a plate culture with a bacterial colony.
- Lab 4h – DNA Extraction from Bacteria - Students will extract DNA from bacterial cells and compare them to pervious extracted DNA samples.
- Lab 4j – Using Gel Electrophoresis to Study DNA Molecules – Students will prepare the gel boxes for loading, run DNA samples, and analyze the DNA fragments.

Key Assignments and Mastery:

The key assignments that will help students master the above skills are:

1. “Microscopic Measurements” is an activity that reinforces the tools (digital microscopes) and the skills necessary for observing microorganisms. Students will use both prepared slides and wet mount organisms to estimate sizes of cells and structures. The activity reinforces student’s understanding of microorganisms and the underlying structures that make them ideal to use in a biotechnology lab.
2. “Growing and Maintaining Model Organisms” is a laboratory activity in which students prepare media and grow model organisms in the lab. Of the model organisms grown, E. coli and C. elegans are maintained throughout the course, making them readily available for use in other activities. Students will master the skill of proper lab techniques, recording of procedures, and their understanding of how microorganisms and other model organisms grow, reproduce, and meet their energy requirements.
3. Stem Cells and Bioethics” Students use planaria as a model organism to begin their study of stem cells. They identify stages in the development of human embryos and compare the types and potency of stem cells, and they learn about a variety of techniques used for obtaining stem cells and the scientific and ethical implications of those techniques. Students will be provided an opportunity to become familiar with

policies and regulations for stem cell research that are currently in place in the United States, the issues regarding private and public funding, and the implications for treatment of disease and advancement of scientific knowledge. The lesson culminates with students developing a position on embryonic stem cell research through the use of a Decision-Making Framework. In a group assessment, students develop a proposal for NIH funding to research treatment for a chosen disease using either embryonic or 'adult' stem cells and communicate this through expository writing.

Scope of Key Assignment #2:
In “Growing and Maintaining Model Organisms” students work directly with common model organisms used in biotechnology labs. Through laboratory work, students gain an appreciation and understanding of why these particular organisms are useful in a laboratory setting. Students will directly maintain organisms to help accomplish this learning goal.

Unit 5: Protein Studies and Structure
Chapter 5: Introduction to Studying Proteins

- Describe the structure of proteins, including the significance of amino acid R-groups and their impact on the three-dimensional structure of proteins.
- Explain the steps of translation and transcription in protein synthesis.
- Discuss the role of naturally occurring proteins and recombinant proteins in biotechnology.
- Differentiate proteins that function as part of structure, as antibodies, and as enzymes.
- Describe the structure of antibodies and explain the relationship between antibodies and antigens.
- Discriminate among the classes of enzymes and discuss the effects of reaction conditions on enzyme activity.
- Summarize gel electrophoresis and identify its usefulness for studying proteins.
- Setting up experiments, documenting conditions, analyzing data, and reporting results.
- Be able to test for an antibody-antigen reaction.
- Be able to test for an enzyme’s activity.
- Be able to prepare samples for and conduct a vertical polyacrylamide gel electrophoresis (PAGE) for the purpose of determining protein size.

Labs and Activities

- Activity 5.1 – Gathering Information on the Structure and Function of Proteins - Computer research using scientific journals to find existing information on the size, structure, and function of a protein. Information about their protein will be presented.
- Lab 5a – The Specificity of Antibodies: A Simulation – Students will use an Ouchterlony test to determine if antibodies to allergens are present in a sample.
- Lab 5b – The Action of Different Enzymes on Apple Juice Production – Students will use different enzymes to determine which one will increase the apple juice yield.
- Biotech Online – Enzymes: Catalysts for Better Health – Students will use the internet to determine which enzymes cause different diseases and disorders, along with current treatments and therapies.

- Activity 5.2 – Determining the Amino Acid Sequence of Insulin –Students will determine the amino acid sequence of insulin and propose a three-dimensional structure of the insulin molecule.
- Lab 5f – Characterizing Proteins Using Polyacrylamide Gel Electrophoresis (PAGE) – Students will determine the structure characteristics of proteins by running samples on a PAGE gel.
- Bioethics Dilemma – Who Owns the Patent on the Genetic Code for Your Proteins? – Students will provide arguments for different scenarios of when genetic fingerprints should be or should not be available.

Scope of Key Assignment "Activity 5.2"
Students will plan and carry out their own investigation into the protein insulin. They will then execute this plan to collect evidence on the amino acid sequence of insulin. Ultimately, student will analyze and interpret their data to submit a proposal for the 3-d structure of insulin. Each group will be critiqued on how successful they were at collecting and analyzing their data to come up with a solution.

Unit 6: Protein Products
Chapter 6: Identifying a Potential Biotechnology Product

- Give examples of biotechnology products derived from plant and animal sources and discuss the challenges of identifying potential product sources.
- Discuss the types of assays done as potential products move through process development and identify the additional assays required for pharmaceutical development.
- Describe how an Enzyme-Linked Immunosorbent Assay (ELISA) or Western blot is conducted and what the results of each assay can reveal.
- Explain how scientists test the effectiveness of antibiotics and antimicrobials and discuss the significance of antibiotic resistance.
- Describe the role of Chinese hamster ovary cells (CHO) in protein product development.
- Describe the typical recombinant DNA protein product pipeline, additional steps required by the FDA for pharmaceutical proteins, and possible formulations of the final product.
- Be able to test for the presence of amylase's substrate, starch.
- Be able to test for the presence of the product of amylase activity, the sugar, maltose.
- Be able to assess an enzyme's activity by comparing substrate use and product production.
- Be able to measure the presence and concentration of amylase in a solution using an ELISA technique.
- Be able to verify a protein band on a PAGE gel by a technique called Western blot.

Labs and Activities

- Activity 6.1 – Exploring Potential Products – Students will research potential products to be placed in a company's pipeline and make a presentation that provides evidence for acceptance or rejection.

- Lab 6c – Assaying for Amylase Activity – Students will compare the behavior of human salivary amaylase compared with bacterial amylase solution.
- Biotech Online – ELISA Technology in Diagnostic Kits – Students will explore how ELISA diagnostics are used in home pregnancy testing and be able to explain what is happening with the antibodies and antigens in these tests.
- Lab 6d – Direct ELISA of Bacterial Alpha-Amylase – Determine the concentration of a-amylase in unknown samples by a direct ELISA.
- Lab 6e – Western Blot to Identify Alpha-Amylase – Determine the concentration of a-amylase in unknown samples on a Western blot.
- Bioethics Dilemma – Limited Medication: Who Gets It? – Students will research and determine how a limited amount of therapeutic medication should be distributed to different regions of the world. A timeline with the distribution schedule and a position paper that justifies your decision for distribution will also be created.

Key Assignments and Mastery:
The key assignments that will help students master the above skills are:

1. "Purification of GFP or FRP from Bacteria" is a laboratory in which the proteins from the bacteria grown in unit 4 are harvested and quantified. Many recombinant proteins in biotechnology are used in the medical field, research, and industry. GFP or FRP will be separated (purified) using chromatography. The hydrophobic interactions of the chromatography column (chemistry), further analyzed through SDS-PAGE and the industry and research applications of recombinant proteins are mastered.

Scope of Key Assignment #1:
To successfully complete this assignments, students will define the problem of how to purify a protein. Based on the physical properties of the protein, students will choose chromatography techniques that will work to separate their protein from a mixture of cell components. Students will then analyze their product using SDS-PAGE to determine the success of their problem definition and scientific investigation. Students will hold a physical vial of protein that glows in the dark if they capture the learning goals of this assignment.

Unit 7: Protein Spectrophotometry
Chapter 7: Spectrophotometers and Concentration Assays

- Describe how a spectrophotometer operates, compare and contrast ultraviolet and visible (white light) spectrophotometers, and give examples of their uses.
- Determine which type of spectrophotometer is needed for a particular application and the wavelength to be used.
- Explain the relationship between absorbance and transmittance in spectrophotometry and interpret the meaning of absorbance measurements.
- Justify the need for buffers, describe how buffers are prepared, and calculate the amount of buffering agent needed when making a particular buffer.
- Explain how protein indicator solutions are used with and without a spectrophotometer.

- Describe how VIS and UV/VIS spectrophotometers are used to measure protein or DNA concentrations.
- Be able to use a UV spectrophotometer to determine the presence and concentration of a colorless protein in solution.

Labs and Activities

- Activity 7.1 – Visual Spectrophotometry Virtually - Students will use a spectrophotometer simulator to measure photons and record the transmittance and absorbance data.
- Lab 7g – Determining the Concentration of Amylase in Solution – Students will determine the concentrations of two unknown amylase solutions using a spectrophotometer.
- Bioethics Dilemma – Test Results: Who Should Get Access to Them? – Students will decide who should have access to an individual's medical records and under what circumstances for three different scenarios.

Key Assignments and Mastery:

The key assignments that will help students master the above skills are:

1. "Who Should Get Access to Them?" is an activity where students will create and defend an argument regarding medical records. Students will be encouraged to collaborate to develop the best form of their argument. Arguments will be delivered orally and given critical feedback.

Scope of Key Assignment #1:

Students will demonstrate proficiency on "Who should get access to them?" by delivering an oral presentation to this class. This oral presentation will allow students to deliver their construction explanations along with supporting evidence. Successful communication will answer the "why" and "how do you know" questions of audience members. When not presenting, students will complete a graphic organizer that has students summarize arguments and record key pieces of evidence used. Students will then make a decision on whether presented arguments were convincing.

Unit 8: Products of Genetic Engineering

Chapter 8: The Production of Recombinant Biotechnology Product

- Outline the fundamental steps in a genetic engineering procedure and give examples of genetically engineered products.
- Describe the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production.
- Discuss techniques used to probe DNA for specific genes of interest.
- Explain the steps of bacterial transformation and various selection processes for identifying transformants.
- Differentiate transformation, transfection, and transduction.
- Discuss the considerations for scaling up the production of transformed or transfected cells, the general cell culture protocol for scale-up, and the importance of complying with standard manufacturing procedures.

- Explain the usefulness of plasmid preparations, how they are performed, and how the concentration and purity of plasmid samples can be determined.
- Be able to transform bacteria cells into amylase producers.

Labs and Activities

- Biotech Online – Some Say Genetic Engineering Is a Fishy Business – Using the internet, students will research how genetic engineering has modified several aquatic species. They will discuss the methods used for gene transfer and the pros and cons of genetic engineering in a fish species.
- Lab 8b – Restriction Digestion to Verify pAmylase Plasmid - Students will determine if DNA fragments indicate if a sample has characteristics of pAmylase.
- Biotech Online – BACs versus YACs – Students will research and explain how Bacterial Artificial Chromosomes (BACs) and Yeast Artificial Chromosomes (YACs) are critical for transformation, sequencing, and genome projects.

Key Assignments and Mastery:

The key assignments that will help students master the above skills are:

1. “Seafood Substitution” is an inquiry lab in which students use SDS-PAGE to identify substitutions of seafood in the market. Students collect fish samples, extract proteins from these samples, and run them on SDS-PAGE to analyze the protein content. They formulate hypotheses based on research of the industry and typical fish substitutions, analyze data from the lab,

Scope of Key Assignment #1:

Students will apply the SDS-PAGE lab techniques to learn about seafood substitution in the fish/market industry. Based on lab data collected, students can make inferences about the types of common fish substitutions and then further engage in an evaluation of why certain substitutions are common. These evaluations will be peer-reviewed and submitted as a lab report.

Unit 9: Protein Manufacturing

Chapter 9: Bringing a Biotechnology Product to Market

- Outline major steps in a bringing a genetically engineered product from a selection plate through biomanufacturing to marketing.
- Compare and contrast the methods for harvesting intracellular and extracellular proteins.
- Define chromatography and distinguish between paper, layer-thin, and column chromatography.
- Discuss the variables used to optimize column chromatography.
- Describe the clinical testing process of pharmaceuticals.
- Be able to use ion-exchange chromatography to separate out proteins.

Labs and Activities

- Biotech Online – Products “in the Pipeline” - Using the internet, students will research drug products in stages I, II and III of clinical trials and identify potential applications.

- Lab 9c – Using Ion-Exchange to Separate Proteins – Students will use ion-exchange chromatography to separate two different proteins.

Key Assignments and Mastery:
The key assignments that will help students master the above skills are:

1. Lab 9a-c are laboratory experiments in which the proteins from the bacteria grown in previous units harvested and quantified. Many recombinant proteins in biotechnology are used in the medical field, research, and industry. Amylase will be separated (purified) using chromatography. The hydrophobic interactions of the chromatography column (chemistry), further analyzed through SDS-PAGE and the industry and research applications of recombinant proteins are mastered.
2. "Products in the Pipeline" analysis brings real-life company research into focus. The process of gathering company research (proteins) into focus connects student labs with current application of lab techniques in real life. Students gain an appreciation for the skills they are receiving and knowledge of their ability to participate in science at an advanced level.

Scope of Key Assignment #1:
Students will define the problem of how to purify a protein. Based on the physical properties of the protein, students will choose chromatography techniques that will work to separate their protein from a mixture of cell components. Students will then analyze their product using SDS-PAGE to determine the success of their problem definition and scientific investigation. The completion of this assignment allows students to model the process of scientific inquiry and solve a research problem.

Standards Met
CTE - http://www.cde.ca.gov/ci/ct/sf/documents/healthmedical.pdf
-Biotechnology standards pages 15-18

NGSS - http://www.cde.ca.gov/pd/ca/sc/ngssstandards.asp
HS LS3-1
LS1.A
LS3.A
HSLS3-3
LS3.B
HSLS4-2
LS4.B
LS4.C
HSLS4-4
LS4.C
HSPS1-3
PS1.A

HSPS1-5
PS1.B

Reading Materials*

What textbook is associated with this?
Biotechnology: Science for the New Millennium, Ellyn Daugherty, 2012, Paradigm Publishing, Inc.
Biotechnology: Laboratory Manual, Ellyn Daugherty, 2012, Paradigm Publishing, Inc.

Will this textbook require a new purchase?
Yes
If yes, What is the projected cost of new text?
$15,000.00
Where would funds come from to purchase the text?
CTE Perkins grant

**CPC Approval is for the course ONLY. Any textbooks associated with the course must go through the proper CPC textbook pilot process.*