

Unit 4: Proteins as Products (Life Science) Copied from: Biotechnology (Life Science), Copied on: 12/15/21

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Title Section

Department of Curriculum and Instruction



Belleville Public Schools

Curriculum Guide

BIOTECHNOLOGY, GRADE 10 ACADEMY

PROTEINS AS PRODUCTS

Belleville Board of Education

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Unit Overview

We will begin with a quick look at the many applications of proteins in a variety of industries. Then we will look at the nature of protein structures, paying special attention to the process of protein folding. With that as a foundation, we will delve into some details of protein processing, beginning with methods of purifying individual proteins. We then will learn how expressed proteins are purified and examine the processes used to analyze and verify the final product. Lastly, we will look at the various common techniques used to purify individual proteins.

Enduring Understanding

Proteins are large molecules required for the structure, function, and regulation of living cells. Each protein molecule has a unique function in the biochemical reactions that sustain life. The applications of proteins are

as numerous as the proteins themselves. The use of proteins in manufacturing processes is a time-tested technology. Biotechnology proteins have revolutionized the health care and pharmaceutical industries in the past several decades

Essential Questions

What are some important protein- based pharmaceutical products?

What is the structural arrangement of a protein?

How are proteins produced?

How are proteins expressed?

How can we purify proteins?

What are some crucial post-purification analysis methods?

What is proteomics?

Exit Skills

UPON COMPLETION OF THIS UNIT, STUDENTS SHOULD BE ABLE TO:

- Explain some advantages for producing proteins biotechnologically
- Explain why some common household products may include manufactured proteins as ingredients
- Provide three examples of proteins produced for medical applications

- Discuss the advantages and disadvantages of bacterial, fungal, plant, and animal sources of expressed proteins
- Explain why *E. coli* frequently is used for protein production, and describe *E. coli*'s limitations
- Explain why the need for protein post-translational modification may determine the choice of a protein expression system
- Describe the general scheme for protein purification of a protein such as hemoglobin, based on its known chemical characteristics
- Explain how a target protein can be separated from other cell proteins in a specific purification sequence
- Discuss the benefits of being able to predict a protein's structure from the DNA sequence (i.e proteomics)
- Describe the value that understanding protein biology/chemistry has for achieving the delivery of small molecules across membranes, such as occurs in drug delivery

New Jersey Student Learning Standards (NJSL-S)

NextGen Science Standards

SCI.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.
SCI.HS.LS1.A	Structure and Function
SCI.HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
SCI.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.
12.9.3.ST.2	Use technology to acquire, manipulate, analyze and report data.
12.9.3.ST.3	Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
12.9.3.ST.6	Demonstrate technical skills needed in a chosen STEM field.

Interdisciplinary Connections

LA.WHST.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
LA.WHST.9-10.2.E	Establish and maintain a style and tone appropriate to the audience and purpose (e.g., formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
LA.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.
LA.WHST.9-10.10	Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

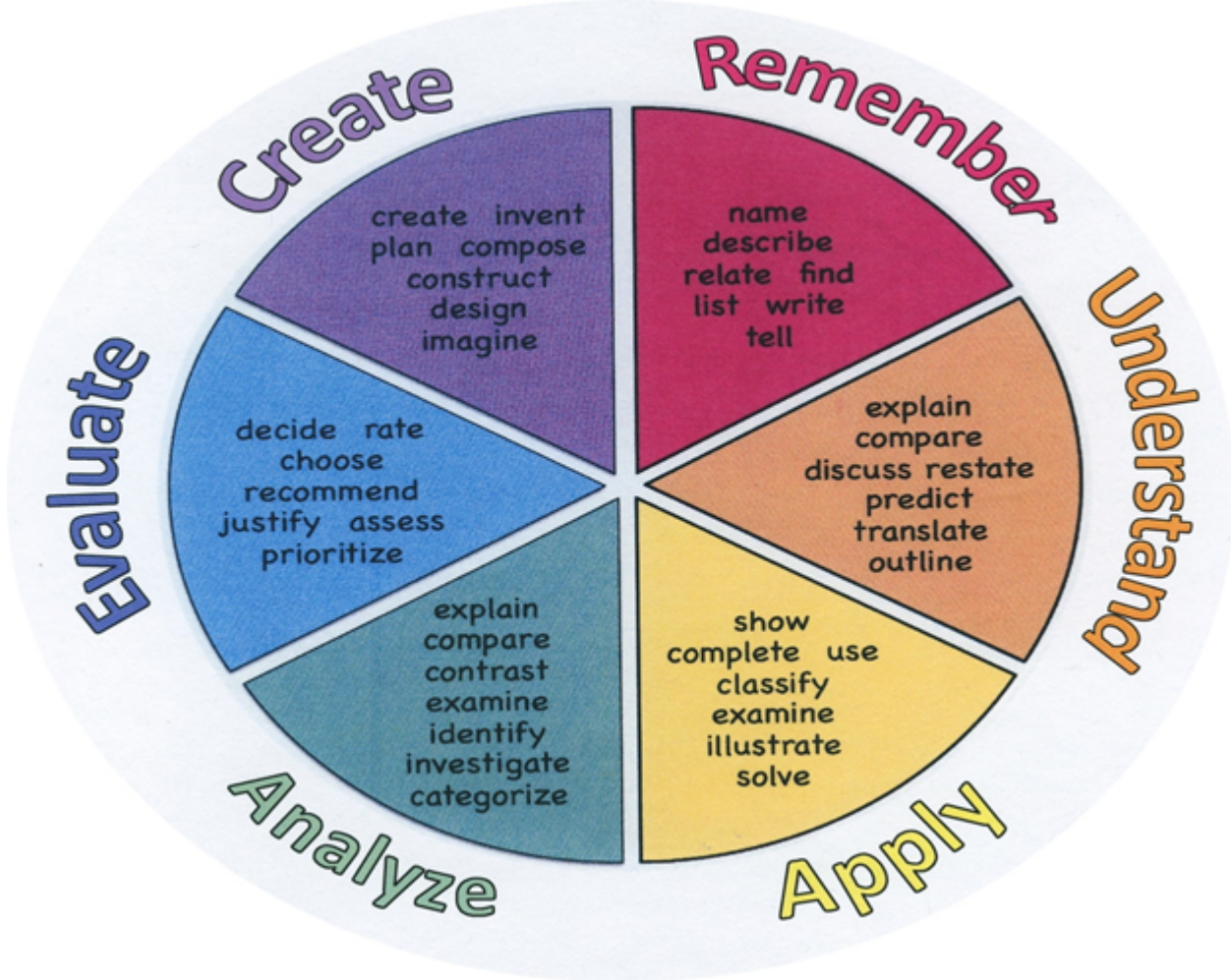
Learning Objectives

- Explain some advantages for producing proteins biotechnologically
- Explain why some common household products may include manufactured proteins as ingredients
- Provide three examples of proteins produced for medical applications
- Compare and contrast the advantages and disadvantages of bacterial, fungal, plant, and animal sources of expressed proteins
- Explain why *E. coli* frequently is used for protein production, and describe *E. coli*'s limitations
- Explain why the need for protein post-translational modification may determine the choice of a protein expression system
- Describe the general scheme for protein purification of a protein such as hemoglobin, based on its known chemical characteristics
- Explain how a target protein can be separated from other cell proteins in a specific purification sequence
- Analyze the benefits of being able to predict a protein's structure from the DNA sequence (i.e proteomics)
- Describe the value that understanding protein biology/chemistry has for achieving the delivery of small molecules across membranes, such as occurs in drug delivery

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose	Classify	Choose	Categorize	Appraise	Combine
Describe	Defend	Dramatize	Classify	Judge	Compose
Define	Demonstrate	Explain	Compare	Criticize	Construct
Label	Distinguish	Generalize	Differentiate	Defend	Design
List	Explain	Judge	Distinguish	Compare	Develop
Locate	Express	Organize	Identify	Assess	Formulate
Match	Extend	Paint	Infer	Conclude	Hypothesize
Memorize	Give Examples	Prepare	Point out	Contrast	Invent
Name	Illustrate	Produce	Select	Critique	Make
Omit	Indicate	Select	Subdivide	Determine	Originate
Recite	Interrelate	Show	Survey	Grade	Organize
Select	Interpret	Sketch	Arrange	Justify	Plan
State	Infer	Solve	Breakdown	Measure	Produce
Count	Match	Use	Combine	Rank	Role Play
Draw	Paraphrase	Add	Detect	Rate	Drive
Outline	Represent	Calculate	Diagram	Support	Devise

Point Quote Recall Recognize Repeat Reproduce	Restate Rewrite Select Show Summarize Tell Translate Associate Compute Convert Discuss Estimate Extrapolate Generalize Predict	Change Classify Complete Compute Discover Divide Examine Graph Interpolate Manipulate Modify Operate Subtract	Discriminate Illustrate Outline Point out Separate	Test	Generate Integrate Prescribe Propose Reconstruct Revise Rewrite Transform
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Suggested Activities & Best Practices

Read Chapter 4, pages 105-127

Chromatography lab

Electrophoresis lab

Vocabulary Quiz

Chapter test

Assessment Evidence - Checking for Understanding (CFU)

Read lab Reports (Alternate)

Read journal entries (Alternate)

Check vocabulary words (Formative)

Check answers to questions on pages 126 & 127 (Formative)

Quiz (Summative)

Chapter Test (Summative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer

- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

PRIMARY RESOURCES: Introduction to Biotechnology, 4th ed. 2019(text book)

Ancillary Resources

Introduction to Biology Companion Website: www.pearsonhighered.com/biotechnology

Activities from DNAi.org

Gel Electrophoresis Lab

Lab Kits provided

Internet

myDNA @ DNAi.org

Technology Infusion

Gel electrophoresis lab

Chromebooks and internet for research

Pearson companion website

Science Direct search engine

MYDNAi.org

Alignment to 21st Century Skills & Technology

WRK.9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
WRK.9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
WRK.9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
WRK.9.2.12.CAP.5	Assess and modify a personal plan to support current interests and post-secondary plans.
WRK.9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.2.12.A.CS3	The relationships among technologies and the connections between technology and other fields of study.
TECH.8.2.12.B.3	Analyze ethical and unethical practices around intellectual property rights as influenced by human wants and/or needs. Career planning requires purposeful planning based on research, self-knowledge, and informed choices.

21st Century Skills/Interdisciplinary Themes

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list only the **21st Century/Interdisciplinary Themes** that will be incorporated into this unit.

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Please list only the **21st Century Skills** that will be incorporated into this unit.

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

Differentiation

Small Group Instruction- Students will work in groups of 4 to answer questions and internet searches on page 126 & 127

Visual Presentation- power point given with notes for this section

Work with higher functioning students on labs

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations

- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

Provide modifications as dictated in the student's IEP/504 Plan for notes on "proteins as products"

Students working with Assigned Partner for group questions on pages 126 & 127 and DNAI.org activities

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

Google Translate allowed in room and using MY DNA website

Sit student with bilingual partner of same language to discuss postpurification analysis methods

Use google translate to complete lab journal entry on protein microarrays

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarify
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

Tutoring by Peers: ask for help with questions on pages 126 & 127

Using videos, illustrations, pictures, and drawings to explain or clarify

Pair with higher functioning student in gel electrophoresis lab

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of work presented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving

- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

Complete Case Study on pages 128-129 Tau-Tau Protein interaction in Alzheimer's Disease Study

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

See sample in Unit 1.