Unit 5: Microbial, Plant, and Animal Biotechnology (Life Science)

Content Area: **Science**
Course(s): **Sample Course**
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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

BIOTECHNOLOGY, GRADE 10 ACADEMY

MICROBIAL, PLANT, AND ANIMAL BIOTECHNOLOGY

Belleville Board of Education

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Unit Overview

This Unit is a combination of 3 chapters: 5,6,& 7

Chapter 5: Microorganisms, or microbes, are tiny organisms too small to be seen individually by the naked eye; they must be viewed with the help of a microscope.The most abundant microorganisms are bacteria, which have existed on Earth for over 3.5 billion years, and they greatly outnumber humans. The rich abundance of bacteria and other microbes provides a wealth of potential biotechnology applications. Well before the development of gene-cloning techniques, humans used microbes in biotechnology. In this unit, we will discuss the important roles bacteria have played in both old and new practices of biotechnology.

Chapter 6: Today's plants are better than their forebears- more productive, more resistant to disease, and able to grow under a wide range of conditions. This is due to conventional selective breeding, but most importantly it is accelerated and abetted by biotechnology. When used properly, biotechnology can produce plants that are more nutritious and that can be grown with less use of pesticides and fertilizer and a lower demand for water and fossil fuels. In this chapter, we survey some of the key biotechnologies used in agriculture and see how they are applied. Then we will look at concerns these technologies have raised and at the regulatory structures that are in place to prevent unwanted consequences.

Chapter 7: According to a 2018 report in *Animal Biotechnology-Technologies, Markets and Companies,* biotechnology has potential applications in the management of several animal diseases such as foot-and-mouth disease, classical swine fever, avian flu, and bovine spongiform encephalopathy. The most relevant biotech products are vaccines, particularly genetically engineered DNA vaccines. In this chapter, we look at the use of animals in research and then visit some issues at the cutting edge of biotechnology;

cloning, transgenics, and use of animals as bioreactors.

Enduring Understanding

In this unit, students will learn about 3 specific kinds of biotechnology: microbial, plant, and animal. They will analyze how these are used to improve our world on a daily basis and how to use techniques to complete these methods. In a series of labs, students will observe firsthand how scientists use this biotechnology. The skills they learn here will afford them greater understanding when they get to college and graduate school to become scientists.

Essential Questions

Why use animals in research?

What was the greatest breakthrough in cloning and what are the benefits to this technology?

How can biotechnology be used to enhance the selective breeding of plants?

What techniques can directly manipulate the plant genome?

What are several important tools, with practical applications of biotechnology, that help growers?

What are important health and environmental concerns regarding transgenic plants ?

How are microbes used in a variety of everyday applications?

How are vaccines made?

Why sequence microbial genomes?

What was the importance of the human genome project?

How can microbial technology help combat bioterrorism?

Exit Skills

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

- Describe features of bacteria that make them useful for biotechnology
- Appreciate the importance of microbial biotechnology in creating products that we use on a daily basis
- Explain how alcohol and lactic acid fermentation is used to produce common foods and beverages
- Provide examples of valuable proteins that are produced in bacteria using recombinant DNA technology
- Understand the roles that biotechnology can play in combating bioterrorism
- Discuss why studying microbial genomes is valuable
- Describe the impact of biotechnology on agricultural crop production
- Outline how plant biotechnology could reduce hunger and malnutrition around the world
- Explain some advantages of using genetic engineering to improve plants
- List and describe several methods used in genetic engineering of plants
- List some medical advances made by using animal research models
- Discuss some of the regulations protecting animals in animal research
- Outline the process used to clone an animal after gene transfer
- List some of the benefits of using transgenic animals as bioreactors
- Explain why CRISPR-Cas has become the predominate gene editing method used in animal research

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

9-12.HS-LS1-1.6.1	students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
9-12.HS-LS1-1.LS1.A.1	Systems of specialized cells within organisms help them perform the essential functions of life.
9-12.HS-LS3-1.LS1.A.1	All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.
9-12.HS-LS1-1.LS1.A.2	All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.

Interdisciplinary Connections

LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
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.

Learning Objectives

- Describe features of bacteria that make them useful for biotechnology
- Appreciate the importance of microbial biotechnology in creating products that we use on a daily basis
- Explain how alcohol and lactic acid fermentation is used to produce common foods and beverages
- Provide examples of valuable proteins that are produced in bacteria using recombinant DNA technology
- Understand the roles that biotechnology can play in combating bioterrorism
- Discuss why studying microbial genomes is valuable
- Describe the impact of biotechnology on agricultural crop production
- Outline how plant biotechnology could reduce hunger and malnutrition around the world

- Explain some advantages of using genetic engineering to improve plants
- List and describe several methods used in genetic engineering of plants
- List some medical advances made by using animal research models
- Discuss some of the regulations protecting animals in animal research
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- List some of the benefits of using transgenic animals as bioreactors
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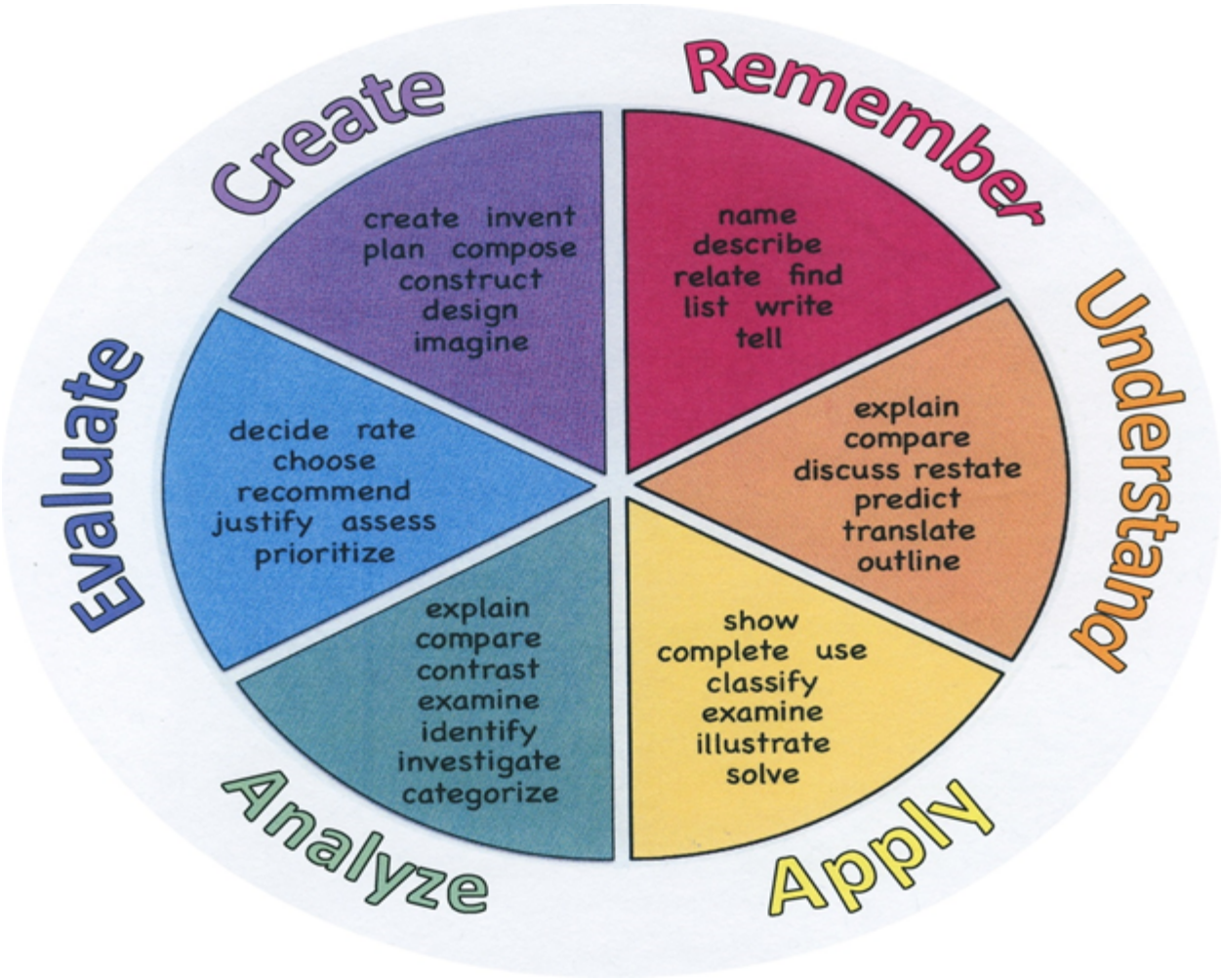
Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

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



Suggested Activities & Best Practices

Read Chapter 5, pages 130-166

Read Chapter 6, pages 167-182

Read Chapter 7, Pages 183-199

Case Studies

Complete Questions on pages 164-165 ,181 ,198

Vocabulary Quiz

Chapter tests- 5,6,& 7

Assessment Evidence - Checking for Understanding (CFU)

Vocabulary Quiz (Summative)

Chapter tests- 5,6,& 7 (Summative)

Group work on case studies in each chapter (Formative)

Benchmark #3 (Benchmarks)

- 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

Internet

myDNA @ DNAi.org

Technology Infusion

Chromebooks and internet for research

Pearson companion website

Science Direct search engine

MYDNAi.org



Alignment to 21st Century Skills & Technology

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP10.1	Career-ready individuals take personal ownership of their own education and career goals, and they regularly act on a plan to attain these goals. They understand their own career interests, preferences, goals, and requirements. They have perspective regarding the pathways available to them and the time, effort, experience and other requirements to pursue each, including a path of entrepreneurship. They recognize the value of each step in the education and experiential process, and they recognize that nearly all career paths require ongoing education and experience. They seek counselors, mentors, and other experts to assist in the planning and execution of career and personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal.

	They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.
CAEP.9.2.12.C	Career Preparation
CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
CAEP.9.2.12.C.6	Investigate entrepreneurship opportunities as options for career planning and identify the knowledge, skills, abilities, and resources required for owning and managing a business.
CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.D	Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
TECH.8.1.12.D.CS1	Advocate and practice safe, legal, and responsible use of information and technology.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.2.12.B	Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.
TECH.8.2.12.B.CS1	The cultural, social, economic and political effects of technology.

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 pages 164-165, 181, 198

Visual Presentation- power point given with notes for this section

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 to enhance cloning understanding

Students working with Assigned Partner for group questions on plant biotechnology and cloning 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 analyze Plant biotechnology

Use google translate to complete lab journal entry on cloning

- teaching key aspects of a topic. Eliminate nonessential information

- using videos, illustrations, pictures, and drawings to explain or clarif
- 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 workpresented 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 164-165 ,181 ,198

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

Pair with higher functioning student in unit labs

- 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 workpresented 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 Studies on pages 166, 182, and 199

Create a multimedia presentation of research you've done on one of the chapters and methods of biotechnology in this unit.

- 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.