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ENGLISH PROFICIENCY

FOR STUDENTS STUDYING IN THE SPECIALTY OF

BIOTECHNOLOGY AND BIOENGINEERING

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як навчальний посібник для студентів закладів вищої освіти IV рівня акредитації
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English Proficiency for Students Studying in the Specialty of Biotechnology and Bioengineering – Англійська мова для студентів, які навчаються за спеціальністю «Біотехнологія та біоінженерія»: Навчальний посібник / О. П. Голінатий, Л. О. Груша, В. В. Квіцинська. – К.: Книга-плюс, 2026. – 137 с.

Навчальний посібник *"English Proficiency for Students Studying in the Specialty of Biotechnology and Bioengineering"* призначений для студентів закладів вищої освіти IV рівня акредитації, які навчаються за спеціальностями «Біотехнологія», «Біоінженерія» та спорідненими напрямами природничих наук.

Метою посібника є формування та розвиток англомовної комунікативної компетентності студентів у академічному та професійному середовищі з акцентом на наукову комунікацію у сфері сучасної біотехнології та біоінженерії.

Зміст посібника охоплює основні теми біотехнології та біоінженерії, зокрема рівні організації живих систем, будову та функції клітини, мікроорганізми та віруси, культури рослинних і тваринних тканин, системи організму людини, генетику, промислову біотехнологію, а також сучасні біомедичні технології, включаючи моноклональні антитіла та таргетну терапію.

Окремий розділ "*Core English Grammar for Academic Communication"* систематизує основні граматичні структури, необхідні для ефективного академічного мовлення.

Посібник спрямований розвивати навички читання, говоріння та письма англійською мовою, формувати вміння розуміти наукові тексти, брати участь в академічних дискусіях, презентувати наукову інформацію та здійснювати професійну комунікацію на міжнародному рівні.

Навчальний посібник може використовуватися для аудиторної роботи, самостійного навчання та в умовах змішаного навчання.

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CONTENT

ПЕРЕДМОВА

Сучасний розвиток біотехнології та біоінженерії характеризується стрімким зростанням обсягу наукових знань, активною міжнародною співпрацею та широким упровадженням інноваційних технологій у медицину, промисловість, сільське господарство й охорону довкілля. У цих умовах володіння англійською мовою є невід'ємною складовою професійної підготовки майбутніх фахівців, оскільки саме англійська мова виступає основним засобом міжнародної наукової комунікації, доступу до сучасних досліджень та професійного розвитку.

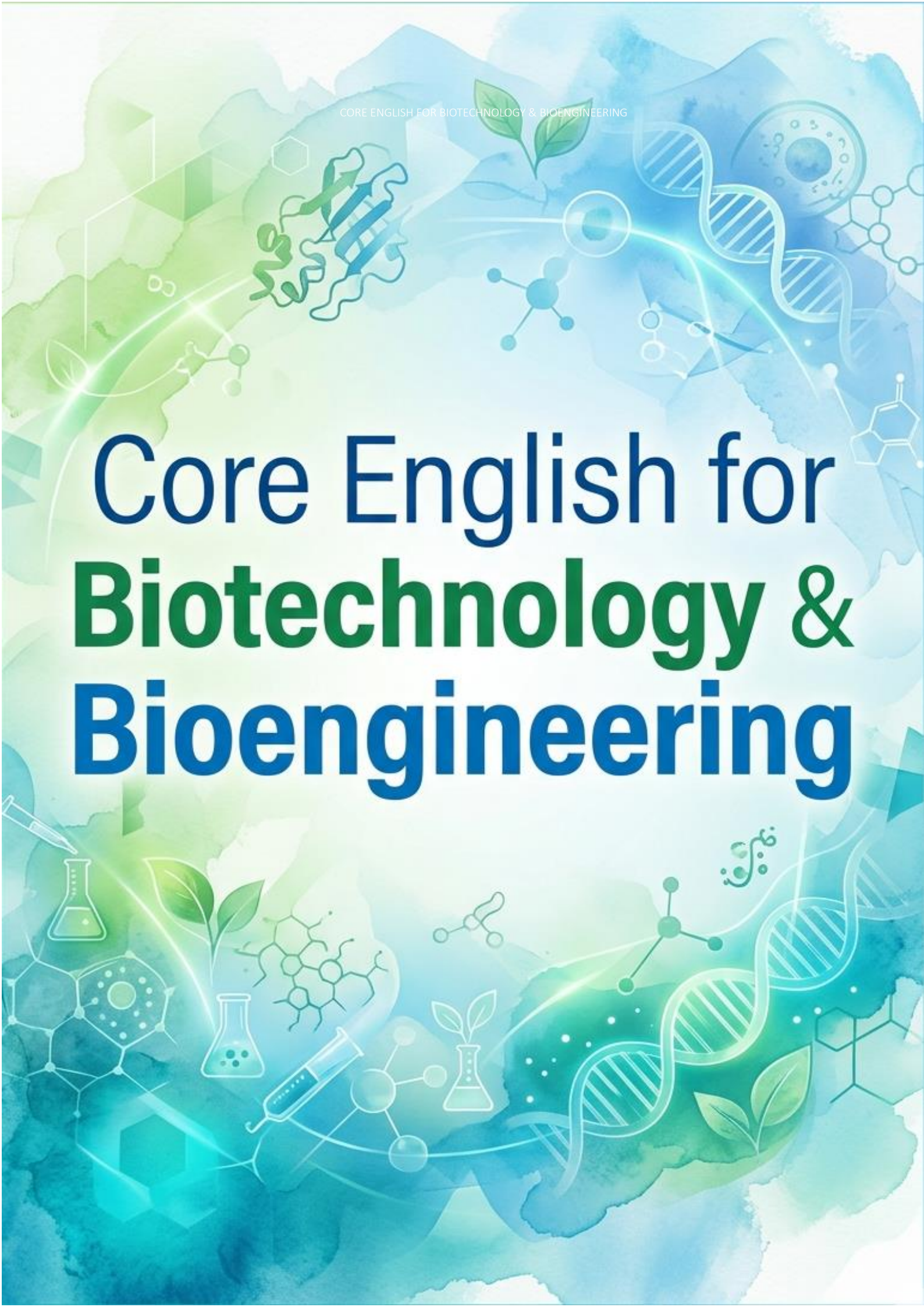
Навчальний посібник «English Proficiency for Students Studying in the Specialty of Biotechnology and Bioengineering» розроблено для студентів закладів вищої освіти, які навчаються за спеціальностями «Біотехнологія», «Біоінженерія» та іншими спорідненими напрямами природничих наук. Його метою є формування та вдосконалення англомовної комунікативної компетентності здобувачів освіти, необхідної для успішної навчальної, наукової та професійної діяльності.

Структура посібника побудована з урахуванням принципу поєднання мовної підготовки з фаховим змістом. Навчальний матеріал охоплює ключові теми сучасної біотехнології та біоінженерії, зокрема об'єкти та методи галузі, рівні організації живої матерії, будову й функції клітини, мікроорганізми, рослинні та тваринні тканини, системи організму людини, основи генетики, промислову біотехнологію та біотехнологічні підходи в медицині. Такий тематичний добір сприяє не лише розвитку мовних навичок, а й поглибленню професійних знань студентів.

Особливу увагу приділено формуванню навичок роботи з англомовними науковими текстами, розвитку академічного письма, усного мовлення та професійної комунікації. Завдання посібника спрямовані на розвиток уміння аналізувати фахову інформацію, брати участь у дискусіях, презентувати результати досліджень і використовувати професійну термінологію в реальних комунікативних ситуаціях.

Окремий розділ «Core English Grammar for Academic Communication» містить систематизований виклад основних граматичних явищ англійської мови, необхідних для ефективного академічного спілкування. Граматичний матеріал подано з урахуванням потреб студентів природничих спеціальностей та орієнтовано на його практичне застосування в навчальній і науковій діяльності.

Посібник може бути використаний під час авдиторних занять, самостійної роботи студентів, а також у змішаному та дистанційному форматах навчання. Матеріали видання сприятимуть формуванню мовної компетентності, розвитку професійної мобільності та підготовці майбутніх фахівців до активної участі в міжнародному науковому та професійному середовищі.



Core English for Biotechnology & Bioengineering

UNIT 1. INTRODUCTION TO BIOTECHNOLOGY AND BIOENGINEERING

LEAD IN

1. Learn the following words. Pay attention to their pronunciation.

biosafety	[ˌbaɪ.oʊˈseɪf.ti]	*біобезпека*
cell	[sel]	*клітина*
cartilage	[ˈkɑː.təlɪdʒ]	*хрящ*
contamination	[kəntæmɪˈneɪʃn]	*зараження, забруднення*
DNA	[ˌdiːenˈeɪ]	*ДНК*
enzyme	[ˈenzaɪm]	*фермент*
field	[fiːld]	*галузь*
gene	[dʒiːn]	*ген*
medium	[ˈmiːdiəm]	*середовище (живильне)*
nutrient	[ˈnjuːtriənt]	*поживна речовина*
protein	[ˈproʊtiːn]	*білок*
purification	[ˌpjʊərɪfɪˈkeɪʃən]	*очищення*
quality	[ˈkwɒləti]	*якість*
separation	[ˌsepəˈreɪʃən]	*розділення*
stem cells	[ˈstem ˌselz]	*стовбурові клітини*
tissue	[ˈtɪʃuː]	*тканина*
viability	[ˌvaɪəˈbɪləti]	*життєздатність*
waste	[weɪst]	*відходи*
yeast	[jiːst]	*дріжджі*

2. What word combinations can you make using words from the two boxes?

1) sterile	**a)** engineering
2) enzyme	**b)** medium
3) recombinant	**c)** system

4) bioprocess	**d)** activity
5) microbial	**e)** culture
6) cell	**f)** DNA
7) culture	**g)** fermentation
8) tissue	**h)** technique
9) genetic	**i)** conditions
10) bioreactor	**j)** technology

3. Get familiar with some facts about organization of living matter and search for more information to present to the group.

1. Biotechnology is the use of living organisms or their components to develop useful products and technologies.
2. Genetic engineering allows scientists to modify DNA and create recombinant organisms.
3. Cell culture is a fundamental laboratory technique used to grow cells under controlled conditions.
4. Microbial fermentation is widely used in the production of antibiotics, alcohol, and enzymes.
5. A bioreactor is a system designed to support biological reactions under controlled environmental conditions.
6. Sterile conditions are essential in biotechnology to prevent contamination of cultures.
7. Enzymes act as biological catalysts that accelerate chemical reactions in cells.
8. Tissue engineering combines biology and engineering to create artificial tissues for medical use.
9. Culture media provide nutrients required for the growth of cells and microorganisms.
10. Bioprocess technology focuses on designing and optimizing industrial biological production systems.

READING PASSAGE

4. Read the text.

INTRODUCTION TO BIOTECHNOLOGY AND BIOENGINEERING

Biotechnology and bioengineering are interdisciplinary fields that combine biology, chemistry, engineering and information technologies to develop solutions in medicine, agriculture, industry and environmental protection by using living systems and biological processes. Biotechnology focuses on the use of living organisms or their components, while bioengineering applies engineering principles to design and optimize biological systems and processes for practical applications. Genetic engineering enables the modification of DNA sequences in organisms, allowing scientists to produce recombinant proteins, improve crops and develop new medical therapies. Cell culture is a basic laboratory technique used to grow animal or plant cells outside the organism under controlled conditions for research and industrial purposes. Microbial fermentation is a widely applied process in biotechnology that uses microorganisms such as bacteria and yeast to produce valuable products including antibiotics, enzymes and alcohol.

A bioreactor is a specialized system designed to provide optimal environmental conditions for biological reactions such as fermentation or cell growth on an industrial scale. Sterile conditions are

essential in all biotechnological processes to prevent contamination by unwanted microorganisms that could interfere with experiments or production. Enzymes are biological catalysts that speed up chemical reactions in cells and are widely used in industrial biotechnology for efficient and selective processes. Tissue engineering combines principles of biology and engineering to create functional biological substitutes such as artificial skin, cartilage or other tissues for medical use. Culture media are nutrient-rich solutions that provide the necessary physical and chemical environment for the growth of cells and microorganisms in laboratory conditions. Bioprocess technology integrates biological sciences with engineering methods to design, scale up and optimize production processes for pharmaceuticals, food products and environmental applications.

Upstream and downstream processing are key stages in biotechnological production, where upstream involves preparation of biological systems and downstream focuses on purification, separation and recovery of final products. Monitoring of physical, chemical and biological parameters is crucial in biotechnology to ensure stability of cultures, prevent contamination and maintain optimal productivity in bioreactors. Modern biotechnology has wide applications in medicine, including vaccine development, in agriculture for improving crop resistance, and in environmental protection through waste treatment and bioremediation processes. Another important aspect of bioengineering is the development of scalable and cost-effective production systems that allow laboratory discoveries to be transferred into industrial-scale manufacturing while maintaining product quality, safety standards and reproducibility across different production batches. Together, these fields form the foundation of modern life sciences and technological innovation worldwide.

Recent advances in biotechnology have been driven by powerful tools such as genome editing, bioinformatics and artificial intelligence, which enable researchers to analyze complex biological data and develop innovative solutions more efficiently. Personalized medicine is an emerging area that uses genetic information to tailor treatments to individual patients, improving therapeutic outcomes and reducing adverse effects. Synthetic biology further expands the possibilities of biotechnology by designing and constructing new biological systems with specific functions for medical, industrial and environmental applications. The growing demand for sustainable technologies has also increased interest in bio-based products, renewable resources and environmentally friendly manufacturing processes. As biotechnology and bioengineering continue to evolve, they play an increasingly important role in addressing global challenges related to health, food security, energy production and environmental sustainability.

LANGUAGE DEVELOPMENT

5. Match English words with the Ukrainian equivalents and make sentences.

1) solution	**a)** хрящ
2) apply	**b)** рішення, розчин
3) design	**c)** дріжджі
4) yeast	**d)** очищення
5) contamination	**e)** забруднення

6) interfere	**f)** застосовувати
7) cartilage	**g)** заважати, втручатися
8) downstream	**h)** проєктувати, розробляти
9) purification	**i)** виробництво
10) manufacturing	**j)** постобробка

6. Match the following terms with their definitions.

1) biotechnology	**a)** the application of living systems and organisms to develop useful products and technologies
2) bioengineering	**b)** the use of engineering principles to design and optimize biological systems and processes
3) upstream	**c)** a process in biotechnology that includes initial stages such as preparation of cells, media and growth conditions before the main production step
4) downstream	**d)** the stage in bioprocessing that involves purification, separation and recovery of the final product
5) cartilage	**e)** a flexible connective tissue found in joints and other parts of the body
6) bioremediation	**f)** the use of living organisms or their products to remove or neutralize environmental pollutants
7) vaccine	**g)** a biological preparation that provides immunity against a specific disease
8) agriculture	**h)** the science and practice of farming, including cultivation of plants and breeding of animals

7. Complete the following sentences by choosing a suitable word from the box.

cell culture *fermentation* enzyme *bioreactor* sterile conditions *culture medium* genetic engineering *purification* downstream *bioprocess*

1. Cells are grown in controlled laboratory environments using ___.
2. Alcohol and antibiotics are often produced through ___ in industrial processes.
3. Many biochemical reactions in cells are accelerated by an ___.

4. A controlled system such as a ___ is used for large-scale biological production.
5. To avoid contamination, experiments must be carried out under ___.
6. The growth of microorganisms depends on an appropriate ___.
7. Scientists can create new traits in organisms through ___.
8. The final product is obtained after ___, which removes unwanted substances.
9. In industrial biotechnology, separation steps are part of ___ processing.
10. The whole process of using living systems for production is called a ___.

8. Say whether the following statements are true or false. Comment on your answer.

1. Biotechnology only deals with medicine and has no applications in industry.
2. Cell culture allows scientists to grow cells outside the organism under controlled conditions.
3. A bioreactor is used to support and control biological reactions on an industrial scale.
4. Enzymes slow down biochemical reactions in living cells.
5. Sterile conditions are important to prevent contamination in biotechnological processes.
6. Genetic engineering cannot be used to modify DNA in organisms.
7. Downstream processing includes purification and recovery of the final product.
8. Culture media are not necessary for the growth of microorganisms in laboratory conditions.
9. Fermentation is only used in food production and has no medical applications.
10. Bioprocess technology is unrelated to industrial production systems.

9. Fill the gaps.

1. Biotechnology and bioengineering are interdisciplinary fields that are organized into … .
2. Modern biotechnology includes working with basic units such as … .
3. Biological molecules can interact and form complex structures through chemical bonds … .
4. Cells are the fundamental units of biotechnology, capable of carrying out essential processes … .
5. Some cells are used independently in laboratory systems such as cell cultures … .
6. Prokaryotic cells are simple unicellular organisms widely used in biotechnology for fermentation and production processes.
7. Biotechnological applications involve organisms ranging from bacteria to … .
8. A bioprocess is a set of operations involving living organisms that … .
9. A bioreactor is a controlled system where cells or microorganisms grow together … .
10. Biotechnological systems provide … .

10. Answer the following questions.

1. What is the focus of biotechnology as a scientific field?
2. What is the main difference between biotechnology and bioengineering?
3. What is a cell culture used for in biotechnology?
4. What role does fermentation play in industrial biotechnology?
5. What is the function of a bioreactor?
6. Why are sterile conditions important in laboratory and industrial processes?
7. What is genetic engineering used for?
8. What does downstream processing include?

9. What is the purpose of culture media?
10. Where are biotechnological methods applied in real life?

11. Translate the following sentences into English.

1. Біотехнологія є міждисциплінарною наукою, що поєднує біологію, хімію та інженерію для створення корисних продуктів.
2. Біоінженерія застосовує інженерні принципи для проєктування та оптимізації біологічних систем.
3. Клітинна культура використовується для вирощування клітин поза організмом у контрольованих умовах.
4. Ферментація є важливим процесом у виробництві антибіотиків, ферментів і біоетанолу.
5. Біореактор забезпечує оптимальні умови для росту клітин і мікроорганізмів у промислових масштабах.
6. Стерильні умови необхідні для запобігання контамінації під час лабораторних досліджень.
7. Генетична інженерія дозволяє змінювати ДНК організмів і створювати рекомбінантні структури.
8. Ензими прискорюють біохімічні реакції, діючи як біологічні каталізатори.
9. Поживні середовища забезпечують необхідні речовини для росту клітин.
10. Біопроцеси включають використання живих систем для отримання корисних продуктів у промисловості.

TALKING POINTS

Using additional information resources, speak on the following topics:

- ecosystems and their role in biological systems;
- interaction between organisms and the environment;
- energy flow and nutrient cycling in ecosystems.

MORE READING

Read the text and provide answers to the following questions.

1. What is an ecosystem?
2. What are the main components of an ecosystem?
3. What is the difference between biotic and abiotic factors?
4. How is energy transferred in an ecosystem?
5. What role do microorganisms play in ecosystems?
6. What is bioremediation?

ECOSYSTEMS

An ecosystem is a complex biological system that includes all living organisms in a specific area and their interactions with each other and with the physical environment. It represents one of the highest levels of organization in biology and is important for understanding natural and engineered biological processes in biotechnology and bioengineering.

Ecosystems consist of two main components: biotic and abiotic factors. Biotic factors include all living organisms such as bacteria, plants, animals, and fungi. Abiotic factors include non-living elements such as water, soil, air, sunlight, and temperature. The interaction between these components determines the structure and stability of the ecosystem.

Energy in ecosystems flows through food chains and food webs. It begins with primary producers such as plants and algae, continues through consumers, and ends with decomposers. Unlike energy, matter is recycled in ecosystems through natural cycles such as the carbon and nitrogen cycles.

Microorganisms play a key role in ecosystems, especially in decomposition processes. They break down organic material and return nutrients to the environment, making them essential for maintaining ecological balance.

In biotechnology, the concept of ecosystems is used in environmental applications such as bioremediation. Bioremediation is a process in which living organisms, usually microorganisms, are used to remove or neutralize pollutants in soil, water, or air.

Understanding ecosystems is important in bioengineering because it helps in designing sustainable technologies that minimize environmental impact and support ecological stability.

Biodiversity is another important characteristic of healthy ecosystems. A greater variety of species increases ecosystem resilience and allows biological communities to adapt more effectively to environmental changes and disturbances. Human activities such as deforestation, pollution, urbanization, and climate change can negatively affect ecosystem structure and function, leading to habitat loss and reduced biodiversity. Modern environmental biotechnology contributes to ecosystem conservation through the development of sustainable waste management systems, wastewater treatment technologies, and biological monitoring methods. Studying ecosystems provides valuable knowledge for protecting natural resources and ensuring the long-term sustainability of both human societies and the environment.

UNIT 2. OBJECTS AND METHODS OF BIOTECHNOLOGY AND BIOENGINEERING

LEAD IN

1. Learn the following words. Pay attention to their pronunciation.

editing	[ˈɛdɪtɪŋ]	*редагування*
implication	[ˌɪmplɪˈkeɪʃən]	*наслідок / значення*
pathway optimization	[ˈpɑːθweɪ ˌɒptɪmaɪˈzeɪʃən]	*оптимізація метаболічних шляхів*
pluripotent stem cells	[ˌplʊərɪˈpəʊtənt stɛm sɛlz]	*плюрипотентні стовбурові клітини*
polymerase chain reaction	[pəˈlɪməreɪz tʃeɪn riˈækʃən]	*полімеразна ланцюгова реакція*
recombinant vectors	[rɪˈkɒmbɪnənt ˈvɛktəz]	*рекомбінантні вектори*
restriction endonucleases	[rɪˈstrɪkʃən ˌendoʊˈnjuːkliːeɪzɪz]	*рестрикційні ендонуклеази*
selective breeding strategies	[sɪˈlɛktɪv ˈbriːdɪŋ ˈstrætədʒiz]	*стратегії селективного розведення*
site-directed mutagenesis	[saɪt dɪˈrɛktɪd ˌmjuːtəˈdʒɛnɪsɪs]	*спрямований мутагенез*
strain	[streɪn]	*штам*
three-dimensional cultures	[θriː daɪˈmɛnʃənl ˈkʌltʃəz]	*тривимірні культури*

2. What word combinations can you make using words from the two boxes?

1. recombinant	**a)** cells
2. restriction	**b)** chain reaction
3. yeast	**c)** cultures
4. polymerase	**d)** vectors
5. site-directed	**e)** strategies
6. three-dimensional	**f)** optimization
7. pluripotent	**g)** endonucleases
8. pathway	**h)** mutagenesis
9. selective breeding	**i)** stem cells

3. Get familiar with some facts about organization of living matter and search for more information to present to the group.

1. Yeast (*Saccharomyces cerevisiae*) is not only used for baking and brewing — it is also used to produce hepatitis B and HPV vaccines, because it performs eukaryotic protein folding like human cells.
2. The polymerase chain reaction is so sensitive that it can amplify DNA from a single cell, making it crucial in forensic medicine, early cancer detection, and viral diagnostics.
3. The revolutionary CRISPR-Cas9 system is a bacterial immune defense mechanism against viruses, later adapted for precise genome editing in humans, plants, and animals.
4. In 3D culture systems, stem cells can spontaneously form mini-organs (organoids) such as brain, liver, or intestinal structures — without a fully developed organism.
5. Gene therapy uses viruses that are genetically modified so they cannot cause disease but still retain the ability to insert genetic material into human cells.
6. Modern bioreactors tightly control pH, oxygen, temperature, and nutrient flow, simulating conditions similar to the human internal environment for optimal cell growth.
7. A single nucleotide change (SNP) can influence: drug metabolism (pharmacogenomics), disease risk (e.g., diabetes, hypertension) and vaccine response
8. Using 3D bioprinting, researchers can already create skin, cartilage, and small tissue structures, and experimental bioengineered kidneys are in development.
9. Even precise tools like CRISPR can sometimes modify unintended DNA regions, which is a major safety concern in clinical gene therapy.
10. Modern biotechnology heavily depends on bioinformatics and AI, where genome sequencing produces datasets larger than traditional clinical databases.

READING PASSAGE

4.Read the text.

OBJECTS AND METHODS OF BIOTECHNOLOGY AND BIOENGINEERING

Biotechnology and bioengineering constitute highly interdisciplinary domains that integrate molecular biology, genetics, biochemistry, cell biology, systems biology, and chemical and biomedical engineering to manipulate biological systems for the production of valuable products and the development of diagnostic and therapeutic technologies. In contemporary biomedical sciences, these fields underpin precision medicine, recombinant therapeutics, gene therapy, regenerative medicine, and industrial biomanufacturing.

The objects of biotechnology represent hierarchical biological systems spanning molecular, cellular, tissue, and organismal levels. At the molecular level, these include nucleic acids (DNA, RNA), recombinant vectors (plasmids, viral vectors), enzymes (restriction endonucleases, ligases, polymerases), regulatory proteins, and signaling molecules. At the cellular level, prokaryotic and eukaryotic systems are widely utilized, including bacterial strains, yeast cells, mammalian cell lines (e.g., CHO, HEK293), stem cells, and primary human cell cultures. At the tissue and organ level, organoids, tissue explants, and bioengineered constructs serve as advanced experimental and translational models. At the organismal level, genetically modified organisms (GMOs), transgenic plants and animals, and model organisms (e.g., *Drosophila melanogaster*, *Mus musculus*) are essential for functional genomics and disease modeling.

Microbial systems remain the cornerstone of industrial biotechnology due to their rapid replication rates, metabolic plasticity, and capacity for heterologous protein expression. *Escherichia*

coli is extensively employed for prokaryotic expression systems, whereas *Saccharomyces cerevisiae* and Pichia pastoris are widely used for eukaryotic recombinant protein production. Viral vectors (adenoviral, lentiviral, retroviral, adeno-associated viral systems) are critical tools in gene delivery, gene editing, and vaccine platforms.

The methods of biotechnology and bioengineering can be classified according to molecular, cellular, organismal, and process engineering levels.

At the molecular level, core methodologies include recombinant DNA technology, molecular cloning, restriction fragment length polymorphism (RFLP) analysis, polymerase chain reaction and its variants (qPCR, RT-PCR, digital PCR), site-directed mutagenesis, next-generation sequencing (NGS), and genome editing technologies such as CRISPR-Cas9, CRISPR-Cas12, and base/prime editing systems. These approaches enable precise genomic manipulation, transcriptomic profiling, and functional gene analysis.

At the cellular level, biotechnology employs advanced cell culture systems, including two-dimensional (2D) monolayer cultures, three-dimensional (3D) cultures, spheroids, and organ-on-a-chip platforms. Hybridoma technology is used for monoclonal antibody production, while somatic cell nuclear transfer (SCNT) and cell fusion techniques facilitate nuclear reprogramming and antibody engineering. Stem cell technologies, including induced pluripotent stem cells (iPSCs), are fundamental for regenerative medicine and developmental biology studies.

At the organismal level, methods include transgenesis, gene knock-out/knock-in models, RNA interference (RNAi), and selective breeding strategies combined with molecular marker-assisted selection (MAS) and genomic selection. Gene therapy approaches are classified into somatic and germline interventions, with somatic gene transfer being clinically applicable in modern medicine, whereas germline editing remains ethically and legally restricted in most jurisdictions.

At the process engineering level, bioprocess engineering involves upstream and downstream processing, bioreactor design (batch, fed-batch, continuous systems), metabolic engineering, and synthetic biology approaches for pathway optimization. Fermentation technology is applied for large-scale production of antibiotics, recombinant proteins, vaccines, monoclonal antibodies, and industrial enzymes, with stringent quality control governed by Good Manufacturing Practice (GMP) standards.

In medical biotechnology, these methodologies are implemented in molecular diagnostics, including biosensor development, liquid biopsy techniques, pharmacogenomic profiling, and high-throughput screening platforms. They are also central to precision medicine, where integrative omics data (genomics, transcriptomics, proteomics, metabolomics) guide individualized therapeutic strategies.

Ethical, biosafety, and regulatory frameworks are integral to biotechnology and bioengineering. Key concerns include genomic integrity, off-target effects of genome editing, environmental risk assessment of GMOs, biosecurity of viral vectors, and long-term implications of epigenetic and germline modifications.

LANGUAGE DEVELOPMENT

5. Match English words with the Ukrainian equivalents and make sentences.

1) recombinant vectors	**a)** генна терапія
2) stem cells	**b)** штами

3) gene therapy	**c)** рекомбінантні вектори
4) polymerase chain reaction	**d)** полімеразна ланцюгова реакція
5) bioengineering	**e)** стовбурові клітини
6) strains	**f)** біоінженерія
7) CRISPR-Cas9	**g)** редагування геному
8) metabolic pathways	**h)** метаболічні шляхи
9) implications	**i)** зародкова лінія
10) germline	**j)** наслідки

6. Match the following terms with their definitions.

1) CRISPR-Cas9	**a)** system for large-scale biological production
2) PCR	**b)** method of DNA amplification
3) RFLP analysis	**c)** precise genome editing tool
4) monoclonal antibodies	**d)** identical antibodies from one cell clone
5) gene knock-out	**e)** technique detecting DNA fragment variation
6) bioreactor	**f)** undifferentiated cells capable of specialization
7) stem cells	**g)** inactivation of a specific gene
8) viral vectors	**h)** gene delivery tools based on viruses

7. Complete the following sentences by choosing a suitable word from the box.

recombinant *vectors* transcription *CRISPR-Cas9* bioreactors *heterologous* metabolic *sequencing* cornerstone *interventions*

1. In molecular biotechnology, _____ DNA technology is used to construct genetically modified organisms for therapeutic protein production.
2. Viral _____ are widely applied as gene delivery systems in both experimental and clinical gene therapy.

3. Next-generation _____ enables high-throughput analysis of genomic and transcriptomic data.
4. _____ systems allow large-scale cultivation of engineered cells under strictly controlled physicochemical conditions.
5. The expression of _____ proteins in bacterial or eukaryotic hosts is a central strategy in industrial biomanufacturing.
6. _____ is a genome editing technology that introduces site-specific modifications in target DNA sequences.
7. Regulation of gene _____ plays a key role in controlling cellular differentiation and functional protein synthesis.
8. _____ pathway engineering is used to optimize biochemical fluxes for enhanced production of metabolites and recombinant products.
9. Microbial systems remain the _____of industrial biotechnology.
10. Gene therapy approaches are classified into somatic and germline _____.

8. Say whether the following statements are true or false. Comment on your answer.

1. Biotechnology is exclusively focused on the manipulation of microorganisms and does not involve eukaryotic systems such as mammalian cell lines or stem cells.
2. Viral vectors used in gene therapy are derived from naturally occurring viruses that have been genetically modified to ensure safe gene delivery.
3. PCR and next-generation sequencing provide identical types of genetic information and are interchangeable in functional genomics research.
4. Stem cells are characterized by self-renewal capacity and the potential to differentiate into specialized cell types, making them essential in regenerative medicine.
5. RFLP analysis is a protein-based technique used to study enzyme activity in metabolic pathways.
6. CRISPR-Cas systems enable targeted genome editing by introducing site-specific double-strand breaks in DNA.
7. Bioreactors operate only under batch culture conditions and are not applicable to continuous bioprocessing systems.
8. Germline genome editing is widely accepted and routinely applied in clinical medical practice across most countries.
9. Fermentation technology is applied for large-scale production of antibodies, recombinant fats.
10. The methods of biotechnology and bioengineering can be classified according to internal and external processes.

9. Fill the gaps.

1. Biotechnology integrates molecular biology and _____ engineering.
2. Recombinant _____ are used in gene delivery systems.
3. _____ sequencing is a modern method for genome analysis.
4. _____ cultures allow three-dimensional cell growth.
5. Metabolic _____ is used to optimize biochemical processes.
6. Gene _____ can target somatic or germline cells.
7. _____ analysis detects DNA fragment length variation.

8. Stem _____ are used in regenerative medicine.
9. Tissue _____is applied to create artificial organs and biological substitutes.
10. CRISPR-based _____ enables precise modification of genetic material.

10. Answer the following questions.

1. Which scientific disciplines are integrated within biotechnology and bioengineering?
2. What biological objects are studied at the molecular, cellular, tissue, and organismal levels in biotechnology?
3. Why are microbial systems considered the cornerstone of industrial biotechnology?
4. Which microorganisms are commonly used for recombinant protein production, and what are their specific applications?
5. What role do viral vectors play in gene delivery, gene editing, and vaccine development?
6. Which molecular-level methodologies enable precise genomic manipulation and functional gene analysis?
7. How do three-dimensional (3D) cell cultures and organ-on-a-chip platforms differ from traditional two-dimensional (2D) cultures?
8. What are induced pluripotent stem cells (iPSCs), and why are they important in regenerative medicine?
9. How are somatic gene therapy and germline gene editing different in terms of clinical application and ethical regulation?
10. What ethical, biosafety, and regulatory concerns are associated with modern biotechnology and bioengineering?

11. Translate the following sentences into English.

1. Біотехнологія інтегрує молекулярну біологію та генну інженерію.
2. Рекомбінантні вектори використовуються для доставки ДНК у клітини.
3. Стовбурові клітини мають здатність до диференціації.
4. Полімеразна ланцюгова реакція ампліфікує ДНК.
5. CRISPR-Cas9 забезпечує точне редагування геному.
6. Біореактори використовуються для промислового виробництва білків.
7. Метаболічні шляхи регулюють клітинні процеси.
8. Генна терапія може бути соматичною або зародковою.
9. На клітинному рівні широко використовуються прокаріотичні та еукаріотичні системи, стовбурові клітини та первинні культури клітин людини.
10. Генетично модифіковані організми (ГМО), трансгенні рослини та тварини є важливими для функціональної геноміки та моделювання захворювань.

TALKING POINTS

Using additional information resources, answer questions:

- possible benefits and risks of using genetically modified organisms in agriculture and medicine;
- strict limits on genome editing in humans: pros and cons:
- biotechnology and global challenges (food security, environmental pollution).

MORE READING

Read the text and provide answers to the following questions.

1. What are the main fields of application of biotechnology and bioengineering?
2. What is the role of medical biotechnology in disease diagnosis and treatment?
3. Which molecular methods are used in modern medical diagnostics?
4. What biological products are produced using recombinant DNA technology?
5. How does pharmaceutical biotechnology contribute to large-scale drug production?
6. What is the purpose of bioreactors in biotechnology?
7. How is agricultural biotechnology used to improve food production?
8. What are the main applications of environmental biotechnology in pollution control?

CORE AREAS OF APPLICATION OF BIOTECHNOLOGY AND BIOENGINEERING

Biotechnology and bioengineering are applied in several key fields that combine molecular biology, genetics, cell technology, and engineering approaches to solve medical, industrial, and environmental problems.

One of the main areas is medical biotechnology, which focuses on diagnostics, prevention, and treatment of diseases. Molecular methods such as PCR and next-generation sequencing are used for rapid detection of pathogens and genetic disorders. In therapy, biotechnology enables the production of recombinant proteins, including insulin, monoclonal antibodies, and vaccines, as well as the development of gene therapy and genome editing technologies such as CRISPR-Cas systems.

Another important field is pharmaceutical biotechnology, which involves the industrial production of biologically active compounds. Using recombinant DNA technology, cell cultures, and bioreactors, large-scale production of antibiotics, hormones, enzymes, and other biopharmaceuticals is achieved. Bioprocess engineering and synthetic biology are used to optimize metabolic pathways and increase production efficiency.

Agricultural biotechnology is applied to improve crop and livestock productivity. Genetically modified plants with resistance to pests, diseases, and environmental stress are widely used to increase yield and ensure food security. Selective breeding and molecular marker-assisted selection are also important tools in animal and plant improvement.

In environmental biotechnology, microorganisms are used for bioremediation of polluted soil and water. Microbial systems can degrade toxic compounds and support wastewater treatment processes, reducing environmental contamination.

Industrial biotechnology focuses on the use of microorganisms and enzymes to produce biofuels, organic acids, and other valuable chemicals through fermentation and metabolic engineering.

Finally, regenerative medicine and tissue engineering use stem cells, biomaterials, and 3D culture systems to develop tissues and organ-like structures for research and potential therapeutic use.

In conclusion, biotechnology and bioengineering are essential for modern medicine, industry, agriculture, and environmental protection, providing innovative solutions to global challenges.

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