

І.О. ПИЛИПЕНКО

ІНОЗЕМНА МОВА ЗА ПРОФЕСІЙНИМ СПРЯМУВАННЯМ

Навчальний посібник
для здобувачів біолого-технологічного факультету

(Спеціальність G21 – Біотехнології та біоінженерія)



Біла Церква

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*Рекомендовано Вченою Радою
Білоцерківського національного аграрного університету
як навчальний посібник для здобувачів закладів вищої освіти*

Біла Церква

2025

УДК 81'243:60(075)
ISBN 978-966-2122-83-1

Рекомендовано
Вченою Радою Білоцерківського НАУ
Протокол № 10 від «27» жовтня 2025р.

Автор: **Пилипенко І.О.**, старший викладач

Пилипенко І.О. «Іноземна мова за професійним спрямуванням» навчальний посібник з англійської мови для здобувачів вищої освіти – спеціальності G21 «Біотехнології та біоінженерія»/Пилипенко І.О. Біла Церква, 2025. 152 с.

Навчальний посібник призначений для практичних та самостійних занять з дисципліни «Іноземна мова за професійним спрямуванням» для здобувачів спеціальності G21 «Біотехнології та біоінженерія». Зміст та структура навчального посібника побудовані за тематичним принципом і включають 4 розділи. Робота за темою в межах кожного розділу організовується на базі текстів із автентичних джерел. До кожного тексту обов'язково додаються: необхідний словниковий матеріал з перекладом, системи вправ репродуктивного та комунікативного характеру, вправи на словник. Метою завдань є вироблення мовленнєвих навичок і вмінь використання лексичного матеріалу, що вивчається в ситуаціях реального спілкування. В кінці навчального посібника подаються тестові завдання на перевірку адекватного розуміння тексту з фаху та активізацію мовного і мовленнєвого матеріалу.

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ПЕРЕДМОВА

Сучасний розвиток біотехнологій та біоінженерії вимагає від фахівців не лише глибоких знань у своїй галузі, але й здатності до ефективної комунікації іноземною мовою на професійному рівні. В умовах глобалізації, швидкого розвитку наукових досліджень та інтеграції у світову спільноту знання іноземної мови стає важливим інструментом для доступу до передових досягнень, професійної співпраці та подальшого розвитку у науковій сфері.

Навчальний посібник «Іноземна мова за професійним спрямуванням» призначений для здобувачів вищої освіти першого (бакалаврського) рівня за спеціальністю G21 «Біотехнології та біоінженерія». Основною метою цього посібника є розвиток мовної компетентності студентів у контексті професійної діяльності, а також формування навичок читання, розуміння та використання науково-технічної інформації іноземною мовою.

Матеріал посібника структуровано відповідно до фахової спрямованості та потреб студентів-біотехнологів, з урахуванням особливостей їхньої майбутньої професії. Посібник охоплює ключові теми, пов'язані з біотехнологіями та біоінженерією, включаючи базову термінологію, сучасні напрями досліджень, методи та технології, що використовуються в галузі.

Видання складається з 4 розділів, кожен з яких включає текст для читання та перелік лексичних одиниць для подальшої активізації їх у вправах. Метою всіх вправ (переклад з англійської на українську мову та навпаки, вправи на тлумачення окремих термінів, на правильність твердження, множинного вибору, відповіді на питання та вправи комунікативного характеру) є закріплення лексичних структур базових текстів до рівня їх запам'ятовування і продуктивного використання в усному та писемному мовленні у професійній діяльності. Обов'язковим елементом кожного розділу є наявність проєктної роботи творчого характеру, спрямована на самостійний пошук інформації.

В кінці навчального посібника пропонуються тестові завдання для самоконтролю, підсумкового оцінювання рівня засвоєння матеріалу, перевірки практичних навичок та підготовки до підсумкових іспитів чи заліків.

Особливу увагу приділено інтеграції мови з професійною підготовкою, що забезпечує формування у студентів не лише комунікативних, але й міждисциплінарних компетенцій, необхідних для успішної професійної діяльності у галузі біотехнологій.

Посібник призначений для аудиторної та самостійної роботи студентів і може бути використаний як у межах навчального процесу, так і для індивідуального вдосконалення рівня володіння іноземною мовою.

Сподіваємось, що цей посібник стане ефективним інструментом для підвищення рівня іншомовної компетентності майбутніх фахівців та сприятиме їхньому професійному зростанню в умовах сучасного наукового та технологічного прогресу.

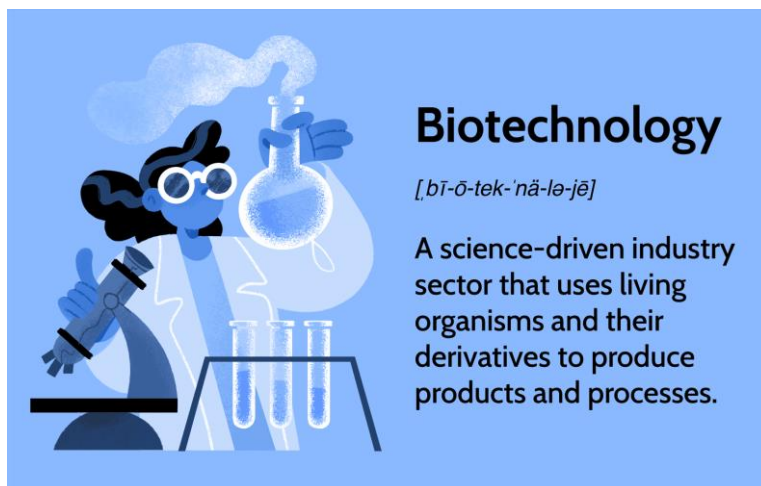
MODULE 1. BIOTECHNOLOGY

1.1. Introduction to Biotechnology

BASIC WORD LIST

Study the following words and expressions.

science-driven industry sector	науково керований сектор промисловості
healthcare-related products	продукти, пов'язані з охороною здоров'я
therapeutics	терапія
DNA fingerprinting	дактилоскопія ДНК
pharmaceuticals	фармацевтика



Biotechnology is a **science-driven industry** sector that uses living organisms and molecular biology to produce **healthcare-related products**. Biotechnology companies also develop **therapeutics** or processes (such as **DNA fingerprinting**).

Biotechnology is best known for its role in medicine and **pharmaceuticals**, but the science is also applied in other areas such as genomics, food production, and the production of biofuels. Biotechnology has often been divided into several categories; every field of this science is sometimes connected with the definite color. Polish chemist Pawel Kafarski is renowned as the person who developed a color code to differentiate the main areas of biotechnology. We will consider these categories in more detail later.

Types of Biotechnology:

Biotechnology has four main types. These are:

1. Medical biotechnology
2. Agricultural & Environmental biotechnology
3. Industrial biotechnology
4. Marine biotechnology

BASIC WORD LIST

Study the following words and expressions.

process of fermentation	процес бродіння
harvesting crops	збирання культур
yields	врожайність
breeding livestock	розведення худоби
groundbreaking work	новаторська робота
large-scale production	великомасштабне виробництво
spur	стимулювати
breakthrough	прорив/досягнення
insulin synthesis	синтез інсуліну
measles	кір
mumps	паротит
rubella	краснуха
biotech-derived drugs	біотехнологічні препарати
cancer and hepatitis B	рак і гепатит В
multiple sclerosis	розсіяний склероз
cystic fibrosis	муковісцидоз

A History of Biotechnology

Biotechnology in its basic form has existed for thousands of years, dating back to an era when humans first learned to produce bread, beer, and wine using the natural **process of fermentation**. For centuries, the principles of biotechnology were restricted to agriculture, such as **harvesting** better **crops** and improving **yields** by using the best seeds and **breeding livestock**.

The field of biotechnology began to develop rapidly from the 19th century with the discovery of microorganisms, Gregor Mendel's study of genetics and **groundbreaking work** on fermentation and microbial processes by giants in the field such as Pasteur and Lister. Early 20th-century biotechnology led to the major discovery of penicillin by Alexander Fleming, which went into **large-scale production** in the 1940s.

Biotechnology took off in the 1950s, **spurred** by a better understanding in the post-war period of cell function and molecular biology. Every decade since then produced major **breakthroughs** in biotechnology. Some of the highlights are the following:

- The discovery of the 3D structure of DNA in the 1950s
- **Insulin synthesis** and the development of vaccines for **measles**, **mumps**, and **rubella** in the 1960s
- Massive strides in DNA research in the 1970s

- The development of the first **biotech-derived drugs** and vaccines to treat diseases such as **cancer and hepatitis B** in the 1980s
- The identification of numerous genes and the introduction of new treatments in decades for managing **multiple sclerosis** and **cystic fibrosis** in the 1990s
- The completion of the human genome sequence in the early 2000s, which made it possible for scientists worldwide to research new treatments for diseases with genetic origins like cancer, heart disease, and Alzheimer's

1.2. Biotech Today

BASIC WORD LIST

Study the following words and expressions.

grow by leaps and bounds	рости як на дріжджах/стрімко
to be engaged in	займатися
bioremediation	біоремедіація
to treat	лікувати
tumors	пухлини
R&D	дослідження та розробки

The biotechnology sector has **grown by leaps and bounds** since the 1990s. There are thousands of small, dynamic biotech companies, many of which are **engaged** in various areas of the medical industry, such as drug development, genomics, or proteomics, while others are involved in areas like **bioremediation**, biofuels, and food products.

There also have been big product introductions in biopharma drugs. Some of the most frequently used biotechnology medical products recently introduced include the following:

- AbbVie's Humira is used to **treat** arthritis, psoriasis, and Crohn's disease.
- Roche's Rituxan, which is used to slow the growth of **tumors** in several types of cancer.
- Amgen/Pfizer's Enbrel, which is used to treat several autoimmune diseases.

Career in Biotechnology

Here are the best biotechnology careers:

- | | |
|---------------------------------|------------------------------|
| ➤ Biomedical Engineer | ➤ Біомедичний інженер |
| ➤ Biochemist | ➤ Біохімік |
| ➤ Clinical Technician | ➤ Клінічний технік |
| ➤ Microbiologist | ➤ Мікробіолог |
| ➤ Process Development Scientist | ➤ Вчений з розвитку процесів |

- | | |
|---|---|
| ➤ Biomanufacturing Specialist | ➤ Спеціаліст з біомануалізації |
| ➤ Business Development Manager | ➤ Менеджер з розвитку бізнесу |
| ➤ Product Strategist | ➤ Продуктовий стратег |
| ➤ Biopharma Sales Representative | ➤ Торговий представник Biopharma |
| ➤ Medical Scientist | ➤ Учений-медик |
| ➤ Biotechnological Technician | ➤ Біотехнологічний технік |
| ➤ Epidemiologist | ➤ Епідеміолог |
| ➤ Microbiologist | ➤ Мікробіолог |
| ➤ Medical and Clinical Lab Technologist | ➤ Медичний та клінічний лабораторний технолог |
| ➤ Biomanufacturing Specialist | ➤ Спеціаліст з біомануалізації |
| ➤ Bioproduction Specialist | ➤ Спеціаліст з біопродукції |
| ➤ R&D Scientist | ➤ R&D вчений |

Assignment 1. In pairs, discuss the following questions:

- 1) Why did you choose this specialty?
- 2) What field of biotechnology are you going to study in future?
- 3) Say in your words what biotechnology is.
- 4) What are the 4 fundamental kinds of biotechnology?
- 5) Who created the biotechnology colours?
- 6) Is biotechnology a new science or not?
- 7) When did modern biotechnology begin?
- 8) What are the highlights of the great breakthroughs in biotechnology you know?
- 9) What areas do thousands of small, dynamic biotech companies pursue today?
- 10) What job is suitable for biotechnology?

Assignment 2. Put the words in the right order:

1. leaps/ sector/ biotechnology/ and/ grown/ by/ The/ the/ 1990s/ bounds/ since/ has.
2. introductions/ There/ have/ drugs/ big/ product/ been/ in/ also/ biopharma .
3. decade/ produced/ then/ Every/ major/ since/ biotechnology/ breakthroughs/ in.
4. are/ There/ of/ biotech/ dynamic/ thousands/ small/ companies.
5. companies/ Biotechnology/ or/ also/ therapeutics/ develop/ processes.

Assignment 3. Make up word combinations using the text:

molecular
harvesting
breeding
multiple
groundbreaking
to treat
biopharma
autoimmune

drugs
diseases
sclerosis
diseases
livestock
work
biology
crops

Assignment 4. Match (1-7) to the descriptions (a-g):

1. tumor	a) the (part of) the fruit of a tree, plant etc from which a new plant may be grown
2. livestock	b) an infectious disease accompanied by red spots on the skin
3. seed	c) an abnormal (dangerous) mass of tissue growing on or in the body
4. fermentation	d) the medical name for German measles
5. giant	e) domestic animals, especially horses, cattle, sheep, and pigs
6. rubella	f) the chemical change occurring when something ferments or is fermented
7. measles	g) a person of very great ability or importance

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Biotechnology is not applied in other areas such as genomics, food production, and the production of biofuels.
2. Biotechnology in its basic form has been around for several years.
3. Early 20th-century biotechnology led to the major discovery of penicillin.
4. Penicillin went into large-scale production in the 1970s.
5. For centuries, the principles of biotechnology were restricted to agriculture.

Assignment 6. Translate the sentences into English using the words you learned:

1. Біотехнологія - науково керований сектор промисловості, який використовує живі організми та молекулярну біологію для виробництва продуктів, пов'язаних з охороною здоров'я.
2. Біотехнологія також застосовується в інших областях, таких як геноміка, виробництво продуктів харчування та виробництво біопалива.
3. Раніше принципи біотехнології обмежувалися збиранням кращих культур і поліпшенням врожайності шляхом використання найкращого насіння і розведення худоби.
4. З відкриттям мікроорганізмів почала швидко розвиватися область біотехнологій.
5. У 1940-х роках пеніцилін пішов у великомасштабне виробництво.
6. Краще розуміння функції клітин і молекулярної біології відбулося у післявоєнний період .
7. У 1980-х роках відбулася перша розробка біотехнологічних препаратів і вакцин для лікування таких захворювань, як рак і гепатит В.
8. У 1990-х роках впровадженні нові методи лікування з розсіяним склерозом та муковісцидозом.
9. Існують тисячі невеликих біотехнологічних компаній, багато з яких займаються різними сферами медичної промисловості.
10. Існує препарат, який використовується для уповільнення росту пухлин при декількох типах раку.

Project work

CHOOSE one of these questions to research and be ready to present it in the classroom.

1. Pros and Cons of Biotechnology.
2. Careers in Biotechnology: An overview of different career paths available in the biotechnology field and required skills.

MODULE 2. BIOTECHNOLOGY: A FLAG OF MANY COLOURS

2.1. Medical “Red” Biotechnology

BASIC WORD LIST

Study the following words and expressions.

enhance	підвищувати
figure out	визначати
ensure	гарантувати
antibodies	антитіла
diseases	хвороби
proteins	білки
enzymes	ферменти
hamster	хом'як
heart disease	серцеве захворювання
detect	виявляти
AIDS	СНІД



Medical biotechnology is all about human health and medicine. So, medical biotechnology will involve producing new pharmaceutical drugs, antibodies, vaccines, and more.

Red biotechnology offers a lot of value to the pharmaceutical industry and the medical profession. It helps to **enhance** patients' quality of life while also alleviating the experience of pain and suffering.

Red biotechnology can **figure out** the best drug dosages for patients, thus working towards making drugs and treatments much more specific for people based on their genetic code. This is going to change the future of medicine and **ensure** that doctors will treat their patients in a more unique, personal way.

Red biotechnology makes use of biological materials to find solutions to health-related problems. Often, gene expression, **antibodies**, and proteins are researched to find how they can be used to create genetically-modified cells or organisms to assist in treating various **diseases**.

Some examples include how **proteins** have been modified to encourage the

production of **enzymes** in **hamster** cells and these can be used to treat heart disease in humans.

Red biotechnology is considered to be an inclusive field of research that uses biological processes, treatments in conventional forms and advanced forms (such as genetic engineering), and diagnostic methods to **detect** disease.

This approach has resulted in biotechnologists working on finding cures to various human diseases, such as **AIDS** and hepatitis.

Assignment 1. In pairs, discuss the following questions:

- 1) What is medical biotechnology all about?
- 2) What are some of the products that medical biotechnology can produce?
- 3) How can red biotechnology help enhance patients' quality of life?
- 4) How can red biotechnology help make drugs and treatments more specific for people based on their genetic code?
- 5) What types of biological materials are used in red biotechnology to find solutions to health-related problems?
- 6) Can you give an example of protein modification for disease treatment?
- 7) What are some of the diseases that red biotech has been used to find cures for?

Assignment 2. Put the words in the right order:

1. Medical/ medicine/ all/ human/ biotechnology/ about/ is/ and/ health.
2. biotechnology/ materials/ Red/ use/ biological/ problems/ makes/ to/ of/ find/ to/ health-related/ solutions.
3. Red/ is/ to be/ an/ considered/ field/ of/ biotechnology/ inclusive/ research.
4. working/ diseases/ on/ Biotechnologists/ cures/ to/ various/ and/ finding/ human,/ such as/ AIDS/ hepatitis.
5. Medical/ will/ drugs/ producing/ involve/ biotechnology/ pharmaceutical/ new.

Assignment 3. Match (1-6) to the descriptions (a-f):

1. enzymes	a) a special substance that you take into your body to prevent a disease.
2. antibodies	b) any natural or artificially made chemical that is used as a medicine.
3. protein	c) the smallest basic unit of a plant or animal.

4. drugs	d) proteins that protect you when an unwanted substance enters your body.
5. cell	e) one of the many substances found in food such as meat, cheese, fish, or eggs, that is necessary for the body to grow and be strong.
6. vaccine	f) proteins that help speed up metabolism, for the chemical reactions in our bodies.

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Medical biotechnology is all about the human body and brain.
2. Medical biotechnology will involve producing new pharmaceutical drugs.
3. Red biotechnology helps to enhance patients' quality of life.
4. Red biotechnology uses artificial materials to find solutions to health-related problems.
5. Enzymes in worm cells can be used to treat heart disease in humans.
6. Red biotechnology can't figure out the best drug dosages for patients.

Assignment 5. Make up word combinations using the text:

medical	code
genetic	problems
biological	profession
pharmaceutical	materials
health-related	industry

Assignment 6. Translate the sentences into English using the words you learned:

1. Медична біотехнологія передбачає виробництво нових фармацевтичних препаратів, антитіл, вакцин тощо.
2. Червона біотехнологія використовує біологічні матеріали для пошуку рішень проблем, пов'язаних зі здоров'ям.
3. Антитіла та білки постійно досліджують, щоб допомогти в лікуванні різних захворювань.
4. Ферменти у клітинах хом'яків можуть бути використані для лікування серцевих захворювань у людей.
5. Червона біотехнологія допомагає підвищити якість життя пацієнтів.

2.2. Industrial “White” Biotechnology

BASIC WORD LIST

Study the following words and expressions.

Biocatalyst	біокаталізатор
mould	цвіль
yeast	дріжджі
regulation	норма
biodegradable	біорозкладні
renewable	поновлювані
starch	крохмаль
destructive	руйнівний
recovery	відновлення
conventional	звичайний
sludge	мул
trickling	струминні
amino acids	амінокислоти
vertebrates	хребетні
fungi	гриби
mites	кліщі
to be unwanted	бути небажаним



Biotechnology has a wide area of application that plays a very important role in our daily life. There is one important field of biotechnology known as ‘White biotechnology’. White biotechnology is just an implementation of biotechnology in the industrial

sphere that helps the growing bioeconomy. The primary key tools of white technology are **Biocatalysts**. Biocatalysts are widely used in various chemical and agro-food industries.

Biocatalysts are new enzymes and microorganisms that are the improved version of enzymes that act as a toolbox that is used in evaluation techniques that are applied in Enzyme engineering.

Now, the question is why this biotechnology is known as white biotechnology the answer is when we apply application part of this field in our daily life during the practical process we use **mould**, bacteria, yeast, and different enzymes that help to

synthesize products that are easy to degrade, they create less waste and for their function, they require less energy for their production. In short, we can say that white biotechnology has stricter environmental **regulations** and helps to grow a mass of **biodegradable** products.

The role of white biotechnology sees in many innovations in the chemical, food, packaging, health care industries, and textile industries also.

Let's discuss all major application parts of White Biotechnology :

1. Production of energy from renewable biomasses

White biotechnology helps in the production of energy from **renewable** biomasses (renewable biomasses are like **starch** from corn, potatoes, organic matter such as wood, crop waste garbage, etc) they are known as biopower technologies that help to convert renewable biomass fuels into heat and electricity. It is a conversion process like the conversion of stored biomass to produce biopower. These types of energy are helpful to reduce pollution in our environment.

2. Production of biodegradable plastics

As we see in our daily life we use plastics in very large amounts which leads us to cause degradation of our environment because they are non-biodegradable and causes environmental pollution that shows a **destructive** impact on living organisms. So, replacement of this harmful plastic is required to reduce its impact on our environment. In white biotechnology, there is one important application part that is known as the Production of biodegradable plastics.

3. Role in Recovery of metals

In the White biotechnology field, several bio-based technologies are used for various research and development activities. White biotechnology offers pyrometallurgical technology and biohydrometallurgy that is very helpful in the **recovery** of metal. These methods are constructive, show lower environmental impact, or be cost-effective compared to **conventional** methods.

4. Helps in the production of Bio-Based fuel & Energy

White biotechnology has the greatest contribution to the production of ethanol i.e. greatest contribution to energy production. White biotechnology helps in the production of biofuels that help to control environmental pollution, help to decrease oil prices, and increase the advancement to promote the development of alternative energy.

5. White biotechnology used in waste treatment

In biotechnology, there are different types of methods like activated **sludge**, **trickling** filters, oxidation ponds, biofilters, and anaerobic methods that are biological techniques based, and are used in waste treatment.

6. Production of Different types of metabolites

The white biotechnology field shows advanced technologies for the production of various types of metabolites either primary metabolites or secondary metabolites.

Primary metabolites like **amino acids**, nucleosides, etc are used in various processes such as fermentation or chemical synthesis and are rarely used in therapeutic compounds.

Secondary metabolites are low molecular mass that is produced during the idiophase of microorganisms. They are used for human health and the economic purposes of our society.

7. White biotechnology application part in the production of Biocontrol agent

White biotechnology plays a very important role in controlling various organisms like **vertebrates**, **fungi**, bacteria, viruses, **mites**, insects, and natural chemicals. Biocontrol agents are those that help to control and for the protection of resources that are not good for human beings. These biocontrol agents will be developed using GM technologies. For example, FBCAs (Fungal biocontrol agents) produce mycotoxins (toxigenic fungi) that **are** useful to control **unwanted** vegetation.

Like all technologies, white biotechnology provides enormous benefits that are very beneficial to our environmental health. By using this technology we have to solve problems and make useful products.

Assignment 1. In pairs, discuss the following questions:

- 1) What does White biotechnology deal with?
- 2) Why is this biotechnology known as white biotechnology?
- 3) What are the main tools of White Technology? And where are they used?
- 4) What are Biocatalysts?
- 5) In which industries is White Biotechnology used?
- 6) What are the examples of industrial biotechnology using?
- 7) How does White biotechnology help in energy production?
- 8) Why is it necessary to produce biodegradable plastics?
- 9) What technologies does White biotechnology offer in metal recovery?
- 10) What is the use of biofuel production?
- 11) What methods are used in waste treatment?
- 12) What fungi are useful for controlling unwanted vegetation?

Assignment 2. Put the words in the right order:

1. are/ Biocatalysts/ used/ chemical/ various/ and/ widely/ agro-food/in /industries.
2. environment/ types/ are/ These/ helpful/ energy/ to/ of/ reduce/ pollution/ in/ our.
3. are/ society/ used/ and/ for/ the/ health/ economic/ human/ our/ purposes/ They/of.
4. tools/ are/ white/ key/ The/ technology/ primary/ of/ Biocatalysts.
5. White/ helps/ in/ biomasses/ production/ the/ energy/ of/ from/ biotechnology/ renewable.

Assignment 3. Make up word combinations using the text:

industrial	pollution
white	vegetation
environmental	filters
biodegradable	sphere
destructive	impact
conventional	sludge
environmental	products
activated	methods
trickling	regulations
unwanted	technology

Assignment 4. Match (1-6) to the descriptions (a-f):

1. mould	a) a substance in foods such as rice, bread, and potatoes
2. sludge	b) a green or black substance that grows in wet places or on old food
3. mite	c) things that are not wanted, especially what remains after you have used something
4. fungi	d) an extremely small insect with eight legs
5. starch	e) soft, wet soil, or a substance that looks like this
6. waste	f) a type of plant without leaves and without green colouring that gets its food from other living or decaying things

Assignment 5. Are the following statements true or false? Correct the false ones:

1. White biotechnology is primarily focused on improving agricultural practices.
2. Biocatalysts are advanced enzymes and microorganisms used in various industries.
3. The production of biodegradable plastics is a significant application of white biotechnology.

4. White biotechnology has no impact on energy production.
5. The text states that white biotechnology can help recover metals using bio-based technologies.
6. Primary metabolites are commonly used in therapeutic compounds according to the text.
7. White biotechnology can help control harmful organisms through biocontrol agents.

Assignment 6. Match the words from the left to their synonyms on the right and compare their meanings:

contribution	purpose
waste	decrease
synthesize	advantageous
reduction	manage
role	input
conventional	advancements
beneficial	produce
innovations	traditional
control	residue

Assignment 7. Translate the sentences into English using the words you learned:

1. Під час практичного процесу ми використовуємо цвіль, бактерії, дріжджі та різні ферменти, які допомагають синтезувати продукти.
2. Біотехнологія має широку область застосування, яка відіграє дуже важливу роль у нашому повсякденному житті.
3. Білі біотехнології відіграють дуже важливу роль у контролі різних організмів, таких як хребетні, віруси, бактерії, гриби, комахи, кліщі та природні хімічні речовини.
4. Біокатализатори – це нові ферменти і мікроорганізми, які є поліпшеною версією ферментів.
5. Біла біотехнологія дає величезні переваги, які дуже корисні для нашого екологічного здоров'я.
6. Виробництво біорозкладаних пластмас одна з важливих частин застосування у білій біотехнології.

2.3. Agricultural and Environmental “Green” Biotechnology

BASIC WORD LIST

Study the following words and expressions.

biopesticides	біопестициди
thrive	розквітати/ процвітати
artificial insemination	штучне запліднення
contaminated sites	забруднені ділянки
eliminate	знищувати/ усувати
pollutants	забруднюючі речовини
convert	перетворювати
invent	винаходити, першим створювати
reduce	зменшити
instead of	замість



These two areas of biotechnology are both put into the “green” color category.

Basically, green biotechnology concentrates on technologies related to agriculture, such as when it comes to finding ways to produce stronger crops or creating new **biopesticides** to reduce how many chemicals are used by farmers.

Other projects that agricultural biotechnologists will be involved in include the following:

- Using bacteria to encourage plant growth and improve crop yields.
- Using plants to remove heavy metals from the environment that can be toxic to it as well as to human health.
- Using genetic manipulation to help plants **thrive** in spite of damaging weather conditions, such as frost.
- Using technology in animal breeding, such as the use of **artificial insemination**, which is said to be the most widely applied animal biotechnology.

As for environmental biotechnology, the main goal is combining biology with engineering. This can develop various processes to clean **contaminated sites**.

Fungi, bacteria, and microbes are often used as organic ways of **eliminating pollutants** in the environment. Some tasks that environmental biotechnologists will have include the following:

- **Converting** plants into biofuels.
- **Inventing** plant-based bioplastics that are kinder to the environment and can **reduce** waste.
- Engineering microbes or plants that can process and eliminate toxins and contaminants in the environment.
- Using geographic information systems to find and map contaminated sites as well as how the pollutants spread.
- Transforming waste into biogas or other natural sources of energy.
- Finding ways to make industrial processes cleaner, such as by using biological enzymes **instead of** chemical substances.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the primary focus of green biotechnology?
- 2) How does green biotechnology aim to reduce the use of chemicals in farming?
- 3) What role do bacteria play in agricultural biotechnology?
- 4) How can plants be used to benefit the environment in agricultural biotechnology?
- 5) Why is genetic manipulation important in agriculture, particularly regarding weather conditions?
- 6) What is one of the most widely applied technologies in animal breeding?
- 7) What is the main goal of environmental biotechnology?
- 8) How do fungi, bacteria, and microbes contribute to environmental biotechnology?
- 9) What are some of the benefits of converting plants into biofuels?
- 10) How can geographic information systems be used in environmental biotechnology?

Assignment 2. Make up word combinations using the text:

green	sites
heavy	waste
weather	substances
artificial	conditions
reduce	metals
contaminated	biotechnology
chemical	insemination

Assignment 3. Put the words in the right order:

1. is/ biotechnology/ most/ animal/ Artificial/ widely/ used/ insemination/ by.

2. improve/ to /Using/ plant/ encourage/ bacteria/ yield/s growth/ and/ crop.
3. on/ concentrates/ biotechnology/ related/ agriculture/ Green/ technologies/ to.
4. other/ waste/ or/ into/ Transforming/ biogas/ energy/ sources/ natural/ of.
5. of/ enzymes/ Use/ chemicals/ of/ biological/ instead.

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Plant bioplastics can increase waste.
2. Geographic information systems are used to find and map contaminated sites, as well as ways to spread pollutants.
3. Using chemicals instead of biological enzymes is a way to make industrial processes cleaner.
4. The use of genetic manipulation helps plants thrive despite harmful weather conditions such as frost.
5. Waste can be transformed into biogas or other natural energy sources.
6. Fungi, bacteria and microbes are often used as inorganic ways to eliminate pollutants in the environment.

Assignment 5. Match (1-4) to the descriptions (a-d):

1. insemination	a) anything growing from the ground, having a stem, a root and leaves
2. crop	b) a place where a building, town etc is, was, or is to be, built
3. site	c) a plant which is farmed and harvested
4. plant	d) the act of sowing (of seeds in the ground or, figuratively, of germs in the body or ideas in the mind, etc.)

Assignment 6. Translate the sentences paying attention to the italicized words:

1. The *site* for the new factory has not been decided.
2. This *site* has a lot of useful links for finding out more about the subject.
3. There are some *plants* that are used only in medicine.
4. In our country there are some *plants* producing chemical fertilizers.

5. That bird has a large **crop**.
6. Grain **crops** are widely grown by farmers.

Assignment 7. Complete the translation of the sentences:

1. (Штучне запліднення) is a common technique in agricultural biotechnology, improving the genetics of livestock and increasing production efficiency.
2. Biotechnologists are developing methods to clean (забруднених місць) by using plants that naturally absorb and (знищують) pollutants.
3. Using bacteria that (процвітають) in polluted environments allows for the natural remediation of (забруднених місць), a process known as bioremediation.
4. (Замість того, щоб) relying on traditional chemical fertilizers, biotechnology offers biofertilizers that can naturally improve soil health and (врожайність).
5. Certain plants can absorb heavy metals from the soil, helping to (усунути) contaminants and improve soil quality for future crops.
6. Scientists continuously (винаходять) biopesticides that target specific pests without harming beneficial organisms, reducing the need for chemical pesticides.

Assignment 8. Translate the sentences into English using the words you learned:

1. Створення нових біопестицидів необхідні для зменшення кількості хімічних речовин, які використовуються фермерами.
2. Бактерії можуть стимулювати ріст рослин і поліпшити врожайність.
3. Зелена біотехнологія концентрується на технологіях, пов'язаних з сільським господарством.
4. Важкі метали з навколишнього середовища можуть бути токсичними для нього, а також для здоров'я людини.
5. Найбільш широко застосовуваною біотехнологією тварин є використання штучного запліднення.
6. Основна мета екологічної біотехнології – поєднання біології з інженерією.
7. Одне із завдань біотехнологів-екологів є перетворення рослин в біопаливо.

2.4. Marine “Blue” Biotechnology

BASIC WORD LIST

Study the following words and expressions.

food supplements	харчові добавки
algae	водорості
shellfish	молюски
terrestrial organisms	земні організми
sponge	губка
venom	отрута
cone snail	конусоподібний равлик
painkiller	знеболююче
potent	потужний
microalgae	мікрowodорості
jellyfish	медуза



The oceans cover 70% of our planet's surface with a vast expanse of sea water. Human beings have been relying on the ocean's resources to sustain themselves.

However, with the rise of modern society and the emergence of new technologies we have been able to explore the oceans more and understand better the many marine

organisms that inhabit the seas. So how do we use ocean resources?

Blue biotechnology is sometimes regarded as the fourth main type of biotechnology. It refers to the study of marine organisms with a focus on using these organisms for various human purposes, such as creating new medicines, cosmetics, and **food supplements** to enhance human health.

Drug discovery represents one of the most promising and highly visible outcomes of blue biotechnology. Biochemical compounds that are produced by marine invertebrates, **algae**, bacteria and **shellfish**, are very different than those from related **terrestrial organisms** and thus offer great potential as new classes of medicines. Some of the examples of marine-derived drugs include an antibiotic from a fungi, two closely related compounds extracted from a **sponge** that can be used to treat cancer and the herpes virus, and a neurotoxin, a substance derived from the **venom** of **cone snails**, that has a kind of **painkiller** properties which makes it 10,000 times more **potent** than morphine without having any side effects to the patient.

An exciting idea is using marine biotechnology to create alternative sources of energy. Biofuel, for example, can be made from **microalgae**. The benefit is that algal biomass can be artificially grown without competing with other plants.

The industrial sector benefits greatly from “blue” biotechnology. Various proteins, biopolymers, biomaterials, and enzymes are produced in large quantities from the marine ecosystem.

Examples include biotechnology products such as green fluorescent protein derived from **jellyfish** that’s used to create energy due to how it reacts to UV light.

Assignment 1. In pairs, discuss the following questions:

- 1) What does marine biotechnology do?
- 2) What is one of the most promising and highly visible results of Blue biotechnology?
- 3) What diseases are treated with compounds extracted from a sponge?
- 4) What substance is derived from the venom of cone snails? And what properties does it have?
- 5) What algae can be used to make biofuels? And what is their advantage?
- 6) What are the benefits of blue biotechnology for the industrial sector?
- 7) What is derived from jellyfish? And what is used for?

Assignment 2. Match the words from the left to their synonyms on the right and compare their meanings:

venom	obtain
outcome	salt water
produce	populate
derive	invent
inhabit	create
create	poison
marine	result

Assignment 3. Put the words in the right order:

1. is/ type/ biotechnology/ the/ regarded/ as/ Blue/ main/ fourth/ of/ biotechnology.
2. sources/ Using/ alternative/ biotechnology/ create/ marine/ to/ energy.
3. kind/ painkiller/ Neurotoxin/ of/ properties/ has/ a.
4. protein/ fluorescent/ from/ Green/ energy/ derived/ create/ jellyfish/ to/ used.

5. extracted/ a/ herpes/ sponge/ Compounds/ be/ treat/ virus/ used/ to/ from/ can/ the/ cancer/ and.

Assignment 4. Make up word combinations using the text:

cone	biotechnology
terrestrial	sources
blue	snail
alternative	organisms
marine	resources
modern	protein
ocean	ecosystem
fluorescent	society

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Green fluorescent protein derived from shellfish used to create energy.
2. The oceans cover 90% of our planet's surface.
3. Neurotoxin has a kind of painkiller properties.
4. One of the most promising and highly visible outcomes of blue biotechnology is cosmetic discovery.
5. Blue biotechnology is sometimes regarded as the fourth main type of biotechnology.
6. Morphine is derived from cone snail venom.
7. Various proteins, biopolymers, biomaterials, and enzymes are produced in large quantities from the marine ecosystem.

Assignment 6. Match (1-5) to the descriptions (a-e):

1. sponge	a) a drug etc which lessens or removes pain
2. venom	b) a drug made from opium, used to stop people from feeling pain or to make people feel calmer
3. painkiller	c) made by man; not natural; not real
4. morphine	d) the poison produced by some snakes, scorpions etc, transmitted by biting or stinging
5. artificial	e) a type of sea animal, or its soft skeleton, which has many holes and is able to suck up and hold water

Assignment 7. Complete the translation of the sentences:

1. The (губка) is an example of a marine organism that has been studied for its antibacterial and antifungal properties.
2. Some marine animals, like the (конусоподібний равлик), produce (отрута) that has shown remarkable medicinal potential.
3. Unlike typical pain medications, this marine-derived (знеболюючий засіб) is highly effective without causing harmful side effects.
4. (Водорості) and (мікроводорості) are commonly used in this field due to their high nutritional value and potential for producing biofuels.
5. Unlike (наземні організми), marine species like (молюски) and (губки) produce unique bioactive compounds valuable for health and medical research.

Assignment 8. Translate the sentences into English using the words you learned:

1. Синя біотехнологія відноситься до вивчення та використання морських організмів для створення нових ліків, косметики, харчових добавок для поліпшення здоров'я людини.
2. З появою сучасного суспільства та нових технологій люди дослідили більше океанів і краще зрозуміли багато морських організмів, які населяють моря.
3. Водорості біомаси можуть бути штучно вирощені без конкуренції з іншими рослинами.
4. З морської екосистеми виробляються у великій кількості різні білки, біополімери, біоматеріали та ферменти.
5. Приклади ліків морського походження включають грибковий антибіотик і дві сполуки, отримані з губки, для лікування раку та герпесу.
6. Іншим прикладом є нейротоксин з отрути конусного равлика, який має безпечні властивості в 10 000 разів сильніші за морфін без побічних ефектів.

2.5. Yellow Biotechnology

BASIC WORD LIST

Study the following words and expressions.

repository	сховище
nutrient	поживна речовина
health-promoting additives	корисні для здоров'я добавки
fortification	збагачення
fermentation	бродіння
storage	зберігання
preservation	збереження/консервація
test-tube meat	м'ясо з пробірки
non-healing wounds	незагойні рани
tobacco hornworm	тютюновий роговик
silkworm	шовкопряд
pest	шкідник



Yellow biotechnology is analogous to the red (animals) and green (plants) biotechnology. Making the enormous **repository** of all the natural substances available to the bio-economy is yellow biotechnology, which is also called 'Insect Biotechnology'.

In other words, Yellow Biotechnology is mainly the use of biotechnological techniques on insects or their cells to develop different products or services that are used in agriculture, medicine, and industry.

These Are What Yellow Biotechnology Includes

- Minimizing environmental exploitation from meat production
- Modification of plant toxins
- Extracting useful insects products

Goals of Yellow Biotechnology

The major goal of yellow biotechnology is to provide high **nutrient** value quality foods to humans that have **health-promoting additives** without harming (or polluting) the environment.

The On-Going Applications of Yellow Biotechnology

1. Insect Derived Enzymes for White Biotechnology

Insects can eat any organic product because they have specialized enzymes.

These specialized enzymes can be used for the food industry and waste management of organic products.

2. Nutritional Food Production

Production of quality foods, improvement, and nourishment by using technologies such as **fortification**, enzymatic, microbial, and GMOs.

Using fermentation technologies for enhancing food aroma, taste, and nutrition quality. **Storage** and **preservation** of food from the various harmful microbes and enhancing their self-life.

3. Genetically Modified (GM) Crops

Genetic engineering is the main tool for the removal and addition of particular gene codes in organisms, plants, or animals. So by removing unwanted genes from the plants or animals and the addition of useful genes provides more nutritious, healthy, and tasty food.

Majorly grown agricultural crops like maize, rice, wheat, tomato, eggplant, bean, cauliflower, potato, apple, orange, etc. are already genetically modified and successfully grown at the commercial level. Similarly, animals that are used for eggs and meat production are also genetically modified for high-quality eggs and meat.

4. In-Vitro Cell Culture Technology

By using animal tissue culture techniques test-tube meat was also produced. For the production of meat, in vitro cell culture technology is used on adult cow stem cells.

5. Drugs from Insects

Lucilia sericata (common green bottle fly) is used for the treatment of chronic or non-healing wounds. Larval secretions of *Lucilia sericata* in-vitro were found to improve wound closure.

6. RNAi technology for Insect Pest Management

Insects are major pests that affect the crop directly or indirectly and they are the major constraint to fulfill global food demands. Traditional pest control strategies like chemical, mechanical, biological, etc. have limitations. Using chemicals and pesticides is harmful to the environment and for us. The use of existing transgenic approaches also has certain limitations.

RNAi (RNA interference) technology is sequence-specific silencing for the targeted gene is a naturally occurring process in plants that provide defense against pathogens or pests. So using RNAi technology we can control the maximum types of insects.

7. Insect Chitinases as Biopesticides

Chitinases isolated from insects such as **tobacco hornworm**, **silkworm**, etc. Insect chitinases are used as the biological control agent for **pest** control either alone or with combination insecticidal proteins like *Bacillus thuringiensis*.

Assignment 1. In pairs, discuss the following questions:

- 1) What is Yellow biotechnology?
- 2) What is another name for Yellow biotechnology?

- 3) What does Yellow biotechnology include?
- 4) What is the main purpose of Yellow biotechnology?
- 5) Why can insects eat any organic food?
- 6) What are fermentation technologies used for?
- 7) What can be gained by removing unwanted genes from plants or animals and adding useful genes?
- 8) What has been produced using animal tissue culture techniques?
- 9) For what purposes is the common green bottle fly used?
- 10) Using what technology can we control the maximum number of insect species?
- 11) How are insect Chitinases used?

Assignment 2. Match the words from the left to their synonyms on the right and compare their meanings:

types	delete
goal	nutrition
remove	delicious
food	fit
tasty	species
healthy	purpose

Assignment 3. Put the words in the right order:

1. can/ because/ specialized/ eat/ enzymes/ organic/ Insects/ products/ they/ have/ any.
2. Using/ harmful/ the/ pesticides/ is/ chemicals/ us/ to/ and/ environment/ and/ for.
3. chitinases/ biological/ are/ as/ control/ for/ the/ Insect/ agent/ used/ control/ pest.
4. RNAi\ Using/ technology/ maximum/ we/ of/ can/ control/ insects/ types/ of.
5. Using/ aroma,/ technologies/ quality/ nutrition/ for/ taste,/ enhancing/ food/ and/ fermentation.

Assignment 4. Make up word combinations using the text:

natural	control
harmful	modified
gene	cells
genetically	economy
stem	code
pest	substances
test-tube	fly

bio-
bottle

microbes
meat

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Yellow biotechnology is analogous to red and Blue biotechnology.
2. Genetic engineering is the main tool for the removal and addition of particular gene codes in organisms, plants, or animals.
3. Insects can eat any organic product because they have specialized proteins.
4. For the production of meat, in vitro cell culture technology is used on adult pig stem cells.
5. Traditional pest control strategies like chemical, mechanical, biological, etc. have limitations.
6. Using DNA technology we can control the maximum types of insects.

Assignment 6. Match (1-5) to the descriptions (a-e):

1. pest	a) a physical hurt or injury
2. nutrient	b) the act of storing or state of being stored
3. pesticide	c) a creature that is harmful or destructive, eg a mosquito, a rat
4. wound	d) a substance which gives nourishment
5. storage	e) etc a substance that kills animal and insect pests

Assignment 7. Translate the sentences into English using the words you learned:

1. Жовту біотехнологію також називають «біотехнологією комах».
2. Жовта біотехнологія включає: мінімізацію впливу на навколишнє середовище від виробництва м'яса; модифікацію рослинних токсинів; добування корисних для комах продуктів.
3. Генна інженерія є основним інструментом для видалення та додавання певних генних кодів в організмах, рослинах і тваринах.
4. Видалення небажаних генів із рослин або тварин і додавання корисних генів забезпечує більш поживну, здорову та смачну їжу.
5. Використання хімікатів і пестицидів шкодить навколишньому середовищу і людям.

2.6. Grey Biotechnology

BASIC WORD LIST

Study the following words and expressions.

disposal	утилізація
mining	видобуток корисних копалин
endangered organisms	зникаючі організми
survive	вижити
Bioremediation	Біоремедіація
deforestation	вирубка лісів
converting	перетворення
deposit	наносити
organic compounds	органічні сполуки
decompose	розкладати
biodiversity	біорізноманіття
update	оновлення
to track	відслідковувати
preservation	збереження
sewage	стічні води
bio manure	біоген
weed	бур'ян
environmentally friendly	екологічно чистий



This is quite similar to green biotechnology. It focuses on the use of living organisms to improve our environment.

So, it can include removing pollutants from the environment with the use of microorganisms. Other tasks and processes that can fall under grey biotechnology include the following:

- Protecting the flora and fauna from pollution.
- Human waste **disposal** and management with the use of microorganisms.
- Controlling pollution with the use of microorganisms.

The need for Grey Biotechnology arises due to environmental pollution that is caused by human activities like urbanization, **mining**, industrialization, and overexploitation of flora and fauna resources. To minimize the impact of man's activities on the environment it protects the environment.

Every year's tons of waste products produced by various industries like chemicals, pharmaceuticals, agriculture, food, plastic, etc. cause various harmful impacts on organisms. These waste products cause pollution in the air, water, and land. If we properly manage these waste products we can reduce environmental pollution and save **endangered organisms** who are unable to **survive** due to pollution. Currently, we are facing three main types of pollution.

- Air Pollution
- Water Pollution
- Soil Pollution

Grey Biotechnology Applications

1. Bioremediation

Bioremediation is the application of microorganisms for removal or **converting** less harmful to the toxic pollutants in the soil or land. Leather, textile, and paper industry **deposits** harsh chemicals to Land or soil that can be reduced or completely eliminated by Bioremediation applications. The main advantage of bioremediation is its ability to destroy a wide range of **organic compounds**.

2. Plastic degradation

Petroleum-based plastics are the main polluting agent on the Earth that do not degrade easily. A promising way to degrade plastic waste is recombinant microbial enzymes and the development of mutant microorganisms that can **decompose** these waste materials.

3. Biodiversity Maintenance

Biodiversity is all the different kinds of flora and fauna you'll find in one area. Due to **deforestation**, industrialization, and pollution, lots of plants and animals fall under the endangered category and it is very harmful to good biodiversity. To maintain biodiversity, record and **update** all available species, their gene data banks, genetic analysis **to track** and clone endangered species for their **preservation** are used.

4. Sewage Treatment

After urbanization, there is a need to develop a system for human waste management. Flowing the **sewages** in rivers causes harmful effects on the environment and aquatic organisms. By applying biotechnological techniques large-scale microorganisms are used for the treatment of sewage to the production of biogas and sludge that can be used as **bio manure**.

5. Biological control agents

Application of chemical agents like pesticides, fungicides, insecticides, etc. to protect the plants from diseases, insects, mites, and **weeds** cause harmful effects on the soil and are the main pollutants. Therefore, reducing these pollutants through the use of biological control or biocontrol agents is a safer and more **environmentally friendly** approach.

Assignment 1. In pairs, discuss the following questions:

1) What does gray biotechnology do?

- 2) What tasks and processes can fall under the gray biotechnology?
- 3) What human activity leads to environmental pollution?
- 4) What are the main types of pollution we are currently facing?
- 5) What is Bioremediation?
- 6) What is the way to degrade plastic waste?
- 7) What is Biodiversity?
- 8) What is used to preserve biodiversity?
- 9) What are used in the application of biotechnological technologies for sewage treatment?
- 10) What are the main pollutants that cause harmful effects on the soil?

Assignment 2. Match the words from the left to their synonyms on the right and compare their meanings:

way	damaging
maintain	contaminate
sewage	maintain
eliminate	method
preserve	wastewater
harmful	remove
pollute	preserve

Assignment 3. Put the words in the right order:

1. biotechnology/ Green/ on/ organisms/ use/ of/ living/ focuses/ improve/ the/ our/ environment/ to.
2. there/ urbanization,/ waste/ need/ is/ human/ a/ to/ develop/ a/ for/ After/ system/ management.
3. year's/ produced/ various/ waste/ products/ of/ Every/ tons/ industries/ by.
4. all/ in/ the/ Biodiversity/ of/ flora/ is/ and/ different/ you'll/ find/ one/ fauna/ kinds/ area.
5. pollution/ land/ of/ air,/ water/ Waste/ causes/ and.

Assignment 4. Make up word combinations using the text:

organic	pollution
environment	organisms
endangered	compounds

bio
environmental
living

friendly
organisms
manure

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Biological control or biocontrol agents are safe and environment friendly.
2. The use of chemicals has a positive effect on the soil.
3. Flowing the sewages in rivers causes harmful effects on the environment and aquatic organisms.
4. The main disadvantage of bioremediation is its ability to destroy a wide range of organic compounds.
5. Petroleum-based plastics are one of the polluting agents on the Earth that are easily degraded.

Assignment 6. Match (1-5) to the descriptions (a-e):

1. sewage	a) the process of cutting down or burning all the trees in a forested area
2. weed	b) to make (something) suitable for the present time by adapting it to recent ideas etc
3. deforestation	c) the act of getting rid of something
4. disposal	d) waste matter (carried away in sewers)
5. update	e) any wild plant, especially when growing among cultivated plants or where it is not wanted

Assignment 7. Translate the sentences into English using the words you learned:

1. Сіра біотехнологія захищає навколишнє середовище щоб мінімізувати вплив діяльності людини на навколишнє середовище .
2. Через вирубку лісів, індустріалізацію та забруднення багато рослин та тварин підпадають під категорію, що знаходиться під загрозою зникнення.
3. Щороку тонни відходів виробництва різних галузей промисловості викликають різні шкідливі наслідки для організмів.
4. Головною перевагою біоремедіації є її здатність руйнувати широкий спектр органічних сполук.

2.7. Brown Biotechnology

BASIC WORD LIST

Study the following words and expressions.

Arid Zone	посушлива зона
low-rainfall	низький рівень опадів
drylands	посушливі земелі
meager	мізерний
negligible	незначний
high yielding livestock	високопродуктивна худоба
drought tolerance	посухостійкість
mandate crops	обов'язкові культури
chickpea	нут
groundnut	земляний горіх
pigeon pea	голубиний горох
millet	просо
wetlands regions	водно-болотні угіддя
solidifying	затвердіння



Brown biotechnology is similar to grey biotechnology. The brown color represents the brown soil in such an area. Brown biotechnology is also called **Arid Zone** and **Desert Biotechnology**. Brown biotechnology is a branch of biotechnology that is related to the management of arid lands and deserts. The technology aims at making a beneficial

impact by using improved disease-free high-quality seeds, creation of new agricultural methods and makes the rational use of water in **low-rainfall** areas. Also, it's about using the microorganism and other livestock animals that can be useful in an arid region.

Deserts and arid lands make a large part of the earth. Especially, in a continent like Africa, where two-thirds of the area is desert or **drylands**, arid soil condition has a major impact. Half of Africa's population live in these deserts. Also, they are among the poorest countries in the world, with **meager** national resources and only primary level education. Likewise, there are inadequate technical infrastructures and weak or **negligible** technological base. And the dry arid soil has been the reason for all these deficiencies in the desert. While primary necessity as feeding the deficiencies has become a major issue in these areas, other infrastructure like health and

education goes unnoticed. Feeding the population in such an area is what Brown biotechnology is all about.

It Includes:

- Use of GMO technology for making improved seeds;
- Develop best post-harvest preservation technology for the arid region;
- Development of saline agriculture and aquaculture;
- Developing Cross-breed high **yielding livestock**.

Applications of Brown Biotechnology

1. Developments of genomic resources in SAT crops have made the “orpan” crops the ‘genomic resource-rich’ one. Using MABC technique they have discovered **drought tolerance** in chickpeas.
2. Around 300 improved cultivars of the plant have been released among the **mandate crops (chickpea, groundnut, pigeon pea, millet, and sorghum)** for the arid regions.
3. Swedish architecture student, Magnus Larson, recently did an experiment that can be practically implemented. His work on the concept of stopping the spread of the Sahara desert by using *Bacillus pasteurii* bacteria. This bacteria excretes calcium carbonate and gluing substances and are able to set the dunes like a block of concrete after twenty-four hours. He suggested the possibility of forming a wall from the existing sand dunes by covering the dunes with these bacteria that are commonly found in **wetlands regions**. *Bacillus pasteurii* are non-pathogenic bacteria that die in the process of **solidifying** the sand.

Assignment 1. In pairs, discuss the following questions:

- 1) What is another name for Brown Biotechnology?
- 2) What does Brown Biotechnology do?
- 3) What continent is home to half the world's population?
- 4) What is the primary need on the continent of Africa?
- 5) What does Brown Biotechnology include?
- 6) What was discovered using the MABC technique?
- 7) How many improved plant varieties have been released among the mandatory crops for arid regions and which ones?
- 8) What did Swedish student Magnus Larson propose to stop the spread of the Sahara Desert?
- 9) How do *Bacillus pasteurii* bacteria die?

Assignment 2. Match the words from the left to their synonyms on the right and compare their meanings:

area	healthy
desert	variety
disease-free	region
preservation	ground
land	scarce
cultivar	arid region
meager	conservation

Assignment 3. Put the words in the right order:

1. Brown/ animals/ is/ about/ the/ an/ arid/ microorganism/ using/ biotechnology/ can/ be/ and/ other/ that/ useful/ in/ livestock/ region.
2. Africa's/ the/ population/ Half/ of/ lives/ desert/ in.
3. make/ part/ and/ arid/ a/ earth/ large/ of/ Deserts/ the/ lands.
4. MABC/ drought/ technique/ they/ Using/ chickpea/ discovered/ have/ tolerance/ in.
5. Larson/ did/ can/ be/ an/ implemented/ experiment/ Magnus/ that/ practically.

Assignment 4. Translate the sentences paying attention to the italicized words:

1. They extensively investigated several **branches** of periodic solutions and their stability.
2. She's third **seed** in the competition.
3. Only man has **reason** – animals do not.
4. Structural damage to each tree was recorded: trunk snap, **branch** damage, bark damage, or a leaning bole.
5. Using **seed** oil in your skincare routine can help moisturize your skin.
6. For similar **reasons**, we examine attitudes towards gender roles and moral issues.

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Brown biotechnology focuses on improving agricultural methods in dry areas.
2. The majority of Africa's population lives in urban areas.
3. The use of genetically modified organisms is part of brown biotechnology.
4. Bacillus pasteurii bacteria are harmful and can cause diseases.

5. Brown biotechnology aims to address food shortages in arid regions.
6. Magnus Larson's experiment involved using bacteria to stop the spread of the Sahara desert.
7. The text states that brown biotechnology has no impact on education in desert areas.
8. Africa is among the richest countries in the world, with rich natural resources and high-level education.

Assignment 6. Match (1-6) to the descriptions (a-f):

1. drought	a) an area of barren country, usually hot, dry and sandy, where there is very little rain
2. experiment	b) having good effects
3. desert	c) (a period of) lack of rain
4. beneficial	d) a test done in order to find out something, eg if an idea is correct
5. resources	e) a large amount of tiny particles of crushed rocks, shells etc, found on beaches etc
6. sand	f) the wealth of a country, or the supply of materials etc which bring this wealth

Assignment 7. Translate the sentences into English using the words you learned:

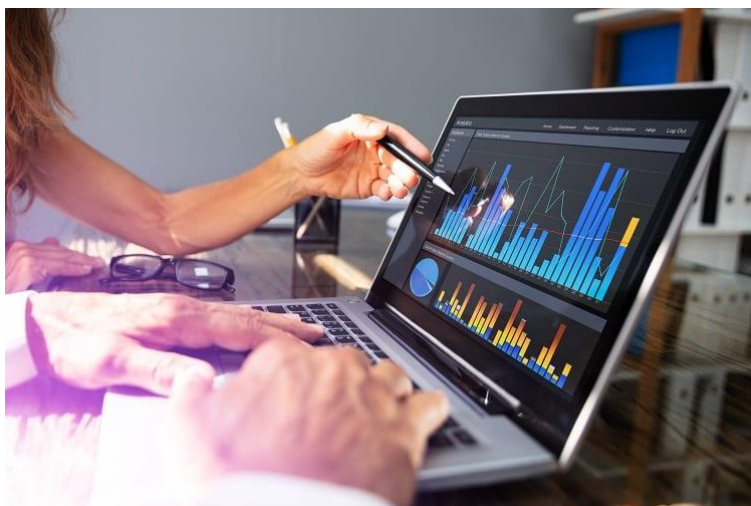
1. Коричнева біотехнологія — галузь біотехнології, яка пов'язана з управлінням посушливими землями і пустелями.
2. Більшість Африканських країн є найбіднішими у світі, з мізерними національними ресурсами та освітою лише початкового рівня.
3. Бактерії *Bacillus pasteurii* виділяють карбонат кальцію та речовини, що склеюють, і здатні через двадцять чотири години скріплювати дюни, як бетонний блок.
4. Одним із напрямків коричневої біотехнології є раціональне використання води в районах з низьким рівнем опадів.
5. *Bacillus pasteurii* — це непатогенні бактерії, які гинуть в процесі затвердіння піску.

2.8. Gold Biotechnology

BASIC WORD LIST

Study the following words and expressions.

knack	хист
brew the idea	виношувати ідею
data	дані
nanoscale	нанорозмір
computational	обчислювальний
vast	величезний
amounts	обсяги/кількість
approximately	приблизно
equal	рівний; однаковий
database	база даних
sequence	послідовність
update	оновлювати



In this article we will be discussing one of the many other colours, Gold Biotechnology, which is a fairly new addition to the biotechnology spectrum.

In the 1980s, Dr. Paul Gold decided to leave his lab work because he believed researchers needed a low-cost, high-quality alternative for chemicals and reagents.

Recognizing his **knack** for business, he began **brewing** the idea for a company during a time when startup incubators were nearly unheard of, and the Internet, social media and crowdfunding didn't exist. Armed with a supportive wife, generous family members and helpful people within his network, Dr. Gold established GoldBio in 1986.

The ambitious startup began its journey selling three products: IPTG, X-Gal and X-Gluc. Now, after more than 30 years, GoldBio has evolved significantly, expanding its catalog from three products to more than 3000 products.

Some of the main areas included in golden biotech are:

- **Bioinformatics.** Field that focuses on analyzing large sets of biological **data**.
- **Nanotechnology.** Field that uses technology at a **nanoscale**, or in other words, at atomic, molecular and macromolecular levels.

- **Computational Biology.** Although closely linked to Bioinformatics, Computational Biology consists of using **computational** methods to develop models for the study of biological systems. This means relying on technologies like Machine Learning, Algorithms, Big Data (to name a few) for building these models.

1. Bioinformatics

1.1 An Introduction to Bioinformatics

Bioinformatics is the application and development of computational tools such as software in order to understand the large complex sets of data generated by the different biological functions. This field incorporates the theoretical and practical knowledge of various fields such as statistics, mathematics, computer sciences, engineering and biology in order to analyse and present the data interpretation in an *in silico* (computer modelling/simulation) manner for further applications.

The Human Genome Project, initiated in 1990 and completed in 2003, was the first to sequence the entire human genome, generating **vast amounts** of data. With **approximately** 50 to 300 million base pairs and an **equal** number of bases, this project significantly impacted the field of bioinformatics.

In genomics, bioinformatics concentrates on identifying single nucleotide polymorphisms (SNPs) and candidate genes for comparative analysis. This analysis helps locate genes and understand their functions and regulation.

1.2 Software Tools

Large data sets lead to the creation of **databases**, essential for comparative **sequence** analysis. These tools allow bioinformaticians to **retrieve**, sort, analyze, predict, and store DNA and protein sequence data. Notably, many of these resources are available for free as websites or Open Source Software (OSS), ensuring easy and reliable access to regularly **updated** data.

Assignment 1. In pairs, discuss the following questions:

- 1) Who is Dr. Paul Gold and what did he believe researchers needed in the 1980s?
- 2) How did Dr. Gold start his company, GoldBio, in 1986?
- 3) What were the three products that GoldBio initially started selling?
- 4) How has GoldBio evolved over the past 30 years?
- 5) What are some of the main areas included in golden biotech?
- 6) What does the field of bioinformatics focus on?
- 7) How is computational biology different from bioinformatics?
- 8) What is bioinformatics and what does it involve?
- 9) When was the Human Genome Project initiated and completed?

- 10) Why are databases essential for comparative sequence analysis in bioinformatics?
- 11) Where can bioinformaticians access many software tools for free?
- 12) What type of data do software tools in bioinformatics help retrieve, analyze, predict, and store?

Assignment 2. Put the words in the right order:

1. that/ analyzing/ Field/ biological/ large/ sets/ of/ focuses/ on/ data.
2. This/ helps/ their/ genes/ and/ and/ understand/ functions/ locate/ analysis/ regulation.
3. sets/ to/ creation/ sequence/ the/ of /databases,/ data/ essential/ lead/ for/ comparative/ Large/ analysis.
4. is/ application/ tools/ and/ the/ Bioinformatics/ development/ of/ computational.
5. X-Gluc/ The/ X-Gal/ began/ ambitious/ and/ its/ selling/ three/ journey/ products:/ IPTG,/ startup.

Assignment 3. Choose the correct answer:

1. What was the primary motivation for Dr. Paul Gold to establish GoldBio?
 - a. To develop computational tools for bioinformatics
 - b. To provide a low-cost, high-quality alternative for chemicals and reagents
 - c. To expand the biotechnology product catalog
 - d. To conduct research in the field of nanotechnology
2. Which of the following is NOT one of the main areas included in the field of Golden Biotechnology?
 - a. Genomics
 - b. Bioinformatics
 - c. Computational Biology
 - d. Nanotechnology
3. How did GoldBio's product offerings evolve over time?
 - a. From 3 products to over 30,000 products

- b. From 3 products to over 300 products
 - c. From 3 products to over 3,000 products
 - d. From 30 products to over 3,000 products
4. What is the primary function of the software tools used in Bioinformatics?
- a. To predict and store DNA and protein sequence data
 - b. To ensure easy and reliable access to regularly updated data
 - c. To analyze and present data interpretation in a computer simulation
 - d. All of the above
5. How did the Human Genome Project impact the field of Bioinformatics?
- a. It led to the development of new computational methods.
 - b. It generated vast amounts of data that needed to be analyzed.
 - c. It helped locate genes and understand their functions and regulation.
 - d. Both B and C
6. What is the main focus of Computational Biology?
- a. Analyzing large sets of biological data
 - b. Using technology at a nanoscale
 - c. Developing computational models for the study of biological systems
 - d. Studying the functions and regulation of genes
7. How did Dr. Paul Gold establish GoldBio in the 1980s?
- a. With the support of startup incubators and crowdfunding
 - b. With the help of the internet and social media
 - c. With the backing of a large biotechnology company
 - d. With the support of his wife, family members, and helpful people within his network

Assignment 4. Are the following statements true or false? Correct the false ones:

- 1. Gold Biotechnology was founded by Dr. Paul Gold in the 1990s.
- 2. GoldBio initially sold only three products.
- 3. Bioinformatics is a field that combines knowledge from various disciplines to analyze biological data.

4. The Human Genome Project was completed in 2003.
5. Nanotechnology in golden biotech focuses on the study of large biological systems.
6. Computational Biology and Bioinformatics are completely unrelated fields.
7. Many bioinformatics software tools are available for free as Open Source Software.

Assignment 5. Match (1-5) to the descriptions (a-e):

1. equal	a) the ability to do something skilfully and easily
2. sequence	b) to make (something) suitable for the present time by adapting it to recent ideas etc
3. update	c) a large amount of information which is stored in a computer
4. knack	d) the same in size, amount, value etc
5. database	e) a series of events etc following one another in a particular order

Assignment 6. Translate the sentences into English using the words you learned:

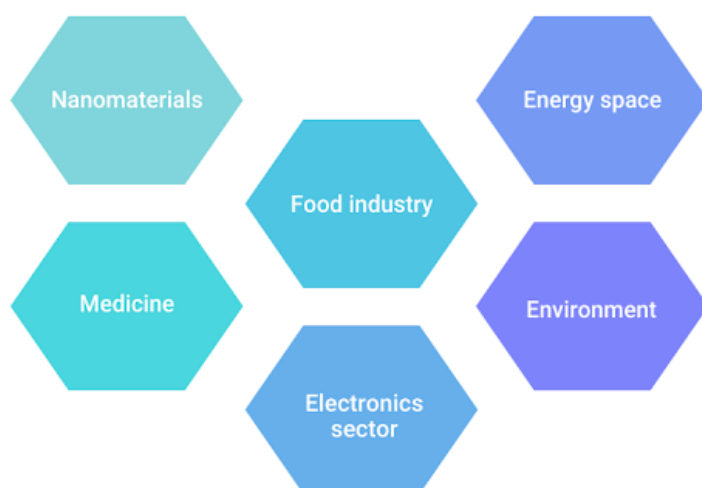
1. Проект «Геном людини» був першим, хто секвенував весь геном людини, створивши величезну кількість даних.
2. Після більш ніж 30 років Goldbio значно розвинувся, розширивши загальну кількість продуктів з трьох до більш ніж 3000 продуктів.
3. Маючи підтримку членів сім'ї та колег доктор Голд заснував GoldBio у 1986 році.
4. Доктор Пол Голд вважав, що дослідникам потрібна недорога високоякісна альтернатива хімікатам і реагентам.
5. Нанотехнології це поле, яке використовує технологію на нанорозмірі, або іншими словами, на атомному, молекулярному та макромолекулярному рівнях.

2. Nanotechnology

BASIC WORD LIST

Study the following words and expressions.

naked eye	неозброєне око
interaction	взаємодія
relationship	зв'язок
properties	властивості
carbon	вуглець
consumption	споживання
validate	перевіряти
obtain	отримати
innovative scientists	вчені-новатори
exceed	перевищувати
revenue	дохід



2.1 Nanotechnology Introduction

Nanotechnology is a novel scientific field and involves the research and application of science, engineering and technology on a nano, atomic or supramolecular scale – usually 0.1-100 nm (one nanometer (nm) is one billionth of a meter).

However, the nanoscale is so small it is impossible to view anything on it with the **naked eye**. It was only with the introduction of the Scanning Tunneling Microscope (STM) and the Atomic Force Microscope (AFM) that the age of nanotechnology started to make leaps and bounds within the scientific community.

The research focuses on individual molecules, examining their structure, **interactions**, and **relationship** to macroscopic **properties**. Nanotechnology is applied to design and synthesize materials and devices with at least one nanoscale dimension, primarily benefiting medical, physiological, and technological fields.

2.2 Applications of Nanotechnology

Nanotechnologies in medicine and physiology are designed for high specificity at the molecular level, enhancing interaction between biological, chemical, physical, and technological fields. By manipulating drugs and materials on a nano scale, their bioactivity can be increased, making them more effective.

In computer science, a key research area is enhancing device speed and performance, heavily influenced by transistors. Most transistors are silicon-based, but limitations call for cheaper, more effective alternatives. Nanotechnology and **carbon** nanotubes offer a solution, promising improved performance, reduced production costs, and lower energy **consumption** for electronic devices.

2.3 Nanoinformatics

Even though it is still in its' early stages, a new approach in gold biotechnology, involves the implementation of both bioinformatics and nanotechnology developing a new field of nanoinformatics. This field is related to the research and determination of which information is relevant to nanoscience and nanoengineering. From there a set of methods needs to be developed and implemented in order to collect, **validate**, store, share, analyze, model and apply that data and information **obtained**.

2.4 Nanotechnology on the market

As nanotechnology expands, so do its opportunities, presenting challenges for **innovative scientists**. According to a 2015 BBC article by McWilliams, the nanotechnology market was projected to **exceed** \$64 billion by 2019 due to its diverse applications. When combined with bioinformatics, the total market potential for nanoinformatics reached \$80 billion. Additionally, applying these technologies in the medical sector could raise **revenues** to over \$500 billion by 2022.

Assignment 1. In pairs, discuss the following questions:

- 1) What is nanotechnology and what does it involve?
- 2) How small is the nanoscale, and why is it impossible to view with the naked eye?
- 3) What technological advancements allowed for the development of nanotechnology?
- 4) How does nanotechnology benefit the medical and physiological fields?
- 5) In what ways can nanotechnology enhance drug effectiveness?
- 6) What are some potential advantages of using nanotechnology in electronic devices?
- 7) What is nanoinformatics and how does it relate to nanoscience and nanoengineering?
- 8) According to the text, what was the projected size of the nanotechnology market by 2019?
- 9) How does combining nanotechnology with bioinformatics impact the market potential for nanoinformatics?

10) How could applying nanotechnology and bioinformatics in the medical sector affect revenues by 2022?

Assignment 2. Match the words from the left to their synonyms on the right and compare their meanings:

devices	receive
small	gather
energy	income
collect	power
obtain	tools
revenue	tiny

Assignment 3. Choose the correct answer:

1. What is the primary purpose of nanotechnology research?
 - a. To examine the interactions between biological, chemical, and physical fields
 - b. To design and synthesize materials and devices on a nano scale
 - c. To enhance the performance and speed of computer devices
 - d. To increase the bioactivity and effectiveness of drugs and materials
2. Which of the following is a key challenge for the field of nanoinformatics?
 - a. Determining which information is relevant to nanoscience and nanoengineering
 - b. Reducing production costs for electronic devices
 - c. Increasing the size of the nanotechnology market
 - d. Designing and synthesizing materials with at least one nanoscale dimension
3. How is nanotechnology being applied in the medical and physiological fields?
 - a. By developing new methods for data collection and validation in nanoinformatics
 - b. By enhancing the interaction between biological, chemical, physical, and technological fields
 - c. By improving the speed and performance of computer devices
 - d. By manipulating drugs and materials on a nano scale to increase their bioactivity

4. According to the passage, what is the projected size of the combined nanotechnology and bioinformatics market?
- a. Over \$500 billion by 2022
 - b. \$64 billion by 2019
 - c. \$80 billion
 - d. The passage does not provide a specific market size projection
5. What technological advancement enabled the development of nanotechnology?
- a. The implementation of bioinformatics and nanotechnology
 - b. The limitations of silicon-based transistors in computer science
 - c. The diverse applications of nanotechnology in various fields
 - d. The invention of the Scanning Tunneling Microscope and Atomic Force Microscope
6. What is the nanoscale range mentioned in the passage?
- a. 0.1-100 micrometers
 - b. 0.1-100 millimeters
 - c. 0.1-100 nanometers
 - d. 0.1-100 meters
7. Which of the following is a key research area in computer science related to nanotechnology?
- a. Enhancing device speed and performance
 - b. Improving the bioactivity of drugs and materials
 - c. Developing methods for data collection and validation in nanoinformatics
 - d. Increasing the size of the nanotechnology market

Assignment 4. Are the following statements true or false? Correct the false ones:

- 1) Nanotechnology can be observed with the naked eye.
- 2) The Scanning Tunneling Microscope (STM) and the Atomic Force Microscope (AFM) were crucial in advancing nanotechnology.
- 3) Nanotechnology is only beneficial for the medical field.

- 4) Carbon nanotubes are being researched as a potential alternative to silicon in transistors.
- 5) Nanoinformatics combines bioinformatics and nanotechnology to manage and apply data relevant to nanoscience.
- 6) The nanotechnology market was projected to exceed \$64 billion by 2019.
- 7) The application of nanotechnology in the medical sector could potentially raise revenues to over \$500 million by 2022.

Assignment 5. Match (1-5) to the descriptions (a-e):

1. property	a) money which comes to a person etc from any source or sources (eg property, shares), especially the money which comes to a government from taxes etc
2. share	b) to put into a place for keeping
3. revenue	c) an invitation to a contest
4. challenge	d) a quality (usually of a substance)
5. store	e) to have, use etc (something that another person has or uses); to allow someone to use (something one has or owns)

Assignment 6. Translate the sentences into English using the words you learned:

1. Більшість транзисторів виготовлені на основі кремнію, але обмеження вимагають більш дешевих і ефективних альтернатив.
2. Наномасштаб настільки малий, що неможливо побачити щось на ньому неозброєним оком.
3. Нанотехнології - це галузь науки та техніки, яка зосереджена на проектуванні та виробництві надзвичайно малих пристроїв і структур.
4. Наноінформатика пов'язана з дослідженнями і визначенням того, яка інформація має відношення до нанонауки та наноінженерії.
5. Маніпулюючи ліками та матеріалами в наномасштабі, можна підвищити їх біоактивність, що зробить їх ефективнішими.

Посилання на відео до тексту:

<https://www.youtube.com/watch?v=lichkzk21hA>

2.9. Violet Biotechnology

BASIC WORD LIST

Study the following words and expressions.

encompass	охоплювати
property	власність
ethical issues	етичні питання
delivered	виголошувати/виносити
crucial	вирішальне значення
knowledge-intensive	наукомісткість
vital	життєво важливий
rely on	покладатися на
asset	актив
traceability	відстеження
conventional	звичайний
framework	основа; база
multiple	кілька/багато



Violet Biotechnology is the legal branch of Biotechnology that **encompasses** intellectual **property** rights, patents, laws, **ethical issues**, biosecurity, philosophic issues, biosafety, and legal issues. Violet biotechnology has to deal with all ethical, moral, and patent issues developed by the modification of genes in living

organisms, plants, and animals.

Purple Biotechnology is mainly related to legal and regulatory issues in biotechnology. While ethical issues, biosafety, biosecurity, and philosophic issues related to Biotechnology fall under Violet Biotechnology. Purple Biotechnology majorly focuses on the making of rules, laws, and publishing patents related to biotechnology. But majorly Purple and Violet Biotechnology are considered the same area of Biotechnology.

History of Violet Biotechnology

Patenting on living organisms is not new. It is about 148 years old. For the first time, Louis Pasteur got US Patent No. 141.072 in the year 1873 for the organic germ-free Yeast as the article of manufacture. Later in 1975, the German Federal Supreme Court **delivered** a judgment in Baker's yeast case that 'Microorganisms are patentable'.

Violet biotechnology was created in 1980 when the U.S. Supreme Court decided that genetically modified microorganisms could be patented.

Major Areas of Violet Biotechnology

Violet Biotechnology can be broadly divided into three broad categories.

1. IPRs in Biotechnology
2. Legal and Regulatory Issues in Biotechnology
3. Ethical and Philosophical Issues in Biotechnology

1. IPRs in Biotechnology

Intellectual Property Rights (IPRs) are **crucial** for innovation, particularly in **knowledge-intensive** sectors like biotechnology. Patents and copyrights drive innovation by protecting commercially valuable products developed through human intellect. Since biotech research is costly, patents are **vital** for recovering investments, especially for start-ups and firms that **rely on** innovation as their primary **asset**.

2. Legal and Regulatory Issues in Biotechnology

Key elements in biotechnology regulation include risk analysis, lab control, environmental release, **traceability**, monitoring, and socio-economic factors. Different countries adopt various regulatory approaches. In 1992, the U.S. FDA stated that biotechnological products are as safe as **conventional** food, requiring pre-market approval only under specific conditions. In India, the Biotechnology Regulatory Authority of India (BRAI) bill was passed in 2013, providing a formal **framework** to regulate the biotechnology industry, which was previously governed by **multiple** laws like the Environment Protection Act and Biological Diversity Act.

3. Ethical and Philosophical Issues in Biotechnology

Every field has its ethics, and biotechnology's ethics, known as bioethics, focus on preserving the planet's ecology while applying scientific advancements. Key bioethical issues include research on human subjects, organ transplantation, genetics, reproduction, and end-of-life care. Ethical evaluation in biotechnology requires understanding the science and weighing risks against benefits. The power of molecular techniques to manipulate life, such as inserting genes between species, raises ethical concerns, especially when comparing controlled lab use (e.g., insulin production) to releasing genetically modified organisms into the environment.

Assignment 1. In pairs, discuss the following questions:

- 1) What does Violet Biotechnology encompass in terms of legal aspects?
- 2) How is Purple Biotechnology different from Violet Biotechnology?
- 3) When was the concept of patenting living organisms first introduced?
- 4) What landmark decision in 1980 led to the creation of Violet Biotechnology?
- 5) What are the three major areas that Violet Biotechnology can be divided into?
- 6) What is the significance of the German Federal Supreme Court's judgment in the Baker's yeast case?

- 7) Why are Intellectual Property Rights (IPRs) important in the field of biotechnology?
- 8) How do different countries approach the regulation of biotechnological products?
- 9) What is bioethics, and why is it important in the field of biotechnology?
- 10) What are some key bioethical issues discussed in the text related to biotechnology?

Assignment 2. Choose the correct answer:

1. What is the main purpose of Violet Biotechnology?
 - a. To focus on the legal and regulatory aspects of biotechnology
 - b. To address the ethical and philosophical issues in biotechnology
 - c. To promote innovation through intellectual property rights
 - d. All of the above
2. When was the first patent granted for a living organism?
 - a. 1873
 - b. 1920
 - c. 1950
 - d. 1980
3. Which country established a regulatory framework for the biotechnology industry in 2013?
 - a. United States
 - b. Germany
 - c. India
 - d. Japan
4. Which of the following is NOT a key element in the regulation of biotechnology?
 - a. Risk analysis
 - b. Commodity pricing
 - c. Monitoring
 - d. Environmental impact assessment

5. What is the primary benefit of patents in the biotechnology industry?
 - a. To ensure product safety
 - b. To promote competition
 - c. To protect financially valuable innovations
 - d. To address ethical concerns
6. Which of the following is a significant bioethical issue in biotechnology?
 - a. Organ transplantation
 - b. Biotechnology patents
 - c. Regulatory compliance
 - d. Both A and B
7. How are Violet Biotechnology and Purple Biotechnology related?
 - a. They are distinct and separate areas of biotechnology.
 - b. Violet Biotechnology is a subset of Purple Biotechnology.
 - c. Violet Biotechnology and Purple Biotechnology are considered the same field.
 - d. Purple Biotechnology is a subset of Violet Biotechnology.

Assignment 3. Complete the translation of the sentences.

1. Innovation is the most valuable (активом) for many technology-driven companies.
2. In biotech research, securing patents to protect innovations is absolutely (важливим).
3. A robust regulatory (база) is essential for ensuring the safety and efficacy of new biotech products.
4. In biotech, patents are critical for protecting intellectual (власності).
5. In the development of new biotech therapies, rigorous testing and compliance with regulations are (життєво важливими).
6. Biotech companies often (покладаються на) advanced genetic engineering techniques to develop innovative medical treatments.

7. In purple biotechnology, ensuring (відстеження) of genetically modified organisms is essential for maintaining safety and regulatory compliance.

Assignment 4. Make up word combinations using the text:

valuable	patents
primary	evaluation
conventional	care
organ	asset
end-of-life	food
publishing	products
ethical	transplantation

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Violet Biotechnology deals with ethical and moral issues related to gene modification.
2. Purple Biotechnology is primarily concerned with ethical issues in biotechnology.
3. The first patent for a living organism was granted to Louis Pasteur.
4. Violet Biotechnology was established in the 1980s.
5. Intellectual Property Rights are not important for innovation in biotechnology.
6. The U.S. FDA requires all biotechnological products to have pre-market approval.
7. Bioethics in biotechnology focuses on the benefits of scientific advancements without considering risks.

Assignment 6. Match (1-6) to the descriptions (a-f):

1. property	a) involving a big decision; of the greatest importance
2. framework	b) the act or state of agreeing to or being pleased with (a person, thing etc)
3. crucial	c) a subject for discussion and argument
4. vital	d) essential; of the greatest importance
5. approval	e) the basic supporting structure of anything
6. issue	f) something that a person owns

2.10. Dark Biotechnology

BASIC WORD LIST

Study the following words and expressions.

heal	виліковувати, загоювати(ся)
bioweapon	біологічна зброя
biowarfare	біологічна війна
bioterrorism	біотероризм
diverse	різноманітний
instantly	миттєво
bubonic plague	бубонна чума
intentional	навмисний
devastating	спустошливий; руйнівний; жахливий
emergencies	критичне становище; надзвичайний стан
contagious	заразний
Anthrax	сибірська виразка
Smallpox	віспа
severe	тяжкий, серйозний
respiratory failure	дихальна недостатність



Every science has a dark side, and biotechnology is no exception. Dark Biotechnology uses microorganisms and toxins to cause diseases and death in humans, animals, and plants, aiming to damage bioeconomies. We can say that dark biotechnology is good science that has ended up in the wrong hands and is being used to harm instead of **heal**.

Research in this field focuses on creating virulent, resistant pathogens for **bioweapons**. Dark Biotechnology explores the negative aspects of biological sciences, including engineering organisms for more effective use in bioweapons.

Parts of Dark Biotechnology

For a better understanding of Dark Biotechnology, we can divide it into three major parts.

1. Bioweapon
2. Biowarfare
3. Bioterrorism

1. Bioweapon (Biological Weapon)

A bioweapon is any microbiological agent or product that causes disease, harm, or death in targeted organisms, such as bacteria, viruses, fungi, or toxins. These weapons are inexpensive, highly targeted, and **diverse**, capable of affecting humans, crops, livestock, and the environment. They can act slowly or **instantly** and are used to cause widespread damage, with examples including Anthrax, Botulinum, and Smallpox. Biotechnology can enhance bioweapons through genetic engineering, making them more dangerous and capable of causing mass destruction.

2. Biowarfare

Biowarfare involves using bioweapons, such as microorganisms or toxins, to harm humans, animals, plants, and other living organisms by spreading diseases through air, water, or food. Unlike natural pandemics like the **bubonic plague** or COVID-19, biowarfare is **intentional**, but both can have similarly **devastating** effects.

3. Bioterrorism

Bioterrorism involves the use of bioweapons in acts of terrorism, where harmful biological agents target individuals, societies, or nations. It is a serious global concern as terrorist groups may use it against nations. Protecting the public requires nations to research bioterrorism and develop techniques to detect such attacks in advance, as even small-scale attacks can cause public health **emergencies**.

Examples of Bioweapons

The most dangerous bioweapons are highly **contagious** microorganisms that thrive in extreme conditions, including pathogenic viruses, bacteria, and fungi. Here are some major biological weapons:

1. **Bacillus Anthracis (Anthrax)**

A gram-positive, rod-shaped bacterium, its odorless and tasteless spores make Anthrax a highly deadly bioweapon.

2. **Botulinum Toxin**

Produced by *Clostridium botulinum*, this toxin causes Botulism, a lethal muscle-paralyzing disease. Just 1 gram dispersed in the air can kill 1 million people.

3. **Variola major (Smallpox)**

This contagious viral disease caused by the Variola major virus led to the deaths of 300 million people in the 20th century.

4. **Ebola**

First detected in 1976, the Ebola virus primarily destroys the human immune system and has a high fatality rate, affecting both humans and livestock.

5. **Bubonic Plague**

Caused by *Yersinia pestis*, this infectious disease spreads through respiratory droplets and can lead to **severe** symptoms, **respiratory failure**, and death if untreated.

Assignment 1. In pairs, discuss the following questions:

- 1) What is Dark Biotechnology and what does it aim to do?
- 2) How is Dark Biotechnology being used in the wrong way?
- 3) What are the three major parts into which Dark Biotechnology can be divided for better understanding?
- 4) What is a bioweapon, and what types of organisms can they target?
- 5) What is biowarfare, and how does it differ from natural pandemics?
- 6) What are some examples of bioweapons mentioned in the text?
- 7) What is bioterrorism and who does it target?
- 8) What are some examples of highly contagious microorganisms used as biological weapons?
- 9) How does *Bacillus Anthracis* (Anthrax) make it a deadly bioweapon?
- 10) How lethal is Botulinum Toxin, and how much is needed to kill 1 million people?
- 11) What was the impact of *Variola major* (Smallpox) in the 20th century?
- 12) How does Ebola affect humans and livestock?

Assignment 2. Choose the correct answer:

1. What is the main purpose of Dark Biotechnology according to the passage?
 - a. To create new medicines and treatments
 - b. To use microorganisms and toxins to cause harm
 - c. To study the environmental impact of biotechnology
 - d. To promote the positive applications of biotechnology
2. Which of the following is NOT considered a major part of Dark Biotechnology?
 - a. Bioweapon
 - b. Biowarfare
 - c. Bioterrorism
 - d. Biofuels
3. What is the key difference between natural pandemics and biowarfare?
 - a. The scale of the outbreak
 - b. The types of microorganisms involved

- c. The intentional nature of biowarfare
 - d. The geographical spread of the disease
4. Which of the following bioweapons has the potential to kill the most people if dispersed in the air?
- a. Botulinum Toxin
 - b. Anthrax
 - c. Smallpox
 - d. Ebola
5. What makes Anthrax an effective bioweapon according to the passage?
- a. Its high contagiousness
 - b. Its ability to thrive in extreme conditions
 - c. Its deadly impact on the human body
 - d. All of the above
6. Which bioweapon primarily targets and destroys the human immune system?
- a. Bacillus Anthracis (Anthrax)
 - b. Botulinum Toxin
 - c. Ebola
 - d. Variola major (Smallpox)
7. How can nations protect the public from bioterrorism according to the passage?
- a. By banning all research on bioweapons
 - b. By developing early warning systems and detection techniques
 - c. By promoting international cooperation and information sharing
 - d. Both B and C

Assignment 3. Make up word combinations using the text:

resistant
widespread
mass
bubonic
pathogenic
natural
extreme

destruction
conditions
pathogens
pandemics
damage
plague
viruses

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Dark biotechnology is used to improve public health by creating new medicines.
2. Bioweapons can be enhanced through genetic engineering to become more dangerous.
3. Biowarfare is similar to natural pandemics because both are intentional.
4. Bioterrorism is a concern because it can be used by terrorist groups against nations.
5. Anthrax is a bioweapon that is easily detectable due to its strong odor.
6. Ebola is a virus that primarily affects the human immune system.
7. Smallpox was responsible for the deaths of millions of people in the 20th century.

Assignment 5. Match (1-5) to the descriptions (a-e):

1. heal	a) spreading from one person to another by physical contact
2. emergency	b) the act or process of destroying or being destroyed
3. plague	c) an unexpected, especially dangerous happening or situation
4. contagious	d) to make or become healthy; to (cause to) return to a normal state or condition
5. destruction	e) especially formerly, an extremely infectious and deadly disease, especially one carried by fleas from rats

Assignment 6. Complete the translation of the sentences:

1. In black biotechnology, dealing with highly (заразними) pathogens requires strict safety protocols to prevent outbreaks.
2. Innovations in bioterrorism defense must be implemented (миттєво) to counter potential threats in black biotechnology.
3. Research in black biotechnology involves a (різноманітні) range of microorganisms, from bacteria to viruses, that can be engineered for both harmful and beneficial purposes.

4. Black biotechnology often involves the (навмисне) manipulation of dangerous pathogens for research or defense purposes.
5. The release of bioengineered organisms can lead to (серйозних) consequences if not carefully controlled.
6. Despite its risks, advances in black biotechnology could also be used to (лікування) individuals affected by biological weapons.
7. Rapid response systems are critical for addressing (надзвичайних ситуацій) involving the accidental or intentional spread of harmful biological agents.

Assignment 7. Translate into English using the words you learned:

бути не винятком; викликати захворювання; потрапити в чужі руки; досліджувати негативні сторони; бути недорогим, цілеспрямованим і різноманітним; мати руйнівні наслідки; розробити методику завчасного виявлення атак; заразні мікроорганізми, які розвиваються в екстремальних умовах; смертельна хвороба, що паралізує м'язи; висока летальність; поширюватися через дихальні краплі.

Project work

CHOOSE one of these questions to research and be ready to present it in the classroom.

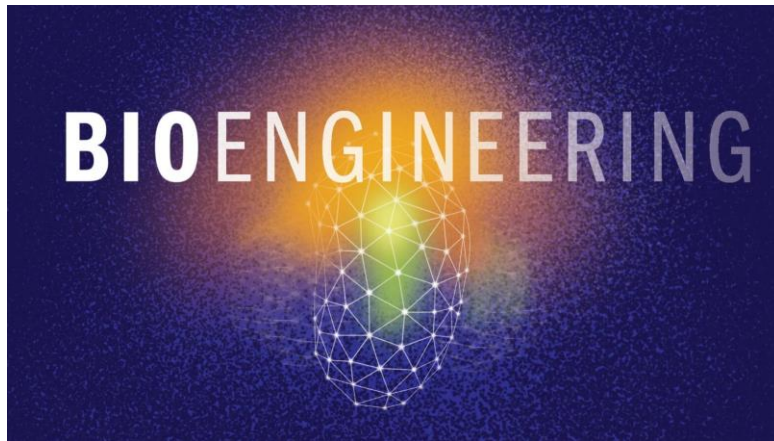
1. Top 5 Trends in Nanotechnology.
2. Discover the Top 10 Trends in Biotechnology (2025).
3. «Ecological innovations».
 - ✓ Develop a group project on the topic "Environmental innovations in biotechnology." Each member of the group should present one aspect, for example, alternative energy sources or waste recycling.

Посилання на відео до тексту:

<https://www.youtube.com/watch?v=YOtklbzA2CQ>

MODULE 3. BIOENGINEERING

3.1. Introduction to Bioengineering



Bioengineering focuses on the application of engineering on biological processes, food, agriculture and environmental processes. Bioengineering is the use of the principles of engineering as well as its techniques to problems that arise in biology and medicine.

Types of Bioengineering:

There are many different types, or branches, of bioengineering. Let's take a look at them.

1. Biomedical engineering (Tissue engineering; Neural engineering; Pharmaceutical engineering; Clinical engineering; Biomechanics)
2. Agricultural engineering
3. Bionics
4. Biochemical engineering
5. Human-factors engineering
6. Environmental health engineering
7. Genetic engineering
8. Biomimicry

Career in Bioengineering

Here are the best Bioengineering careers:

- | | |
|---|---|
| ➤ Bioinstrumentation | ➤ Біоінструментація |
| ➤ Biomaterials | ➤ Біоматеріали |
| ➤ Biomechanics | ➤ Біомеханіка |
| ➤ Cellular, Tissue, and Genetic Engineering | ➤ Клітинна, тканинна та генетична інженерія |
| ➤ Clinical Engineering | ➤ Клінічна інженерія |
| ➤ Medical Imaging | ➤ Медична візуалізація |
| ➤ Orthopedic Bioengineering | ➤ Ортопедична біоінженерія |
| ➤ Rehabilitation Engineering | ➤ Реабілітаційна інженерія |
| ➤ Systems Physiology | ➤ Системна фізіологія |

3.2. Current Trends in Bioengineering

BASIC WORD LIST

Study the following words and expressions.

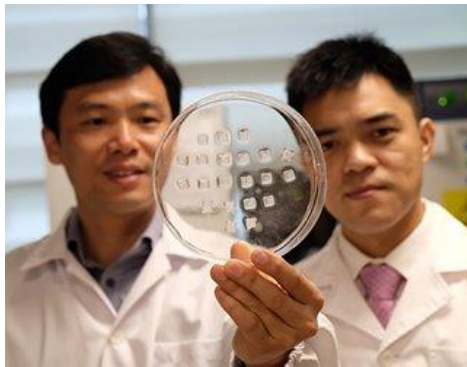
tissue	тканина
cell	клітина
to be deposited on	відкладаються на
biodegradable scaffolds	біорозкладні каркаси
deposition method	метод осадження
transdermal patches	трансдермальні пластирі (патчі)
nicotine addiction	нікотинова залежність
application	застосування
obesity	ожиріння
microneedles	мікроголки
penetrate	проникати
wearable devices	пристрої, які можна носити
wires	дроти
blood pressure	кров'яний тиск
stroke	інсульт
exoskeleton	екзоскелет
cardiovascular system	серцево-судинна система
virtual dissections	віртуальні розтини
cadaver	труп
ultrasound beam	ультразвуковий промінь
sustainable foods	біопродукти
microscale models	мікромасштабі моделі
inflammation processes	запальні процеси
early-warning indicator	індикатор раннього попередження
autoimmune responses	аутоімунні реакції
loading on joints	навантаження на суглоби
by-products	побічні продукти

Below are ten of the hottest bioengineering R&D trends happening this decade.



1. Tissue Engineering

Living **tissue** can be made from biologically active **cells**, which are **deposited on biodegradable scaffolds** in controlled conditions. A popular **deposition method** is bioprinting – a process very similar to 3D printing, but that uses “bioinks” consisting of human cells instead of plastic.



2. Transdermal Patches

Transdermal patches have evolved significantly since their use for **nicotine addiction**. Advances in structure and materials have expanded their **applications**. For instance, researchers at Nanyang Technological University in Singapore developed a patch that fights **obesity** by releasing drugs through biodegradable **microneedles** that minimally **penetrate** the skin. As the needles dissolve, the drugs are gradually delivered into the body.



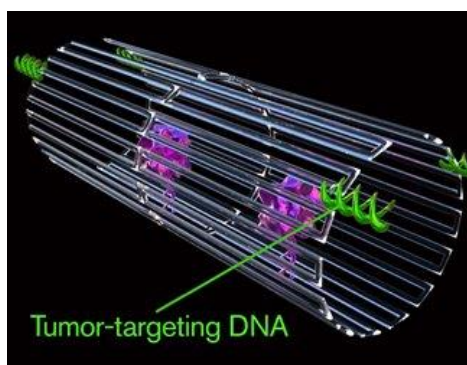
3. Wearable Devices

Sensors, wires, and electronics that are flexible, waterproof, and stretchable can be 3D-printed or woven into the fabric. Wearable technologies are becoming more multifunctional and can monitor multiple health parameters, such as pulse rate and **blood pressure**, which can also be transmitted in real-time to a medical facility.



4. Robotic Surgeons and Rehabilitation

Robot manufacturers are developing multifunctional robots to assist surgeons, enhancing precision in minimally invasive surgeries. Additionally, robots aid **stroke** and brain injury patients in relearning motor skills. The Lokomat, a gait training system with a robotic **exoskeleton**, helps patients regain walking functions while allowing therapists to control walking speed and support levels.



5. Nanorobots

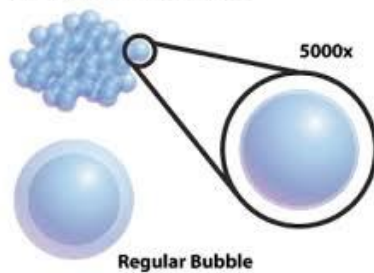
Researchers are developing nano-sized robots that can enter the bloodstream to target and kill cancer cells. These DNA-based nanorobots contain cancer-fighting drugs that bind to specific proteins on tumors, releasing the medication directly into the cancerous tissue. This targeted delivery reduces overall toxicity and minimizes side effects, enhancing the patient experience.



6. Virtual Reality

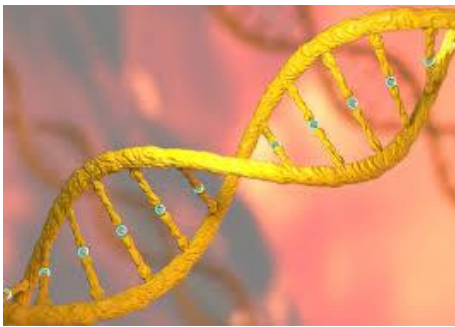
Virtual reality (VR) is a valuable medical tool that provides detailed 3D views of a patient's body, such as the **cardiovascular system**. It allows surgeons to examine models from various angles and practice complex procedures before surgery. Additionally, VR serves as an essential teaching tool, enabling medical students to conduct **virtual dissections** instead of using cadavers.

Microbubbles



7. Microbubbles

Researchers are exploring selective drug delivery methods to protect healthy cells. One innovative approach involves microbubbles—tiny gas-filled particles. When injected, these drug-loaded microbubbles disperse throughout the body, but an **ultrasound beam** can disrupt them, delivering the drug precisely where needed.



8. Prime Editing

Prime editing alters DNA by cutting only one strand to add, remove, or replace base pairs, enabling the correction of more genetic mutations than previous methods. So far, it has been tested only in human and mouse cells. Its potential benefits include correcting more genetic disease mutations and introducing beneficial changes in crops for healthier, **sustainable foods**.



9. Organ-on-a-Chip

Chip technologies enable the creation of **microscale models** that mimic human physiology outside the body. Organs-on-chips are used to investigate tissue behavior, disease progression, and drug interactions in functional sample sizes. For instance, researchers study **inflammation processes** to understand triggers and their role as **early-warning indicators** of conditions like **autoimmune responses**, as well as other processes like thrombosis, **joint loading**, and aging.



10. Mini Bioreactors

Bioreactors are systems that support biologically active organisms and their **by-products**. Smaller bioreactors are easier to manage and require lesser sample volumes.

Assignment 1. In pairs, discuss the following questions:

- 1) How is living tissue made in tissue engineering?
- 2) What is the difference between bioprinting and 3D printing?
- 3) What is the purpose of the patch developed by researchers at Nanyang Technological University in Singapore?
- 4) What health parameters can wearable devices monitor, and how are they transmitted to medical facilities?
- 5) How do robotic surgeons assist in minimally invasive surgeries?
- 6) How do nanorobots target and kill cancer cells in the bloodstream?
- 7) How does virtual reality benefit surgeons in the medical field?
- 8) What is one innovative approach researchers are exploring for selective drug delivery?
- 9) What is prime editing and how does it differ from previous methods of altering DNA?
- 10) How do organ-on-a-chip technologies mimic human physiology outside the body?

Assignment 2. Choose the correct answer:

1. Which of the following is a key feature of the bioprinting process mentioned in the passage?
 - a. It involves the use of plastic instead of bioinks.
 - b. It is similar to 3D printing but uses only non-living materials.
 - c. It creates living tissue from biologically active cells.
 - d. It uses biodegradable scaffolds to deposit human cells.
2. What is the primary purpose of the transdermal patch developed by researchers at Nanyang Technological University?
 - a. To deliver nicotine for addiction treatment.
 - b. To monitor multiple health parameters in real-time.
 - c. To release drugs through biodegradable microneedles.
 - d. To enhance precision in minimally invasive surgeries.

3. Which of the following best describes the capabilities of wearable devices mentioned in the passage?
- a. They can only monitor pulse rate and blood pressure.
 - b. They are limited to a single health parameter.
 - c. They can transmit health data to medical facilities in real-time.
 - d. They are not flexible, waterproof, or stretchable.
4. What is the main function of the Lokomat system described in the passage?
- a. To assist surgeons in complex procedures.
 - b. To help stroke and brain injury patients regain walking functions.
 - c. To conduct virtual dissections for medical students.
 - d. To target and kill cancer cells using nanorobots.
5. How do the DNA-based nanorobots mentioned in the passage work?
- a. They enter the bloodstream and release drugs directly into cancerous tissue.
 - b. They provide detailed 3D views of a patient's body for surgical planning.
 - c. They disperse throughout the body and can be disrupted by ultrasound.
 - d. They corrected genetic mutations in human and mouse cells.
6. What is the primary use of virtual reality technology described in the passage?
- a. To investigate tissue behavior and disease progression.
 - b. To support biologically active organisms and their by-products.
 - c. To create microscale models that mimic human physiology.
 - d. To examine detailed 3D models of the cardiovascular system.
7. What is the main benefit of the prime editing technology mentioned in the passage?
- a. It enables the introduction of beneficial changes in crops.
 - b. It can correct more genetic disease mutations than previous methods.
 - c. It protects healthy cells by delivering drugs selectively.
 - d. It helps relearn motor skills for stroke and brain injury patients.

Assignment 3. Are the following statements true or false? Correct the false ones:

1. Bioprinting uses plastic materials to create living tissue.

2. Transdermal patches can now deliver drugs through microneedles that dissolve in the skin.
3. Wearable devices are only used to monitor pulse rate.
4. Robotic surgeons are used to assist in minimally invasive surgeries.
5. Nanorobots can target cancer cells without affecting healthy cells.
6. Virtual reality is used to practice surgeries and teach medical students.
7. Prime editing has been tested only in human cells.

Assignment 4. Match (1-6) to the descriptions (a-f):

1. obesity	a) the system of blood flow that delivers nutrients, oxygen, and hormones throughout the body and removes waste.
2. stroke	b) secondary products created during the production or processing of a primary product, like whey in cheese-making.
3. sustainable foods	c) a person receiving medical care or treatment under the supervision of healthcare professionals.
4. by-products	d) a condition of excessive body fat that raises the risk of health problems like diabetes and heart disease.
5. bloodstream	e) a disruption of blood flow to the brain, causing brain tissue damage and potentially impacting movement, speech, and cognitive function.
6. patient	f) foods produced with minimal environmental impact, conserving natural resources for future generations.

Assignment 5. Complete the translation of the sentences:

1. Bioengineers are advancing (тканинна) engineering by developing (біорозкладні каркаси) that support the growth of (клітин) for organ repair and regeneration.
2. In this process, cells (пошарово наносяться) scaffolds in layers using a (метод осадження) such as bioprinting to create complex tissue structures.
3. To address (ожиріння), some patches now utilize (мікроголки) that gently (проникають) the skin, delivering anti-obesity drugs directly into the bloodstream.

4. (Трансдермальні пластирі) are expanding beyond (нікотинова залежність) treatment, with new (застосуваннями) in areas like pain management and hormone therapy.
5. (Носимі пристрої) equipped with (дроти) and sensors now track (артеріальний тиск) and heart rate, helping in the early detection of health issues such as a (інсульт).
6. Bioengineers are exploring how the (серцево-судинна система) functions using (віртуальні розтини) instead of traditional (трупів), improving training methods for medical students.
7. Research in (біо-продуктів) is focusing on cellular agriculture, which uses fewer resources and creates fewer (побічних продуктів) than conventional farming methods.

Assignment 6. Match the words from the left to their synonyms on the right and compare their meanings:

cadaver	miniature
deposited	focused
biodegradable	examine
precision	groundbreaking
targeted	in-depth
detailed	placed
innovative	accuracy
investigate	decomposable
microscale	corpse

Assignment 7. Translate into English using the words you learned:

популярний метод осадження; трансдермальні пластирі; боротися з ожирінням; проникати у шкіру; розчинятися; передавати в режимі реального часу; багатофункціональні роботи; роботизований екзоскелет, допомагати пацієнтам відновлювати функції ходьби; препарати для боротьби з раком; проводити віртуальні розтини замість використання трупів; селективні методи доставки ліків; генетичні мутації хвороб; стійкі продукти; імітувати фізіологію людини поза тілом; навантаження на суглоби; побічні продукти.

MODULE 4. TYPES OF BIOENGINEERING AND THEIR APPLICATIONS IN DETAIL

4.1. Biomedical Engineering

BASIC WORD LIST

Study the following words and expressions.

evident	очевидно
consciousness	свідомість
proliferation	поширення/ розповсюдження
pacemaker	кардіостимулятор
skyscraper	хмарочос
sonar	гідролокатор
breakthrough	прорив
push the boundaries	розширювати межі



It is quite difficult to find an accurate definition of biomedical engineering. The most common definition is: “Biomedical engineering is the application of engineering principles and techniques to the medical field”. This is **evident** throughout healthcare, from diagnosis and

analysis to treatment and recovery, and has entered the public **consciousness** through the **proliferation** of implantable medical devices, such as **pacemakers** and artificial hips, to more futuristic technologies such as stem cell engineering and the 3-D printing of biological organs.

Engineering itself is an innovative field, the origin of ideas leading to everything from automobiles to aerospace, **skyscrapers** to **sonar**. Biomedical engineering focuses on the advances that improve human health and health care at all levels.

How is Biomedical Engineering Different?

Biomedical engineers differ from other engineering disciplines that have an influence on human health in that biomedical engineers use and apply an intimate knowledge of modern biological principles in their engineering design process. All aspects of mechanical engineering, electrical engineering, chemical engineering, materials science, chemistry, mathematics, and computer science and engineering are integrated with human biology in biomedical engineering to improve human

health, whether it be an advanced prosthetic limb or a **breakthrough** in identifying proteins within cells.

What do Biomedical Engineers do?

Biomedical engineers work in a variety of fields and disciplines. In industry, there are opportunities to innovate, design, and develop new technologies; in science, they can advance research and **push the boundaries** of what is medically possible, as well as test, implement, and develop new diagnostic tools and medical devices; and in government, they can set safety standards for medical devices. Many biomedical engineers find work at cutting-edge startups or become entrepreneurs themselves.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the most common definition of biomedical engineering?
- 2) In which aspects of healthcare is biomedical engineering evident?
- 3) What are some examples of innovations mentioned in the text resulting from biomedical engineering?
- 4) How do biomedical engineers differ from other engineering disciplines related to healthcare?
- 5) Which scientific and engineering disciplines are integrated into biomedical engineering?
- 6) How does biomedical engineering contribute to improving human health?
- 7) In which fields do biomedical engineers work?
- 8) What opportunities for innovation are available to biomedical engineers in the industry?
- 9) What roles do biomedical engineers play in scientific research?
- 10) How can biomedical engineers influence the establishment of safety standards for medical devices?

Assignment 2. Choose the correct answer:

1. What is the primary focus of biomedical engineering according to the passage?
 - a) Improving the efficiency of healthcare systems
 - b) Advancing medical research and developing new technologies
 - c) Integrating various engineering disciplines with human biology
 - d) Designing and manufacturing medical devices and prosthetics

2. Which of the following best describes the role of biomedical engineers in the healthcare industry?
- a) They work exclusively in research and development.
 - b) They are responsible for setting safety standards for medical devices.
 - c) They collaborate with medical professionals to develop new treatments.
 - d) They work in a variety of fields, including industry, science, and government.
3. What is the key distinguishing factor between biomedical engineers and other engineering disciplines?
- a) Biomedical engineers have a deeper understanding of human anatomy and physiology.
 - b) Biomedical engineers are solely focused on developing medical devices and prosthetics.
 - c) Biomedical engineers integrate knowledge from multiple engineering fields with human biology.
 - d) Biomedical engineers work exclusively in the healthcare industry.
4. According to the passage, what is one example of a "futuristic" technology in biomedical engineering?
- a) Pacemakers
 - b) 3-D printing of biological organs
 - c) Artificial hips
 - d) Mechanical prosthetics
5. Which of the following is NOT mentioned as a common field or discipline that biomedical engineers work in?
- a) Industry
 - b) Science
 - c) Government
 - d) Finance
6. What is the main purpose of the passage?
- a) To provide a comprehensive definition of biomedical engineering
 - b) To highlight the various career paths available in biomedical engineering

- c) To explain how biomedical engineering differs from other engineering disciplines
 - d) To discuss the historical origins and development of biomedical engineering
7. Which of the following is a key aspect of the definition of biomedical engineering provided in the passage?
- a) The integration of various engineering disciplines with human biology to improve human health
 - b) The application of engineering principles and techniques to the medical field
 - c) The development of innovative technologies for the healthcare industry
 - d) The use of an intimate knowledge of modern biological principles in the engineering design process

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

definition
principles
evident
futuristic
advances
integrated
entrepreneurs
proliferation

progress
spread
combined
business owners
explanation
clear
innovative
fundamentals

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Biomedical engineering is solely focused on creating implantable medical devices.
2. Biomedical engineers integrate knowledge from various scientific fields with human biology.
3. The text suggests that biomedical engineering is not related to the development of new medical technologies.
4. Biomedical engineers can work in government to establish safety standards for medical devices.
5. The text states that biomedical engineering is a branch of mechanical engineering.

6. Biomedical engineering includes the use of 3-D printing technology for biological organs.

7. Biomedical engineers are involved in both research and the implementation of new diagnostic tools.

Assignment 5. Match (1-5) to the descriptions (a-e):

1) pacemaker	a) a person who starts or organizes a business company, especially one involving risk
2) skyscraper	b) referring to the most advanced and innovative level of development in a field.
3) breakthrough	c) an electronic device to make the heart beats regular or stronger
4) cutting-edge	d) a sudden solution of a problem leading to further advances, especially in science
5) entrepreneur	e) a very tall building, typically found in urban areas and used for offices, apartments, or hotels

Assignment 6. Translate the sentences paying attention to the italicized words:

1. The **application** of engineering principles has transformed modern medicine.
2. She submitted her **application** for a job at the hospital.
3. New **treatments** for cancer are being developed in biomedical research.
4. His kind **treatment** of animals made him a beloved veterinarian.
5. **Recovery** after surgery has become faster with advanced biomedical devices.
6. The **recovery** of stolen artifacts took years of investigation.

Assignment 7. Translate into English using the words you learned:

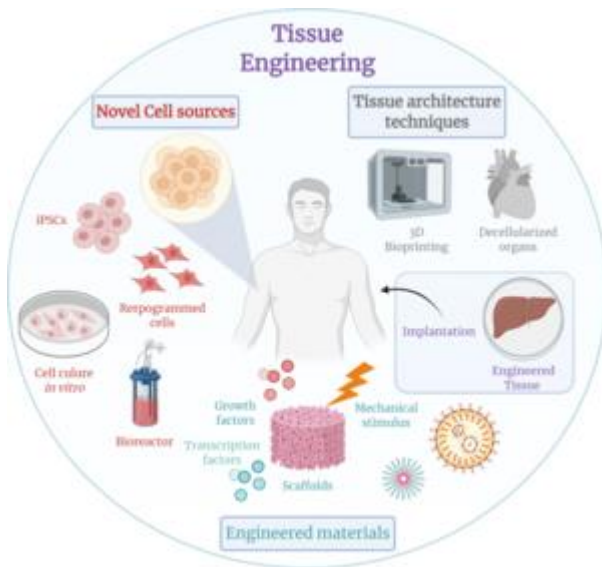
діагностика та аналіз; суспільна свідомість; кардіостимулятори та штучні стегна; друк біологічних органів; джерело ідей; покращувати здоров'я людини та медичне обслуговування; використовувати і застосовувати глибокі знання; проектування та розробка нових технологій; впроваджувати та розробляти; встановлювати стандарти безпеки; передові стартапи; підприємці.

4.2. Tissue Engineering

BASIC WORD LIST

Study the following words and expressions.

seminal	основоположний
controversy	суперечки, дискусія
excitement	хвилювання
hope and hype	надія та галас
mold	сформувати
mesh	сітка
cartilage	хрящ
core	основний
scaffold	каркас
maturation	дозрівання
kidney	нирка
liver	печінка
blood vessel	кровоносна судина
porous	пористий
craniofacial	черепно-лицевий



Tissue engineering is a biomedical engineering discipline that uses a combination of cells, engineering, materials methods, and suitable biochemical and physicochemical factors to restore, maintain, improve, or replace different types of biological tissues.

The idea of tissue engineering emerged just over 30 years ago, in 1988. The two men credited with doing the **seminal** work in this field are Joseph Vacanti and Robert Langer. The field gained attention nearly a decade later with the unveiling of the "Vacanti mouse" – a

mouse with a human ear on its back. This sparked **controversy** among animal rights activists and fear of genetic engineering, but also **excitement** and wonder, leading to an era of tissue engineering filled with both **hope and hype**.

The Vacanti mouse remains impressive. Researchers **molded** a biodegradable plastic **mesh** into an ear shape, added cow **cartilage** cells, and implanted it under the mouse's skin. After 12 weeks, they removed the ear and found new cartilage had grown within the structure.

The **core** idea of tissue engineering remains: a biodegradable **scaffold** is shaped like the target organ or tissue, seeded with specific cells. After implantation

or lab **maturation**, the scaffold degrades, allowing the cells to form a functional organ or tissue.

However, despite 30 years of dedicated research, we are still relying on organ donation rather than growing **kidneys, livers**, and hearts in the lab. So the question is – what real-world applications has this research produced?

Two of the most successful examples are INTEGRA and Osteopore. INTEGRA, used for skin repair after burns, has two layers: a collagen matrix that promotes skin and blood **vessel** growth, and a non-degradable outer layer that protects against infection. After a few weeks, the outer layer is removed, revealing regenerated skin. Osteopore, a **porous** biodegradable material, is used to repair bone in **craniofacial** surgery.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the main purpose of tissue engineering in biomedical engineering?
- 2) When did the concept of tissue engineering first appear, and who were the pioneers in this field?
- 3) What was the "Vacanti mouse," and why did it attract public attention?
- 4) What materials and cells did researchers use to create the ear on the "Vacanti mouse"?
- 5) Describe the core technique used in tissue engineering to create new tissues or organs.
- 6) Why, despite decades of research, are we still reliant on organ donation instead of lab-grown organs?
- 7) What is INTEGRA, and how does it aid in skin repair?
- 8) How does Osteopore contribute to craniofacial surgery?
- 9) What two layers make up INTEGRA, and what functions do they serve?
- 10) How does a biodegradable scaffold work in tissue engineering, and what happens to it over time?

Assignment 2. Make up word combinations using the text:

sparked
blood
craniofacial
plastic
outer

mesh
layer
controversy
surgery
vessel

Assignment 3. Choose the correct answer:

1. What is the primary goal of tissue engineering?
 - a. To create new medical devices
 - b. To study the structure and function of different organs
 - c. To restore, maintain, improve, or replace biological tissues
 - d. To develop new genetic engineering techniques
2. How long ago did the idea of tissue engineering first emerge?
 - a. Around 20 years ago
 - b. In the 1970s
 - c. Just over 30 years ago
 - d. In the 1990s
3. What was unique about the "Vacanti mouse" experiment?
 - a. Researchers used genetically modified cells to grow the ear
 - b. The mouse was able to grow a human-like ear on its back
 - c. The experiment was conducted without any ethical concerns
 - d. The mouse was used to test new organ transplantation techniques
4. Which of the following is the core idea behind tissue engineering?
 - a. Using a biodegradable scaffold to grow new organs
 - b. Developing synthetic materials to replace damaged tissues
 - c. Studying the growth and development of different cell types
 - d. Genetically modifying cells to create functional organs
5. Why has tissue engineering research not yet led to widespread practical applications?
 - a. The technology is too expensive and not widely available
 - b. Ethical concerns have slowed down the development of these technologies
 - c. The human body is too complex to successfully grow organs in a lab setting
 - d. The research has not yet produced practical real-world solutions
6. What is the purpose of the INTEGRA product in tissue engineering?
 - a. To protect against infection in skin grafts
 - b. To promote skin and blood vessel growth after burns

- c. To regenerate damaged organs
 - d. To repair bone in craniofacial surgery
7. What is the main function of Osteopore in tissue engineering?
- a. To grow new organs in the lab
 - b. To develop synthetic skin grafts
 - c. To protect against infection in tissue implants
 - d. To repair bone in craniofacial surgery

Assignment 4. Match the words from the left to their synonyms on the right and compare their meanings:

discipline	use
restore	enthusiasm
seminal	breaks down
controversy	encourages
impressive	development
excitement	revitalize
degrades	pioneering
maturation	remarkable
application	area
promotes	debate

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Tissue engineering combines cells and engineering to create new biological tissues.
2. The concept of tissue engineering was first introduced in the 1990s.
3. The Vacanti mouse was a significant milestone in tissue engineering.
4. Tissue engineering has completely replaced the need for organ donations.
5. INTEGRA is a successful application of tissue engineering used in skin repair.
6. Osteopore is used to repair bone in heart surgery.
7. Tissue engineering involves using a biodegradable scaffold to form new tissues.

Assignment 6. Translate the sentences paying attention to the italicized words:

1. The **core** idea of tissue engineering is to use a biodegradable scaffold to grow tissues.

2. The **core** of the Earth is extremely hot and composed mainly of iron and nickel.
3. Scientists hope to grow functional **organs** like kidneys and hearts in the lab.
4. The church **organ** filled the hall with music during the ceremony.
5. Tissue engineering is a relatively new **field** in biomedical sciences.
6. The **field** was covered with snow after the storm.
7. Cartilage **cells** were used to grow new tissue in the shape of an ear.
8. He was kept in a prison **cell** for several years.

Assignment 7. Match (1-6) to the descriptions (a-f):

1. tissue	a) a protein that is a primary component of connective tissue, providing strength and elasticity.
2. scaffold	b) the process of introducing or implanting a structure or material into the body.
3. cartilage	c) pertains to the bones of the skull and face, often used in surgical contexts to describe the reconstruction or restoration of these areas.
4. implantation	d) a structure used as a framework to support the growth of new cells or tissues.
5. craniofacial	e) a flexible connective tissue covering joints and shaping certain body parts, such as the ears and nose.
6. collagen	f) a group of cells that perform a common function in an organism

Assignment 8. Translate into English using the words you learned:

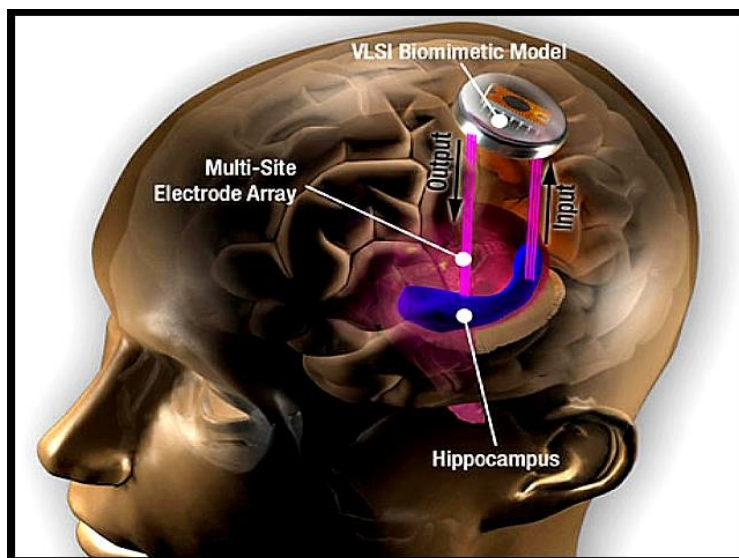
викликати суперечки; миша з людським вухом на спині; хвилювання та подив; сформувати біорозкладну пластикову сітку у формі вуха; коров'ячий хрящ; імплантувати під шкіру; лабораторне дозрівання; донорство органів; відновлення шкіри після опіків; сприяти росту шкіри та кровоносних судин; зовнішній шар; пористий біорозкладаний матеріал; черепно-лицева хірургія; утворити функціональний орган або тканину.

4.3. Neural Engineering

BASIC WORD LIST

Study the following words and expressions.

neural engineering	нейронна інженерія
electrochemistry	електрохімія
robotics	робототехніка
neuroprosthetics	нейропротезування
regrowth	відновлення
computational techniques	обчислювальні методи
robust	надійний
alter	змінювати(ся), переробляти
utilize	використовувати
auditory	слухові
engine prostheses	рухові протези
excitable	збудливий
autonomic features	вегетативні функції
pressure	тиск
disorders	розлади
sophisticated	складні
penetrate	проникати
retinal	сітківка ока



Neural engineering is a growing self-discipline that converts research discoveries into neurotechnologies. These technologies provide new tools for neuroscience analysis, while resulting in enhanced care for patients with nervous-system conditions. Neural engineers aim to understand, repair, replace, and enhance nervous-system function. They achieve this by concepts and solutions resulting from neuroscience,

information technology, **electrochemistry**, materials technology, **robotics**, and other areas.

Neural engineering can be considered as the driving technology behind several actual fields: functional electrical stimulation, stereotactic and efficient neurosurgery, **neuroprosthetics** and neuromodulation. The wide opportunity of NE also involves neurodiagnostics, neuroimaging, neural tissue **regrowth**, and **computational techniques**. By using statistical designs of neural function

(computational neuroscience), scientists are capable of doing **robust** testing of therapeutic techniques before they are used on patients.

Working:

Neuromodulation and Neuroaugmentation: Neural engineering applications programs have two wide goals: neuromodulation and neuroaugmentation. Neuromodulation (**altering** nervous system function) **utilizes** stimulators and infusion devices, among other methods. It can be used at several levels: cortical, subcortical, spinal, or peripheral. Neurological enhancement is designed to increase neural function and uses sensory (**auditory**, visual) and **engine prostheses**.

Neuromuscular Stimulation: Depending on a technique that has remained unchanged for many decades, electrodes are placed within the **excitable** cells that provide a present to stimulate certain routes. This supplements or changes lost motor or **autonomic features** in patients with paralysis.

Impact on Industry:

Neural engineering is a fast-developing bioengineering specialised that is predicted to develop tremendously. The improving social **pressure** of neurological **disorders**, and the need for more **sophisticated** medical devices, will generate a rise in new professions and careers.

Applications: Some of the most typical programs of NE techniques are described below.

Cochlear Implants:

Cochlear implants (CI), by far the most effective neurological sensory prostheses up to now, have **penetrated** the mainstream therapeutic arsenal. Their popularity is beaten only by the cardiac pacemakers and deep brain stimulation (DBS) systems.

Retinal Bioengineering:

Retinal photoreceptor cells contain visible color, which takes up light and starts the procedure of transducing it into electric signals.

Assignment 1. In pairs, discuss the following questions:

- 1) What is neural engineering, and how does it contribute to neurotechnologies?
- 2) What are the main goals of neural engineers?
- 3) Which fields of science and technology contribute to neural engineering solutions?
- 4) What are some key areas of application for neural engineering?
- 5) How does computational neuroscience help in developing therapeutic techniques?
- 6) What are the two primary goals of neural engineering applications, and how are they achieved?
- 7) How is neuromodulation used to alter nervous system function?

- 8) What is neuromuscular stimulation, and how does it assist patients with paralysis?
- 9) Why is neural engineering considered a fast-developing field in bioengineering?
- 10) What are two examples of neural engineering applications, and how do they work?

Assignment 2. Choose the correct answer:

1. Which of the following best describes the primary aim of neural engineering?
 - a) Advancing neuroscience research
 - b) Developing innovative technologies for the nervous system
 - c) Improving patient care for neurological conditions
 - d) All of the above
2. Which of these is not a key goal of neural engineering?
 - a) Repairing nervous system function
 - b) Replacing damaged nervous system components
 - c) Monitoring the overall health of the nervous system
 - d) Enhancing the capabilities of the nervous system
3. What is the primary purpose of using neuromodulation techniques in neural engineering?
 - a) To increase neural function and performance
 - b) To alter the way the nervous system operates
 - c) To restore lost motor or autonomic functions
 - d) To stimulate specific excitable cells in the body
4. Which type of neural engineering application is considered the most successful sensory prosthetic to date?
 - a) Cardiac pacemakers
 - b) Deep brain stimulation systems
 - c) Cochlear implants
 - d) Neuromuscular stimulators
5. What is the main role of retinal photoreceptor cells in visual perception?
 - a) They convert light into electrical signals

- b) They transmit signals directly to the brain
 - c) They stimulate the optic nerve
 - d) They enhance overall visual acuity
6. How has neural engineering impacted the industry according to the passage?
- a) It has reduced the need for specialized professionals
 - b) It has decreased the social pressure from neurological disorders
 - c) It has slowed the overall development of the field
 - d) It has led to increased demand for new medical devices
7. What is the primary benefit of using computational neuroscience in neural engineering research?
- a) To design more advanced neural prosthetics
 - b) To test therapeutic techniques before clinical use
 - c) To better understand the underlying mechanisms of the nervous system
 - d) To improve overall patient outcomes and satisfaction

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

alter	use
robust	approach
utilize	change
devices	neural implant
pacemaker	brain surgery
neurosurgery	cardiac regulator
neuroprosthetic	instruments
solution	impulse
signal	strong

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Neural engineering aims to improve nervous-system function using various scientific fields.
2. Neuromodulation is a technique that decreases neural function.
3. Cochlear implants are the most popular neurological sensory prostheses.
4. Neural engineering is expected to grow due to increasing neurological disorders.

5. Retinal bioengineering involves converting light into electrical signals.
6. Neuromuscular stimulation is a new technique developed recently.
7. Neural engineering includes applications in neuroimaging and neurodiagnostics.

Assignment 5. Complete the sentences using the given words from the box:

penetrate	regrowth	utilize	retinal
auditory	robotics	autonomic features	disorders

1. Neural engineering focuses on the of damaged neural tissues to restore brain and spinal cord functions.
2. Advanced technologies in this field robotics and computational techniques for precision in neurosurgery.
3. Neural prosthetics can restore lost , such as heart rate control, in patients with nervous system injuries.
4. Retinal bioengineering aims to develop devices that deeper into the eye for enhanced vision restoration.
5. Neural engineers work on solutions for treating neurological , including Parkinson's disease and epilepsy.
6. Innovations in are integrated into neural engineering to assist in motor function recovery.
7. Cochlear implants are revolutionary devices that restore perception for individuals with hearing impairments.
8. Research in engineering seeks to create artificial vision systems for patients with degenerative eye diseases.

Assignment 6. Translate into English using the words you learned:

нові інструменти для нейронаукового аналізу; нейронаука, інформаційні технології, електрохімія, технологія матеріалів, робототехніка; покращити функцію нервової системи; широкі можливості НІ; відновлення нервової тканини; обчислювальна нейронаука; нейромодуляція та нейроаугментація; використовувати сенсорні і рухові протези; збудливі клітини; втрачені рухові або вегетативні функції; швидко розвивається; неврологічні розлади; кардіостимулятори та системи глибокої стимуляції мозку; сітківка ока.

4.4. Pharmaceutical Engineering

BASIC WORD LIST

Study the following words and expressions.

adherence	дотримання чогось
encompas	охоплювати
excipient	допоміжна речовина
mammalian	ссавці
batch	партія
volumes	обсяги
solid	тверді
blockbuster	популярний
high-potency drugs	препарати з високою дією
setups	налаштування
compliance	відповідність
vial	флакон
syringe	шприц
fill and finish	наповнення та обробка
assembly	збірка
versus	проти



Pharmaceutical engineering focuses on designing, building, and improving manufacturing facilities that produce drugs. Some pharma engineers work on drug discovery, but most focus solely on providing solutions for optimal production processes in drug production facilities. Pharma engineering stands out for its

strict **adherence** to good manufacturing practice (GMP). Successful engineers in this field must navigate complex GMP requirements to ensure medicine safety. GMP is crucial at all stages, from conceptual design to implementing a pharmaceutical quality system.

The pharma industry focuses on four areas of expertise, which together **encompass** pharmaceutical engineering practices:

- Biotech and API
- Oral solid dosage
- Fill and finish
- Assembly and pack

Biotech and API (active pharmaceutical ingredient)

Drugs consist of two main parts: an active pharmaceutical ingredient (API) and an inactive substance, like lactose or sesame oil, called an **excipient**. APIs can be synthetic, biotechnological, or a combination. Biopharmaceuticals, a rapidly growing area, need different production methods, such as microbial or **mammalian** systems for most drugs and special methods for vaccines. The industry faces challenges with complex medicines like antibody-drug **conjugates**, which require adaptable production facilities. Future facilities must accommodate various manufacturing technologies and scale, from small **batches** for personalized medicine to large **volumes** for widespread diseases.

OSD (oral solid dosage)

Tablets, or oral **solid** dosages (OSD), are the most common drug delivery method, with OSD manufacturing remaining a key focus in the pharma industry. As traditional **blockbuster** OSD products lose patent protection, newer, **high-potency drugs** for smaller volumes demand flexible production **setups**. Manufacturers face pressure to reduce costs, compete with generics, and adapt to emerging markets while meeting stricter regulatory, health, and environmental standards. Innovative delivery methods like sprays and sustained-release forms add complexity to production. Ensuring **compliance** with high OHS (occupational health and safety) and EHS (environment, health and safety) requirements is essential for handling potent drugs in modern facilities.

Fill and finish

In pharma production, keeping products sterile and ensuring the correct dosage are very important, especially when filling **vials**, **syringes**, or blister packs. The industry is moving toward greater flexibility to accommodate high-value, sensitive, and potent products in smaller batches. This means factories need to be cost-effective, productive, and able to prevent contamination. New technologies are needed to meet regulatory demands for aseptic **fill and finish** processes. High-value products also require better packaging to reduce waste and address the growing use of devices.

Assembly and pack

Optimized **assembly** and packaging can significantly impact costs and competitiveness in pharma manufacturing. Increasing demands for compliance, quality, tracking, and patient-centric solutions are driving complexity and raising stock-keeping unit (SKU) counts. To stay efficient and competitive, manufacturers need to update their methods, be flexible, and improve packaging designs for diverse markets. Balancing product segmentation – low volume/high price **versus** high volume/low price – while ensuring reliable supply is essential. Scalable and well-designed processes are key to success in meeting future business demands.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the primary focus of pharmaceutical engineering?
- 2) How does pharmaceutical engineering ensure the safety of medicines?

- 3) What are the four key areas of expertise in the pharmaceutical industry?
- 4) What are APIs, and what types can they include?
- 5) Why are flexible facilities essential for producing biopharmaceuticals?
- 6) What challenges do OSD manufacturers face in adapting to market demands?
- 7) How are regulatory, health, and environmental standards influencing OSD manufacturing?
- 8) Why is sterility crucial in the "fill and finish" process?
- 9) What role do new technologies play in aseptic fill and finish processes?
- 10) How does optimized assembly and packaging contribute to competitiveness in pharmaceutical manufacturing?

Assignment 2. Choose the correct answer:

1. What is the primary focus of pharmaceutical engineering?
 - a) Discovering new drugs
 - b) Designing and improving drug manufacturing facilities
 - c) Developing active pharmaceutical ingredients (APIs)
 - d) Ensuring regulatory compliance for pharmaceutical products
2. Which of the following is NOT a key area of expertise in pharmaceutical engineering?
 - a) Biotech and API
 - b) Oral solid dosage
 - c) Packaging and distribution
 - d) Fill and finish
3. What is the most common drug delivery method in the pharmaceutical industry?
 - a) Injections
 - b) Capsules
 - c) Oral liquids
 - d) Tablets
4. What is a key challenge faced by pharmaceutical manufacturers in the oral solid dosage (OSD) area?

- a) Adapting to the rise of personalized medicine and smaller batch sizes
 - b) Developing new biotechnological production methods
 - c) Adhering to strict occupational health and safety (OHS) requirements
 - d) Maintaining sterility and ensuring the correct dosage in fill and finish processes
5. What is a primary driver for changes in pharmaceutical assembly and packaging?
- a) The need to reduce manufacturing costs
 - b) The growth of the biotechnology sector and biopharmaceuticals
 - c) The rise of generic drug competition
 - d) Increasing demands for compliance, quality, tracking, and patient-centric solutions
6. What is an essential factor for pharmaceutical manufacturers to remain efficient and competitive in the assembly and packaging area?
- a) Specializing in the production of a limited range of product types
 - b) Focusing solely on high-volume, low-price product segments
 - c) Embracing flexibility and optimizing packaging concepts for diverse markets
 - d) Investing heavily in automated assembly and packaging equipment
7. How does the pharmaceutical industry address the challenge of producing complex medicines like antibody-drug conjugates?
- a) By using traditional manufacturing methods
 - b) By adapting their production facilities to accommodate various manufacturing technologies and scale
 - c) By relying on microbial or mammalian production systems
 - d) By building highly specialized production facilities

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

encompass
manufacturing
facilities
adherence
challenges

size
wrapping
difficulties
production
plants

scale
sterile
packaging
cost-effective

cover
economical
compliance
uncontaminated

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Pharmaceutical engineering primarily focuses on drug discovery rather than production processes.
2. Active pharmaceutical ingredients (APIs) can be made using synthetic or biotechnological methods.
3. Oral solid dosage forms, like tablets, are the least common method of drug delivery.
4. The industry is facing challenges with complex medicines that require flexible production facilities.
5. Aseptic fill and finish processes are not important in pharmaceutical production.
6. Manufacturers must adapt their techniques to meet increasing demands for compliance and quality.
7. The text suggests that balancing product segmentation is unimportant for manufacturers.

Assignment 5. Match (1-8) to the descriptions (a-h):

1. vial	a) a type of packaging in which a product is sealed in plastic, often with a cardboard backing.
2. batch	b) a tall annual herbaceous plant of tropical and subtropical areas.
3. volume	c) a place, amenity, or piece of equipment provided for a particular purpose.
4. blister	d) a small container, typically cylindrical and made of glass, used especially for holding liquid medicines.
5. sesame	e) a quantity of goods produced at one time.
6. facility	f) the amount of space occupied by something, expressed in cubic measurement.
7. efficient	g) not expensive, therefore able to compete successfully with the prices etc of rivals.
8. competitive	h) achieving maximum productivity with minimum wasted effort or expense.

Assignment 6. Complete the sentences using the given words from the box:

setups	facility	encompasses	batches
competitive	assembly	efficient	adherence

1. A pharmaceutical must meet strict regulatory standards to ensure safe and drug production.
2. To remain , manufactures invest in flexible production for both high-volume and small-batch manufacturing.
3. Strict to good manufacturing practices (GMP) is essential for ensuring the safety of pharmaceutical products.
4. Pharma engineering various areas, including biotech, oral solid dosage, and fill-and-finish processes.
5. Modern facilities must handle of varying sizes, from small quantities for personalized medicine to large-scale production.
6. The fill and finish and stages are critical in packaging, as they balance product quality versus cost efficiency.

Assignment 7. Translate the sentences paying attention to the italicized words:

1. Everyone deserves access to a quality healthcare *facility* in their area.
2. He has a great *facility* for writing catchy pop songs.
3. She applied iodine to the *blister* to keep it clean and safe.
4. The *blister* pack protects the pills from light and air exposure.
5. Trade agreements often aim to enhance the *volume* of trade between partners.
6. This library contains over a million *volumes*.

Assignment 8. Translate into English using the words you learned:

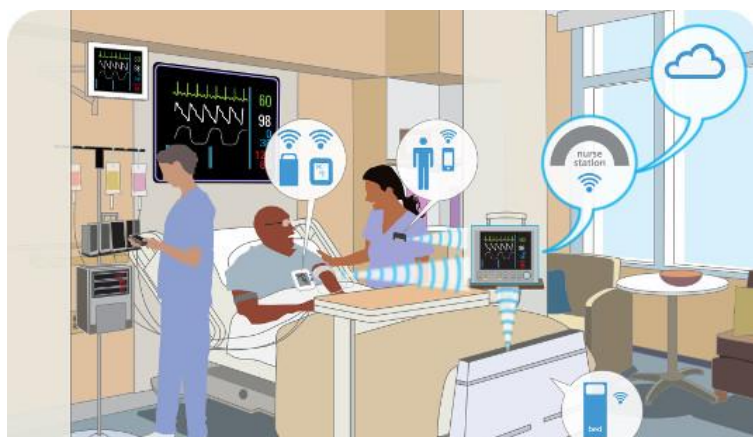
суворе дотримання; фармацевтична промисловість; допоміжна речовина;
стикатися з проблемами; невеликі партії; великі обсяги; пероральні тверді
دوزи; втрачати патентний захист; гнучкі налаштування виробництва; сучасні
підприємства; наповнення флаконів; запобігати забрудненню; залишатися
ефективними та конкурентоспроможними; дизайн упаковки; ключ до успіху.

4.5. Clinical Engineering

BASIC WORD LIST

Study the following words and expressions.

procurement	закупівля
spare parts	запчастини
increasingly	дедалі більше
sophisticated	складний
asset	активи
in-house operations	внутрішні операції
supervision	нагляд
maintenance staff	обслуговуючий персонал
assessment	оцінка



Clinical engineering is a specialty within Biomedical engineering responsible primarily for applying and implementing medical technology to optimise healthcare delivery. A Clinical Engineer is a professional who supports and advances patient care by applying engineering and management skills to

healthcare technology. The department of Clinical Engineering plays an important role beginning from the **procurement** process and facilitates effective management of medical devices which are especially used in health care facilities.

Additionally, the clinical engineering department increases the life cycle of medical devices, optimizes **spare parts** and technical services' costs of medical devices in order to improve the quality of healthcare.

Definition of Clinical Engineers.

" A Clinical Engineer is a specialist who helps improve patient care by using engineering and management skills to work with medical technology." -ACCE Definition, 1992

As clinical medicine has become **increasingly** dependent on more **sophisticated** technologies and the complex equipment associated with it, the Clinical Engineer has become the bridge between modern medicine and modern engineering.

Roles and responsibilities of a Clinical Engineer.

Clinical engineering is an interdisciplinary field practiced in a variety of settings and presenting a diversity of challenges. The Clinical Engineer is, by education and training, a problem solver, working with complex human and

technological systems. In the hospital, shared service, and **asset** management firm, the Clinical Engineer often functions as the technology manager for medical equipment systems.

The responsibilities in this setting include financial or budgetary management, service contract management, data processing systems for managing the medical equipment, and coordination of service agreements and **in-house operations**. The hospital-based clinical engineer may also have responsibility for **supervision** of the in-house **maintenance staff**, depending on his or her skill set and the structure of the department.

Hospital-based clinical engineers also fill other important functions in assuring that the medical equipment is safe and effective. These functions include participation in the planning process and in the **assessment** of new technology, assuring regulatory compliance in the medical technology management area, investigation of incidents, and active participation in training and education of technical and medical personnel.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the main focus of clinical engineering as a specialty within biomedical engineering?
- 2) What skills does a Clinical Engineer use to support and advance patient care?
- 3) What role does the clinical engineering department play in the procurement process?
- 4) How does the clinical engineering department optimize the costs of spare parts and technical services for medical devices?
- 5) According to the ACCE Definition (1992), what is the main role of a Clinical Engineer?
- 6) Why is the Clinical Engineer considered a bridge between modern medicine and engineering?
- 7) What responsibilities does a Clinical Engineer have in hospital-based settings?
- 8) How does a Clinical Engineer ensure that medical equipment is safe and effective?
- 9) What functions does a Clinical Engineer perform in the planning and assessment of new technology?
- 10) How does a Clinical Engineer contribute to the training and education of medical and technical staff?

Assignment 2. Choose the correct answer:

1. What is the main purpose of a Clinical Engineer?
 - a) To design and manufacture medical equipment
 - b) To provide direct patient care
 - c) To optimize healthcare technology and delivery
 - d) To conduct medical research
2. Which of the following is NOT a responsibility of a hospital-based Clinical Engineer?
 - a) Supervising the in-house maintenance staff
 - b) Assuring regulatory compliance for medical equipment
 - c) Managing the hospital's budget
 - d) Participating in the assessment of new technology
3. Based on the passage, which of these best describes the role of a Clinical Engineer?
 - a) A specialist who bridges the gap between medicine and engineering
 - b) A technician responsible for repairing medical equipment
 - c) A manager focused on the financial aspects of healthcare technology
 - d) A researcher developing new medical technologies
4. What is the primary function of the Clinical Engineering department, according to the passage?
 - a) To increase the life cycle of medical devices
 - b) To optimize the costs of technical services for medical devices
 - c) To improve the quality of healthcare delivery
 - d) To coordinate service agreements and in-house operations
5. Which of the following skills is most important for a Clinical Engineer, as described in the passage?
 - a) Expertise in both medical and engineering fields
 - b) Strong financial management abilities
 - c) Proficiency in medical procedures
 - d) Advanced research capabilities

6. The passage states that Clinical Engineers work with "complex human and technological systems." What does this suggest about their role?
- a) They are responsible for training medical personnel.
 - b) They have a diverse set of responsibilities and skills.
 - c) They focus primarily on the technical aspects of medical equipment.
 - d) They act as mediators between doctors and engineers.
7. What is the primary reason the role of the Clinical Engineer has become more important, according to the passage?
- a) The increasing complexity of medical technology
 - b) The need to reduce healthcare costs
 - c) The growing emphasis on regulatory compliance
 - d) The advancement of medical research

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

spare parts	management
sophisticated	property
responsibilities	personnel
bridge	oversight
coordination	replacement parts
supervision	connection
staff	duties
asset	complex

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Clinical engineering focuses on improving healthcare by using medical technology.
2. A Clinical Engineer is only responsible for the maintenance of medical devices.
3. The Clinical Engineering department helps manage the costs associated with medical devices.
4. Clinical Engineers work solely in hospitals and do not operate in other settings.
5. Clinical Engineers do not participate in training medical personnel.

6. The Clinical Engineer plays a role in ensuring that medical equipment is safe and effective.
7. The Clinical Engineer acts as a link between healthcare and engineering.

Assignment 5. Complete the sentences using the given words from the box:

diversity	equipment	assessment	staff
management	supervision	in-house	procurement

1. Clinical Engineering involves the of medical devices to ensure hospitals have the right tools for patient care.
2. The of maintenance teams is often a key responsibility of clinical engineers in hospitals.
3. Effective of medical equipment ensures that devices are safe, reliable, and meet regulatory standards.
4. Many hospitals rely on technical staff to maintain and repair medical equipment quickly and efficiently.
5. Clinical engineers play a role in the of new technology to determine its suitability for healthcare facilities.
6. The proper functioning of medical is essential for accurate diagnoses and effective treatments.
7. Clinical engineering is a field that requires working with a of technologies and solving varied challenges.
8. Training the hospital to use medical devices correctly is an important part of a clinical engineer's role.

Assignment 6 . Translate the sentences paying attention to the italicized words:

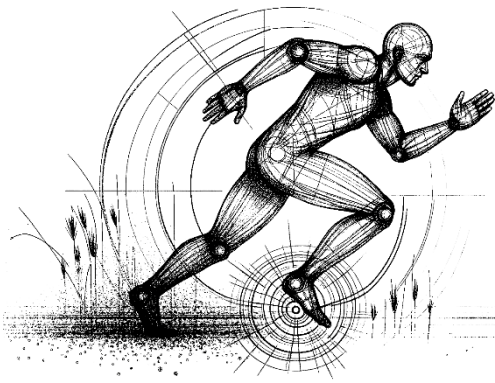
1. The rubber band will **contract** when it is cooled.
2. The hospital signed a **contract** with a clinical engineering firm.
3. The company's most valuable **asset** is its headquarters in the city center.
4. Her excellent communication skills are a great **asset** to the team.
5. The laboratory uses **sophisticated** machines to analyze medical samples.
6. His **sophisticated** taste in art impressed everyone at the gallery.

4.6. Biomechanics

BASIC WORD LIST

Study the following words and expressions.

notable	відомий
relevant	актуальний
dissect	розкривати
locomotion	пересування
injury	ушкодження
intervention	втручання
pattern	модель
restore	відновлення
contributes	сприяти
posture	поза
musculoskeletal disorders	порушення опорно-рухового апарату
outcomes	результати



Biomechanics is the study of the mechanics of living organisms, including humans and animals. It combines principles from physics, engineering, and biology to understand how the forces and movements within the body affect its structure, function, and overall performance. Biomechanics has various applications across

different fields, including sports science, medicine, rehabilitation, ergonomics, and robotics.

Where did it all start from?

The development of biomechanics began with early scientific interest in human anatomy. **Notable** contributions came in the 15th-17th centuries, including Leonardo Da Vinci's anatomical illustrations, which remain **relevant** today. Despite lacking formal medical training, Da Vinci **dissected** over 30 bodies, blending art and science to explore the human form. Andreas Vesalius, the "father of human anatomy," made significant advances in the field, while Galileo studied bone strength and shape underweight. Borelli calculated human joint forces in equilibrium conditions.

By the 19th century, researchers focused on **locomotion** and biomechanics. In the 20th century, biomechanics emerged as a modern science, with studies on locomotion, muscle activity, and the human center of gravity expanding knowledge worldwide.

Here are some notable applications of biomechanics:

1. Injury Prevention and Rehabilitation:

Biomechanics plays a crucial role in understanding the causes and mechanisms of **injuries**. It helps in identifying risk factors and designing **interventions** to prevent injuries in athletes and individuals engaged in physical activities. Biomechanical analysis is also used in rehabilitation programs to assess movement **patterns**, monitor progress, and guide the design of exercises and therapies to **restore** normal function.

2. Prosthetics and Orthotics:

Biomechanics is instrumental in the design and development of prosthetic limbs and orthotic devices. By studying the mechanics of human movement, researchers can create artificial limbs and supportive devices that mimic natural movements and provide better functionality and comfort to individuals with limb loss or musculoskeletal conditions.

3. Ergonomics and Workplace Design:

Biomechanics **contributes** to ergonomics, which focuses on optimizing the interaction between humans and their work environment. By studying body movements, forces, and **postures**, biomechanics helps in designing workstations, tools, and equipment that reduce the risk of **musculoskeletal disorders**, improve performance, and enhance worker comfort and safety.

4. Biomechanical Modeling and Simulation:

Computational biomechanical modeling and simulation techniques are used to analyze and predict the behavior of biological structures and systems. These models help in understanding complex physiological processes, predicting the **outcomes** of interventions, and optimizing treatment strategies. They are particularly useful in fields such as orthopedics, cardiovascular research, and neurology.

Assignment 1. In pairs, discuss the following questions:

- 1) What is biomechanics, and what principles does it combine?
- 2) How does biomechanics affect the structure and function of living organisms?
- 3) What fields benefit from the applications of biomechanics?
- 4) Who made significant contributions to biomechanics during the 15th-17th centuries, and what were their achievements?
- 5) How did Andreas Vesalius contribute to the field of human anatomy?
- 6) What was Galileo's contribution to biomechanics?
- 7) How did biomechanics evolve in the 19th and 20th centuries?
- 8) How is biomechanics applied in injury prevention and rehabilitation?
- 9) In what ways does biomechanics assist in the development of prosthetics and orthotics?

10) How does biomechanics contribute to workplace safety and ergonomics?

Assignment 2. Choose the correct answer:

1. Which of the following best describes the primary focus of biomechanics?
 - a) The study of the mechanics of living organisms
 - b) The analysis of human anatomy and physiology
 - c) The design and development of engineering systems
 - d) The optimization of workplace ergonomics
2. In which century did biomechanics emerge as a modern science?
 - a) 15th-17th centuries
 - b) 18th century
 - c) 19th century
 - d) 20th century
3. Who is credited as the "father of human anatomy"?
 - a) Leonardo Da Vinci
 - b) Galileo
 - c) Andreas Vesalius
 - d) Borelli
4. How does biomechanics contribute to injury prevention and rehabilitation?
 - a) By identifying risk factors and designing interventions to prevent injuries
 - b) By optimizing the interaction between humans and their work environment
 - c) By creating artificial limbs and supportive devices that mimic natural movements
 - d) By analyzing and predicting the behavior of complex physiological processes
5. What is a key application of biomechanics in the field of prosthetics and orthotics?
 - a) Studying body movements, forces, and postures to design workstations and equipment
 - b) Identifying risk factors and designing interventions to prevent injuries in athletes
 - c) Creating artificial limbs and supportive devices that mimic natural movements

- d) Analyzing and predicting the behavior of biological structures and systems
- 6. How does biomechanics contribute to ergonomics and workplace design?
 - a) By creating artificial limbs and supportive devices that mimic natural movements
 - b) By analyzing and predicting the behavior of complex physiological processes
 - c) By studying body movements, forces, and postures to design workstations and equipment
 - d) By identifying risk factors and designing interventions to prevent injuries in individuals
- 7. What is a key application of biomechanical modeling and simulation?
 - a) Optimizing the interaction between humans and their work environment
 - b) Improving the design of prosthetic limbs and orthotic devices
 - c) Identifying risk factors and designing interventions to prevent injuries
 - d) Analyzing and predicting the behavior of complex physiological processes

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

prosthetics
orthotics
ergonomics
locomotion
notable
injuries
rehabilitation

supportive devices
artificial limbs
remarkable
recovery
workplace optimization
movement
wounds

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Biomechanics is only concerned with human movement.
2. Leonardo Da Vinci made important contributions to the study of human anatomy.
3. The field of biomechanics has no relevance in sports science.
4. Biomechanics helps in designing better prosthetic devices.
5. The author states that biomechanics emerged as a modern science in the 19th century.
6. Biomechanics can assist in preventing injuries during physical activities.

7. Ergonomics focuses on improving the interaction between humans and their environment.

Assignment 5. Translate the sentences paying attention to the italicized words:

1. The team was fully **engaged** in preparing the final presentation for the conference.
2. They have been **engaged** for six months and are planning their wedding.
3. Da Vinci dissected over 30 **bodies** to study human anatomy.
4. The governing **body** approved the new biomechanics research initiative.
5. Biomechanics is the **study** of the mechanics of living organisms.
6. He spent hours in his **study** preparing for the biomechanics exam.
7. Biomechanics contributes to the **design** of prosthetic limbs.
8. The **design** behind his experiments was to improve rehabilitation techniques.

Assignment 6. Match (1-6) to the descriptions (a-f):

1) locomotion	a) say or estimate that will happen in the future or will be a consequence of something.
2) engaged	b) relating to the heart and blood vessels.
3) workstation	c) an act of changing physical location or position or of having this changed.
4) movement	d) a desk and a computer for one person to work at in an office.
5) cardiovascular	e) busy; not free; occupied.
6) predict	f) movement or the ability to move from one place to another.

Assignment 7. Translate into English using the words you learned:

механіка живих організмів; загальна продуктивність; значний внесок; поєднати мистецтво та науку; міцність і форма кісток під вагою; центр тяжіння людини; профілактика травм і реабілітація; вирішальна роль; фактори ризику; розробка вправ і терапії; відновлення нормальної функції; протези кінцівок і ортопедичні пристрої; імітувати природні рухи; втрата кінцівок; робоче середовище; знизити ризик розладів опорно-рухового апарату; підвищувати комфорт і безпеку працівників; поведінка біологічних структур і систем.

4.7. Agricultural Engineering

BASIC WORD LIST

Study the following words and expressions.

sustainable	стійкий / сталий
plough	плуг
animal domestication	одомашнення тварин
irrigation systems	системи поливу
seed drill	сівалка
reaper	жатка
boost	підвищувати
alongside	а також
combat	боротися
precision	точність
harvester	комбайн
barn	сарай
moisture	вологість
raw materials	сировина
feed	корм
conserve	збереження



Agricultural engineering is a multidisciplinary field that combines the principles of mechanical, civil, electrical, and chemical engineering with agricultural knowledge to enhance farming practices and optimize crop production. As the global population continues to grow, the demand for **sustainable** and efficient

agricultural solutions is more critical than ever.

History of Agricultural Engineering.

1. Early Agricultural Innovations: The roots of agricultural engineering lie in early human advancements, including the **plough**, **animal domestication**, and **irrigation systems**, forming the basis for modern practices.
2. Industrial Revolution (18th-19th Century): The Industrial Revolution advanced agricultural technology with Jethro Tull's **seed drill** (1701) and Cyrus McCormick's mechanical **reaper** (1831), **boosting** efficiency and shaping agricultural engineering as a discipline.
3. Early 20th Century: In the early 20th century, agricultural engineering became a

formal discipline, with the first department founded at Iowa State University in 1905, focusing on soil mechanics, drainage, and irrigation.

4. Mid-20th Century: In the mid-20th century, agricultural engineering expanded rapidly to meet global food demands, introducing advanced machinery like tractors and combines, **alongside** chemical fertilizers and pesticides.

5. Green Revolution (1960s-1970s): The Green Revolution saw agricultural engineers boost crop yields and **combat** hunger through high-yield crops, improved irrigation, and advanced machinery.

6. Late 20th Century to Present: In recent decades, agricultural engineering has advanced with a focus on sustainability, **precision** agriculture, GPS-guided machinery, drones, and biotechnology integration.

Types of Agricultural Engineering.

1. Farm Machinery and Equipment Engineering: Focuses on designing and optimizing farm machinery like tractors and **harvesters**, integrating GPS, sensors, and automation for efficiency.

2. Agricultural Structures and Environmental Engineering: Deals with designing **barns**, silos, and greenhouses, alongside waste management, ventilation, and heating systems for healthy environments.

3. Soil and Water Engineering: Manages water resources through irrigation, drainage systems, soil erosion control, and maintaining soil **moisture** for crops.

4. Precision Agriculture and Remote Sensing: Uses technology like GPS, remote sensing, and variable rate tools to optimize crop production and minimize waste.

5. Agricultural Processing and Food Engineering: Focuses on processing, preserving, and packaging agricultural products sustainably, turning **raw materials** into food, **feed**, and biofuels.

6. Agricultural Biotechnology and Genetic Engineering: Applies genetic engineering to improve crop yields, pest resistance, and develop new varieties using molecular biology and genomics.

7. Agricultural Waste Management and Environmental Control: Manages agricultural waste sustainably to reduce pollution and **conserve** resources.

8. Agroforestry and Land Management: Integrates trees into agriculture to improve soil, conserve water, and support wildlife, while promoting sustainable land use to boost productivity and reduce environmental impact.

Assignment 1. In pairs, discuss the following questions:

1) What is agricultural engineering, and which engineering principles does it combine?

2) Why is the demand for sustainable and efficient agricultural solutions growing?

3) What early innovations laid the foundation for modern agricultural engineering?

4) Which technological advancements during the Industrial Revolution shaped agricultural engineering?

- 5) When and where was the first formal agricultural engineering department established?
- 6) What key developments characterized agricultural engineering during the Green Revolution?
- 7) How has agricultural engineering evolved in recent decades, and what technologies are now emphasized?
- 8) What is the focus of Farm Machinery and Equipment Engineering, and how does it use advanced technology?
- 9) How does Soil and Water Engineering contribute to agricultural productivity?
- 10) What are the goals of Agroforestry and Land Management in agricultural engineering?

Assignment 2. Choose the correct answer:

1. According to the passage, what is the primary goal of agricultural engineering?
 - a) Enhancing farming practices and optimizing crop production
 - b) Designing and manufacturing advanced farm machinery
 - c) Improving soil and water management for agriculture
 - d) Developing new agricultural biotechnologies
2. What was a key advancement during the Industrial Revolution that shaped the field of agricultural engineering?
 - a) The introduction of chemical fertilizers and pesticides
 - b) The domestication of animals for use in farming
 - c) The development of Jethro Tull's seed drill
 - d) The focus on improving irrigation systems
3. Which type of agricultural engineering deals with the design and optimization of farm machinery like tractors and harvesters?
 - a) Agricultural Structures and Environmental Engineering
 - b) Soil and Water Engineering
 - c) Precision Agriculture and Remote Sensing
 - d) Farm Machinery and Equipment Engineering

4. How did the Green Revolution impact the field of agricultural engineering according to the passage?
- a) It led to the development of high-yield crops and advanced machinery.
 - b) It focused on sustainability and precision agriculture.
 - c) It introduced chemical fertilizers and pesticides.
 - d) It laid the foundation for agricultural biotechnology.
5. What is the primary focus of Agricultural Processing and Food Engineering as described in the passage?
- a) Improving soil erosion control and maintaining soil moisture
 - b) Applying genetic engineering to enhance crop yields and pest resistance
 - c) Processing, preserving, and packaging agricultural products sustainably
 - d) Integrating trees into agriculture to improve soil and conserve water
6. Which recent advancement in agricultural engineering involves the integration of GPS and sensors in farm machinery?
- a) Agroforestry and Land Management
 - b) Agricultural Biotechnology and Genetic Engineering
 - c) Precision Agriculture and Remote Sensing
 - d) Agricultural Waste Management and Environmental Control
7. What is the primary focus of Agricultural Biotechnology and Genetic Engineering as described in the passage?
- a) Designing and optimizing farm machinery
 - b) Applying genetic engineering to improve crop yields and pest resistance
 - c) Managing agricultural waste sustainably
 - d) Integrating trees into agriculture to boost productivity

Assignment 3. Are the following statements true or false? Correct the false ones:

1. Agricultural engineering combines various engineering principles with knowledge of farming.
2. Iowa State University was the first to establish a department for agricultural engineering.

3. The Industrial Revolution had no impact on agricultural technology.
4. The Green Revolution focused on reducing crop yields to combat hunger.
5. Precision agriculture uses technology to improve crop production and reduce waste.
6. Agricultural biotechnology is unrelated to improving crop resistance and yields.
7. Agroforestry helps improve soil and conserve water in agricultural practices.

Assignment 4. Match the words from the left to their synonyms on the right and compare their meanings:

boost	fight
optimize	preserve
efficient	eco-friendly
innovations	equipment
sustainable	effective
machinery	advancements
conserve	enhance
combat	increase

Assignment 5. Translate the sentences paying attention to the italicized words:

1. Jethro Tull invented the seed **drill** to enhance planting efficiency.
2. The team practiced their emergency **drill** regularly.
3. The new irrigation system increased the crop **yield**.
4. Drivers must **yield** the right of way to emergency vehicles.
5. Agricultural **waste** must be managed sustainably.
6. Don't **waste** time on unproductive tasks.
7. Proper **soil** management is crucial for healthy crops.
7. His reputation was **soiled** by false accusations.

Assignment 6. Translate into English using the words you learned:

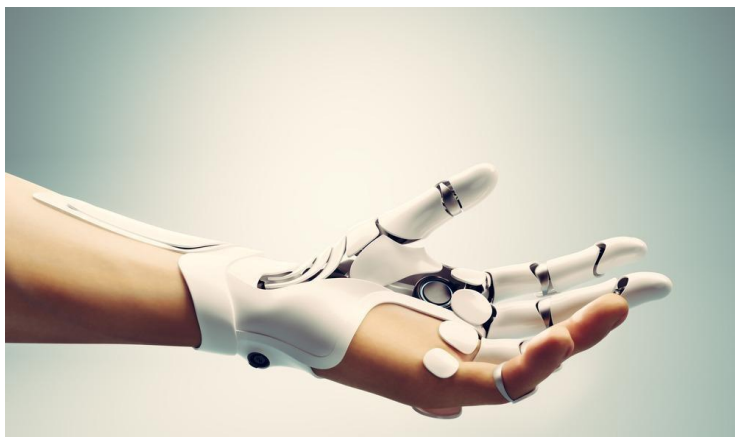
одомашнення тварин; підвищити ефективність; глобальні потреби в продуктах; передові машини; хімічні добрива та пестициди; боротьба з голодом; техніка з GPS-наведенням; трактори та комбайни; опалення; вологість ґрунту; інструменти зі змінною швидкістю; сировина; стійкість до шкідників; збереження ресурсів; підтримка дикої природи; стале землекористування; зменшення впливу на навколишнє середовище.

4.8. Bionics

BASIC WORD LIST

Study the following words and expressions.

mimic	імітувати
overlap	частково збігатися
groundbreaking	новаторський
via	через / за допомогою
cortex	кора головного мозку
array	матриця
brainstem	стовбур головного мозку
hereditary	спадковий
physical disability	фізична вада



Bionics is a field of engineering that studies and develops mechanical systems that accurately **mimic** living organisms' function or parts. Biological structures, methods, and systems are applied to the design of engineering systems and modern technologies.

Bionic engineering draws inspiration from how organisms adapt and evolve for optimal survival. It blends engineering with life sciences and **overlaps** with fields like biomechanics, cybernetics, and bioengineering. The field began in 1960 when scientists gathered at a congress in Ohio. Early biomimetic innovations include Cat's eye reflectors and Velcro. Today, bionics is advancing fields like physiotherapy, robotics, and medical science with **groundbreaking** biomimetic devices.

Bionic Vision

The bionic eye is a potential breakthrough technology that can enhance the vision of patients with eye conditions and partial and complete blindness.

Bioelectric implants can transmit visual data to the brain **via** the visual **cortex**. Two key challenges are replicating retinal function and meeting consumer demands for compact, implantable devices. Despite these challenges, the bionic vision market has various prototypes and products, such as the Argus II by Second Sight Medical Products. This device uses a microelectronic **array** in the retina, a camera in wearable glasses, and an image processing unit. The camera captures images, which are processed and transmitted to the array, stimulating retinal cells and bypassing damaged photoreceptors.

Auditory Bionics

Bionic devices, such as cochlear, auditory midbrain, and **brainstem** implants, assist those with hearing loss by creating a link between the brain and the auditory source via a microelectronic array. Unlike visual bionics, auditory bionics is a more established field with broader global adoption and a larger range of products. Companies like MED-EL, Advanced Bionics, and Cochlear Limited lead this market.

Bionic Limbs

According to the WHO, around 15% of the world's population live with some form of physical disability, whether it is **hereditary** or stemming from injuries and accidents. Around 190 million people worldwide have a severe functional difficulty.

For about a century, prosthetic limbs have provided limited independence for patients. Recently, bionic limbs have begun replacing them, offering greater control by interfacing with the neuromuscular system. This allows brain-controlled movements like grasping and bending through an electronic pathway. The University of Utah's Bionic Engineering Lab is advancing bionic limbs, including AI-controlled legs. MIT also launched the K. Lisa Yang Center for Bionics, focusing on limb reconstruction and brain-controlled exoskeletons. Bionic technology has potential beyond medicine, such as in biomimicking robots and military exoskeletons, including a bird-inspired morphing wing.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the primary focus of the field of bionics in engineering?
- 2) How does bionic engineering apply biological structures and methods to technology?
- 3) When and where did the field of bionics begin?
- 4) What are some examples of early biomimetic innovations mentioned in the text?
- 5) In what ways is bionics currently advancing in fields like physiotherapy, robotics, and medical science?
- 6) What are the main functions of a bionic eye, and how does it work?
- 7) What challenges exist in the development of bionic vision technology?
- 8) How do auditory bionics devices assist people with hearing loss?
- 9) What role does the University of Utah's Bionic Engineering Lab play in the development of bionic limbs?
- 10) Besides medical uses, what are other potential applications of bionic technology?

Assignment 2. Choose the correct answer:

1. What is the primary goal of bionic engineering according to the passage?
 - a. Designing innovative medical devices for the human body
 - b. Developing mechanical systems that mimic living organisms
 - c. Advancing the field of robotics and artificial intelligence
 - d. Creating new energy-efficient technologies
2. Which of the following is an example of an early biomimetic innovation mentioned in the passage?
 - a. Cochlear implants
 - b. Argus II retinal device
 - c. Velcro
 - d. Bionic limbs
3. What are the two key challenges in developing bionic vision technology as stated in the passage?
 - a. Transmitting visual data and training the brain to interpret it
 - b. Replicating retinal function and meeting consumer demands for compact, implantable devices
 - c. Securing funding and attracting top talent in the field
 - d. Navigating regulatory requirements and safety concerns
4. Which statement about the current status of auditory bionics is accurate according to the passage?
 - a. It is a less established field compared to bionic vision.
 - b. It has not achieved widespread global adoption.
 - c. It faces significant technological hurdles compared to bionic vision.
 - d. It is a more established field with broader global adoption.
5. What is the estimated percentage of the world's population that lives with some form of physical disability, as mentioned in the passage?
 - a. 5%
 - b. 10%
 - c. 15%
 - d. 20%

6. How do bionic limbs interface with the user's neuromuscular system according to the passage?

- a. By creating an electronic pathway for brain-controlled movements
- b. Through voice commands and gesture recognition
- c. By directly connecting to the user's nervous system
- d. Through a combination of sensors and computer algorithms

7. Beyond medical applications, the passage mentions the potential use of bionic technology in which of the following areas?

- a. Advancements in artificial intelligence and machine learning
- b. Developing new forms of renewable energy
- c. Biomimicking robots and military exoskeletons
- d. Energy-efficient transportation systems

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

mimic	send
groundbreaking	matrix
array	adjust
transmit	innovative
inspiration	small
adapt	imitate
compact	motivation

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Bionics combines engineering with life sciences and is closely related to biomechanics and cybernetics.
2. The bionic eye is already widely used and has no significant challenges to overcome.
3. Auditory bionics is a newer field compared to visual bionics.
4. The University of Utah is working on AI-controlled bionic limbs.
5. Bionic limbs offer more independence than traditional prosthetic limbs by connecting with the neuromuscular system.
6. Bionic technology is only applicable in the medical field.
7. The K. Lisa Yang Center for Bionics focuses on brain-controlled exoskeletons.

Assignment 5. Translate the sentences paying attention to the italicized words:

1. Mechanical systems in bionics can replicate any **part** of a living organism.
2. She took **part** in the international bionics conference.
3. Bionic engineering **draws** inspiration from nature to create functional designs.
4. He **draws** intricate diagrams to explain the concepts of bionics.
5. The **range** of bionic products available today is expanding rapidly.
6. The mountain **range** behind the research center was breathtaking.
7. The Argus II device includes an image processing **unit** to help with vision.
8. Each **unit** in the apartment complex is fully furnished and ready for rent.

Assignment 6. Complete the sentences using the given words from the box:

brainstem	limbs	hereditary	exoskeletons
retina	mimic	array	cortex

1. Scientists in bionics are studying the to develop advanced neural interfaces that can process sensory information for prosthetic devices.
2. The, which controls basic bodily functions, inspires the design of biorobotic systems that can autonomously regulate movement and balance.
3. Some innovations in bionics aim to correct conditions, such as vision loss, by developing artificial retinas.
4. Engineers are creating an of sensors to integrate with prosthetic, allowing users to feel and control movements naturally.
5. Advanced are being designed to the natural movements of the human body, helping individuals with mobility impairments regain independence.
6. Bionic implants are a breakthrough technology, offering hope to restore vision by directly stimulating the optic nerve.

Assignment 7. Translate into English using the words you learned:

черпати натхнення; виживання; збиратися; новаторські пристрої; проривна технологія; часткова та повна сліпота; задоволення потреб споживачів; матриця в сітківці ока; фіксувати зображення; фізична вада; обмежена незалежність; керований мозком; протези кінцівок; хапання та згинання.

4.9. Biochemical Engineering

BASIC WORD LIST

Study the following words and expressions.

economically yielding	економічно прибутковий
scale-up	масштабування
cornstarch	кукурудзяний крохмаль
brewing	пивоваріння
rigid	твердий; негнучкий
mitigate	пом'якшувати
spill	пролиття
oversight	контроль



Biochemical engineering, often considered a branch of chemical engineering, deals with applying the advancements in science and technology to biological systems and materials. It is a multidisciplinary field that carries the knowledge from chemistry, biology, mathematics, engineering and designing for environmental

friendly and **economically yielding** large scale bioprocess development. Biochemical engineers study and use the principles of mechanical, industrial and electrical engineering for **scale-up** and development of living cell based processes or those that utilize the biological components.

It is a broad field that involves designing equipment, process planning and development, and the study and maintenance of processes that occur in living organisms or involve biomolecules to achieve specific research or commercial goals. These include eco-friendly solid waste management systems, healthcare, wastewater treatment, biopharmaceuticals, paper production from bio-materials, bioreactor and fermenter design, food biotechnology, and biofuels.

Applications of Biochemical Engineering

Food Industry

Biochemical engineering plays a crucial role in modern food processing, including product synthesis, packaging, and storage. Enzymes such as proteases, amylases, and carbohydrases are widely used, with rennin employed in cheese production and glucoamylase in **cornstarch** processing as notable examples.

Fermentation Industry

From bread-making to **brewing** and pharmaceuticals, fermentation relies on biochemical engineering. Genetically modified strains and advanced bioreactors enhance product yield and quality.

Agriculture

Biochemical engineering supports eco-friendly practices by developing biopesticides and biofertilizers, reducing the need for harmful chemicals. Specialized machinery ensures effective synthesis and application.

Biopharmaceuticals

Biochemical engineering enables the production of biopharmaceuticals like insulin through genetically engineered bacteria. Vaccines and antibiotics, such as penicillin, are manufactured in controlled fermenters.

Energy Generation

Biofuels from algae and fungi, along with biogas from animal waste, are produced using specialized equipment, reducing reliance on fossil fuels.

Waste Management

Innovative machinery converts solid waste into materials like **rigid** cement. Advanced recycling processes are also driven by biochemical engineering.

Environmental Conservation

Biochemical engineering **mitigates** chemical pollution by utilizing living organisms, as seen in oil **spill** treatments in marine environments.

Biological Warfare

Although heavily regulated, biochemical engineering has the potential for weaponizing microorganisms, highlighting the need for strict **oversight**.

Biotechnology Integration

Biochemical engineering collaborates with biotechnology to scale complex biological systems for industrial applications.

Assignment 1. In pairs, discuss the following questions:

- 1) What is biochemical engineering, and how does it relate to chemical engineering?
- 2) Which scientific disciplines contribute to the multidisciplinary nature of biochemical engineering?
- 3) What principles do biochemical engineers apply from mechanical, industrial, and electrical engineering?
- 4) What are some examples of processes designed by biochemical engineers to achieve environmental or commercial goals?
- 5) How does biochemical engineering contribute to the food industry, and what are some specific enzymes used?
- 6) What role does biochemical engineering play in the fermentation industry, and how are genetically modified strains utilized?

- 7) How does biochemical engineering promote eco-friendly practices in agriculture?
- 8) What are the contributions of biochemical engineering to biopharmaceutical production, such as insulin or vaccines?
- 9) In what ways does biochemical engineering address energy generation, particularly through biofuels and biogas?
- 10) How does biochemical engineering integrate with biotechnology to scale biological systems for industrial applications?

Assignment 2. Choose the correct answer:

1. According to the passage, which field does biochemical engineering fall under?
 - a) Electrical engineering
 - b) Chemical engineering
 - c) Environmental engineering
 - d) Biological engineering
2. Which of the following is NOT a key area of focus for biochemical engineers?
 - a) Designing equipment for biological processes
 - b) Developing biofuels from renewable sources
 - c) Studying the principles of mechanical engineering
 - d) Improving the efficiency of electronic systems
3. What is the role of biochemical engineering in the food industry?
 - a) Developing biopesticides and biofertilizers
 - b) Producing insulin through genetically engineered bacteria
 - c) Utilizing enzymes in food processing and manufacturing
 - d) Designing advanced recycling processes for solid waste
4. How does biochemical engineering contribute to the pharmaceutical industry?
 - a) By enabling the production of biopharmaceuticals like insulin
 - b) By developing eco-friendly solid waste management systems
 - c) By improving the efficiency of mechanical and electrical systems
 - d) By designing equipment and processes for effective waste-to-energy conversion

5. What is the potential concern regarding the application of biochemical engineering in biological warfare?
- a) It can lead to the development of eco-friendly practices.
 - b) It can enhance product yield and quality in the fermentation industry.
 - c) It has the potential to weaponize microorganisms, requiring strict oversight.
 - d) It can mitigate chemical pollution by utilizing living organisms.
6. How does biochemical engineering collaborate with biotechnology?
- a) By designing equipment and processes for industrial applications
 - b) By developing biopesticides and biofertilizers for agriculture
 - c) By studying the principles of mechanical, industrial, and electrical engineering
 - d) By scaling complex biological systems for industrial applications
7. Which industry utilizes biochemical engineering to reduce reliance on fossil fuels?
- a) Food industry
 - b) Energy industry
 - c) Waste management industry
 - d) Pharmaceutical industry

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

yield	minimization
storage	sector
reduction	output
controlled	standard
industry	preservation
integration	regulated
quality	combination

Assignment 4. Are the following statements true or false? Correct the false ones:

- 1. The field of biochemical engineering combines knowledge from various disciplines.
- 2. Biochemical engineering is solely focused on chemical processes.

3. Biochemical engineers do not work with living organisms.
4. Enzymes are used in the food industry for product synthesis.
5. Biochemical engineering has no role in agriculture.
6. Biofuels can be produced from organic materials like algae.
7. Biochemical engineering can potentially be misused for harmful purposes.

Assignment 5. Translate the sentences paying attention to the italicized words:

1. Engineers study processes for **scale-up** to industrial production.
2. He weighed the materials using a digital **scale**.
3. **Solid** waste management is crucial for the environment.
4. The company has a **solid** reputation in the biotechnology sector.
5. The engineers published a **paper** on their recent discoveries.
6. Biochemical engineers can produce **paper** from bio-materials.
7. **Light** is essential for photosynthesis in algae-based systems.
8. The equipment is designed to be **light** and portable.

Assignment 6. Match (1-5) to the descriptions (a-e):

1. yielding	a) the amount produced by natural means
2. yield	b) giving a product or generating a financial return of a specified amount.
3. convert	c) work jointly on an activity, especially to produce or create something.
4. collaborate	d) make less severe, serious, or painful.
5. mitigate	e) cause to change in form, character, or function.

Assignment 7. Translate into English using the words you learned:

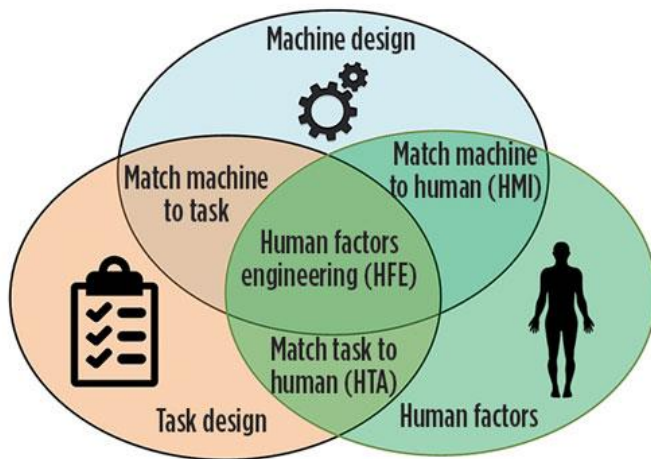
хімічна інженерія; екологічно чистий; економічно прибутковий; масштабування та розробка; дослідницькі та комерційні цілі; тверді відходи; харчова біотехнологія; пакування та зберігання; виробництво хліба; шкідливі хімікати; твердий цемент; використання живих організмів; морське середовище; суворе регулювання; контроль; промислове застосування.

4.10. Human-factors Engineering

BASIC WORD LIST

Study the following words and expressions.

error	помилка
lifecycle costs	витрати на життєвий цикл
layout	розташування
workflow	робочий процес
inadequate	недостатній
laydown areas	місця складування
counter-intuitive	неінтуїтивний
ventilator	апарат штучної вентиляції легень
consequences	наслідки
three-pin plug	триконтактний штекер
misuse	неправильне вживання



Human Factors Engineering (HFE) is the application of human factors knowledge to the design and construction of equipment, products, work systems, management systems and tasks. The objective is to provide equipment and systems that reduce the potential for human **error**, increase system availability, lower **lifecycle costs**, improve safety and enhance overall system performance.

Human Factors Engineering = “Integrating human factors requirements into design”

There are two main objectives to addressing HFE in the design of plant and equipment:

1. To protect the comfort, health, safety and well-being of personnel
2. To minimise the risk of design-induced human performance issues, which may lead to major incidents, other adverse events, and reliability issues.

Common Problems When HFE is Overlooked:

The following are common problems in the oil, gas and chemicals industries when human factors have not been considered in the design phase (similar issues can be found in other industries):

- ✓ Limited access for equipment operation.
- ✓ Insufficient space for installation or maintenance.
- ✓ Poor sight-lines for crane operations.
- ✓ Illogical equipment **layout** and **workflow**.
- ✓ Equipment obstructing walkways.

- ✓ **Inadequate** storage and **laydown areas**.
- ✓ Invisible signage and labelling from work areas.
- ✓ Unsuitable stair, ladder, and walkway designs.

Case study: The design of medical devices

Human error in medical device use is a growing concern, as many devices are developed without considering their users or contexts. Operated by diverse users, including patients at home, poorly designed devices can be **counter-intuitive**, hard to learn, and unsafe, impacting patient safety.

The UK's Design for Patient Safety initiative emphasizes better design to reduce risk and enhance patient-centred care. In April 2020, the UK Chartered Institute of Ergonomics & Human Factors (CIEHF) issued guidance for **ventilator** design during Covid-19, focusing on user interface, environment, tasks, risks, instructions and training. Although written for a very specific application, the advice and guidance in this document would be helpful in the design of many other products.

Error resistant and error tolerant

Systems, equipment, and workplaces should be designed to minimize errors and their **consequences**:

- **Error Resistant:** Prevents errors by simplifying design, reducing options, and making the correct method the easiest. For example, a **three-pin plug** fits only one way, eliminating **misuse** and reducing training needs.
- **Error Tolerant:** Minimizes the impact of errors by making them visible to users or supervisors and enabling timely corrective action. Errors should be easy to recover from with minimal consequences.

Assignment 1. In pairs, discuss the following questions:

- 1) What is the main objective of Human Factors Engineering (HFE)?
- 2) What are the two main objectives of addressing HFE in the design of plant and equipment?
- 3) What are some common problems that can arise when HFE is overlooked in the design phase?
- 4) How can human error in medical device use be a growing concern?
- 5) What does the UK's Design for Patient Safety initiative emphasize?
- 6) What are the two key design principles mentioned in the text to minimize errors and their consequences?
- 7) How can an error-tolerant design help minimize the impact of errors?
- 8) Have you ever experienced a situation where poor design led to mistakes or accidents?

- 9) Can you share an example of a product that you think is well-designed?
- 10) In your opinion, what should be prioritized more: comfort or functionality in design?

Assignment 2. Choose the correct answer:

1. What is the primary purpose of Human Factors Engineering (HFE) according to the passage?
 - a) To reduce the potential for human error
 - b) To increase system performance and availability
 - c) To lower lifecycle costs
 - d) All of the above
2. Which of the following is not a common problem when HFE is overlooked in industrial settings?
 - a) Poor sight-lines for crane operations
 - b) Intuitive and user-friendly equipment designs
 - c) Inadequate storage and laydown areas
 - d) Invisible signage and labeling from work areas
3. What does the UK's Design for Patient Safety initiative primarily focus on?
 - a) Developing new medical device technologies
 - b) Improving training for healthcare professionals
 - c) Enhancing patient-centered design of medical devices
 - d) Promoting standardization in medical device regulations
4. What is the key distinction between "error resistant" and "error tolerant" design approaches?
 - a) Error resistant designs prevent errors, while error tolerant designs minimize the impact of errors.
 - b) Error resistant designs are more costly, while error tolerant designs are more cost-effective.
 - c) Error resistant designs are more common in medical devices, while error tolerant designs are used in other industries.

- d) Error resistant designs simplify the user interface, while error tolerant designs provide more options.
5. According to the passage, what are the two main objectives of addressing HFE in the design of plant and equipment?
- a) Improving safety and reducing lifecycle costs
 - b) Enhancing system performance and user comfort
 - c) Protecting personnel and minimizing design-induced issues
 - d) Increasing availability and reducing human error
6. Which of the following is an example of an "error resistant" design feature mentioned in the passage?
- a) Providing clear visual instructions
 - b) Incorporating multiple safety mechanisms
 - c) Offering comprehensive user training
 - d) A three-pin plug that fits only one way
7. What is the primary focus of the CIEHF guidance for ventilator design during COVID-19?
- a) Improving the user interface, environment, and tasks
 - b) Reducing the risks and enhancing instructions/training
 - c) Optimizing the overall system performance
 - d) Both A and B

Assignment 3. Make up word combinations using the text:

human	consequences
common	costs
poor	device
laydown	errors
minimize	areas
minimal	error
lifecycle	problems
medical	sight-lines

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Human Factors Engineering aims to enhance system performance and reduce human error.
2. The main goal of HFE is to increase the risk of design-induced human performance issues.
3. Poorly designed medical devices can negatively affect patient safety.
4. The UK's Design for Patient Safety initiative focuses on improving medical device design.
5. Error resistant systems make it easier for users to make mistakes.
6. The text mentions that equipment layout and workflow should be logical to avoid problems.
7. Human Factors Engineering is only relevant in the medical field.

Assignment 5. Match (1-6) to the descriptions (a-f):

1. misuse	a) the manner in which something is displayed or laid out.
2. consequence	b) a device for making an electrical connection, especially between an appliance and a power supply.
3. layout	c) wrong or bad use.
4. ladder	d) a device used medically to support or replace the breathing of a person who is ill, injured, or anesthetized.
5. plug	e) a result or effect of an action or condition.
6. ventilator	f) a set of rungs or steps between two long supports, for climbing up or down.

Assignment 6. Complete the sentences using the given words from the box:

layout	consequences	lifecycle costs	three-pin plug
workflow	misuse	error	inadequate

1. Human-factors engineering focuses on minimizing by designing systems that are intuitive and user-friendly.
2. Properly considering human factors in design can significantly reduce by preventing accidents and the need for frequent maintenance.

3. The of equipment and workspaces is critical to ensure smooth operations and reduce the likelihood of user mistakes.
4. Optimized design allows tasks to be performed efficiently, minimizing delays and confusion.
5. An understanding of user needs can result in poorly designed systems that are prone to failure and errors.
6. The of poor human-factors engineering include safety risks, increased errors, and higher operational costs.
7. A well-designed exemplifies an error-resistant product that eliminates misuse by ensuring correct orientation during use.
8. Avoiding through thoughtful design not only protects users but also enhances safety and reduces the lifecycle costs of equipment.

Assignment 7. Translate the sentences paying attention to the italicized words:

1. Better design ensures devices are *safe* for use.
2. He kept his documents locked in a *safe*.
3. The *guidance* document helps manufacturers design safer products.
4. This manual serves as a *guide* for new users.
5. Protecting the *health* and safety of personnel is a priority.
6. The *health* of the machine is monitored regularly.
7. The latest *issue* of the journal includes a study on HFE.
8. Reliability *issues* in the equipment led to frequent maintenance.

Assignment 8. Translate into English using the words you learned:

людська помилка; знижувати витрати протягом життєвого циклу; основні цілі; безпека та добробут персоналу; недостатньо місця; розташування обладнання; сходи та драбина; робочий процес; прилади з поганим дизайном; зосередити увагу на інтерфейсі користувача; апарат штучної вентиляції легень; стати у нагоді; поради та вказівки; мінімізувати помилки та їх наслідки; триконтактний штекер; неправильне використання; коригувальні дії; запобігати помилкам; керівники; легко виправлятися.

4.11. Environmental Health Engineering

BASIC WORD LIST

Study the following words and expressions.

pristine	незайманий, чистий
depletion	виснаження
tackle	вирішувати (проблему)
alter	змінювати
millennia	тисячоліття
well	колодязь
aqueduct	акведук
outbreak	спалах
purification	очищення
odor	запах
acceptance	визнання, схвалення
discharge	випускати, виливати



We often imagine a world with clean air, **pristine** waters, and thriving ecosystems, but reality is marked by pollution, climate change, and resource **depletion**. Environmental engineering applies engineering principles to protect ecosystems, health, and quality of life. Using tools like geographic information systems (GIS) and

environmental modeling, engineers analyze data and design sustainable solutions to **tackle** these challenges.

History of Environmental Engineering

Humans have **altered** the environment for **millennia**, with early civilizations like the Indus Valley developing advanced water management systems, including **wells**, sewage, and irrigation. Greeks built **aqueducts** and sewer systems for irrigation.

Modern environmental engineering emerged in 19th-century London, where Joseph Bazalgette designed the first sewage system. Initially, waste was dumped into the Thames, causing cholera **outbreaks**. Engineers then developed waste and water treatment systems to prevent disease.

By the mid-20th century, environmental engineering became a distinct field focused on improving and preserving the environment.

Environmental engineering applications

1. Water **Purification** and Treatment

Environmental engineers assess water needs and watershed capacity, designing treatment processes and storage systems to meet demand. Using computer-aided design (CAD) software, they create efficient water treatment and distribution systems.

Treatment removes toxins, improves taste and **odor**, and ensures water quality for domestic, irrigation, and fire suppression purposes.

2. Environmental Impact Assessment

Engineers evaluate the potential environmental effects of activities and propose mitigation strategies. These assessments inform decision-makers about the consequences of proposed projects, ensuring environmental considerations are prioritized.

Methods include lifecycle analysis for industrial products and fuzzy logic to estimate non-quantifiable impacts, such as landscape quality and social **acceptance**.

3. Solid Waste and Wastewater Management

Environmental engineers develop solutions for waste collection, processing, and disposal to minimize environmental harm.

For wastewater, they design treatment plants to prevent disease outbreaks and protect ecosystems. Techniques include aeration, flocculation, sedimentation, activated sludge treatment, and disinfection. Advanced systems remove sludge, nitrogen, and phosphorus before safe discharge into water bodies.

4. Air Pollution Management

Environmental engineers develop strategies to control air toxicity, improve air quality, and manage pollutants. They study greenhouse gas emissions, propose control methods, and address issues like acid rain. Engineers also advise authorities on reducing sulfur dioxide and nitrogen dioxide levels.

Assignment 1. In pairs, discuss the following questions:

- 1) What are the main environmental challenges mentioned in the text?
- 2) What is environmental engineering, and what are its primary goals?
- 3) What tools do environmental engineers use to analyze data and create sustainable solutions?
- 4) What examples of water management systems were developed by the Indus Valley civilization and ancient Greeks?
- 5) Who designed the first modern sewage system in London, and what problems did it initially cause?
- 6) How is an environmental impact assessment conducted, and what methods are used?
- 7) What processes are used to purify water and ensure its quality for consumption?

- 8) How did environmental engineering evolve by the mid-20th century?
- 9) What techniques are used to treat wastewater and minimize environmental harm?
- 10) How do environmental engineers address air pollution and greenhouse gas emissions?

Assignment 2. Choose the correct answer:

1. Which of the following is considered a key responsibility of modern environmental engineers?
 - a) Developing advanced irrigation systems
 - b) Designing aqueducts and sewer networks
 - c) Improving and preserving the environment
 - d) Constructing large-scale industrial facilities
2. What is the primary purpose of environmental impact assessments conducted by engineers?
 - a) To estimate the environmental effects of proposed projects
 - b) To create efficient water treatment and distribution systems
 - c) To manage solid waste and wastewater disposal
 - d) To develop strategies for air pollution control
3. Which treatment process is most effective in removing toxins and ensuring water quality?
 - a) Sedimentation
 - b) Disinfection
 - c) Aeration
 - d) All of the above
4. How do environmental engineers utilize computer-aided design (CAD) software?
 - a) To evaluate non-quantifiable environmental impacts
 - b) To estimate greenhouse gas emissions
 - c) To design sustainable water infrastructure
 - d) To manage solid waste collection and disposal

5. What is the primary goal of environmental engineers when addressing air pollution issues?
- a) Reducing sulfur dioxide and nitrogen dioxide levels
 - b) Developing strategies to control air toxicity
 - c) Proposing methods to mitigate greenhouse gas emissions
 - d) All of the above
6. When did environmental engineering emerge as a distinct field of study?
- a) During the Indus Valley civilization
 - b) In ancient Greek society
 - c) In the 19th century in London
 - d) In the mid-20th century
7. Which of the following is a key technique used in wastewater treatment?
- a) Lifecycle analysis
 - b) Fuzzy logic modeling
 - c) Activated sludge treatment
 - d) Environmental impact assessment

Assignment 3. Compare the following English words with their synonyms:

imagine	cleaning
depletion	reduction
climate	clean
altered	avoid
prevent	modified
purification	envision
mitigation	exhaustion
pristine	weather

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Environmental engineering focuses on improving health and quality of life.
2. The first sewage system was designed in ancient Greece.
3. Environmental engineers use computer software to design water treatment systems.
4. The text states that environmental engineering is a new field that started in the 21st century.

5. Engineers assess the environmental impact of projects to help decision-makers.
6. Wastewater treatment plants are designed to increase disease outbreaks.
7. Environmental engineers study air pollution to improve air quality.

Assignment 5. Match (1-6) to the descriptions (a-f):

1. pristine	a) soft, slimy mud, grease or other matter which settles at the bottom of a liquid.
2. tackle	b) the sudden or violent start of something unwelcome, such as war, disease, etc.
3. well	c) a structure like a bridge that carries water across a valley.
4. aqueduct	d) a lined shaft made in the earth from which to obtain water, oil, natural gas etc.
5. outbreak	e) to deal with or try to solve (a problem).
6. sludge	f) in its original condition; unspoiled.

Assignment 6. Complete the sentences using the given words from the box:

well	outbreak	alter
purification	pristine	tackle

1. Environmental health engineering strives to restore conditions in ecosystems affected by industrial activities.
2. Engineers design innovative systems to challenges like air pollution and waste management.
3. Human activities often natural ecosystems, requiring engineering solutions to mitigate harm.
4. A properly functioningcan provide clean water for communities, reducing the risk of waterborne diseases.
5. During a disease , environmental health engineers play a vital role in controlling contamination and protecting public health.
6. Water systems are essential for ensuring safe drinking water and maintaining overall environmental health.

Assignment 7. Translate into English using the words you learned:

процвітаючі екосистеми; розробляти стійкі рішення; колодязі, каналізація та зрошення; спалахи холери; ландшафт; стічні води; очисні споруди; мул.

4.12. Genetic engineering

BASIC WORD LIST

Study the following words and expressions.

concern with	пов'язана з
alteration	переробка
hotbed	осередок
accelerate	прискорювати
factor in	враховувати
germ-line	зародкова (генетична терапія)
interventions	втручання
inheritable	успадковується
predisposition	схильність
disorder	розлад
sickle cell anemia	серповидно-клітинна анемія
traits	риси



Genetic engineering is the area of biotechnology **concerned with** the directed **alteration** of genetic material. Biotechnology has already had countless applications in industry, agriculture, and medicine. It is a **hotbed** of research. The finishing of the human genome project – a “rough draft” of the entire human genome was published

in the year 2000 – was a scientific milestone by anyone’s standards. Research is now shifting to decoding the functions and interactions of all these different genes and to developing applications based on this information. The potential medical benefits are too many to list; researchers are working on every common disease, with varying degrees of success. Progress takes place not only in the development of drugs and diagnostics but also in the creation of better tools and research methodologies, which in turn **accelerates** progress.

When considering what developments are likely over the long term, such improvements in the research process itself must be **factored in**. The human genome project was completed ahead of schedule (it usually takes ten years to get from proof-of-concept to successful commercialization). Genetic therapies are of two sorts: somatic and **germ-line**. In somatic gene therapy, a virus is typically used as a vector to insert genetic material into the cells of the recipient's body. The effects of such **interventions** do not carry over into the next generation. Germ-line genetic therapy

is performed on sperm or egg cells, or on the early zygote, and can be **inheritable**. Embryo screening, in which embryos are tested for genetic defects or other traits and then selectively implanted, can also count as a kind of germ-line intervention. Human gene therapy, except for some forms of embryo screening, is still experimental. Nonetheless, it holds promise for the prevention and treatment of many diseases, as well as for uses in enhancement medicine.

The potential scope of genetic medicine is vast: virtually all disease and all human traits – intelligence, extroversion, conscientiousness, physical appearance, etc. – involve genetic **predispositions**. Single-gene **disorders**, such as cystic fibrosis, **sickle cell anemia**, and Huntington's disease are likely to be among the first targets for genetic intervention. Polygenic traits and disorders, in which more than one gene is implicated, may follow later, although even polygenic conditions can sometimes be influenced in a beneficial direction by targeting a single gen.

Assignment 1. In pairs, discuss the following questions:

- 1) What is genetic engineering?
- 2) Where does biotechnology have its applications?
- 3) What is the human genome project?
- 4) Is there any sense of genetic engineering for medicine?
- 5) What about the human genome project?
- 6) Genetic therapies are of two sorts, aren't they? Can you name them?
- 7) What is somatic gene therapy?
- 8) What is the main idea, principle of germ-line genetic therapy?
- 9) What is the potential scope of genetic medicine?
- 10) How can polygenic conditions sometimes be influenced?

Assignment 2. Complete the sentences using the given words from the box in the correct form:

concern	germ-line	common disease	interactions
embryo screening	intervention	inheritable	somatic embryos

- 1) Genetic engineering with the directed alteration of genetic material.
- 2) Germ-line genetic therapy can be
- 3) Human gene therapy, except for some forms of , is still experimental.
- 4) Research wants to decode the functions and of all these different genes.

- 5) Genetic therapies are of two sorts: and
- 6) Researchers are working on every with varying degrees of success.
- 7) Embryo screening tests for genetic defects or other traits.
- 8) Single-gene disorders are the first targets for genetic

Assignment 3. Put the words in the right order:

- 1) is /biotechnology /research /of /a hotbed.
- 2) different genes /and /research /of /decodes/the functions /interactions.
- 3) into /the effects /the next generation /do not carry over.
- 4) are /genetic defects /embryos /tested for.
- 5) human /still experimental/ therapy /is /gene.
- 6) involve /and /predispositions /all disease /all human traits /genetic.

Assignment 4. Match (1-6) to the descriptions (a-f):

1. germ-line	a) an environment promoting the growth of something, especially something unwelcome
2. hotbed	b) a series of germ cells each descended or developed from earlier cells in the series
3. screening	c) the deliberate modification of the characteristics of an organism by manipulating its genetic material
4. genetic engineering	d) the evaluation or investigation of something as part of a methodical survey
5. predisposition	e) a very important event in the development of smth.
6. milestone	f) a liability or tendency to suffer from a particular condition, hold a particular attitude, or act in a particular way

Assignment 5. Are the following statements true or false? Correct the false ones:

1. Genetic engineering is primarily focused on altering genetic material in a random manner.
2. The human genome project was completed faster than initially planned.
3. Somatic gene therapy can affect future generations.
4. Embryo screening is considered a type of germ-line intervention.

5. Genetic medicine has the potential to address both single-gene and polygenic disorders.
6. Human gene therapy is widely used and no longer experimental.
7. Biotechnology has applications only in medicine.

Assignment 5. Translate the sentences paying attention to the italicized words:

1. Germ-***line*** therapies target cells in the reproductive line.
2. She waited patiently in ***line*** for her turn.
3. Genetic therapies are advancing in the ***treatment*** of rare diseases.
4. His ***treatment*** of the subject was thorough and insightful.
5. Biotechnology innovations are often intended for ***commercial*** use.
6. The ***commercial*** on TV advertised a new fitness product.
7. The human genome project produced a rough ***draft*** of the genome in 2000.
8. A cold ***draft*** was coming in through the open window.

Assignment 6. Match the words from the left to their synonyms on the right and compare their meanings:

alteration
countless
milestone
scope
benefits
potential
factors

limitless
range
possibility
change
elements
achievement
advantages

Assignment 7. Translate into English using the words you learned:

незліченна кількість застосувань; осередок досліджень; прискорювати прогрес; проект геному людини; соматична генна терапія; зародкова генетична терапія; скринінг ембріонів; перевіряють на наявність генетичних дефектів; профілактика та лікування захворювань; потенційні можливості; риси людини; зовнішній вигляд; серповидно-клітинна анемія та хвороба Гентінгтона; генетичне втручання; генетична схильність; кістозний фіброз; в позитивному напрямку; один ген.

4.13. Biomimicry

BASIC WORD LIST

Study the following words and expressions.

time-tested	перевірений часом
denticles	зубчики
align	вирівняти
beaver	бобер
blubber layer	шар жиру
dense fur	щільне хутро
wetsuit	гідрокостюм
velcro	липучка
burrs	задирки
tiny	маленький
fins	плавники
blade	лопать
propeller	повітряний гвинт
boost	збільшити
repel	відштовхувати
debris	сміття
spotless	чистий
shell	панцир

Biomimicry is the practice of drawing inspiration from nature's **time-tested** designs to improve human innovations. By emulating efficient, evolved strategies, it offers sustainable solutions to modern challenges.

Here are eight striking examples of biomimicry.



Sharkskin = Swimsuit

Sharkskin-inspired swimsuits gained attention during the 2008 Olympics, especially with Michael Phelps. Under an electron microscope, sharkskin shows overlapping scales, or dermal **denticles**, with grooves that **align** with water flow, reducing turbulence and discouraging parasitic growth. Scientists replicated this in swimsuits (now banned in competitions) and boat hulls, improving efficiency and reducing cleaning needs. The technique is also being used to create bacteria-resistant surfaces in hospitals.



Beaver = Wetsuit

Beavers stay warm with a thick **blubber layer** and **dense fur** that traps air, keeping them warm and dry in water. Inspired by this, MIT engineers developed rubbery, fur-like materials for potential use in bioinspired **wetsuits**.



Termite Den = Office building

Termite dens maintain a steady 87°F inside, despite extreme outside temperatures. Architect Mick Pearce applied this natural cooling method to the Eastgate Centre in Zimbabwe. Using large chimneys that cool the building at night, the 333,000-square-foot structure uses 90% less energy for heating and cooling than traditional buildings.



Burr = Velcro

Velcro is a well-known example of biomimicry, invented in 1941 by Swiss engineer George de Mestral after studying how **burrs** stuck to his dog. The **tiny** hooks on the burrs inspired him to create Velcro. Without it, we wouldn't have sports like Velcro jumping, where people in Velcro suits stick to walls.



Whale = Turbine

Whales are highly efficient swimmers, diving deep and staying submerged for hours. Scientists found that the bumps on whale **fins** reduce drag by 32% and increase lift by 8%. This design is now being applied to wind turbine **blades**, cooling fans, airplane wings, and **propellers** for improved efficiency.



Birds = Jets

Birds can **boost** their flight distance by over 70% using a V-formation, where each bird benefits from the updraft created by the one ahead. Researchers at Stanford, led by Professor Ilan Kroo, believe passenger airlines could save 15% on fuel by adopting a similar formation, with jets taking turns leading, just like birds.



Lotus = Paint

The lotus flower's micro-rough surface naturally **repels** dirt, keeping its petals clean. Water rolling over the leaf collects **debris**, leaving it **spotless**. Inspired by this, German company Ispo developed a paint that mimics this effect, reducing the need to clean building exteriors.



Beetle = Water Collection

The Stenocara beetle collects water in the desert using smooth bumps on its **shell**, which funnel condensed fog into its mouth. Inspired by this, MIT researchers, building on work by Oxford's Andrew Parker, developed a material that efficiently gathers water from the air. This improvement could greatly benefit the 22 countries using nets for water collection.

Assignment 1. In pairs, discuss the following questions:

- 1) How does biomimicry offer sustainable solutions to modern challenges?
- 2) What are the key features of sharkskin that have been replicated in swimsuits and boat hulls?
- 3) How do beavers stay warm in water, and how has this inspired the development of bioinspired wetsuits?
- 4) How does the Eastgate Centre in Zimbabwe use a termite den's cooling method to reduce energy consumption?
- 5) What is the connection between burrs and the invention of Velcro, and how has this led to the development of sports like Velcro jumping?
- 6) How have the design features of whale fins been applied to improve the efficiency of wind turbine blades, cooling fans, airplane wings, and propellers?
- 7) How could passenger airlines potentially save fuel by adopting a flight formation similar to that of birds?
- 8) What are some examples of designs or products that you think might be inspired by nature?

- 9) Have you ever noticed how nature inspires technology in your daily life?
- 10) Have you ever used a product that was designed based on nature? What was it?

Assignment 2. Choose the correct answer:

1. According to the passage, what is the main purpose of biomimicry?
 - a) To study the natural world and discover new materials
 - b) To find sustainable solutions by imitating nature's designs
 - c) To create innovative technologies that outperform nature
 - d) To preserve the environment by reducing human impact
2. Which of the following is NOT a characteristic of sharkskin that was replicated in human-made products?
 - a) Reducing turbulence in water flow
 - b) Discouraging parasitic growth
 - c) Increasing buoyancy for swimmers
 - d) Improving overall efficiency
3. How did the design of the Eastgate Centre building differ from traditional buildings?
 - a) It used less energy for heating and cooling.
 - b) It had a higher level of thermal insulation.
 - c) It incorporated natural ventilation systems.
 - d) It was built using more environmentally-friendly materials.
4. What is the main advantage of the Velcro design over traditional fasteners?
 - a) It is more durable and long-lasting.
 - b) It is easier to attach and detach.
 - c) It is more aesthetically pleasing.
 - d) It is more cost-effective to produce.
5. How did the design of whale fins inspire improvements in wind turbine technology?
 - a) It made the blades more resistant to wear and tear.
 - b) It allowed the blades to generate more power from the wind.

- c) It reduced the noise and vibration produced by the turbines.
 - d) It increased the blades' lift and reduced drag.
6. What is the main benefit of the V-formation used by birds during flight?
- a) It allows them to conserve energy and fly for longer distances.
 - b) It helps them to navigate more efficiently and avoid obstacles.
 - c) It enables them to communicate and coordinate their movements better.
 - d) It provides them with a higher vantage point for spotting prey or predators.
7. What is the primary purpose of the lotus-inspired paint developed by Ispo?
- a) To improve the aesthetic appearance of building exteriors.
 - b) To enhance the thermal insulation properties of buildings.
 - c) To reduce the need for frequent cleaning of building exteriors.
 - d) To increase the durability and longevity of the building's paint.

Assignment 3. Match the words from the left to their synonyms on the right and compare their meanings:

collect	increase
repel	clasp
boost	gather
cooling	motivated
inspired	capture
natural	chilling
trap	organic
hook	resist

Assignment 4. Are the following statements true or false? Correct the false ones:

1. Sharkskin-inspired swimsuits were popularized during the 2008 Olympics.
2. The Eastgate Centre in Zimbabwe uses more energy for heating and cooling than traditional buildings.
3. Velcro was inspired by the way burrs attach to animals.
4. The Stenocara beetle can collect water from the air using its shell.
5. Birds flying in a V-formation can reduce their flight distance significantly.
6. The lotus flower's surface helps keep its petals dirty.
7. Scientists are using whale fin designs to improve various types of machinery.

Assignment 5. Translate the sentences paying attention to the italicized words:

1. The sharkskin's overlapping **scales** help reduce turbulence in water.
2. The company expanded its operations on a global **scale**.
3. Beaver fur effectively **traps** air, providing insulation in water.
4. The adventurers set a **trap** to catch small animals for food.
5. The chimneys in the termite-inspired building help **cool** the interior naturally.
6. That skateboard trick was really **cool**!
7. **Spring** is my favourite season.
8. The lotus flower's design allows dirt to roll off like water from a **spring**.

Assignment 6. Match (1-7) to the descriptions (a-g):

1. blubber	a) to put in a straight line or in parallel lines.
2. propeller	b) a rubber suit for wearing in cold conditions when diving etc.
3. debris	c) a device, consisting of revolving blades, used to drive a ship or an aircraft.
4. fog	d) absolutely clean or pure.
5. wetsuit	e) the remains of something broken, destroyed etc.
6. spotless	f) a thick cloud of moisture or water vapour/vapor in the air which makes it difficult to see.
7. align	g) the fat of whales and other sea animals.

Assignment 7. Complete the sentences using the given words from the box:

boost	repel	debris	time-tested	fins
tiny	spotless (2)	blubber layer	wetsuits	burrs

1. Biomimicry uses nature designs to inspire solutions.
2. Beavers' and dense fur inspired engineers to create bioinspired for better insulation.
3. Some materials can repel , keeping surfaces
4. Scientists aim to energy efficiency by applying lessons from birds' V-formations to jet formations.
5. Velcro was inspired by that stick to animal fur.

6. The lotus flower's surface can water, leaving its petals free of debris and completely

7. The bumps on whale reduce drag and improve lift, which has influenced wind turbine blade designs.

Assignment 8. Translate into English using the words you learned:

пропонувати стійкі рішення; купальники в стилі акул'ячої шкіри; перешкоджати росту паразитів; корпуси човнів; стійкі до бактерій поверхні у лікарнях; зберігати тепло; гідрокостюм; опалення та охолодження; стрибки на липучках; нерівності на китових плавниках; збільшити дальність польоту; природним чином відштовхувати бруд; скочуватися по листку; квітка лотоса; панцир; збирати воду в пустелі; фарба, яка імітує ефект...; пелюстки.

Project work

CHOOSE one of these questions to research and be ready to present it in the classroom.

1. Innovative Technologies Shaping the Future of Agricultural Engineering.

2. "Bioengineering Solutions for Environmental Problems".

- ✓ Develop bioengineering methods to address issues like pollution, climate change, or deforestation. (Select an environmental issue, propose a bioengineering solution, and analyze its feasibility) .

3. "Comparative Analysis of National and International Standards".

- ✓ In groups, compare the requirements of national (DSTU) and international standards (ISO, WHO) regarding the quality of biotechnological products. Develop a presentation in which you explain the advantages and challenges of implementing international standards in Ukrainian practice.

Тестові завдання

TEST 1

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

bacteria, biocatalysts, bioeconomy, eco-friendly, healthcare, chemical, biotechnology, innovation, biodegradable, treatment

White biotechnology is a field focused on industrial applications that support the _____(1). Its main tools are biocatalysts – advanced enzymes and microorganisms – used widely in _____(2) and agro-food industries. These _____(3) are designed to improve production efficiency, acting as tools in enzyme engineering. White biotechnology emphasizes _____(4) production, using molds, _____(5), and yeast to create _____(6) products with minimal waste and energy. This approach aligns with stricter environmental regulations, promoting sustainable practices. It drives _____(7) in sectors like chemicals, food, _____(8), packaging, and textiles, contributing to cleaner, greener industry standards. White _____(9) is used for Metabolite production, Waste _____(10), Production of biocontrol agents, Bio-based fuel & energy, etc.

B. Read the text again and decide if the statements are true (T) or false (F).

1. White biotechnology is primarily used in the automotive industry.
2. Biocatalysts in white biotechnology help make production more efficient.
3. White biotechnology does not focus on eco-friendly production methods.
4. The use of molds, bacteria, and yeast in white biotechnology helps reduce waste.
5. White biotechnology contributes to innovation in the healthcare sector.
6. Biocontrol agents are not a product of white biotechnology.
7. White biotechnology aligns with stricter environmental regulations.

C. Find synonyms to the words below in the text.

1. branch
2. increase
3. uses
4. advancement
5. productivity

D. Translate into English using the text.

1. ферменти
2. дріжджі
3. здатний до біорозкладу
4. екологічно чистий
5. паливо

TEST 2

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

*organisms, substances, medicine, genes, beneficial, cells, modify, biology,,
technological, species*

Biotechnology is a technology based on _____(1) especially when used in agriculture, food science, and _____(2). Of many different definitions available, the one formulated by the UN Convention on Biological Diversity is one of the broadest: "Biotechnology means any _____(3) application that uses biotechnological systems, living _____(4), or derivatives thereof, to make or _____(5) products or processes for specific use".

Biotechnology may be defined as use of biotechnological methods to modify genetic material of living _____(6), so they will produce new _____(7) or new functions. The example is recombinant DNA technique in which a copy of a piece of DNA containing one or a few _____(8) is transferred between organisms or within the same organism in order to take _____(9) genetic feature from one _____(10) to another.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Biotechnology is only used in agriculture and medicine.
2. The UN Convention on Biological Diversity provides a broad definition of biotechnology.
3. Biotechnology involves modifying genetic material to create new functions.
4. Recombinant DNA technique transfers DNA between different organisms.
5. Biotechnology does not use living organisms in its applications.
6. The text defines biotechnology as a technology based on chemistry.
7. Recombinant DNA technique is used to transfer beneficial genetic features.

C. Find synonyms to the words below in the text.

1. life forms
2. variety
3. use
4. move
5. favourable

D. Translate into English using the text.

1. сільське господарство
2. корисний
3. застосування
4. доступний
5. клітина

TEST 3

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

sugars, yields, soil, carbohydrates, harvesting, waste (2), fermentation, bacteria, biotechnology

As a matter of fact, _____(1) has a very long history. For centuries, people have been selecting and _____(2) the best seeds to receive high _____(3) of crops.

Early cultures also understood the importance of using natural processes to break down _____(4) products into inert forms. From very early nomadic tribes to pre-urban civilizations it was a common knowledge that given enough time organic _____(5) products would be absorbed and eventually integrated into the _____(6). It not until the advent of modern microbiology and chemistry that this process was fully understood and attributed to _____(7).

The process of Ethanol _____(8) was also one of the first forms of biotechnology. Cultures such as those in Mesopotamia, Egypt, and Iran developed the process of brewing which consisted of combining malted grains with specific yeasts to produce alcoholic beverages. In this process the _____(9) in the grains were broken down into _____(10) such as alcohol.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Biotechnology has been used by humans for a long time to improve crop yields.
2. Early cultures did not understand how organic waste could be broken down.
3. The process of ethanol fermentation was developed in modern times.
4. Brewing involves using yeasts to turn grains into alcoholic drinks.
5. The role of bacteria in breaking down waste was known before modern science.
6. Mesopotamia, Egypt, and Iran were among the first to develop brewing techniques.
7. Biotechnology only became significant with the advent of modern microbiology.

C. Find synonyms to the words below in the text.

1. sugars
2. collecting
3. realize
4. past
5. drink

D. Translate into English using the text.

1. насіння
2. відбирати
3. врожай
4. ґрунт
5. відходи

TEST 4

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

cells, fight, harmful, problem, disease, genes, animal, enzymes, destroy, plant

Genetic engineering often uses _____(1) for antibiotic resistance as "selectable markers". Early in the engineering process, these markers help select _____(2) that have taken up foreign genes. Although they have no further use, the genes continue to be expressed in _____(3) tissues. Most genetically engineered plant foods carry fully functioning antibiotic-resistance genes. The presence of antibiotic-resistance genes in foods could have two _____(4) effects. First, eating these foods could reduce the effectiveness of antibiotics to _____(5) disease when these antibiotics are taken with meals. Antibiotic-resistance genes produce _____(6) that can degrade antibiotics. If a tomato with an antibiotic-resistance gene is eaten at the same time as an antibiotic, it could _____(7) the antibiotic in the stomach. Second, the resistance genes could be transferred to human or _____(8) pathogens, making them impervious to antibiotics. If transfer were to occur, it could aggravate the already serious health _____(9) of antibiotic-resistant _____(10) organisms.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Genetic engineering uses antibiotic-resistance genes to identify cells that have absorbed foreign genes.
2. Antibiotic-resistance genes are removed from plant tissues once no longer needed.
3. Consuming genetically engineered foods with antibiotic-resistance genes can make antibiotics less effective.
4. Antibiotic-resistance genes in foods can enhance the effectiveness of antibiotics.
5. Eating a tomato with an antibiotic-resistance gene can destroy stomach antibiotics.
6. There is a risk that resistance genes could transfer to human or animal pathogens.
7. The transfer of resistance genes to pathogens could help solve the problem of antibiotic-resistant diseases.

C. Find synonyms to the words below in the text.

1. in the beginning
2. choose
3. go on
4. illness
5. break down

D. Translate into English using the text.

1. шлунок
2. ген
3. клітина
4. тканина
5. шкідливі наслідки

TEST 5

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

world, depend on, beet, people, engineering, feed, herbicide, wild, crops,
necessary

Proponents of genetic _____(1) argue that the technology is safe, and that it is _____(2) in order to maintain food production that will continue to match population growth and help _____(3) millions in the Third World countries more effectively. Others argue that there is more than enough food in the _____(4) and that the problem is food distribution, not production, so _____(5) should not be forced to eat food that may carry some degree of risk.

Some fear that certain types of genetically engineered _____(6) will further reduce biodiversity in the cropland; herbicide-tolerant crops will, for example, be treated with the relevant _____(7) to the extent that there are no _____(8) plants (weeds) able to survive, and plants toxic to insects will mean insect-free crops. This could result in declines in other wildlife (e.g. birds) which _____(9) weed seeds and/or insects for food recourses. The recent (2003) farm scale studies in the UK found this to be the case with GM sugar _____(10) and GM rapeseed, but not with GM maize.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Genetic engineering is considered necessary by some to address food distribution issues.
2. There is a concern that genetically modified crops could harm biodiversity.
3. The text suggests that there is a shortage of food globally.
4. Herbicide-tolerant crops may lead to a decrease in wild plant survival.
5. The UK farm scale studies found that GM maize affected wildlife negatively.
6. Some people believe that the risks of genetically modified food are acceptable.
7. The text mentions that genetically modified crops are beneficial for insects.

C. Find synonyms to the words below in the text.

1. for instance
2. kind
3. be afraid of
4. decrease
5. protected from harm

D. Translate into English using the text.

1. прихильник
2. залежати від
3. виробництво
4. біологічне різноманіття
5. вижити

TEST 6

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

second, drug, organs, generation, science, growth, plastics, cell, third, use

Nanotechnology is an emerging _____(1), which is expected to have rapid and strong future developments. It is predicted to contribute significantly to economic _____(2) and job creation in the EU in the coming decades. According to scientists, nanotechnology is predicted to have four distinct generations of advancement. We are currently experiencing the first, or maybe second generation of nanomaterials.

The first _____(3) is all about material science with enhancement of properties that are achieved by the incorporating "passive nanostructures". This can be in the form of coatings and/or the _____(4) of carbon nanotubes to strengthen _____(5). The _____(6) generation makes use of active nanostructures, for example, by being bioactive to provide a _____(7) at a specific target _____(8) or organ. This could be done by coating the nanoparticle with specific proteins. The complexity advances further in the _____(9) and fourth generations. Starting with an advance nanosystem for e.g. nanorobotics and moving on to a molecular nanosystem to control growth of artificial _____(10) in the fourth generation of nanomaterials.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Nanotechnology is expected to have a slow development in the future.
2. The first generation of nanotechnology involves the use of passive nanostructures.
3. The second generation of nanotech focuses on enhancing material properties.
4. Nanotechnology is predicted to have four generations of advancement.
5. The third generation of nanotech includes the development of nanorobotics.
6. The fourth generation of nanotech aims to control the growth of artificial organs.
7. Nanotechnology is not expected to contribute to economic growth in the EU.

C. Find synonyms to the words below in the text.

1. fast
2. progress
3. effect
4. progress
5. rise

D. Translate into English using the text.

1. покоління
2. штучний
3. вуглець
4. білок
5. клітина

TEST 7

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

surface, microalgae, sponges, industrial, jellyfish, renewable, branch, exploring, biopolymers, painkillers

The oceans, covering 70% of Earth's _____(1), have long provided essential resources for human life. As modern technology advances, we're _____(2) marine ecosystems more deeply, uncovering diverse organisms. Blue biotechnology, the study of marine organisms for human benefit, is emerging as a key field in biotechnology. This _____(3) offers applications in drug discovery, producing unique compounds from marine species that differ significantly from terrestrial organisms, potentially leading to groundbreaking medicines. For instance, antibiotics from marine fungi, cancer treatments from _____(4), and powerful, side-effect-free _____(5) from cone snail venom have shown promise. Additionally, marine biotechnology is exploring _____(6) energy sources, like biofuel from _____(7), which can be sustainably cultivated. Industries are also harnessing marine-derived proteins, _____(8), and enzymes. Notably, green fluorescent protein from _____(9) is used to create bio-based energy solutions. Blue biotechnology, therefore, holds immense promise for health, energy, and _____(10) applications.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Marine biotechnology is focused solely on discovering new medicines.
2. Blue biotechnology includes the study of marine organisms for human benefit.
3. Renewable energy from microalgae is not considered sustainable.
4. Green fluorescent protein from jellyfish is used in bio-based energy solutions.
5. Marine-derived proteins are not used in any industries.
6. Cone snail venom has been researched for its potential as a painkiller.
7. The text suggests that blue biotechnology has limited applications.

C. Find synonyms to the words below in the text.

1. area
2. oceanic
3. finding
4. innovative
5. kind

D. Translate into English using the text.

1. комахи
2. безпечливий засіб
3. сполуки
4. наземні організми
5. рак

TEST 8

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

crops, minimizing, bottle, harmful, quality, medicine, meat, cells, insect, goals

Yellow biotechnology, also known as _____(1) biotechnology, applies biotechnological techniques to insects or their _____(2) for agriculture, _____(3), and industry. Its main _____(4) include providing nutrient-rich foods and _____(5) environmental impact. Applications include using insect-derived enzymes for waste management, enhancing food _____(6) through fermentation, and genetic modification for improved _____(7) and animal products. Techniques like RNA interference (RNAi) are employed for pest management by targeting specific insect genes, reducing the need for _____(8) pesticides. Insect chitinases act as natural biopesticides, while enzymes from insects benefit food and waste sectors. Other uses include drugs from insects, such as wound-healing secretions from the green _____(9) fly. In-vitro cell culture also enables lab-grown _____(10) production, reducing reliance on traditional livestock.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Yellow biotechnology focuses on using insects to improve food quality and reduce environmental harm.
2. Insect-derived enzymes are used to increase the nutritional value of crops.
3. RNA interference is a technique used in yellow biotechnology to manage pests without harmful chemicals.
4. Insect chitinases are used to enhance the flavor of food products.
5. Drugs derived from insects can include substances that help heal wounds.
6. Lab-grown meat production in yellow biotechnology relies heavily on traditional livestock.
7. Yellow biotechnology includes the use of insect cells for industrial applications.

C. Find synonyms to the words below in the text.

1. use
2. improving
3. effect
4. reducing
5. conventional

D. Translate into English using the text.

1. комаха
2. клітина
3. переробка відходів
4. пестициди
5. сільськогосподарські культури

TEST 9

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

pandemics, spread, livestock, biowarfare, uses, serious, lead to, resistant, damage, viruses

Dark biotechnology uses microorganisms and toxins for harmful purposes, targeting humans, animals, and plants to _____(1) bioeconomies. This field involves creating _____(2) pathogens that can be used as bioweapons, turning beneficial science into a destructive force. The main components of dark biotechnology are bioweapons, _____(3), and bioterrorism. Bioweapons are microbiological agents like bacteria, _____(4), and toxins that can target crops, _____(5), and humans, such as Anthrax, Botulinum, and Smallpox. Biowarfare is the intentional use of such agents to _____(6) disease, differing from natural _____(7) in its deliberate nature. Bioterrorism, meanwhile, _____(8) these agents for terrorist activities, posing _____(9) global security threats. Examples include highly contagious pathogens like *Bacillus anthracis* (Anthrax), *Clostridium botulinum* (Botulinum toxin), and Ebola, which can _____(10) catastrophic public health crises.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Dark biotech aims to improve bioeconomies by using microorganisms and toxins.
2. Bioweapons are used to intentionally spread diseases.
3. Bioterrorism is a natural occurrence of pandemics.
4. Anthrax and Botulinum are examples of bioweapons.
5. Biowarfare is a form of bioterrorism.
6. Dark biotechnology can turn beneficial science into a harmful force.
7. Ebola is mentioned as a pathogen that can cause public health crises.

C. Find synonyms to the words below in the text.

1. harm
2. elements
3. power
4. disastrous
5. propagate

D. Translate into English using the text.

1. стійкі патогени
2. худоба
3. хвороба
4. завдати шкоди
5. біологічна війна

TEST 10

A. You are going to read a magazine article. Some words are missing from the text. Choose the most appropriate word from the list for each gap (1-10) in the text.

included, implants, robotics, control, modern, military, Engineering, blindness, brain, focused on

Bionics is an engineering field _____(1) creating systems that mimic the function of living organisms. By blending engineering with life sciences, bionics applies biological structures to _____(2) technologies. Starting in 1960, early bionic innovations _____(3) cat's eye reflectors and Velcro. Today, bionics is making strides in _____(4), medical science, and physiotherapy with biomimetic devices. In vision, the bionic eye can aid those with partial or total _____(5) by transmitting visual data to the brain, as seen in devices like Argus II. Auditory bionics, like cochlear _____(6), assist those with hearing loss by linking the auditory source to the _____(7). Bionic limbs offer improved _____(8) over traditional prosthetics by connecting to the neuromuscular system, allowing brain-controlled movements. Research labs like the University of Utah's Bionic _____(9) Lab and MIT's K. Lisa Yang Center for Bionics are leading advancements. Beyond medicine, bionics has applications in robotics and _____(10) exoskeletons.

B. Read the text again and decide if the statements are true (T) or false (F).

1. Bionics combines engineering with life sciences to create systems that imitate living organisms.
2. The first bionic innovations were developed in the 1980s.
3. Bionic eyes can help people with vision impairments by sending visual information to the brain.
4. Cochlear implants are a type of auditory bionics that connect directly to the brain.
5. Bionic limbs are less advanced than traditional prosthetics.
6. The University of Utah's Bionic Engineering Lab is involved in bionics research.
7. Bionics is only used in the medical field.

C. Find synonyms to the words below in the text.

1. combining
2. advancements
3. assist
4. linking
5. enhanced

D. Translate into English using the text.

1. пристрої
2. сліпота
3. мозок
4. кінцівки
5. нервово-м'язова система

"Regulatory Documentation Requirements for Certified Products"

In this article, we'll explore regulatory documentation requirements for certified products by addressing three key areas: production documentation, quality control in production, and international standards in biotechnology. Understanding these components is essential for ensuring that products meet safety, quality, and compliance requirements.

1. General Requirements for Certified Production Documentation

Certified production documentation includes all records that demonstrate a product's compliance with regulatory standards. This documentation typically covers areas such as:

- **Manufacturing Processes:** Step-by-step records that document how a product is made, including details of raw materials, equipment used, and processing methods. These records ensure that each product batch is produced consistently and adheres to required standards.
- **Quality and Safety Checks:** Detailed reports from quality control tests, ensuring that each batch meets specific safety and quality parameters. This can include tests for purity, potency, and other characteristics essential to the product's integrity.
- **Traceability:** Documentation that allows for complete traceability from raw materials to final product distribution. Traceability is crucial for managing recalls and ensuring that any issues can be identified and addressed promptly.

Properly maintained documentation not only supports regulatory compliance but also increases trust among consumers and stakeholders by demonstrating that a certified product is made according to strict standards.

2. General Requirements for Certified Production and Organization of Control over Manufacture and Release of Products

Producing certified products involves establishing strong systems of control over both the manufacturing process and the release of products to the market. Key components include:

- **Good Manufacturing Practices (GMP):** GMP guidelines ensure that products are produced consistently and according to quality standards. They cover areas such as hygiene, equipment maintenance, and staff training. GMP compliance minimizes risks of contamination, mix-ups, and errors in production.

- **Quality Control (QC) Systems:** In a certified production setup, QC systems are implemented to monitor each stage of production. QC involves both in-process inspections and final testing of the product. The aim is to verify that each unit meets the required specifications before it is released.
- **Batch Documentation and Release:** Each batch of a certified product must be thoroughly documented and reviewed by qualified personnel before it is allowed for sale or distribution. This includes checks on batch records, testing results, and confirmation that the batch meets all predefined criteria. Only after passing these reviews can a batch be released to the market.

Effective control measures ensure that every product batch complies with regulatory requirements, providing assurance of quality and safety to both regulatory bodies and consumers.

3. International Standards in Biotechnology

The biotechnology sector is highly regulated globally, with international standards playing a crucial role in ensuring consistent quality and safety. Some of the main standards and organizations include:

- **ISO Standards:** The International Organization for Standardization (ISO) develops standards that cover a range of biotechnological processes, such as ISO 9001 for quality management and ISO 14001 for environmental management. These standards provide a framework for companies to improve their practices and meet global requirements.
- **WHO Guidelines:** The World Health Organization offers guidelines specifically for biotechnological products, especially in the health sector. These guidelines cover aspects such as vaccine production, safety testing, and biopharmaceuticals, helping ensure global health and safety standards.
- **Global Market Access and Compliance:** International standards streamline the process for companies to enter new markets by providing a common set of requirements. Compliance with ISO and WHO standards can make it easier to gain approval in multiple countries, enhancing both market access and consumer trust.

By adhering to these standards, biotech companies can demonstrate that their products are safe, effective, and compliant with global expectations, thus fostering public trust and facilitating smoother international trade.

Summary

Regulatory documentation is fundamental to the certified production process, providing a clear record of compliance and quality. Adhering to GMP, QC practices, and international standards not only assures product safety and efficacy but also strengthens consumer confidence and simplifies access to global markets.

Test 1: Multiple Choice Questions

- 1. What does certified production documentation typically include?**
 - A. Marketing strategies
 - B. Customer feedback forms
 - C. Records of manufacturing processes, quality checks, and traceability
 - D. Employment records
- 2. Which of the following is NOT part of Good Manufacturing Practices (GMP)?**
 - A. Hygiene and equipment maintenance
 - B. Product labeling design
 - C. Staff training
 - D. Error prevention in production
- 3. What is the main purpose of traceability in certified production?**
 - A. To track sales data
 - B. To ensure raw material availability
 - C. To increase production volume
 - D. To manage recalls and address issues quickly
- 4. Which organization is responsible for developing ISO standards?**
 - A. WHO
 - B. FDA
 - C. International Organization for Standardization
 - D. UNICEF
- 5. Who are the primary users of production documentation?**
 - A. Regulators and quality control staff
 - B. External customers
 - C. Marketing teams
 - D. IT technicians

Test 2: True or False

1. ISO 9001 is a standard for environmental management in biotechnology.
2. Batch documentation must be reviewed before a product is released to the market.
3. WHO provides guidelines only for food safety in biotech.
4. Adhering to international standards can help companies enter global markets more easily.
5. GMP includes hygiene, equipment care, and staff training.

Test 3: Fill in the Blanks

1. _____ practices ensure products are consistently produced and controlled to quality standards.
2. Final product testing and in-process inspections are part of _____ systems.
3. Compliance with _____ and WHO guidelines helps establish trust and global safety.
4. The World Health Organization provides _____ for biotechnological product safety.
5. International standards help companies gain _____ to global markets.

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

1. Sharma B, Bharti SK, Anita M (2016) Green biotechnology and scope of genetically modified crops: facts and prejudices. Indian J Agric Bus 2(1):63–72
2. Barcelos MCS, Lupki FB, Campolina GA, Nelson DL, Molina G (2018) The colors of biotechnology: general overview and developments of white, green and blue areas. FEMS Microbiol Lett. <https://doi.org/10.1093/femsle/fny239>
3. Abu-Dieyeh MH, Diab M, Al-Ghouti MA (2017) Ecological and agriculture impacts of bakery yeast wastewater use on weed communities and crops in an arid environment. Environ Sci Pollut Res Int 24(17):14957–14969. <https://doi.org/10.1007/s11356-017-9115-1>
4. DaSilva, E. (2018). The Colours of Biotechnology: Science, Development and Humankind. [online] Ejbiotechnology.info. Available at: <http://www.ejbiotechnology.info/index.php/ejbiotechnology/article/view/1114/1496> [Accessed 25 Aug. 2024].
5. Omics International (2018). Bioinformatics and Systems Biology Journal | Bioinformatics Journals. [online] Omicsonline.org. Available at: <https://www.omicsonline.org/bioinformatics-and-systems-biology-journals-impact-factor-ranking.php> [Accessed 25 Aug. 2024].
6. Priya Vashisth, and Jayesh R. Bellare. "Development of hybrid scaffold with biomimetic 3D architecture for bone regeneration." Nanomedicine: Nanotechnology, Biology and Medicine 14 (4) (2018): 1325-1336 [Link]

Інтернет - ресурси:

1. <https://www.investopedia.com/terms/b/biotechnology.asp>
2. <https://tclglobal.co.uk/difference-between-biotechnology-and-bioengineering/>
3. <https://www.asme.org/topics-resources/content/top-10-bioengineering-trends>
4. <https://biotechhealth.com/what-are-the-4-types-of-biotechnology/>
5. <https://www.kiranjeeetkaurbiotechnologist.com/2022/05/white-biotechnology.html>
6. <https://steemit.com/steemstem/@jepper/all-the-colors-of-biotechnology>
7. <https://www.biotechbug.in/2021/05/overview-of-grey-biotechnology.html>
8. <https://www.treehugger.com/amazing-examples-of-biomimicry-4869336>
9. <https://omicspublishinggroup.wordpress.com/2013/04/24/neural-engineering/>
10. <https://www.mtu.edu/biomedical/departments/what-is/>
11. <https://www.nne.com/careers/what-is-pharmaceutical-engineering/>
12. <https://www.linkedin.com/pulse/biomechanics-applications-impact-jagadhish-v-s->

13. <https://timesagriculture.com/what-is-agricultural-engineering-farming-practices-complete-overview/>
14. <https://discover.hubpages.com/education/Biochemical-Engineering-Introduction-History-Scope-and-Applications>
15. <https://humanfactors101.com/topics/human-factors-engineering/>
16. <https://www.g2.com/articles/environmental-engineering>

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для здобувачів вищої освіти першого (бакалаврського) рівня –
спеціальності G21 «Біотехнології та біоінженерія»

Навчальний посібник

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Комп'ютерна верстка: В.С. Мельник

Здано до складання. Підписано до друку 10.05.2025

Формат 60×84 ¹/₁₆. Ум. друк. арк. . Тираж 20.

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