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ESP: «BIOTECHNOLOGY»

The educational textbook

Recommended by the Academic Council
Of Kyiv National University of Technology and Design
for the students of chemical and biopharmaceutical technologies faculty,
course of study «English for specific purposes»

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The textbook ESP Biotechnology is needed for the students – future specialists in the field of biotechnology. This textbook provides an important opportunity for students to learn the core concepts of biotechnology. At the same time, the textbook includes materials for the following areas of study as chemistry, industrial pharmacy, genetics, biology.

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Part 1. Introduction to biotechnology

Chapter 1. Biotechnology as a science

Unit 1

Topic: THE NATURE OF BIOTECHNOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

a bewildering array	величезна кількість
cell biology	клітинна біологія
to be derived from	походити від
welfare	добробут
raw material processing	переробка сировини
recombinant DNA technologies	технології рекомбінантних ДНК
to yield	виробляти, виготовляти
brewing	пивоваріння
break down	вийти з ладу, зламати, зруйнувати, погіршуватися

II. Read and translate the following text:

There is little doubt that modern biology is the most diversified of all the natural sciences, exhibiting a bewildering array of subdisciplines: microbiology, plant and animal anatomy, biochemistry, immunology, cell biology, molecular biology, plant and animal physiology, morphogenesis, systematics, ecology, genetics and many others. The increasing diversity of modern biology has been derived primarily from the largely post-war introduction into biology of other scientific disciplines such as physics, chemistry and mathematics, which have made possible the description of life processes at the cellular and molecular level. Over the past two decades, more than 20 Nobel Prizes have been awarded for discoveries in these fields of study.

This newly acquired biological knowledge has already made vastly important contributions to the health and welfare of mankind. Yet few people fully recognise that the life sciences affect over 30% of global economic turnover by way of healthcare, food and energy, agriculture and forestry, and that this economic impact will grow as biotechnology provides new ways of influencing raw material processing [1].

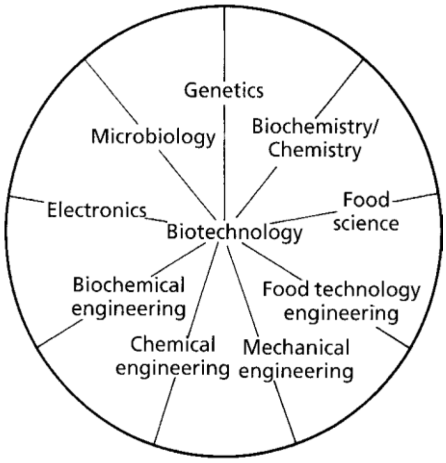


Fig. 1 The interdisciplinary nature of biotechnology

Biotechnology will increasingly affect the efficiency of all fields involving the life sciences, and it is now realistically accepted that by the early twenty-first century it will be contributing many trillions of pounds to world markets.

In the following topics biotechnology will be shown to cover a multitude of different applications ranging from the very simple and traditional, such as the production of beers, wines and cheeses, to highly complex molecular processes, such as the use of recombinant DNA technologies to yield new drugs or to introduce new traits into commercial crops and animals.

The association of old traditional industries such as brewing with modern genetic engineering is gaining in momentum, and it is not for nothing that industrial giants such as Guinness, Carlsberg and Bass are heavily involved in biotechnology research. Biotechnology is developing at a phenomenal pace, and will increasingly be seen as a necessary part of the advance of modern life and not simply a way to make money!

While biotechnology has been defined in many forms (Table 1), in essence it implies the use of microbial, animal or plant cells or enzymes to synthesise, break down or transform materials. The European Federation of Biotechnology (EFB) considers biotechnology as ‘the integration of natural sciences and organisms, cells, parts thereof, and molecular analogues for products and services’.

The aims of this federation are:

(1) to advance biotechnology for the public benefit

(2) to promote awareness, communication and collaboration in all fields of biotechnology

(3) to provide governmental and supranational bodies with information and informed opinions on biotechnology

(4) to promote public understanding of biotechnology [1].

Table 1. Some selected definitions of biotechnology

Some selected definitions of biotechnology
➢ A collective noun for the application of biological organisms, systems or processes to manufacturing and service industries. ➢ The integrated use of biochemistry, microbiology and engineering sciences in order to achieve technological (industrial) application capabilities of microorganisms, cultured tissue cells and parts thereof. ➢ A technology using biological phenomena for copying and manufacturing various kinds of useful substances. ➢ The application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services. ➢ The science of the production processes based on the action of microorganisms and their active components and of production processes involving the use of cells and tissues from higher organisms. ➢ Medical technology, agriculture and traditional crop breeding are not generally regarded as biotechnology. ➢ Really no more than a name given to a set of techniques and processes. ➢ The use of living organisms and their components in agriculture, food and other industrial processes. ➢ The deciphering and use of biological knowledge. ➢ The application of our knowledge and understanding of biology to meet practical needs [1].

III. Answer the questions:

1. What is the term for?

The application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services

a. biotechnology
b. immunology
c. biology
d. mechanichal engineering
e. electronics

2. What is the aim of the European Federation of Biotechnology (EFB)?

a. to promote governmental and supranational bodies
b. to advance biotechnology for the governmental benefit
c. to agree measures
d. to stand in solidarity with everyone from around the world
e. to promote awareness, communication and collaboration in all fields of biotechnology

3. Which breweries are heavily involved in biotechnology research?

a. Guinness, Carlsberg and Microchip Technology
b. Intel, Carlsberg and Bass
c. Guinness, Samsung and Bass
d. Guinness, Cola and Bass
e. Guinness, Carlsberg and Bass

4. Has biotechnology been defined in many forms?
a. Biotechnology has the only definition.
b. Biotechnology has not been defined yet.
c. Biotechnology has been defined in many forms.
d. In Britannica the term “biotechnology” is the most correct.
e. The term “biotechnology” has only two definitions
5. What are applications for biotechnology?
a. food production
b. production of new medicine
c. manufacturing parts for automobiles
d. surgery
e. software development

IV. Find the English equivalents for:

1) добробут	a) a bewildering array
2) величезна кількість	b) cell biology
3) пивоваріння	c) to be derived from
4)технології рекомбінантних ДНК	e) welfare
5) виробляти	f) raw material processing
6) вийти з ладу	g) recombinant DNA technologies
7) походити від	h) to yield
8) переробка сировини	i) brewing
9) клітинна біологія	j) break down

V. Match the words with their definitions:

1) welfare	a) The branch of biology concerned with the structure, function, reproduction, interactions of living cells and the organelles they contain.
2) raw material processing	b) making beer
3) cell biology	c) a technology involves using enzymes and various laboratory techniques to manipulate and isolate DNA segments of interest
4) recombinant DNA technologies	d) to provide or produce something
5) brewing	e) the act of performing a particular series of operations on any material, such as oil, cotton, or sugar in its natural condition, before it has been processed or used in manufactoring
6) to yield	f) the general state of health or degree of success of a person, business, country, etc.

VI. Match the English words with their Ukrainian equivalents:
субдисципліна, здоров'я та добробут людства, опис життєвих процесів, хімія та математика, молекулярні аналоги, клітини та тканини, біотехнологія, виробництво вин та сирів, на благо суспільства, розвивати біотехнологію.

VII. Make up the sentences with the words and phrases:
biotechnology; break down; raw material processing; mankind; DNA technologies.

VIII. Translate into English:

1. Біотехнологія – це галузь, яка вивчає та розробляє методи отримання корисних для людства продуктів за допомогою біологічних об'єктів: мікроорганізмів, клітин тварин і рослин. Біотехнологія — це наука про використання хіміко-біологічних процесів і біологічних об'єктів (мікроорганізмів, культур клітин і тканин рослинного і тваринного походження, ферментних препаратів та інших біологічно активних речовин) у промисловому виробництві.
2. За останні два десятиліття понад двадцяти Нобелівських премій було присуджено науковцям за відкриття в галузі біотехнології.
3. Біотехнологія широко застосовується не лише у виробництві пива, вина та сирів, а й у генетичній та клітинній інженерії.
4. Нещодавно отримані знання з біології – надзвичайно важливий внесок у здоров'я та добробут людства.
5. Принаймні тимчасово, рух або міграцію ДНК з їжі можна простежити до кількох різних органів, а також (ДНК) може проникати через плаценту до плоду і новонароджених.
6. Існує два основних шляхи природньої передачі генетичного матеріалу від одного організму до іншого.
7. Один (шлях) – шляхом вірусної інфекції, а інший – шляхом передачі ДНК від одного покоління до наступного (накраще сказати від матері до дитини).
8. Люди та інші ссавці, будь то м'ясоїдні чи вегетаріанці, постійно їдять їжу, що містить значну кількість ДНК.
9. Хоча зазвичай прийнято вважати, що проковтнутий (ingested) ДНК розкладається на нуклеотиди в кишковому тракті, це не зовсім так.

TEXT B

I. Read and translate the text using a dictionary:

Biotechnology

While biotechnology presents enormous potential for healthcare and the production, processing and quality of foods through genetic engineering of crops, fertilisers, pesticides, vaccines and various animal and fish species, the implications of these new biotechnological processes go well beyond the technical benefits offered. The implementation of the new techniques will be dependent upon their acceptance by consumers. As stated in the Advisory Committee on Science and Technology report *Developments in Biotechnology*: "Public perception of biotechnology will have a major influence on the rate and direction of developments and there is growing concern about genetically modified products. Associated with genetic manipulation are diverse questions of safety, ethics and welfare".

Public debate is essential for new biotechnology to grow up, and undoubtedly for the foresee able future biotechnology will be under scrutiny. Public understanding of these new technologies could well hasten public acceptance. However, the low level of scientific literacy (e.g. in the USA where only 7% are scientifically literate) does mean that most of the public will not be able to draw informed conclusions about important biotechnology issues. Consequently, it is conceivable (and indeed the case) that a small number of activists might argue the case against genetic engineering in such emotive and ill-reasoned ways that both the public and the politicians are misled. The biotechnology community needs to sit up and take notice of, and work with, the public. People influence decision-making by governments through the ballot box or through the presence of public opinion.

Until quite recently most biotechnology companies concentrated almost exclusively on raising financial support, research, clinical trials (if relevant), manufacturing problems and regulatory hurdles. Most companies, however, neglected certain essential marketing questions such as, who will be buying the new products and what do these people need to understand?

These companies have, by and large, failed to appreciate the general public's inability to understand the basic scientific concepts involved in new biotechnology. They must now seriously invest resources to foster a better understanding of the scientific implications of new biotechnology, especially among the new generation. What biotechnology needs with the public is dialogue! To ignore public understanding will be to the industry's peril!

Ultimately, the benefits of biotechnology will speak for themselves as will be seen in the following chapters.

II. Answer the questions:

1. Whom the implementation of the new techniques will be dependent upon?

a. biologists
b. board
c. acceptance by consumers
d. researchers
e. scientists

2. Why should the biotechnology community sit up and work with the public?

a. because most of the public will not be able to draw informed conclusions about important biotechnology issues
b. because of the low level of scientific literacy of public

c. because this is their direct duty
d. because they have no other duty
e. because they should insist on their point of view

3. Ill-reasoned means

a. supported
b. proven
c. logical reasoning
d. illogical reasoning
e. based on weak evidence

III. Make up a plan of the text.

IV. Translate the paragraph in italics in a written form.

V. Give definitions to the words/word expressions:

biotechnological processes, the biotechnology community, manufacturing problems, regulatory hurdles, the benefits of biotechnology.

VI. Render the text in brief in a written form.

TEXT C

I. Read and try to remember:

poverty gap	поріг бідності
distribute	розповсюджувати
abundance	достаток
marketable	ринковий
drop	зменшуватися
endow	наділяти
to a large extent	значною мірою

II. Listen to the text "Biotechnology and the developing world" and be ready to answer the questions:

1. What was NOT mentioned in the text?

a. the issue of gap poverty
b. successful agriculture
c. the death rate in the developing rate

2. What is the text mainly about?

a. how agricultural biotechnology can improve yield
b. the problem of hunger in the developing countries
c. cooperation between countries
d. none of the above-mentioned

III. Listen to the text again. Decide if the statements are true or false.

1) Agricultural biotechnology will never improve quality of crop.

2) It is salutary to note in the last decade the percentage of arrangements implemented by US biotechnology companies with developing countries increased.

3) The percentage of arrangements implemented by US biotechnology companies with developing countries dropped from 20% to 3%.

4) Agriculture may solve the problem of the poverty gap between the rich and poor nations.

5) Improvements depend on the ability of the developing countries to integrate modern developments of biotechnology into their own research and innovation systems.

IV. Unscramble the words to complete the sentences:

Successful agriculture holds the answer to the **TYPOVER AGP** _________(1) between the rich and poor nations.

Worldwide there will be enough food for all, but will it always continue to be disproportionately **DDUISTRIBTE**___________(2)?

Western countries produce an **DANCEABUN** __________(3) of high-quality products.

People will have greater resistance to disease and products will be more **KETABLEMAR** __________(4).

The rate **PDRODEP** ___________(5) from 20% to 3%.

New biotechnology will to a **LGEAR XTENTE** __________(6) depend on their capacity to integrate modern developments.

the affluent nations will become increasingly well **OWEDEND** ____________(7) with an abundance of food.

V. Watch / Listen to the video and complete the gaps.

1. Useful products like l………… f………… consumables and many more can be produced.
2. B……….. is the utilization of organisms or a p……… of the organism or any biological process for the b……… of mankind.
3. Here we’ve used yeast organism to obtain the product of our interest.
4. Processes like fermentation are considered as a part of …….biotechnology as they include the ………….. of organisms.
5. This is where micro organism named ……. comes into play; it feeds on sugars present in the grape juice and ……..alcohol and carbon dioxide as by-products.
6. With the development of biotechnology newer vaccines that are ……….. in nature started getting produced.
7. On the similar lines the commercially available hepatitis B vaccine is now being synthetically made by utilizing a small part of the ………… virus.

Unit 2

Topic: BIOMASS STRATEGY

TEXT A

I. Read and remember the following words and word-combinations:

estimate	оцінити
biomass	біомаса
conventional	звичайний
excel	відзначатися, переважати
feedstocks	вихідна сировина
exploited	використані
large-scale	великомасштабний
derive	вивести
unequal pattern of usage	нерівномірне використання

II. Read and translate the following text:

It has been estimated that the annual net yield of plant biomass arising from photosynthesis is at least 120 billion tonnes of dry matter on land and around 50 billion tonnes from the world's oceans. Of the land-produced biomass, approximately 50% occurs in the complex form of lignocellulose.

The highest proportion of land-based biomass (44%) is produced as forest. It is surprising to note that while agricultural crops account for only 6% of the primary photosynthetic productivity, from this amount is derived a major portion of food for humans and animals as well as many essential structural materials, textiles and paper products. Many traditional agricultural products may well be further exploited with the increasing awareness of biotechnology. In particular, new technological approaches will undoubtedly be able to utilise the large volume of waste material from conventional food processing that presently finds little use. Biomass agriculture, aquaculture and forestry may hold great economic potential for many national economies particularly in tropical and subtropical regions. Indeed, the development of biotechnological processes in developing areas where plant growth excels could well bring about a change in the balance of economic power.

It should be noted that the non-renewable energy and petrochemical feedstocks on which modern society is so dependent (oil, gas and coal) were derived from ancient types of biomass. Modern industrialised nations have come to rely heavily on fossil reserves for both energy and as feedstocks for a wide range of production processes. In little over a century the industrialized world has drawn heavily on fossil fuels that took millions of years to form beneath the beds of the oceans or in the depths of the earth.

Furthermore, it is a very unequal pattern of usage. At present, the USA with 6% and Western Europe with 8% of the world is population use 35% and 25% respectively of the world’s oil and gas production.

While coal stocks may last for many hundreds of years this is not true for oil and gas, and at current usage levels the world is known available sources of oil and gas will have been almost fully exploited by the end oft his century. The answer to these problems must be the use of photosynthetically derived biomass for energy and industrial feedstocks. Currently more than ten times more energy is generated annually by photosynthesis than is consumed by mankind. At present, large-scale exploitation of biomass for fuel and chemical feedstocks is restricted by the cost of fossil alternatives, the heterogeneous nature of biomass sources and their diffuse distribution.

The use of biomass directly as a source of energy has long been practiced in the less industrialized nations such as Latin America, China, India and Africa. In developed nations, biomass derived from agriculture and forestry has largely been directed to industrial and food uses [1].

III.Answer the question.

1. What type of energy does modern society depend on?
2. How has biomass been used in the less industrialized nations?
3. Which sector of economy provides with biomass?
4. Where has biomass been directed after it derived from agriculture?
5. What may hold great economic potential for many national economies particularly in tropical and subtropical regions?

IV. Find the English equivalents for:

1) економічний потенціал	a) fuel
2) вироблені на землі	b) feedstocks
3) паливо	c) a source of energy
4) великомасштабний	e) biomass
5) вихідна сировина	f) economic potential
6) звичайний	g) to be restricted
7) бути обмеженим	h) large-scale
8) джерело енергії	i) land-produced
9) біомаса	j) conventional

V. Match the words with their definitions:

1) to estimate	a) the total quantity or weight of organisms in a given area or volume
2) feedstocks	b) a particular way in which something is done, is organized, or happens
3) large-scale	c) has a root or origin
4) conventional	d) raw material to supply or fuel a machine or industrial process.
5) to derive	e) based on or in accordance with what is generally done or believed.
6) pattern	f) involving large numbers or a large area; extensive.
7) biomass	g) roughly calculate or judge the value, number, quantity, or extent of.

VI. Match the English words with their Ukrainian equivalents:
наземна біомаса, нерівномірне використання, сировина, джерело енергії, розвинені країни, походить від, фотосинтез людство

VII. Make up the sentences with the words and phrases:
estimate, biomass, conventional, excel, feedstocks, exploited, large-scale, derive, unequal pattern of usage

VIII. Translate into English:

1. До невідновлюваних джерел енергії відноситься нафтохімічна сировина, від яких так залежить сучасне суспільство (нафта, газ і вугілля).
2. В даний час широкомасштабна експлуатація біомаси для отримання палива та хімічної сировини обмежена популярністю викопних альтернатив.
3. Кількість біомаси визначається за вагою живих організмів.
4. Певне застосування в енергетиці можуть знайти сільськогосподарські відходи: солома, відходи життєдіяльності тварин і птиці тощо.
5. Першими харчовими продуктами, отримані з біомаси мікроорганізмів, були етанол і оцтова кислота, що вироблялися ферментацією.
6. Біома́са — загальна кількість живих організмів.
7. Рослинна біомаса – наземний і підземний органічний матеріал, наприклад, дерева, чагарники, трави, лісова підстілка, коріння тощо.

TEXT B

I. Read and translate the text using a dictionary:

Natural raw materials

Natural raw materials originate mostly from agriculture and forestry. These are mainly carbohydrates of varying chemical complexity, and include sugar, starch, cellulose, hemicellulose and lignin. Sugar-bearing raw materials such as sugar beet, sugar cane and sugar millet are the most suitable and available to serve as feedstocks for biotechnological processing. As traditional uses of sugar are replaced by more efficient alternatives, the sugar surplus on the commodity market will give further incentive to develop new uses. Many tropical economies would collapse if the markets for sugar were to be removed. Already cane sugar serves as the substrate for the Brazilian gasohol programme, and many other nations are rapidly seeing the immense potential of these new technologies.

Starch-bearing agricultural products include the various types of grain such as maize, rice and wheat, together with potatoes and other root crops such as sweet potato and cassava. A slight disadvantage of starch is that it must usually be degraded to monosaccharides or oligosaccharides by digestion or hydrolysis before fermentation. However, many biotechnological processes using starch are being developed, including fuel production.

There can be little doubt that cellulose, both from agriculture and forestry sources, must contribute a major source of feedstock for biotechnological processes such as fuels and chemicals. However, cellulose is a very complex chemical and invariably occurs in nature in close association with lignin. The ability of lignocellulose complexes to withstand the biodegradative forces of nature is witnessed by the longevity of trees, which are mainly composed of lignocellulose.

Lignocellulose is the most abundant and renewable natural resource available to man throughout the world. However, massive technological difficulties must be overcome before economic use may be made of this plentiful compound. At present, expensive energy-demanding pre-treatment processes are required to open up this complex structure to wide microbial degradation. Pure cellulose can be degraded by chemical or enzymatic hydrolysis to soluble sugars, which can be fermented to form ethanol, butanol, acetone, single cell protein (SCP), methane and many other products.

Exciting advances are being made in laboratories throughout the world, and it is only a matter of time before these difficulties are overcome.

It has been realistically calculated that approximately 3.3×1014 kg of CO2 per year are fixed on the surface of the Earth, and that approximately 6% of this, i.e. 22 billion tonnes per year, will be cellulose. On a worldwide basis land plants produce 24 tonnes of cellulose per person per year. Time will surely show that lignocellulose will be the most useful carbon source for biotechnological developments [1].

II. Answer the questions:

1. What can serve as feedstocks for biotechnological processing?
2. What is the disadvantage of starch?
3. What starch-bearing agricultural products can you name?
4. Which substance can withstand the biodegradative forces of nature?
5. How much cellulose is produced per person per year?

III. Make up a plan of the text.

IV. Translate the paragraph in italics in a written form.

V. Give definitions to the words/word expressions:

raw materials, starch-bearing agricultural products, cellulose, to overcome, energy-demanding

VI. Render the text in brief in a written form.

TEXT C

I.Read and try to remember:

osmosis	осмос
ultrafiltration	ультрафільтрація
purification	очищення
brackish water	солонувата вода
by-products	побічні продукти
control measures	заходи контролю
dilution	розведення

II. Listen to the text “Availability of by-products” and be ready to answer the questions:

1. What is the text about?
2. What do we call a method of separating the high and low molecular weight compounds in a liquid by allowing the liquid and low molecular weight compounds to pass through while holding back the high molecular weight compounds and suspended solids?
3. What is reverse osmosis?
4. How are by-products of the food industry handled?
5. What exactly creates serious environmental pollution problems?

III. Listen to the text again. Decide if the statements are true or false.

1) Waste materials are of no use for economic and environmental reasons.

2) Stricter effluent control measures won`t lead to the concept of waste as a “negative cost” raw material.

3) Ultrafiltration is a method of separating the high and low molecular weight compounds in a liquid.

4) Osmosis is a variety of membrane filtration.

5) Biotechnology may only serve to reduce a pollution hazard.

IV. Unscramble the words to complete the sentences:

Through a unique licensing system, the **ETSAW LAIRETAM** ___________(1) becomes a highly profitable raw material - with unlimited support from the manufacturer.

FILTRATIONULTRA ______________(2) systems are a lot more common in foodservice than they were four years ago when we last covered this category.

They help cut product waste levels, lower energy consumption and effectively recover revenue-generating **SPRODUCT YB** ____________(3).

It is possible any filter or **SMOSISO** _____________(4) system for home use.

Another problem is that **ROLCONT** ___________(5) measures can backfire and make the situation worse.

IV. Watch/ Listen to the video and decide weather the statements are true or false.

1. Banana peels, nut shells, and other left-over foods can not actually power the device you are watching this on.
2. Wood, plants and even animal feces can be a source of electricity or heat as well.
3. At the moment, only around 20% of agricultural space is used for biomass energy crops.
4. Bioreactor is where bacteria eat up the waste in a so-called “digester”, which is sealed off from oxygen. This process is called aerobic digestion.
5. Biogas contains low quantities of methane.
6. The leftover biomass can be used as compost for farming.
7. Biogas plants contain only a quarter of the CO_2 emission that coal plants emit.

Unit 3

Topic: INDUSTRIAL GENETICS

TEXT A

I. Read and remember the following words and word-combinations:

interplay	взаємодія, взаємовплив
ever-increasing	постійно зростаючий
yeast	дріжджі
modify	змінювати
geneticist	генетик
enzyme	ензим
advances	досягнення
strains	штами
mutagenic chemicals	мутагенні хімікати

II. Read and translate the following text:

Biotechnology has so far been considered as an interplay between two components, one of which is the selection of the best biocatalyst for a particular process, while the other is the construction and operation of the best environment for the catalyst to achieve optimum operation.

The most effective, stable and convenient form for the biocatalyst is a whole organism; in most cases it is some type of microbe, for example a bacterium, yeast or mould, although mammalian cell cultures and (to a lesser extent) plant cell cultures are finding ever-increasing uses in biotechnology.

Most microorganisms used in current biotechnological processes were originally isolated from the natural environment, and have subsequently been modified by the industrial geneticist into superior organisms for specific productivity. The success of strain selection and improvement programmes practised by all biologically based industries (e.g. brewing, antibiotics, etc.) is a direct result of the close cooperation between the technologist and the geneticist. In the future, this relationship will be even more necessary in formulating the specific physiological and biochemical characteristics that are sought in new organisms in order to give the fullest range of biological activities to biotechnology.

In biotechnological processes, the aim is primarily to optimise the particular characteristics sought in an organism, for example specific enzyme production or by-product formation. Genetic modification to improve productivity has been widely practised. The task of improving yields of some primary metabolites and macromolecules (e.g. enzymes) is simpler than trying to improve the yields of complex products such as antibiotics. Advances have been achieved in this area by using *screening* and *selection* techniques to obtain better organisms. In a selection system all rare or novel strains grow while the rest do not; in a screening system all strains grow, but certain strains or cultures are chosen because they show the desired qualities required by the industry in question.

In most industrial genetics the basis for changing the organism's genome has been by mutation using X-rays and mutagenic chemicals. However, such methods normally lead only to the loss of undesired characteristics or increased production due to loss of control functions. It has rarely led to the appearance of a new function or property. Thus, an organism with a desired feature will be selected from the natural environment, propagated and subjected to a mutational programme, then screened to select the best progeny.

Unfortunately, many of the microorganisms that have gained industrial importance do not have a clearly defined sexual cycle. In particular, this has been the case in antibiotic-producing microorganisms; this has meant that the only way to change the genome with a view to enhancing productivity has been to indulge in massive mutational programmes followed by screening and selection to detect the new variants that might arise.

Once a high-producing strain has been found, great care is required in maintaining the strain. Undesired spontaneous mutations can sometimes occur at a high rate, giving rise to degeneration of the strain's industrial importance. Strain or culture instability is a constant problem in industrial utilisation of microorganisms and mammalian cells. Industry has always placed great emphasis on strain viability and productivity potential of the preserved biological material. Most industrially important microorganisms can be stored for long periods, for example in liquid nitrogen, by lyophilisation (freeze-drying) or under oil, and still retain their desired biological properties.

However, despite elaborate preservation and propagation methods, a strain has generally to be grown in a large production bioreactor in which the chances of genetic changes through spontaneous mutation and selection are very high. The chance of a high rate of spontaneous mutation is probably greater when the industrial strains in use have resulted from many years of mutagen treatment. Great secrecy surrounds the use of industrial microorganisms and immense care is taken to ensure that they do not unwittingly pass to outside agencies.

There is now a growing movement away from the extreme empiricism that characterised the early days of the fermentation industries. Fundamental studies of the genetics of microorganisms now provide a background of knowledge for the experimental solution of industrial problems, and increasingly contribute to progress in industrial strain selection.

In recent years, industrial genetics has come to depend increasingly on two new ways of manipulating DNA - protoplast and cell fusion, and recombinant DNA technology. These are now important additions to the technical repertoire of the geneticists involved with biotechnological industries.

A brief examination of these techniques will attempt to show their increasingly indispensable relevance to modern biotechnology [1].

III.Answer the question.

1.What key issues are discussed in the article?

2. Why have microorganisms been modified by the industrial geneticist into superior organisms?

3. What does the author of the article tell about genetic changes?

4. Which things make modern biotechnology progressive?

5. What exactly contributes to solving industrial problems?

IV. Find the English equivalents for:

1) крайній емпіризм	a) modern biotechnology
2) сучасна біотехнологія	b) extreme empiricism
3) промислові проблеми	c) experimental solution
4) дріжджі	e) industrial problems
5) бути зміненим	f) a brief examination
6) експериментальне рішення	g) to be modified
7) короткий огляд	h) strains
8) постійно зростаючий	i) yeast
9) штами	j) ever-increasing

V. Match the words with their definitions:

1) to modify	a) economic activity concerned with the processing of raw materials and manufacture of goods in factories
2) strain	b) microscopic organisms, especially a bacterium, virus, or fungus

3) biotechnology	c) the action or process of mutating
4) geneticist	d) a biologist or physician who studies genetics, the science of genes, heredity, and variation of organisms
5) mutation	e) the exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics, hormones
6) microorganisms	f) a designated group of offspring that are either descended from a modified plant (produced by conventional breeding or by biotechnological means), or which result from genetic mutation.
7) industry	g) to make partial or minor changes to something

VI. Match the English words with their Ukrainian equivalents:
дріжджі, штами, спонтанна мутація, в результаті, мікроорганізми, бажані біологічні властивості, величезна турбота

VII. Make up the sentences with the words and phrases:
preservation and propagation methods, provide a background of knowledge for, techniques, spontaneous mutation, resulted from

VIII.Translate into English:
1. Генетика допомагає пізнати закономірності спадковості і мінливості.
2. Сучасна генетика вирішує багато завдань.
3. За словами Добжанського будь-який факт в біології стає більш зрозумілим лише в світлі генетики.
4. Для яких напрямів біотехнології фундаментальною основою є біохімія?
5. На ґрунті фундаментальних досліджень біохімії створюються біотехнології для медицини.
6. інженерна ензимологія - це галузь, що ґрунтується на використанні каталітичних функцій ферментів у ізольованому стані або у складі певних клітин для одержання продуктів (наприклад, біотехнологія отримання ферментів для освітлення фруктових соків).
7. Ге́нна інжене́рія — це біотехнологічна сукупність прийомів, методів і технологій маніпулювання рекомбінантними РНК і ДНК.
8. Використовуючи векторну систему та відповідний біологічний агент, можна синтезувати молекули РНК і одержати білок з певними якостями і властивостями.
9. Генетика – це наука, що вивчає процеси спадковості та передачі генетичної інформації нащадкам.
10. Мутація – зміна генетичного матеріалу.

TEXT B

I. Read and translate the text using a dictionary:

Protoplasts and cell fusion

Plants and most microbial cells are characterised by a distinct outer wall or exoskeleton, which gives the shape characteristic to the cell or organism. Immediately within the cell wall is the living membrane, or plasma membrane, retaining all the cellular components such as nuclei, mitochondria, vesicles, etc. For some years now it has been possible, using special techniques (in particular, hydrolytic enzymes), to remove the cell wall, releasing spherical membrane-bound structures known as *protoplasts*. These protoplasts are extremely fragile but can be maintained in isolation for variable periods of time. Isolated protoplasts cannot propagate themselves as such, requiring first to regenerate a cell wall before regaining reproductive capacity.

In practice, it is the cell wall that largely hinders the sexual conjugation of unlike organisms. Only with completely sexually compatible strains does the wall degenerate allowing protoplasmic interchange. Thus natural sexual-mating barriers in microorganisms may, in part, be due to cell wall limitations, and by removing this cellwall, the likelihood of cellular fusions may increase.

Protoplasts can be obtained routinely from many plant species, bacteria, yeasts and filamentous fungi. Protoplasts from different strains can sometimes be persuaded to fuse and so overcome the natural sexual-mating barriers. However, the range of protoplast fusions is severely limited by the need for DNA compatibility between the strains concerned. Fusion of protoplasts can be enhanced by treatmentwith the chemical polyethylene glycol, which, under optimum conditions, can lead to extremely high frequencies of recombinant formation that can be increased still further by ultraviolet irradiation of the parental protoplast preparations. Protoplast fusion can also occur with human or animal cell types.

Protoplast fusion has obvious empirical applications in yield improvement of antibiotics by combining yield-enhancing mutations from different strains or even species. Protoplasts will also be an important part of genetic engineering, in facilitating recombinant DNA transfer. Fusion may provide a method of reassorting whole groups of genes between different strains of macro- and microorganisms.

One of the most exciting and commercially rewarding areas of biotechnology
involves a form of mammalian cell fusion leading to the formation of monoclonal antibodies. It has long been recognised that certain cells (B-lymphocytes) within the bodies of vertebrates have the ability to secrete antibodies that can inactivate contaminating or foreign molecules (the antigen) within the animal system. The antibody has a Y-shaped molecular structure and uses one part of this structure to bind the invading antigen and the other part to trigger the body's response to eliminate the antigen/antibody complex. It has

been calculated that a mammalian species can generate up to 100 million different antibodies thereby ensuring that most invading foreign antigens will be bound by some antibody. Antibodies have high binding affinities and specificity against the chosen antigen. For the mammalian system they are the major defence against disease-causing organisms and other toxic molecules.

Attempts to cultivate the antibody-producing cells in artificial media have generally proved unsuccessful, with the cells either dying or ceasing to produce the antibodies. It is now known that individual B-lymphocyte cells produce single antibody types. However, in 1975 George Kohler and Cesar Milstein successfully demonstrated the production of pure or *monoclonal antibodies* from the fusion product (*hybridoma*) of B-lymphocytes (antibodyproducing cells) and myeloma tumour cells. In 1984 they were awarded the Nobel prize for this outstanding scientific achievement. The commercial importance of their scientific findings can be judged from the estimate that the value of therapeutic antibodies alone in the late 1990s was US$6 billion and steadily increasing [1].

II. Answer the questions:

1. What are protoplasts?
2. What is the major defence against disease-causing organisms and other toxic molecules?
3. How can protoplasts be obtained?
4. What are George Kohler and Cesar Milstein famous for?
5. What has happened in 1984?

III.Make up a plan of the text.

IV.Translate the paragraph in italics in a written form.

V.Give definitions to the words/word expressions:

tumour cells, to demonstrate, the living membrane, protoplasts, recombinant DNA transfer

VI. Render the text in brief in a written form.

TEXT C

I. Read and try to remember:

genes	гени
software	програмне забезпечення
propagation	поширення, розмноження
nucleic acid	нуклеїнова кислота
genetic engineering	генна інженерія
heritable material	спадковий матеріал
genetic recombination	генетична рекомбінація

II. Listen to the text "Genetic engineering" and be ready to answer the questions:

1. What is the text manly about?
2. What is the fundamental basis of all life?
3. What does genetic recombination consist of?
4. What does genetic engineering offer?
5. What role do genes play?

III. Listen to the text again. Decide if the statements are true or false.

1) Genes determine the properties of all living forms of life.

2) Genetic manipulation has been performed a decade ago by selective breeding of plants and animals.

3) Genetic engineering offers potentially unlimited opportunities for creating new combinations of genes.

4) Genetic engineering has been defined as the formation of new combinations of heritable material.

5) It becomes impossible to produce desired changes in the characteristics of the organism.

IV. Unscramble the words to complete the sentences:

SENEG __________(1) may be viewed as the biological software

Recombinant **AND** ___________(2) techniques, popularly termed gene cloning or genetic engineering, offer potentially unlimited opportunities for creating new combinations of genes

The insertion of nucleic acid **CUlESMOLE** _____________(3) so as to allow their incorporation into a host organism in which they do not naturally occur.

Genes drive the growth, development and functioning of an **NORGAIMS**___________(4).

V. Watch / Listen to the video and answer these questions.

1. What is grafting?
2. What are two principal engineering branches?
3. What's chemical engineering?
4. What's genetic engineering?
5. Where were the first genetic modifications done and who were they applied to?
6. How can nowadays genetic modifications be done?
7. What are GMOs?

Unit 4

Topic: BIOPROCESS / FERMENTATION TECHNOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

bioprocess	біопроцес
fermentation technology	технологія ферментації
biochemical engineering	біохімічна інженерія
vessels	судини
subjected to	що піддаються
obnoxious	доступний
genetic variations	генетичні варіації
overproduce	надсинтез
cultivate	вирощувати

II. Read and translate the following text:

Bioprocess or fermentation technology is an important component of most 'old' and 'new' biotechnology processes and will normally involve complete living cells (microbe, mammalian or plant), organelles or enzymes as the biocatalyst, and will aim to bring about specific chemical and/or physical changes in biochemical materials derived from the medium. In order to be viable in any specific industrial context, bioprocessing must possess advantages over competing methods of production such as chemical technology. In practice, many bioprocessing techniques will be used industrially because they are the only practical way in which a specific product can be made (e.g. vaccines, antibiotics). Biochemical engineering covers the design of vessels and apparatus suitable for performing such biochemical reactions or transformations.

The very beginnings of fermentation technology, or as it is now better recognised, bioprocess technology, were derived in part from the use of microorganisms for the production of foods such as cheeses, yoghurts, sauerkraut, fermented pickles and sausages, soya sauce and other Oriental products, and beverages such as beers, wines and derived spirits.

In many cases, the present-day production processes for such products are still remarkably similar. These forms of bioprocessing were long viewed as arts or crafts, but are now increasingly subjected to the full array of modern science and technology. Paralleling these useful product formations was the identification of the roles microorganisms could play in removing obnoxious and unhealthful wastes, which has resulted in the worldwide service industries involved in water purification, effluent treatment and solid waste management.

Bioprocessing in its many forms involves a multitude of complex enzyme-catalysed reactions within specific cellular systems, and these reactions are critically dependent on the physical and chemical conditions that exist in their immediate environment. Successful bioprocessing will only occur when all the essential factors are brought together [1].

Although the traditional forms of bioprocess technology related to foods and beverages still represent the major commercial bioproducts, new products are increasingly being derived from microbial, mammalian and plant cell fermentations, namely the ability:

(1) to overproduce essential primary metabolites such as acetic and lactic acids, glycerol, acetone, butyl alcohol, organic acids, amino acids, vitamins and polysaccharides

Table 4.1 Advantages and disadvantages of producing organic compounds by biological rather than chemical means

Advantages	Disadvantages
Complex molecules such as proteins and antibodies cannot be produced by chemical means. Bioconversions give higher yields. Biological systems operate at lower temperatures, near neutral pH, etc. Much greater specificity of catalytic reaction. Can achieve exclusive production of an isomeric compound.	Can be easily contaminated with foreign unwanted microorganisms, etc. The desired product will usually be present in a complex product mixture requiring separation. Need to provide, handle and dispose of large volumes of water. Bioprocesses are usually extremely slow when compared with conventional chemical processes.

(2) to produce secondary metabolites (metabolites that do not appear to have an obvious role in the metabolism of the producer organism) such as penicillin, streptomycin, cephalosporin, giberellins, etc.

(3) to produce many forms of industrially useful enzymes, e.g. exocellular enzymes such as amylases, pectinases and proteases, and intracellular enzymes such as invertase, asparaginase, restriction endonucleases, etc.

(4) to produce monoclonal antibodies, vaccines and novel recombinant products, e.g. therapeutic proteins. All of these products now command large industrial markets and are essential to modern society (Table 4.1).

More recently, bioprocess technology is increasingly using cells derived from higher plants and animals to produce many important products. Plant cell culture is largely aimed at secondary product formations such as flavours, perfumes and drugs, while mammalian cell culture has been concerned with vaccine and antibody formation and the recombinant production of protein molecules such as interferons, interleukins and erythropoietins.

The future market growth of these bioproducts is largely assured because, with limited exceptions, most cannot be produced economically by other chemical processes. It will also be possible to make further economies in production by genetically engineering organisms to higher or unique productivities and utilising new technological advances in processing.

The advantages of producing organic products by biological as opposed to purely chemical methods are listed in Table 4.1. The product formation stages in bioprocess technology are essentially very similar no matter what organism is selected; what medium is used or what product formed. In all examples, large numbers of cells are grown under defined controlled conditions. The organisms must be cultivated and motivated to form the desired products by means of a physical/technical containment system (*the bioreactor*), and the correct medium composition and environmental growth-regulating parameters such as temperature and aeration. Optimisation of the bioprocess spans both the bio- and the technical systems [1].

III.Answer the question.

1. What does bioprocess or fermentation technology involve?
2. What is the guarantee of successful bioprocessing?
3. What are advantages of producing organic products by biological as opposed to purely chemical methods?
4. Are bioprocesses faster or slower compared with conventional chemical processes?
5. What are environmental growth-regulating parameters?

IV. Find the English equivalents for:

1) to overproduce	a) судини
2) aeration	b) квашені продукти
3) optimisation	c) розводити
4) fermented pickles	d) виробляти більше ніж потрібно
5) bioprocess	e) вентилювання
6) to cultivate	f) оптимізація
7) vessels	g) біопроцес

V. Match the words with their definitions:

1) to overproduce	a) the action of making the best or most effective use of a situation or resource
2) optimisation	b) a field which utilises microorganisms and enzymes to produce compounds that find use in pharmaceutical, chemical, energy, material and food industries
3) fermentation technology	c) to produce more of (something) than is wanted or needed
4) biochemical engineering	e) any manufactured device or system that supports a biologically active environment
5) parameters	f) a numerical or other measurable factor forming one of a set that defines a system or sets the conditions of its operation
6) a bioreactor	g) a branch of chemical engineering which applies technological advancements to biological materials.
7) fermented pickles	h) the processes and actions required to manage waste from its inception to its final disposal
8) waste management	i) obtain something from (a specified source)
9) to derive from	j) fermented foods are sour because of a chemical reaction between naturally present sugars and bacteria.

VI. Match the English words with their Ukrainian equivalents:

виробляти більше ніж потрібно, оптимізація, парфуми та ліки, технологічні досягнення в переробці, метаболізм

VII. Make up the sentences with the words and phrases:

producing organic products, the bioreactor, flavours, genetically engineering organisms, temperature and aeration

VIII. Translate into English:

1. В аграрній галузі все більше почали приділяти увагу біологічним системам землеробства.
2. Загалом під впливом біостимуляторів повніше реалізується генетичний потенціал рослин, створений природою та селекційною роботою.

3. Дослідження проводили на посівах сорту пшениці озимої, яку висівали після соняшнику та гороху в оптимальні строки.
4. Катаболізм – це метаболічний розпад молекул в мікроорганізмах.
5. Хоча біореактори й називаються ферментерами, а організми, що вирощуються в них, здійснюють процес бродіння, цільовий продукт, як правило, продуктом бродіння не є.
6. Ферментування харчових продуктів – унікальний біотехнологічний процес, що дозволяє не тільки зберігати їжу та напої протягом довгого часу, а й значно підвищувати харчову цінність продуктів та створювати принципово нові.
7. Винайдення способу ферментування продуктів харчування губиться в далекому минулому.
8. Давні мисливці-збирачі були змушені переживати тривалі періоди без свіжих плодів та м'яса, тому вживання в їжу підгнилих харчів було не рідкістю, що з часом переросло в технології тривалого зберігання їжі.
9. Археологічні знахідки доводять, що мистецтво ферментації походить з Індійського субконтиненту, із поселень, що передували Хараппській цивілізації в долині річки Інд.
10. Якщо в середовищі наявні прості цукри (глюкоза, фруктоза, галактоза), дріжджі зброджують їх до спиртів, а бактерії – до органічних кислот.

TEXT B

I. Read and translate the text using a dictionary:

Applied microbial genetics

An essential aspect of microbial biotechnology is concerned with deriving new and improved strains of producer microorganisms. This will involve the selection of microorganisms from natural sources, from culture collections and other organisations, or by further development of 'in-house' company strains. A wide range of techniques is available to modify, delete or add to the genetic complement of an organism. Selection and screening activities remain a major part of biotechnological programmes. Screening is the use of procedures to allow the detection and isolation of only those microorganisms or metabolites of interest among a large population. Producer microorganisms require to be preserved with minimum degeneration of genetic qualities, and are normally preserved on agar medium, by reduced metabolism, drying, freeze-drying or by ultra-low temperatures.

Genomes can be modified by mutagenesis or by various types of hybridisation. Mutational programmes are primarily aimed at strain improvement, and mutagens available include ultraviolet and ionizing radiation and a wide range of chemical mutagens. Hybridisation between microorganisms is essentially a procedure that facilitates the recombination of genetic material

between microorganisms and can be expressed by sexual and parasexual mechanisms. Protoplast fusion techniques have.
been used with many microbial cells as well as with plant and animal cells.

Fusion rates can be greatly increased by means of the fusogen polyethylene glycol. Recombinant DNA technologies allow the isolation, purification and selective amplification in specific host cells of discrete DNA fragments or genes from almost any organism. The basic technology is described elsewhere.

Recombinant bacteria and fungi are used extensively in certain industrial enzyme productions, while mammalian cell lines are increasingly used for recombinant protein production. Gene manipulations are now widely used to (a) improve yield and quality of existing biomolecules (e.g. metabolites, proteins), (b) improve characteristics of existing products by protein engineering, and (c) alter pathways for synthesis of existing products [1].

II.Answer the questions:
1. What aspect is microbial biotechnology concerned with?
2. What are mutational programs primarily aimed at?
3. Which techniques (processes) can modify genomes?
4. Which procedure facilitates the recombination of genetic material between microorganisms?
5. Where are gene manipulations widely used?

III. Make up a plan of the text.
IV. Translate the paragraph in italics in a written form.
V. Give definitions to the words/word expressions: microbial biotechnology, to facilitate, recombinant bacteria, genomes, strains
VI. Render the text in brief in a written form.

TEXT C

I.Read and try to remember:

a bioreactor	біореактор
to design	проектувати
alter	змінитися
production process	процес виробництва
fermentation	ферментація, бродіння
the ultimate aim	кінцева мета
advanced computer control	удосконалене комп'ютерне керування

II. Listen to the text "The bioreactor" and be ready to answer the questions:
1. What are bioreactors?

2. What is designed for optimising the growth and metabolic activity of the biocatalyst?
3. What types of bioreactors are there?
4. Has the physical form of the most widely used bioreactors altered much over the past forty years?
5. What is the purpose of innovations in bioreactors?

III. Listen to the text again. Decide if the statements are true or false.

1) Bioreactors are used in the production process.

2) Bioreactors can be non-aseptic systems and aseptic systems.

3) Bioreactors with the advanced computer control are still being developed.

4) The physical form of many of the most widely used bioreactors has not altered much over the past forty years.

5) In all forms of fermentation the ultimate aim is to ensure that all parts of the system are subject to the different conditions.

IV. Unscramble the words to complete the sentences:

1. The cylindrical vessels **SSELSVE ____________(1)** of the bioreactors accept single-use gamma-sterilized 3D bags which require no additional mixing device.
2. The orbitally shaken **BIOREORSACT ___________(2)** (OSB) from Kuhner are ideally suited for the cultivation of mammalian and human cell cultures as well as insect and plant cells.
3. **NERMENTATIOF ____________(3)**, chemical process by which molecules such as glucose are broken down anaerobically.
4. Fermentation is the foaming that occurs during the manufacture of **ENWI ___________(4)** and beer, a process at least 10,000 years old.
5. Glycolysis, the breakdown of sugar, was originally defined about 1930 as the **SMMETABOLI** _____________(5) of sugar into lactate.

V.Watch the video and decide on the correct option.

1. Fermentation types are <u>*easy, necessarily, difficult*</u> to catagorize because many traditional ferments are not controlled and may have multiple fermentation processes working in unison.
2. Bacterial ferments are the most common type and are driven by various <u>*strains, flavours, starter cultures*</u> of beneficial bacteria.
3. Mold ferments, perhaps, the rarest types of ferments and play a fascinating role in <u>*the fermented bevarages, fermention processes, surgars and food carbohyrates*</u>
4. Some fermentation cultures involve bacteria and yeast working together <u>*starter cultures, in symbiosis, in the alcohol.*</u>
5. Yeast can be naturally occurring or added to food to <u>*stabilize, deteriorate, facilitate*</u> fermentation.

Part 2. Application of biotechnology

Chapter 3. Enzymes. Biological fuel

Unit 5

Topic: ENZYME TECHNOLOGY

TEXT A

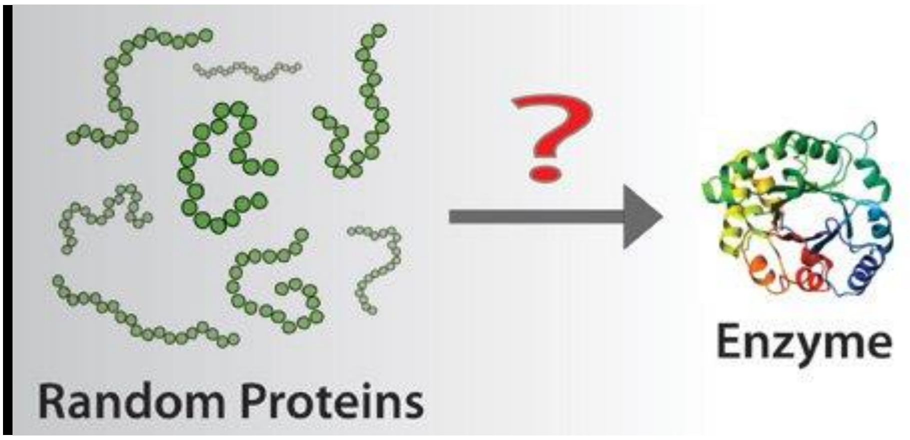
I. Read and remember the following words and word-combinations:

enzymes	ферменти
catalysts	каталізатори
digestion	травлення
saliva	слина
starch	крохмаль
denatured	денатурований
beverages	напої
mold	цвіль
barley	ячмінь
catalytic properties	каталітичні властивості
strains	штами

II. Read and translate the following text:

Enzymes. Enzyme engineering

Enzymes are proteins essential for maintaining life. Present in all living things, including microorganisms, enzymes are catalysts, meaning they speed up various types of reactions. In the body, for example, enzymes involved in digestion metabolize food, providing energy for vital biological processes.



https://astrobiology.nasa.gov/news/check-type-potential-origin-of-primordial-protein-enzymes/

In the human body alone, there are over 3,000 types of enzymes that are found everywhere from saliva to the stomach and liver. Some work to break down alcohol, others to maintain skin cells. Each type of enzyme has a unique shape that determines what kind of substance, or substrate, it can react with. For a reaction to take place, the substrate molecules must precisely match the shape of the enzyme's active site—the way a key fits a lock. Due to their specialized nature, most enzymes can catalyze just one type of reaction. Degradative enzymes are ones that split apart molecules of fat, protein, or carbohydrates like sugar and starch. Other types of enzymes bind substrate molecules together. Because enzymes are left unchanged by these reactions, they can be used again and again, provided optimal temperature and pH conditions are maintained. Absent these optimal conditions, enzymes become less reactive, or denatured.

Since ancient times, humans have harnessed the power of enzymes like those found in microorganisms such as mold to assist with food production. Enzymes are essential for fermentation, for example, which preserves foods and makes them more nutritious and delicious. Through fermentation, raw ingredients like milk, grain, and fruit are converted into cheese, yogurt, and a variety of alcoholic beverages. Enzymes speed up fermentation by liquefying and saccharifying starch, namely breaking it down into sugars. In Japan, enzymes found in koji mold—which forms naturally on rice and other grains—have been utilized for centuries to make soy sauce, miso, sake, and other fermented foods out of rice, barley, and soybeans. With enzymes, limited food resources can be stretched farther, yielding a diverse array of final products [2].

*Enzyme engineering***.** Enzyme engineering is an enzyme technology. With the rapid development of enzymology research, especially the promotion of enzyme application, the basic principle of enzymology is combined with chemical engineering, thus forming enzyme engineering. Enzyme engineering is a technology for the mass production and application of enzyme preparations. Starting from the purpose of application, it combines the theory of enzymology with chemical engineering to study enzymes, and uses the catalytic properties of enzymes in a certain reaction device to convert raw materials into products. As far as the development of enzyme engineering itself is concerned, it includes the following main aspects.

Enzyme production. The sources of enzyme preparations include microorganisms, animals, and plants, but the main source is microorganisms. Because microorganisms have more advantages than animals and plants, excellent enzyme-producing strains are generally selected to produce enzymes through fermentation. In order to increase the enzyme concentration in the fermentation broth, select excellent strains, develop genetically engineered bacteria, and optimize fermentation conditions. Industrial enzymes production necessitates the development of new enzymes with unique properties, such as high temperature-resistant α-amylase, alkali-resistant protease and lipase, etc. Therefore, it is necessary to research and develop strains that produce new enzymes with special properties [3].

III. Answer the questions:

1.What are enzymes?
2.Where do enzymes present?
3.What are enzymes involved in?
4.How many types of enzymes exist in the human body?
5.How many types of reactions can enzymes catalyze?
6.What are degradation enzymes?
7.What makes enzymes usable again and again?
8.Why are enzymes needed in food preparation?
9.What is enzyme engineering?
10.What are the sources of enzyme preparations?
11.What causes the industrial production of enzymes?
12.How do enzymes speed up fermentation?

IV. Match the English words with their Ukrainian equivalents:

1) життєво важливий	a) nutritional
2) вуглеводи	b) reactive
3) оптимальні умови	c) fermentation
4) поживний	e) substrate
5) реактивний	f) carbohydrates
6)бродіння	g) industrial production
7) субстрат	h) life support
8) підтримка життя	i) dilution
9) розрідження	j) vital
10) промислове виробництво	k) optimal conditions

V. Match the words with their definitions:

1) Enzymes	a) is a technology for the mass production and application of enzyme preparations
2) skin cells	b) any food that enters into the composition of a mixture in a natural, crude, uncooked state
3) microorganisms	c) a substance produced by a living organism which acts as a catalyst to bring about a specific biochemical reaction
4) raw ingredients	d) the process of breaking a complex carbohydrate (as starch) into simple sugars
5) saccharifying	e) a microscopic organism, especially a bacterium, virus, or fungus
6) Enzyme engineering	f) the basic building blocks of the skin

VI. Find the English equivalents for:

Джерела ферментних препаратів, мікроорганізми, різні типи реакцій, клітин шкіри, забезпечувати енергію, розщеплення, субстрат, каталізувати, прискорювати бродіння, ферментна технологія.

VII. Make up the sentences with the words and phrases:

mass production and application of enzyme preparations, types of reactions, catalysts, digestion, starch, denatured, mold, strains, with special properties.

VIII. Translate into English:

1. Ферменти - це білки, які допомагають прискорити метаболізм або хімічні реакції в нашому організмі
2. Ферменти утворюють одні речовини і розщеплюють інші.
3. У всіх живих істот є ферменти.
4. Наше тіло природним чином виробляє ферменти. Але ферменти також є в промислових продуктах і їжі.
5. Однією з найважливіших ролей ферментів є допомога в травленні.
6. Травлення - це процес перетворення їжі, яку ми їмо, в енергію.
7. Наприклад, ферменти є в нашій слині, підшлунковій залозі, кишечнику і шлунку. Вони розщеплюють жири, білки і вуглеводи.
8. Наприклад, фермент сахараза розщеплює цукор під назвою сахароза.
9. Лактаза розщеплює лактозу, вид цукру, який міститься в молочних продуктах.
10. Для роботи ферментів потрібні відповідні умови. Якщо умови невідповідні, ферменти можуть не працювати.
11. Тоді вони більше не підходять до субстрату, а тому не працюють належним чином.

12.Лише в організмі людини існує понад 3000 типів ферментів, які знаходяться скрізь, від слини до шлунка та печінки.

TEXT B

I. Read and translate the text using a dictionary:

Enzymes

Preparation of enzymes. The separation and purification technology of enzymes is the core of the current biotechnology post-processing process. Various separation and purification techniques are used to separate and purify enzymes from microbial cells and their fermentation broths, or animal and plant cells and their culture broths, to prepare highly active enzyme preparations of different purities. In order to make the enzyme preparation more widely used in all aspects of the national economy, the activity, purity and yield of the enzyme preparation must be improved, and new separation and purification techniques need to be studied.

Enzyme and cell immobilization. Enzyme and cell immobilization research is a central task of enzyme engineering. In order to improve the stability of the enzyme, the enzyme preparation was repeatedly used to expand the application range of the enzyme preparation, and various immobilization methods were used to immobilize the enzyme to prepare the immobilized enzyme, such as immobilized glucose isomerase, immobilized aminoacylase, etc. Immobilized enzymes have broad market prospects and are highly valued by various fields such as biochemistry, chemical engineering, microorganisms, polymers, and medicine. Immobilized cells are developed on the basis of immobilized enzymes. Various immobilization methods are used to immobilize microbial cells, animal cells and plant cells to produce various immobilized biological cells. Studying the enzymatic properties of immobilized cells, especially the kinetic properties, and researching and developing the application of immobilized cells in various aspects is a hot topic in enzyme engineering today.

Immobilization technology is an important milestone in the modernization of enzyme technology. It is a breakthrough technology that overcomes the shortcomings of natural enzymes in industrial applications and takes advantage of the characteristics of enzyme reactions. It can be said that without the development of immobilization technology, there would be no modern enzyme technology.

Enzyme molecular modification. Enzyme molecular modification is also called enzyme molecular modification. In order to improve the stability of the enzyme, reduce the antigenicity, and prolong the half-life of medicinal bacteria in the body, various modification methods are used to transform the molecular structure of the enzyme, so as to create some excellent characteristics that natural enzymes do not have, such as higher stability, no antigenicity, resistance to protease hydrolysis and so on. It can even create new enzyme activities and expand the application of enzymes, thereby improving the application value of enzymes and achieving greater economic and social benefits [3].

II. Decide if the following statements as true (T) or false (F) according to the text:

1. One separation and purification technique is used to separate and purify enzymes from microbial cells and their fermentation broths to prepare highly active enzyme preparations of different purities.
2. Enzyme and cell immobilization research is a central task of enzyme engineering
3. Immobilized enzymes do not have broad market prospects and are not highly valued.
4. Without the development of immobilization technology, there would be no modern enzyme technology.
5. Enzyme molecular modification is also called enzyme molecular circulation.

III. Make up a plan of the text.

IV. Render the text in a written form.

V. Give definition of the words:

Molecule, technology, enzyme, application, stability, to separate, medicinal bacteria, benefit, prospects.

TEXT C

I. Read and try to remember:

natural origin	природного походження
undesirable secondary reactions	небажані вторинні реакції
drastic processing	кардинальна обробка
easily obtained	легко отримати
to comply	дотримуватися
to predominate	переважати

II. Listen to the text "The use of enzymes" and be ready to answer the questions:

1. What are the advantages of using enzymes?
2. What are the limitations in the use of enzymes?
3. Do enzymes work in moderate conditions of temperature and pH?

4. Is it true that genetic engineering transforms microorganisms and makes them excessive producers of enzymes?
5. What specifications should sugar enzymes meet?
6. Are enzymes used pure in industry?

III. Listen to the text "The use of enzymes" again. Decide if the statements are true or false.

1) The use of enzymes do not have any advantages.
2) Enzymes are of natural origin and are not toxic.
3) The main limitation in using enzymes is in their price.
4) Some of enzymes are very expensive and cannot be easily obtained.
5) Sugar enzymes must comply with certain quality specifications.

IV. Unscramble the words to complete the sentences:

Enzymes have many **PLICAAPTINOS** ________(1). With modern food manufacturing **REPRODUSCE**_________(2), they benefit both industrial **SSETOCR**_______(3) and consumers. Its **SFEPICIC**_______(4)characteristics allow industrialists to exercise stricter quality control. With lower **GYRENE**______(5) consumption and lighter treatment conditions, its effectiveness favors the **TNEVIROMNE**_______(6).

Amongst thousands of known **SEMYZNE**_______(7), only some are produced on an industrial scale to be used in the **ERCUNMATUAF**________(8) of both food and raw materials by the enzymes manufacturers in India**.** Each day increases the number of **SNOITCARE** ______(9) that are carried out by enzymatic routes, and this trend will surely increase as there are more **TSYTACALS**_______(10)of this type in commerce, at affordable prices [4].

V.Watch or listen to the video and complete the sentences.

1. In 1843 ……………. .
2. Enzymes …………. .
3. Enzymes bind to …….. .
4. Active site has a specific …. .
5. Thanks to these amino acids, …… .
6. Cofactors may be ………. .
7. The suitable temperature for enzymes to function ………… .

Unit 6

Topic: BIOLOGICAL FUEL GENERATION

TEXT A

I. Read and remember the following words and word-combinations:

charcoal	деревне вугілля
dedicated crops	виділені зернові культури
residue	залишок
waste streams	потоки відходів
application	застосування
bioenergy plantation	біоенергетична плантація
edible feedstock	їстівна сировина
sugarcane	цукрова тростина
rapeseed	насіння ріпаку
circumvent	спровокувати
microalgae and cyanobacteria biomass	біомаса мікроводоростей і ціанобактерій
terrestrial	наземні
arable land	земля, що оброблюється
industrial emitters	промислові випромінювачі
endogenous pathways	ендогенні шляхи
lignocellulosic biomass	лігноцелюлозна біомаса

II. Read and translate the following text:

Bioenergy

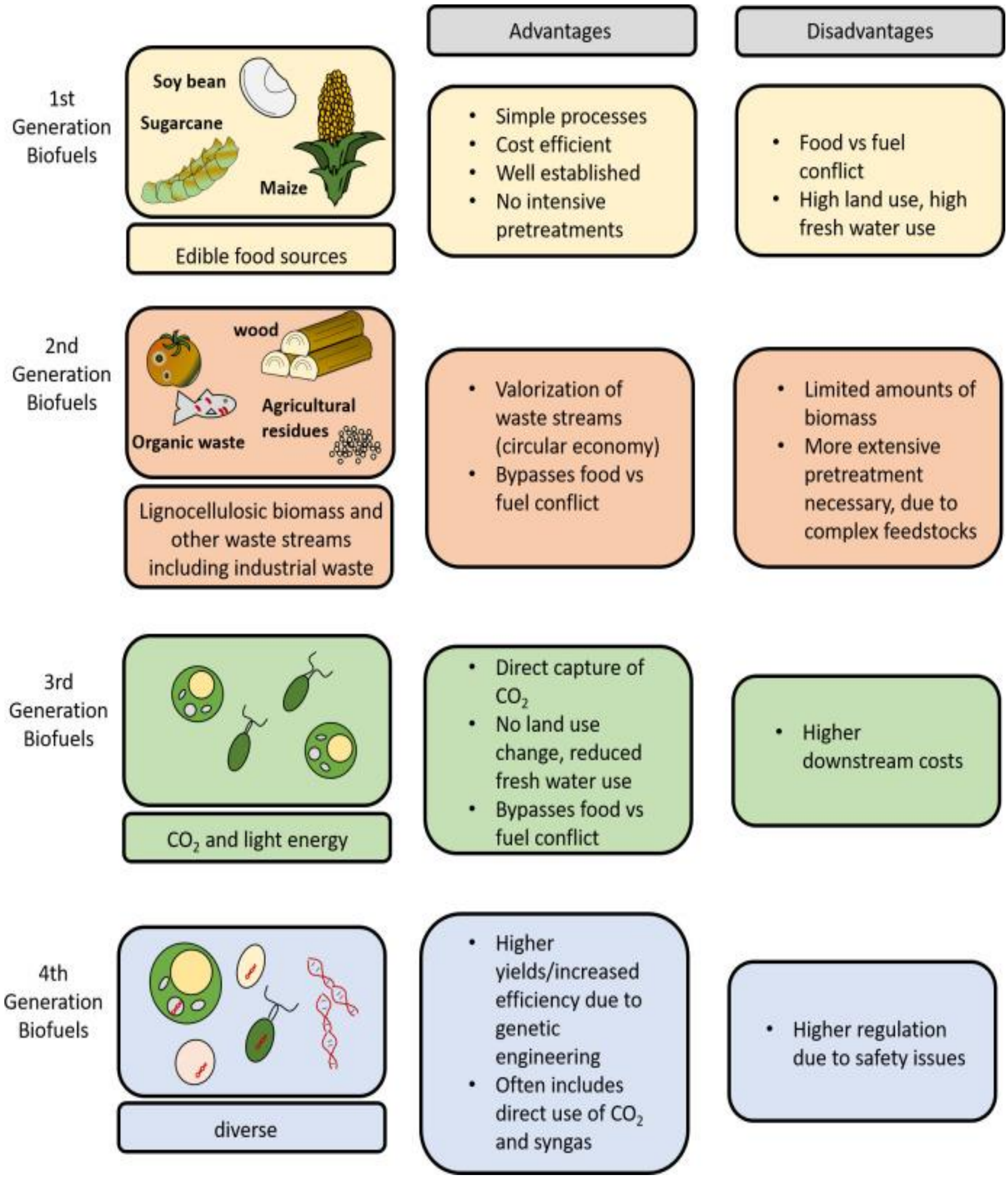
Bioenergy is produced from a variety of organic materials, called biomass, such as wood, charcoal, dung and other manures for heat and power production, and agricultural crops for liquid biofuels. Most biomass is used in rural areas for cooking, lighting and space heating, generally by poorer populations in developing countries.

Modern biomass systems include dedicated crops or trees, residues from agriculture and forestry, and various organic waste streams. Energy created by burning biomass creates greenhouse gas emissions, but at lower levels than burning fossil fuels like coal, oil or gas. However, bioenergy should only be used in limited applications, given potential negative environmental impacts related to large-scale increases in forest and bioenergy plantations, and resulting deforestation and land-use change [6].

The four generations of biofuels

Biofuels of *the first generation* are mainly divided into bioethanol and biodiesel. Bioethanol production of the first generation is based on microbial fermentation of edible feedstocks, rich in starch and sucrose, such as wheat, corn, and sugarcane in Europe, North America, and South America, respectively. Commercial strains include but are not limited to *Saccharomyces cerevisiae*, *S. stipites*, and *S. pombe*. Bioethanol production is not limited to first-generation biofuels; depending on the feedstock and production strain, bioethanol can also be categorized as second and third generation. Biodiesel is mainly obtained from food-grade rapeseed, soy, or palm oil sourced from Europe, South America, and Asia, respectively [5].

As a result of the issues of the first generation, *second-generation biofuels* were developed, utilizing lignocellulosic biomass from agricultural and woodland residues as well as other waste streams (for example, from food industry like wheat bran, animal fats, or wastes of cooking and frying oil). Other non-food plants like the drought-resistant shrub or tree *Jatropha curcas*, which can also be grown in wastelands, might yet be a different promising source for second-generation biofuels. Hence, second-generation biofuels circumvent the need for agricultural land use change and do not compete with food resources. *Third-generation biofuels* are mainly derived from microalgae and cyanobacteria biomass, which can be used to naturally generate alcohols and lipids to transform into biodiesel or any other high energy fuel product. Algae exhibit 2- to 4-fold higher photosynthesis rates than terrestrial plants, resulting in faster biomass formation. Algae do not require arable land or fresh water for cultivation. Many cultures can be grown using waste water, brackish or salt water, which is cost efficient and circumvents competition with agricultural activity. Most importantly, efficient algae cultivation requires a direct CO_2 supply, which can be derived from industrial emitters or by atmospheric carbon capture. In conventional cultivation systems, around 70% of supplied CO_2 is used for photosynthesis. The latest biofuel generation, termed *fourth-generation biofuels*, encompasses the use of genetic engineering to increase desired traits of organisms used in biofuel production. This applies to a variety of traits from utilizing multiple types of sugars (e.g., pentoses and hexoses), to higher lipid synthesis or increased photosynthesis and carbon fixation. Unfortunately, for most native producers of biofuels, the genetic engineering toolbox is far more limited [5].



https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10063169/

III.Answer the questions:

1. How many generations of biofuels are there?
5. What is the production of the first generation bioethanol based on?
6. What is biodiesel mainly obtained from?
7. What is another promising source of second generation biofuel?
8.What is the third generation biofuel made from?
9. What is the rate of photosynthesis in algae?
10. What are the different organic materials used to produce bioenergy?

IV. Match the English words with their Ukrainian equivalents:

1) властивості організмів	a) algae
2) вітчизняні виробники	b) starch
3) водорості	c) agricultural land
4) обмеженіший	e) compete
5) непродовольчі рослини	f) domestic manufacturers
6) крохмаль	g) various signs
7) сільськогосподарські землі	h) properties of organisms
8) конкурувати	i) food resources
9) харчові ресурси	j) non-food plants
10) різноманітні ознаки	k) more limited

V. Match the words with their definitions:

1) bioenergy	a) the period of time, usually considered to be about thirty years, that it takes for children to grow up and become adults and have children of their own.
2) biofuels	b) is the process by which plants use sunlight, water, and carbon dioxide to create oxygen and energy in the form of sugar.
3) generation	c) matter from recently living (but now dead) organisms.
4) photosynthesis	d) is the science and craft of creating, managing, planting, using, conserving and repairing forests and woodlands for associated resources for human and environmental benefits.
5) biomass	e) is energy made or generated from biomass, which consists of recently living (but now dead) organisms, mainly plants.
6) forestry	f) is a fuel that is produced over a short time span from biomass, rather than by the very slow natural processes involved in the formation of fossil fuels, such as oil.

VI. Find the English equivalents for:

деревина, деревне вугілля, добрива для виробництва тепла, сільськогосподарські культури, освітлення та опалення приміщень, викиди парникових газів, викопне паливо, негативний вплив на навколишнє середовище, тепло та електроенергія, біоетанол і біодизельне паливо, пшениця і кукурудза, харчова олія.

VII. Make up the sentences with the words and phrases:
created by burning biomass, residues from agriculture and forestry, organic wastes, in limited applications, deforestation and land-use, commercial strains, non-food plants, microalgae and cyanobacteria, a direct CO_2 supply.

VIII. Translate into English:

1. Відходи рослинного виробництва використовується в сільській місцевості для приготування їжі, освітлення та опалення приміщень, як правило, біднішими верствами населення в країнах, що розвиваються.
2. Виробництво біоетанолу першого покоління базується на дріжджовій ферментації їстівної сировини, багатої на крохмаль і сахарозу, такої як пшениця, кукурудза і цукрова тростина.
3. Інші непродовольчі рослини, такі як посухостійкий чагарник або дерево *Jatropha curcas*, які також можна вирощувати на пустирях, можуть бути ще одним перспективним джерелом біопалива другого покоління.
4. Потенціал біопалива щодо пом’якшення наслідків зміни клімату значно варіюється: від рівнів викидів, порівнянних з викопним паливом в одних сценаріях, до негативних викидів в інших.
5. Біопаливо і біоенергетика в цілому розглядається як відновлюване джерело енергії.
6. Два найпоширеніші типи біопалива - біоетанол і біодизель.
7. Бразилія є найбільшим виробником біоетанолу, тоді як ЄС є найбільшим виробником біодизеля.
8. Вміст енергії у світовому виробництві біоетанолу та біодизеля становить 2,2 та 1,8 ЕДж на рік відповідно.
9. Очікується, що попит на авіаційне біопаливо зросте.
10. Біоетанол — це спирт, отриманий шляхом бродіння, в основному з вуглеводів, що містяться у цукрових або крохмальних культурах, таких як кукурудза, цукрова тростина або солодке сорго.
11. Целюлозна біомаса, отримана з нехарчових джерел, таких як дерева та трави, також досліджується як сировина для виробництва етанолу.

TEXT B

I. Read and translate the text using a dictionary:

Global warming

Global warming**,** the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries. Climate scientists have since the mid-20th century gathered detailed observations of various weather phenomena (such as temperatures, precipitation, and storms) and of related influences on climate (such as ocean currents and the atmosphere's chemical composition). These data indicate that Earth's climate has changed over almost every conceivable timescale since the beginning of geologic time and that human activities since at least the beginning of the Industrial Revolution have a growing influence over the pace and extent of present-day climate change.

Giving voice to a growing conviction of most of the scientific community, the Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP). The IPCC's Sixth Assessment Report (AR6), published in 2021, noted that the best estimate of the increase in global average surface temperature between 1850 and 2019 was 1.07 °C (1.9 °F). An IPCC special report produced in 2018 noted that human beings and their activities have been responsible for a worldwide average temperature increase between 0.8 and 1.2 °C (1.4 and 2.2 °F) since preindustrial times, and most of the warming over the second half of the 20th century could be attributed to human activities [7].

AR6 produced a series of global climate predictions based on modeling five greenhouse gas emission scenarios that accounted for future emissions, mitigation (severity reduction) measures, and uncertainties in the model projections. Some of the main uncertainties include the precise role of feedback processes and the impacts of industrial pollutants known as aerosols, which may offset some warming. The lowest-emissions scenario, which assumed steep cuts in greenhouse gas emissions beginning in 2015, predicted that the global mean surface temperature would increase between 1.0 and 1.8 °C (1.8 and 3.2 °F) by 2100 relative to the 1850–1900 average. This range stood in stark contrast to the highest-emissions scenario, which predicted that the mean surface temperature would rise between 3.3 and 5.7 °C (5.9 and 10.2 °F) by 2100 based on the assumption that greenhouse gas emissions would continue to increase throughout the 21st century. The intermediate-emissions scenario, which assumed that emissions would stabilize by 2050 before declining gradually, projected an increase of between 2.1 and 3.5 °C (3.8 and 6.3 °F) by 2100.

Many climate scientists agree that significant societal, economic, and ecological damage would result if the global average temperature rose by more than 2 °C (3.6 °F) in such a short time. Such damage would include increased extinction of many plant and animal species, shifts in patterns of agriculture, and rising sea levels. By 2015 all but a few national governments had begun the process of instituting carbon reduction plans as part of the Paris Agreement, a treaty designed to help countries keep global warming to 1.5 °C (2.7 °F) above preindustrial levels in order to avoid the worst of the predicted effects. Whereas authors of the 2018 special report noted that should carbon emissions continue at their present rate, the increase in average near-surface air temperature would reach 1.5 °C sometime between 2030 and 2052, authors of the AR6 report suggested that this threshold would be reached by 2041 at the latest.

The scenarios referred to above depend mainly on future concentrations of certain trace gases, called greenhouse gases, that have been injected into the lower atmosphere in increasing amounts through the burning of fossil fuels for industry, transportation, and residential uses. Modern global warming is the result of an increase in magnitude of the so-called greenhouse effect, a warming of Earth's surface and lower atmosphere caused by the presence of water vapour, carbon dioxide, methane, nitrous oxides, and other greenhouse gases. In 2014 the IPCC first reported that concentrations of carbon dioxide, methane, and nitrous oxides in the atmosphere surpassed those found in ice cores dating back 800,000 years.

A vigorous debate is in progress over the extent and seriousness of rising surface temperatures, the effects of past and future warming on human life, and the need for action to reduce future warming and deal with its consequences [7].

II. Decide if the following statements as true (T) or false (F) according to the text:

1. Global warming, the phenomenon of reduction average air temperatures near the surface of Earth over the past one to two centuries.
2. These data indicate that Earth's climate hasn't changed over almost every conceivable timescale/
3. Giving voice to a growing conviction of most of the scientific community, the Intergovernmental Panel on Climate Change (IPCC) was formed in 1988/
4. Many climate scientists agree that significant societal, economic, and ecological damage would result if the global average temperature rose by more than 2 °C (3.6 °F) in such a short time/
5. Modern global warming is the result of a decrease in magnitude of the so-called greenhouse effect.
6. Modern global warming is the result of a warming of Earth's surface and lower atmosphere caused by the presence of water vapour, carbon dioxide, methane, nitrous oxides, and other greenhouse gases.
7. We need actions to reduce future warming and deal with its consequences.

III. Make up a plan of the text.

IV. Render the text in a written form.

V.Give definition of the words:

Climate, warming, Earth, human being, government, scientific community, greenhouse gas emissions, fossil fuels, magnitude.

TEXT C

I.Read and try to remember:

cellular organisms	клітинні організми
respiration	дихання
oxygenic photosynthesis	кисневий фотосинтез

cyanobacteria endergonic reaction conversion	ціанобактерії ендергонічна реакція перетворення

II. Listen to the text "Photosynthesis" and be ready to answer the questions:

1. What is photosynthesis?
2. What is oxygenic photosynthesis?
3. What organisms are called photoautotrophs?
4. What is photosynthesis responsible for?
5. Which 3 approaches does photosynthesis involve?
6. How many research groups around the world are working to understand the fundamental relationships and develop prototypes?

III. Listen to the text "Photosynthesis" again. Decide if the statements are true or false.

1. Photosynthesis is a biological process usedby many cellular organisms to convert light energy into chemical energy.
2. The term "Photosynthesis" usually refers to oxygenic photosynthesis.
3. Photosynthesis doesn't responsible for producing and maintaining the oxygen content of the Earth's atmosphere.
4. Artificial photosynthesis refers to processes that convert electrical light into sustainable fuels.
5. Artificial photosynthesis comprises 5 approaches.

IV. Unscramble the words to complete the sentences:

Photosynthesis, the **CEPORSS**_________(1) by which green plants and certain other organisms transform light **YNEREG**________(2) into chemical energy. During **SISETYTOPHOHN**_______(3)in green plants, light energy is captured and used to convert water, carbon dioxide, and **NRAMIESL**_______(4) into oxygen and energy-rich **INARGOC** _________(5) compounds.
It would be impossible to overestimate the importance of photosynthesis in the maintenance of life on **HTAER**______(6). If photosynthesis ceased, there would soon be little **OODF** _______(7)or other organic matter on Earth. Most organisms would disappear, and in time
Earth's **MOATSHPEER**_______(8) would become nearly devoid of gaseous oxygen. The only organisms able to **XETSI**_______(9)under such conditions would be the chemosynthetic **ACABRETI**_______(10), which can utilize the chemical energy of certain inorganic compounds and thus are not dependent on the conversion of light energy [10].

V. Watch / Listen to the video and write down 10 sentences containing key information on the video.

Chapter 4. Biotechnology and environmental situation

Unit 7

Topic: ENVIRONMENTAL BIOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

disease-producing organisms	хвороботворні організми
contaminated water	контамінована вода
potable	питний
consumption	споживання
purification procedures	процедури очищення
intestinal tract of humans	кишковий тракт людини
sedimentation	осадження
filtration	фільтрація
chlorination	хлорування
sewage	стічні води
exploiting the biochemical abilities	використання біохімічних здібностей
anaerobic degradation	анаеробний розпад
to pertain	відноситись
inhabiting aquatic environments	мешканці водних середовищ
algae	водорості
fungi	гриби
protozoa	найпростіші
biofilms	біоплівки
microbial mats	мікробні плівки
phytoplankton	фітопланктон

II. Read and translate the following text:

Environmental biology: microbiology of water supplies, wastewater, and others

Long before the establishment of microbiology as a science, water was suspected of being a carrier of disease-producing organisms. But it was not until 1854, when an epidemic of cholera was proved to have had its origin in polluted water, that contaminated water was considered more seriously as a source of disease. Since that time there has been continuous research on the microbiology of public water supplies, including the development of laboratory procedures to determine whether the water is potable, or safe for human consumption. At the same time, purification procedures for these supplies have emerged.

A highly standardized and routine laboratory procedure to determine the potability of water is based upon detecting the presence or absence of the bacterium *Escherichia coli*. *E. coli* is a normal inhabitant of the intestinal tract of humans; its presence in water indicates that the water is polluted with intestinal wastes and may contain disease-producing organisms.

The principal operations employed in a municipal water-purification plant are sedimentation, filtration, and chlorination. Each of these operations removes or kills microorganisms, and the microbiological quality of the treated water is monitored at frequent intervals.

The used water supply of a community, commonly referred to as sewage, is microbiologically significant in two ways.

First, sewage is a potential carrier of pathogenic microorganisms, so measures such as chlorination must be implemented to prevent these microbes from contaminating drinking-water supplies.

Second, sewage-treatment plants purify water by exploiting the biochemical abilities of microbes to metabolize contaminants. Raw sewage is processed through large tanks, first for anaerobic degradation of complex substrates and later for aerobic oxidation of soluble products. This “activated sludge” treatment is dependent upon incubation conditions that favour the growth and metabolic activity of appropriate microorganisms.

Another aspect of the microbiology of water pertains to natural bodies of water such as ponds, lakes, rivers, and oceans. Aquatic microbes perform a host of biochemical transformations and are an essential component of the food chain in these environments. For example, the microbial flora of the sea comprises bacteria, algae, fungi, and protozoa. The microorganisms inhabiting aquatic environments are collectively referred to as plankton; phytoplankton refers to the photosynthetic microbes (primarily algae), whereas protozoa, and other small animals, are zooplankton. Phytoplankton is responsible for converting solar energy into chemical energy—the components of plankton cells that serve as food for higher aquatic life. The magnitude of this process can be appreciated by calculations indicating that it takes 1,000 tons of phytoplankton to support the growth of one ton of fish.

There is a growing interest in other ecological aspects of aquatic microbiology, such as the role of microbes in global warming and oxygen production. Experimental approaches are being developed to study the complex biology and ecology of biofilms and microbial mats. These assemblages of microbes and their products, while potentially useful in several ways, are complex. In many instances the microbial flora involved must sometimes be studied in its natural environment because the environment cannot be reproduced in the laboratory [11].

III. Answer the questions:

1. In what year was it proven that the cholera epidemic originated in contaminated water?
2. What is the high standard and routine laboratory procedure for determining drinking water based on?
3. What do you know about E. coli from the text?
4. What are the operations used in municipal wastewater treatment plants?
5. Why is the water used by a community, commonly called wastewater, microbiologically important?
6. How is raw wastewater treated?
7. What does the microbial flora of the sea consist of?
8. What is called plankton?
9. What is phytoplankton?
10. What is zooplankton?

IV. Match the English words with their Ukrainian equivalents:

1) осадження	a) fungi and protozoa
2) зоопланктон	b) to metabolize
3) мікробна флора моря	c) treatment plant
4) бактерії	e) sedimentation
5) гриби і найпростіші	f) zooplankton
6) метаболізувати	g) pathogenic microorganisms
7) очисні споруди	h) human intestinal tract
8) патогенні мікроорганізми	i) bacteria
9) кишковий тракт людини	j) microbial flora of the sea

V. Match the words with their definitions:

1) microbial flora	a) is a physical water treatment process using gravity to remove suspended solids from water
2) bacteria	b) is an organism which is capable of causing diseases in a host (person)
3) chlorination	c) is a physical separation process that separates solid matter and fluid from a mixture using a filter medium that has a complex structure through which only the fluid can pass.

4) pathogenic microorganism	d) is a term that refers to a community of bacteria that exist on or inside the body, and possess a unique ecological relationship with the host.
5) sedimentation	e) are small single-celled organisms and are found almost everywhere on Earth and are vital to the planet's ecosystems.
6) filtration	f) is the process of adding chlorine to drinking water to kill parasites, bacteria, and viruses.

VI. Find the English equivalents for:

носії хвороботворних організмів, епідемія холери, дослідження мікробіології, лабораторні процедури, кишкова паличка, питна вода, стічні води, харчовий ланцюг, мікробна флора моря.

VII. Make up the sentences with the words and phrases:

microbiology as a science, polluted water, source of disease, purification procedures, the intestinal tract, water-purification plant, exploiting the biochemical abilities of microbes, phytoplankton.

VIII. Translate into English:

1. Мікроорганізми та їх діяльність життєво важливі практично для всіх процесів на Землі.
2. Мікроорганізми мають значення, оскільки вони впливають на кожен аспект нашого життя.
3. Мікробіологія - це наука про всі живі організми, які занадто малі, щоб їх можна було побачити неозброєним оком.
4. Це включає бактерії, археї, віруси, гриби, пріони, найпростіші та водорості, відомі під загальною назвою «мікроби».
5. Ці мікроби відіграють ключову роль у кругообігу поживних речовин, біорозпаді, зміні клімату, псуванні харчових продуктів, причині хвороб і боротьбі з ними, а також у біотехнології.
6. Завдяки своїй універсальності мікроби можуть використовуватися багатьма способами: виготовляти життєво необхідні ліки, виготовляти біопаливо, очищати забруднення та виробляти їжу та напої.
7. Мікробіологічні дослідження були і залишаються центральними для вирішення багатьох поточних глобальних прагнень і викликів, таких як підтримка харчової, водної та енергетичної безпеки для здорового населення на придатній для життя землі.
8. Мікробіологічні дослідження також допоможуть відповісти на такі важливі питання, як «наскільки різноманітне життя на Землі?» і «чи існує життя деінде у Всесвіті»?
9. Високостандартизована лабораторна процедура дослідження безпеки питної води заснована на виявленні присутності або відсутності бактерії *Escherichia coli*.

10. Кишкова паличка є умовно-патогеним мікроорганізмом; його присутність у воді вказує на те, що вода забруднена кишковими відходами та може містити хвороботворні організми.
11. Основними етапами очистки, що застосовуються на міських водоочисних спорудах, є відстоювання, фільтрація та хлорування.
12. На кожному з цих етапів видаляються або елімінуються мікроорганізми, а мікробіологічна якість очищеної води контролюється через певні проміжки часу.
13. Стічні води є потенційним носієм патогенних мікроорганізмів, тому необхідно вжити таких заходів, як хлорування.

TEXT B

I. Read and translate the text using a dictionary:

Environmental pollution

Environmental pollution can be caused by natural events such as forest fires and active volcanoes, use of the word *pollution* generally implies that the contaminants have an anthropogenic source - that is, a source created by human activities. Pollution has accompanied humankind ever since groups of people first congregated and remained for a long time in any one place. Indeed, ancient human settlements are frequently recognized by their wastes—shell mounds and rubble heaps, for instance. Pollution was not a serious problem as long as there was enough space available for each individual or group. However, with the establishment of permanent settlements by great numbers of people, pollution became a problem, and it has remained one ever since.

Cities of ancient times were often noxious places, fouled by human wastes and debris. Beginning about 1000 CE, the use of coal for fuel caused considerable air pollution, and the conversion of coal to coke for iron smelting beginning in the 17th century exacerbated the problem. In Europe, from the Middle Ages well into the early modern era, unsanitary urban conditions favoured the outbreak of population-decimating epidemics of disease, from plague to cholera and typhoid fever. Through the 19th century, water and air pollution and the accumulation of solid wastes were largely problems of congested urban areas. But, with the rapid spread of industrialization and the growth of the human population to unprecedented levels, pollution became a universal problem [12].

Pollution control, in environmental engineering, any of a variety of means employed to limit damage done to the environment by the discharge of harmful substances and energies. Specific means of pollution control might include refuse disposal systems such as sanitary landfills, emission control systems for automobiles, sedimentation tanks in sewerage systems, the electrostatic precipitation of impurities from industrial gas, or the practice of recycling. For full treatment of major areas of pollution control, *see* air pollution control, wastewater treatment, solid-waste management, and hazardous-waste management.

Next to the conservation of species from the loss of biological diversity, the control of pollution is the conservation problem of greatest magnitude; it might even be argued that pollution control is more urgent and important. Ultimately, the control of pollution involves a number of social decisions: 1) not to allow the escape into the environment of substances or forms of energy that are harmful to life, 2) to contain and recycle those substances that could be harmful if released into the environment in excessive quantities, and 3) not to release into the environment substances that persist and are toxic to living things. The knowledge and technology needed to put these decisions to work are now available. Pollution control does not mean an abandonment of existing productive human activities but their reordering so as to guarantee that their side effects do not outweigh their advantages [13].

https://www.britannica.com/technology/pollution-control

II. Decide if the following statements as true (T) or false (F) according to the text:

1. Pollution has accompanied humankind ever since groups of people first congregated and remained for a long time in any one place.

2. Pollution was a serious problem since there was enough space available for each individual or group**.**

3. Beginning about 1000 CE, the use of coal for fuel caused considerable air pollution.

4. In the North, from the Middle Ages into the early modern era, unsanitary urban conditions favoured the outbreak of population-decimating epidemics of disease.

5. Next to the conservation of species from the loss of biological diversity, the control of pollution is the conservation problem of greatest magnitude

6. Pollution control mean an abandonment of existing productive human activities.

III. Make up a plan of the text.

IV. Render the text in a written form.

V. Give definition of the words:

Pollution, human activities, human settlements, epidemics of disease, solid wastes, energy, sanitary landfills, emission control system, biological diversity, recycle, toxic, to guarantee.

TEXT C

I. Read and try to remember:

crucial role	вирішальна роль
soil bacteria	ґрунтові бактерії
carbon dioxide	вуглекислий газ
sodium	натрій
potassium	калій
greenhouse gases	парникові гази

II. Listen to the text "Microbes" and be ready to answer the questions:

1. Could we live without microbes?
2. What is called the decomposers?
3. Wtat these nutrients are returned to the environment for?
4. In what processes s are involved microbes?
5. Where are scientists trying to include microbial activity?

III. Listen to the text "Microbes" again. Decide if the statements are true or false.

1. Microbes don't play a crucial role in our lives.
2. Nutrients: carbon dioxide, water, sodium and potassium are returned to the environment so that other living things can use them.
3. The cyclical process by which essential elements are released and reused is known as recycling.
4. Microbes are involved in few processes.
5. Microbes could have various positive and negative feedback responses to temperature.
6. Microbes live in small communities that do not interact with other organisms and the environment.
7. Human activities have helped to increase the production of greenhouse gases by microbes.

IV. Unscramble the words to complete the sentences:

The surfaces of the **ANUHM** ________(1) body inside and out, for example the skin, mouth and the intestines, are covered in millions of **UALINIDIV**_______(2) micro-organisms that don't do us any harm. In fact they help to **ETCORPT**________(3) us from becoming infected with harmful **SBEORCIM_**______(4). They are known as the normal body **RAOFL**_______(5).The number of normal **LABETCRI_**_____(6)cells that live on the body is in the region of 100 million. This number is 10 times greater than the 10 million **LELCES** ______(7) that make up the human body.

The microbes associated with our food **DNTE**_____(8) to have a bad name – food **NGINOSOPI**______(9) is often in the news. Yet while some make us ill and others can be a nuisance by spoiling our food, without the activities of microbes there would no bread, cheese, beer or **CTELHCOA** ________(10). Friend or foe – food microbes are always on the menu [14].\

V. Watch / Listen to the video and tell about the key concepts concerning the ecology.

- ☑ **Ecosystem**
- ☑ **Population**
- ☑ **Habitat**
- ☑ **Community**
- ☑ **Niche**
- ☑ **Species**

Unit 8

Topic: PLANT AND FOREST BIOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

crop production	рослинництво
crosspollinated	перехреснозапильний
breeding	розведення
scrutinize	уважно вивчати
superior plants	вищі рослини
first filial generation	перше покоління
retain	зберегти
vigor	бадьорість
water holding ability	здатність утримувати воду
offspring	потомство
barley	ячмінь
lengthen	подовжити
unpredictability	непередбачуваність
plant cells	рослинні клітини
tissues	тканини
micropropagation	мікророзмноження

a sterile workplace rubber	стерильне робоче місце гумовий

II.Read and translate the following text:

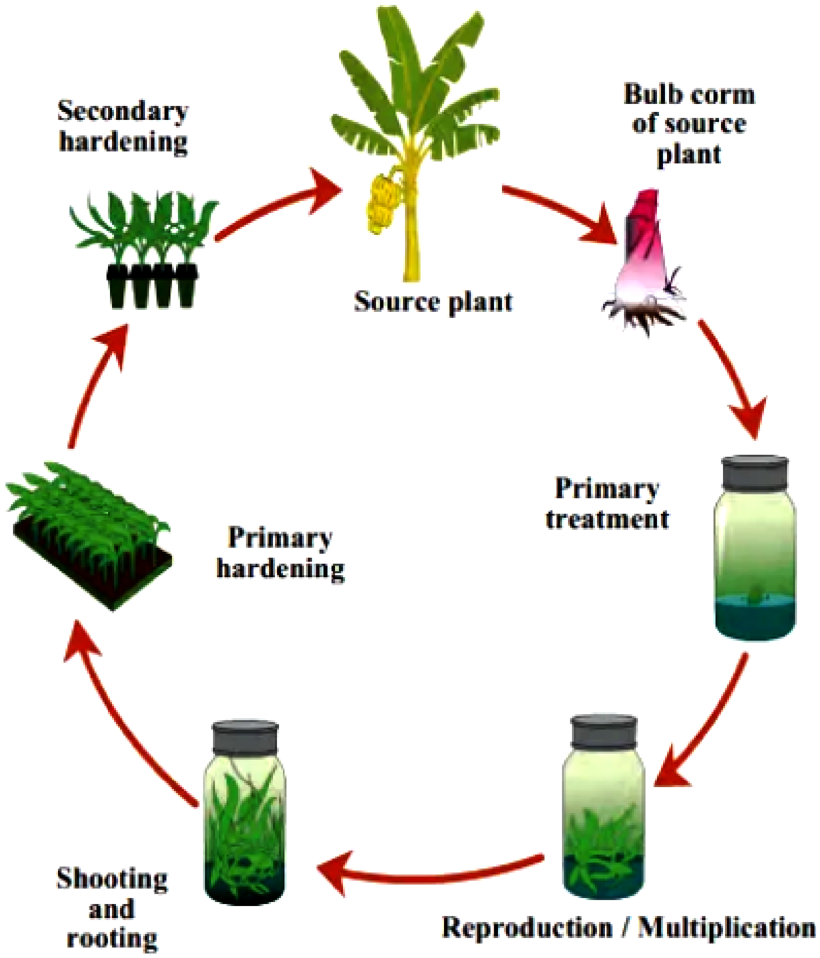
Biotechnologies in crop production

Since agriculture began, farmers have been altering the genetic makeup of the crops they grow through selection of the best plants and seeds and saving them for the next season. Early farmers also discovered how some plants can be crosspollinated to combine the desirable characteristics of the parent plants in their offspring. Recognizing desirable traits is vital in plant breeding. Breeders scrutinize their fields in search of individual plants with desirable traits. As plant breeding is further developed, breeders understand better the selection of superior plants and use them to create new and improved varieties. These activities have dramatically changed the productivity and quality of domesticated plants.

Hybrid seed technology. F1 (first filial generation) hybrid variety. OP varieties, when maintained and produced properly, retain the same characteristics when multiplied. The only technique used with OP varieties is the selection of the seedbearing plants. Hybrid seeds have improved qualities, such as good vigor, trueness to type, heavy yields and high uniformity, compared to open pollinated varieties. Other characteristics such as earliness, disease and insect resistance and good water holding ability have also been incorporated into most F1 hybrids. For example, a plant breeder picks a plant with good traits but needs improvement on a certain trait. The breeder then picks another plant with not necessarily good overall traits but has the desirable trait to be improved. Each plant will be self-pollinated separately. Their offspring seeds will be harvested and then re-sown. The procedure is repeated for several seasons until identical plants appear each time the seeds are sown. These are now “pure lines”.

Many cultivars of popular vegetables or ornamental plants are also F1 hybrids. Tropical vegetable breeders have improved plant characteristics over the last two decades including: • *Yield improvement.* Hybrids often outyield traditional OP varieties due to its improved vigor, improved genetic disease resistance, improved fruit setting under stress, and higher female/male flower ratios.• *Extended growing season***.** Hybrids often mature earlier than local OP varieties. For many crops, hybrid’s advantage over OP is most pronounced under stress conditions. • *Quality improvement.* Hybrids have helped stabilize product quality at a higher, and more uniform level.

Mutation breeding Occasionally, good traits also arise spontaneously through a process called mutation. However, it is unreliable in terms of producing plant traits that breeders want. Moreover, the natural rate of mutation is very slow. However, in the late 1920s, researchers discovered that they could increase the number of mutations by exposing plants to X-rays and chemicals. Mutation breeding was further developed after World War II, when the techniques of the nuclear age became widely available. Plants were exposed to gamma rays, protons, neutrons, alpha particles, and beta particles to see if these would induce useful mutations. Mutation breeding efforts continue around the world today. The International Atomic Energy Agency (IAEA) holds a record of 3,222 varieties approved through mutation breeding. Plants that have been produced via mutation breeding include wheat, barley, rice, potatoes, soybeans, and onions.



Various processes in tissue-culture

https://www.sarthaks.com/1687032/define-the-term-tissue-and-explain-the-concept-of-tissue-culture

What is tissue culture? Scientists have searched for methods to make exact copies of superior plants that possess good traits. However, plants usually reproduce through sexual reproduction where sex cells, containing DNA, combine unpredictably, creating unique plants. This unpredictability presents problems for plant breeders as it lengthens the time required for breeding plants. However, researchers have developed methods of making exact copies of plants through "tissue culture". Tissue culture (TC) is the cultivation of plant cells, tissues, or organs on specially-formulated nutrient media. Under the right conditions, whole plants can be generated from a single cell using this technology.

Tissue culture has been vital in the production of uniform, disease-free, quality plants and planting materials. Micropropagation, a tissue culture technique enabling the production of multiple copies of plants relatively quickly, is used to multiply planting materials for large scale planting. Micropropagated plants establish quickly, grow more vigorously, have shorter and more uniform production cycle, and yield higher than conventional propagules. Tissue culture only requires a sterile workplace, nursery, and greenhouse, and trained manpower. However, it can be labor intensive, time consuming, and costly. Important crops have been grown using tissue culture such as banana, rubber, sweet potato, and tomato [15].

III.Answer the questions:

1. What did early farmers discover?
2. Why do breeders carefully research their fields?
3. What do you know about the first filial generation?
4. How are "pure lines" formed?
5. How have tropical vegetable breeders improved plant characteristics over the last two decades?
6. What is called a mutation?
7. What do you know about International Atomic Energy Agency?
8. What is “tissue culture”?
9. What is “micropropagation”?
10. What does tissue culture require?

IV. Match the English words with their Ukrainian equivalents:

1) breeding	a) життєво важливий
2) micropropagation	b) без хвороб
3) first filial generation	c) ненадійні риси
4) planting materials	e) бути створено з
5) mutation	f) викриття
6) unreliable in terms	g) розведення
7) exposing	h) садивні матеріали
8) be generated from	i) мікророзмноження
9) disease-free	j) мутація
10) vital	k)перше дочірнє покоління

V. Match the words with their definitions:

1) tissue culture	a) completely clean and free from germs
2) first filial generation	b) are basically genetic engineers and their main objective is to improve crops by utilizing different breeding techniques.

3) sterile workplace	c) to examine (something) carefully especially in a critical way
4) plant breeders	d) is the artificial process of producing plants vegetatively through tissue culture or cell culture techniques
5) scrutinize	e) is the cultivation of plant cells, tissues, or organs on specially formulated nutrient media
6) micropropagation	f) is the first set of offsprings obtained from the parental generation or “P” generation

VI. Find the English equivalents for:

Генетичний склад культур, перехресно запилювати, характеристики батьківських рослин, селекція рослин, життєво важливий, вдосконалення сортів, гібридний сорт, продуктивність і якість, технологія гібридного насіння.

VII. Make up the sentences with the words and phrases:

To alter the genetic makeup of the crops; selection of the best plants and seeds; offspring, plant breeding, selection of superior plants, hybrid seeds, self-pollinated, technique.

VIII. Translate into English:

1. Доступні різні інструменти біотехнології, які включають звичайну селекцію рослин, технологію культури тканин та ін.
2. Вчені продовжують розробку кількох програм та продуктів, які запобігають бідності і голоду.
3. Незважаючи на те, що гібриди коштують дорожче, вони мали величезний вплив на продуктивність сільського господарства.
4. Сьогодні більшість всієї кукурудзи і рису є гібридами.
5. У США, використання гібридів кукурудзи збільшило більш ніж утричі урожайність зерна кукурудзи.
6. Гібридна технологія допомогла Китаю збільшити виробництво рису.
7. Традиційне розведення рослин мало величезний вплив на сільське господарство продуктивності за останні десятиліття.
8. Звичайна селекція рослин також має обмеження.
9. Кенія пережила занепад виробництва бананів в останні два десятиліття, в основному через деградацію ґрунту, а також шкідникам і зараженню хворобами.

TEXT B

I.Read and translate the text using a dictionary:

Biotechnology in foresty

Forestry today is on the threshold of promising change as biotechnology is introduced into its operations. Sophisticated tissue cultures for cloned seedlings and genetically modified organisms portend many benefits as more of the world's industrial wood is being produced on planted forests. In many cases biotechnology in forestry is simply an extension of agricultural innovations, such as herbicide resistance. However, biotechnology also has applications unique to forestry, such as fiber modification, lignin reduction and extraction, and sterility, which is an important factor to prevent modified genes from "leaking" into the natural environment.

The economic benefits from the introduction of biotechnology to forestry will be lower costs and increased availability of wood and wood products. Additionally, innovations in forest biotechnology have the potential to address important environmental issues, including the rehabilitation of habitats altered by disease, like the American Chestnut blight, or invasive exotics. Moreover, the increased productivity of tree plantations may free large areas of natural, or primary, forest from pressures to supply industrial wood and thus improve their ability to preserve biodiversity. And as trees are modified to grow in previously unsuitable areas—such as arid lands or saline soils—the new forests could not only produce more wood but also enhance watershed protection and sequester carbon for climate change mitigation.

Some history. The planting of forests for timber began in earnest in the 19th century in Europe and about the middle of the 20th century in North America. Over the past 30 years, industrial plantation forests have become a major supplier of industrial wood, largely because of the higher productivity of planted forests and the higher costs of extracting timber from natural forests under more stringent environmental standards. The traditional breeding techniques practiced in forestry have followed the model of other agricultural crops. Early improvements in trees involved identification of superior trees with desired traits and attempts to capture offspring having those traits. The planting of genetically improved stock began about 1970. In the 1990s, modern biotechnology, including tissue culture and genetic modification, began to be undertaken in forestry in earnest. As more of the world's industrial wood is being produced on planted forests, the potential benefits from introducing desired genetic alterations into the seedling utilized in planting have become obvious. Benefits will be found, first, in lower costs of wood production, which in turn will result in lower costs to consumers of wood and wood products. And second, biotechnology in forestry has the potential to address important environmental issues. On the cost side, however, concerns relate to potential genetic transfers between transgenic and wild trees, and the potential implications for the natural environment.

Biotechnological innovation in forestry falls into three main areas: the use of vegetative reproduction methods; the use of genetic markers; and the production of genetically modified organisms (GMOs), or transgenic trees. Most of the biotechnologies used in forestry today involve vegetative reproduction through tissue culture and molecular marker applications. However, GMOs are also likely to play a major role in forestry. Using techniques adapted from agriculture, selected foreign genes are introduced into the plant genome. In one such approach, specific genes are identified and modified to affect biochemical pathways and the resulting phenotypes. For example, the promise of controlling the lignin—cells that impart strength to the tree's structure but that must be removed in papermaking— depends on the ability to identify and modify lignin genes, thereby altering the amount, type, and form of lignin that is produced in the tree. The ease of gene transformation varies with different species, generally being more difficult in conifers than in hardwoods.The benefits of biotechnology in forestry go beyond economic advantages—including increased production, lower costs to consumers, and trees modified for easy processing or specific production values—to such environmental benefits as helping to preserve biodiversity and mitigate global warming. But biotechnological innovations also raise concerns about biosafety and the effects of transgenic plants on the resistance of pathogens and on the natural ecosystem, particularly the question of genetic exchange between domestic and wild populations [16].

II. Decide if the following statements as true (T) or false (F) according to the text.

1. Sophisticated tissue cultures for cloned seedlings and genetically modified organisms do not portend many benefits.
2. Biotechnology in forestry is simply an extension of agricultural innovations.
3. The economic benefits from the introduction of biotechnology to forestry will be higher costs and decreased availability of wood and wood products.
4. Innovations in forest biotechnology do not have the potential to address important environmental issues.
5. The planting of forests for timber began in earnest in the 18th century in Europe and about the middle of the 19th century in North America.
6. The traditional breeding techniques practiced in forestry have followed the model of other agricultural crops.
7. Biotechnology in forestry has the potential to address important environmental issues.
8. Biotechnological innovation in forestry falls into one main area - the use of vegetative reproduction methods.

III. Make up a plan of the text.

IV. Render the text in a written form.

V. Give definition of the words:

Forestry, reproduction methods, genetic markers, genetically modified organisms, transgenic trees, genes, plant genome, approach, phenotypes, a cell.

TEXT C

I. Read and try to remember:

sequester	секвестр
preservation	збереження
contribute	сприяти
pesticide	пестицид
rehabilitation	реабілітація
degraded lands	деградовані землі
lumber	пиломатеріали
resilient	пружний

II. Listen to the text "Biotech/GM trees" and be ready to answer the questions:

1. What basic human needs do trees provide?
2. What gases are effectively absorbed by trees?
3. Why are genetically modified (GM) trees developed?
4. For which industries are GM trees useful?
5. In what ways are GM trees more resilient?

III. Listen to the text "Biotech/GM trees" again. Decide if the statements are true or false.

1.Trees provide man's basic needs.
2. Trees are known to effectively and efficiently sequester CO2 and other greenhouse gases.
3. Biotechnology and electronic engineering are tools that can contribute to the improvement of crops and trees.
4. The economics of tree plantations lowers through creation of suitable raw materials.
5. Engineering trees are less able to defend against pests and diseases is critical to keep our forests and trees healthy.

IV. Unscramble the words to complete the sentences:

Papaya Ringspot Virus resistant papaya

Hawaii in 1997 **DERESFFU**_______ (1) a devastating 40% economic **SOLS**_____(2) due to papaya ringspot **SVRUI**______(3). The US$17 million papaya **RYNISUDT**______(4) was saved in 1998 by the U.S. government's Environment **ORPCETTNOI**________(5) Agency, Food and Drug Administration, and U.S. Department of Agriculture Animal and Plant Health Inspection Service approval of GM papaya Rainbow resistant to the PRSV disease. Researchers from Cornell **VERINUTYSI**_______(6) and the University of Hawaii expressed the virus-derived coat protein **ENEG**______(7), and within four years of its **NOITORTNIDUC**_______(8), papaya production returned to previous level. An additional PRSV Papaya X1’ 7-2 was deregulated in the US in 2009. By 2014, GM papaya occupies 1,000 hectares in Hawaii, and 8,475 hectares in China [15].

V. Decide on the true (T) or false (F) options.

1. All / Some plants have several structural features in common.
2. Plants have a root system which serves to absorb water, mineral ions / vitamins and nutrients from the soil.
3. Carrots and ginger are plant stems that we eat.
4. Sucrose as sugar and amino acids are transported in the phloem.
5. Water and minerals move up through the xylem.
6. Xylem has a substance called quinine which helps keep the stem upright.
7. Potatoes are actually part of a swollen underground stem.

Part 3. Realms of biotechnology

Chapter 5. Food biotechnology. Animal and insect biotechnology

Unit 9

Topic: ANIMAL AND INSECT BIOTECHNOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

crop plants	сільськогосподарські рослини
domestic animals	домашні тварини
selective breeding	селекційне розведення
woollier sheep	більш вовнисті вівці
crops	сільськогосподарські культури
livestock	худоба
to alter	змінити
transgenic animal	трансгенна тварина
novel genetic information	нова генетична інформація
descendants	нащадки
a crippled retrovirus vector	пошкоджений ретровірусний вектор
unfertilized	незапліднений
two cell embryos	двоклітинні ембріони
nuclear transplantation	ядерна трансплантація

II. Read and translate the following text:

Transgenic people, primates and pets

New and improved animals. For thousands of years people have improved crop plants and domestic animals by selective breeding, mostly at a trial-and-error level. Woollier sheep and smarter sheep dogs have both been improved through many generations of selective breeding. Obviously, the more we know about genetics, the faster and more effectively, we can improve our crops and livestock.

Today it is possible to alter plants, animals, and even humans by genetic engineering. Most early experiments in animal transgenic were done with mice, but many larger animals have now been engineered, including livestock such as sheep and goats, pets such as cats and dogs, and even monkeys. In a transgenic animal every cell carries new genetic information. In other words, novel genetic information is introduced into the germline, not merely into some somatic cells as in gene therapy. Consequently, the novel genes in a transgenic animal are passed on to its descendants.

Transgenic people, primates and pets. So far, no primate has been successfully cloned, although transgenic rhesus monkeys have been generated. The first successful engineering of a transgenic primate resulted in the birth of ANDi*, a rhesus monkey carrying the *gfp* gene, in late 2000. ANDi* stands for "inserted DNA" (read backwards). A crippled retrovirus vector was used to deliver the gene for GFP* to unfertilized eggs that were later fertilized *in vitro*. Treatment of 224 egg cells gave 20 embryos, five pregnancies, and eventually, three live male monkeys. Only one of these, ANDi, was transgenic and expressed GFP. ANDi does not fluoresce green because GFP levels are too low (also, rhesus monkeys have brown fur over much of their bodies). There have been several exaggerated claims for primate cloning. Rhesus monkeys have been generated by splitting an embryo at the eight-cell stage into four genetically identical two cell embryos, and this has been touted as "cloning." However, it is merely artificial twinning, rather than true nuclear transplantation as with Dolly. Nonetheless, it seems likely that soon rhesus monkeys will have been cloned.

There seems no reason why cloning of monkeys, apes, and humans via nuclear transplantation should not be technically possible. One possible objective for human cloning is to obtain tissue for transplantation rather than to generate a new human individual. Reprogrammed human cells would be grown in culture to provide such material. This is known as therapeutic cloning, and developments in this area are likely to continue rapidly.

In November of 2001, the first pet, a kitten, named CC (for CopyCat) was cloned at Texas A&M University. The objective of this cloning program is for people to have their favorite pets cloned—providing they have enough money, of course.

One cannot help remembering that the ancient Egyptians mummified cats as well as people. CC is the only one of 87 implanted cloned embryos to survive. This is similar to the success rate for cloned sheep, mice, and so forth.

https://vetmed.tamu.edu/news/press-releases/texas-am-says-goodbye-to-cc-worlds-first-cloned-cat/

Obviously, routine cloning of pets needs a higher success rate to be economically feasible.

Primates have not yet been successfully cloned; however, it has been possible to make transgenic rhesus monkeys using retrovirus vectors [17].

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* ANDi, is the first transgenic monkey. The name ANDi is taken from the acronym of "inserted DNA". In this DNA of a fluorescent jellyfish was inaugurated into an unfertilized egg of a Rhesus monkey in a test tube.

*Gfp refers to the gene that produces green fluorescent protein.

III. Answer the questions:

1. What process is used to create transgenic animals?

a. particle bombardment
b. nuclear microinjection
c. nuclear fusion
d. germ line transformation
e. none of the above

2. In the first transgenic animal experiment, which gene from rats was cloned into mice?

a. somatotropin
b. metallothionein
c. myostatin
d. plasminogen
e. PPAR-delta

3. Why are embryonic stem cells important?

a. They can be passed from one generation to the next.
b. These cells carry retroviral genes.
c. They can develop into any tissue in the body, including the germ line.
d. The cells are differentiated and can therefore be manipulated.
e. none of the above

4. How can location effects of transgenes in animals be avoided?
a. by placing LCR sequences in front of the transgene
b. by inclusion of insulator sequences on both ends of the transgene
c. by using natural transgenes instead of the cDNA version
d. by targeting the transgene to a specific location
e. all of the above
5. What is used by targeting vectors to insert transgenes at specific locations within the host genome?
a. homologous recombination
b. transfection
c. transduction
d. conjugation
e. all of the above

IV. Find the English equivalents for:

1)сільськогосподарські рослини	a) domestic animals
2)перенесення генів	b) temporarily
3)новонароджений	c) gene transfer
4)тимчасово	e) two-cell embryos
5)пряме надходження	f) newborn
6)ретровіруси	g) direct income
7)змінити	h) retroviruses
8)ядерна трансплантація	i) livestock
9)худоба	j) to alter
10)двоклітинні ембріони	k) nuclear transplantation

V. Match the words with their definitions:

1) selective breeding	a)is an animal in which there has been a deliberate modification of the genome
2) descendant	b) a method in which the nucleus of a donor cell is relocated to a target cell that has had its nucleus removed (enucleated)
3) transgenic animal	c) plants, or products made from plants, that are grown and harvested for subsistence or for profit
4) nuclear transplantation	d)the process of crossing of two selected varieties having different traits to produce a hybrid having good traits of both
5) to alter	e) to make different without changing into something else

6) crop plants	f) a person or animal that is descended from a specific ancestor

VI. Match the English words with their Ukrainian equivalents:
селекційне розведення, сільськогосподарські культури, запліднений, геном людини, трансгенна тварина, еволюційна історія, нащадки, кишковий тракт, організми.

VII. Make up the sentences with the words and phrases:
experiments in animal transgenics; cell; new genetic information; specific location; different traits.

VIII. Translate into English:

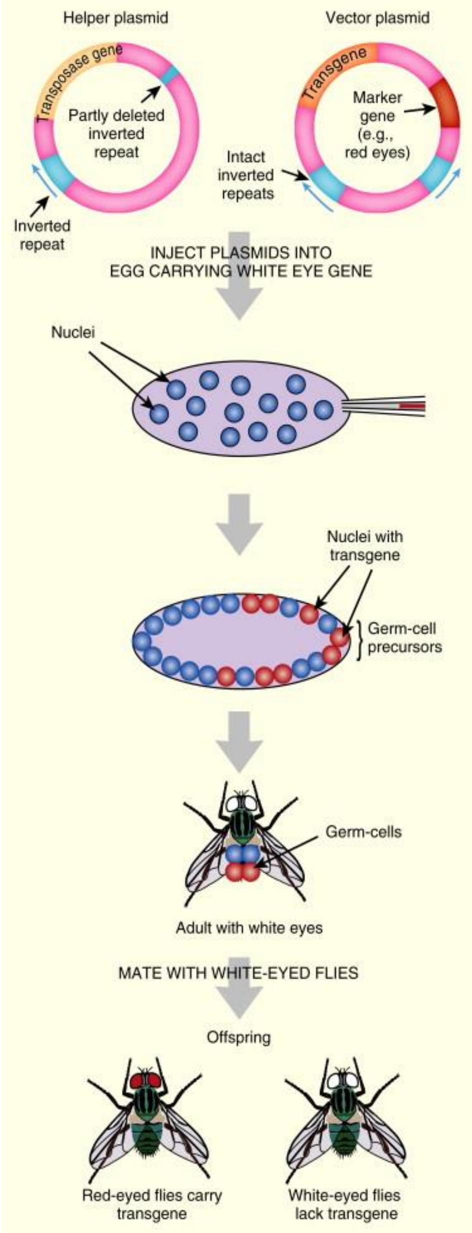
1. Геном людини містить значну кількість генів бактеріального походження.
2. Ймовірно, гени були підібрані на різних етапах в еволюційній історії від різноманітних бактерій.
3. Бактеріям притаманний інший процес передачі генетичного матеріалу - латеральний (або горизонтальний) перенесення організму-ненащадку.
4. Існує два основні шляхи природного отримання генетичного матеріалу від інших організмів.
5. Один (шлях) – шляхом вірусної трансдукції, а інший – шляхом прямого надходження ДНК.
6. Люди та інші ссавці, будь то м'ясоїдні чи вегетаріанці, постійно їдять їжу, що містить значну кількість ДНК.
7. Хоча зазвичай прийнято вважати, що проковтнутий(ingested) ДНК розкладається на нуклеотиди в кишковому тракті, це не зовсім так.
8. Принаймні тимчасово, ДНК з їжі можна простежити до кількох різних органів, а також (ДНК) може проникати через плаценту до плодів і новонароджених.

TEXT B

I.Read and translate the text using a dictionary:

Transgenic insects

Several insects can now be genetically modified. The fruit fly *Drosophila* has been investigated at the molecular level for a long time and, not surprisingly, methods exist for introducing novel genetic material into these flies.



https://www.sciencedirect.com/topics/nursing-and-health-professions/marker-gene

P elements are transposons found in *Drosophila* and other insects, where they cause hybrid dysgenesis. In flies carrying a P element, the frequency of transposition is very low because of synthesis of a repressor protein encoded by the resident P element. When P-carrying males are crossed with P-negative females, the transposition frequency in the fertilized egg is very high for a brief period, due to lack of repressor. Random insertion of P elements then causes a high mutation rate and lowers the proportion of viable offspring, that is, hybrid dysgenesis.

P elements are flanked by perfect 31 base-pair inverted repeats. Any DNA sequence that is included between these inverted repeats will be transposed. Therefore engineered P elements can be used to introduce any sequence of DNA into a strain of fruit flies or other susceptible insects. DNA may be microinjected into embryos of P-negative strains of *Drosophila*. In fruit flies the diploid nucleus divides multiple times without cell division, resulting in a giant cell with many nuclei, known as a syncytium. Microinjection is normally done at this stage, and incoming DNA usually integrates into at least some of the nuclei that will give rise to the future germline cells. These nuclei are clustered at one end of the fertilized egg—the *posterior end*. The nuclei then migrate to the outer membrane where a cleavage furrow forms around each nucleus. These furrows expand to form individual cells for each nucleus. The center part remains undivided and acts as a yolk, providing nutrients to the developing larva. The incoming P element is normally carried on a bacterial plasmid that was constructed in a bacterial host. The P element transposes into the *Drosophila* chromosomes, and the plasmid sequences are left behind.

In practice, two P elements are often used. One, the helper, provides the transposase but cannot itself move because of defective 31 base-pair inverted repeats. The other P element, the vector, carries the desired transgene and has intact 31 base-pair inverted repeats, but lacks the transposase gene. Transposition of the vector depends on transposase made by the helper. Once the P element vector has inserted into a particular location on the insect chromosome, it cannot move in future cell generations, because it has no transposase of its own. Ideally, it will be inherited stably.

The presence of the P element is monitored by appropriate marker genes. Selectable markers used in flies include *neo* (neomycin resistance) and *adh* (alcohol dehydrogenase). Alternatively, eye color genes may be used to reveal the presence of a P element vector. Eye color cannot be positively selected; instead, flies are screened for changes in eye color. For example, flies defective in the *rosy* gene may be used as host. These flies have brown eyes because of lack of xanthine dehydrogenase, which is involved in synthesis of red eye pigment. If a wild-type copy of the *rosy* genes is included in the P element vector, it will restore the red eye color. If the offspring of a rosy −/− transgenic fly has red eyes, this implies that the transgene was inserted into the germline, and all the cells in the offspring will have the transgene.

Transposons known as P elements are widespread in *Drosophila* and other insects. They have been used to introduce transgenic DNA into insects [17].

II.Answer the questions:

1. Which of the following systems can be used to control the expression of the transgene?

a. a modified LacI repressor system
b. the TetR recombinant promoter system
c. use of a heat shock promoter from *Drosophila*
d. the use of steroid receptors
e. all of the above

2. What can be engineered to introduce transgenes into *Drosophila*?

a. Cre recombinase
b. S elements
c. P elements
d. YACs
e. none of the above

3. How can mosquito-borne diseases be controlled through biotechnology?

a. by genetically engineering mosquitoes that are resistant to the disease
b. by creating more efficient pesticides
c. through the cloning, expression, and purification of novel therapeutic agents
d. by engineering non-pathogenic malaria, dengue, and other mosquitoborne diseases
e. none of the above

4. How might mammals be cloned?

a. homologous recombination

b. transfection with a retrovirus
c. YACs
d. nuclear transplantation
e. BACs

5. What is a goal of "therapeutic cloning"?
a. to create a cloned human being
b. to insert transgenes into humans via nuclear transplantation
c. to obtain tissue for transplantation
d. to obtain tissues that express foreign proteins, usually therapeutics
e. none of the above

III. Make up a plan of the text.
IV. Translate the paragraph in italics in a written form.

V. Give definitions to the words/word expressions:
Experiment, cell, transplantation, genetic information, specific location, different traits, to select.

VI. Render the text in brief in a written form.

TEXT C

I. Read and try to remember:

liver	печінка
spleen	селезінка
become committed	здійснитися
tissue	тканина
retain a complete genome	зберегти повний геном
to starve	голодувати
udder cells	клітини вимені
demethylation	деметилювання
a mammary gland cell	клітина молочної залози
nucleus	ядро
a pregnant ewe	вагітна вівця
mammals	ссавці

II. Listen to the text "Dolly the cloned sheep" and be ready to answer the questions:

1. Why might Dolly technically NOT be a true clone?
a. Mitochondria contain DNA and these organelles were provided by the donor enucleated egg cell, not from the cell from which the nucleus was removed.
b. Dolly contained 20% shorter telomeres.
c. Dolly did not look like the donor of the nucleus.
d. Dolly died prematurely, much earlier than her donor.
e. none of the above

2. What is a reason for cloning animals?
a. to give products of more standardized quality
b. to insert a transgene into the nucleus during the cloning process to produce identical animals that express the foreign protein
c. to be able to distribute improved animals more quickly
d. to rescue rare breeds or endangered species of animals without crossbreeding
e. all of the above

III. Listen to the text "Dolly the cloned sheep" again. Decide if the statements are true or false.
1) Cells in an early embryo possess the ability to divide and give rise to any type of body cell (liver, spleen, brain, etc.).
2) Most cells in an adult animal can't either no longer divide or else only give rise to a particular, specialized type of cell.
3) The cloning of Dolly the sheep showed that it is impossible to reset the clock of an adult cell to zero and start development again.
4) In 1998, at the Roslin Institute in Germany, the world's first cloned animal, Dolly the sheep, was born.
5) Dolly is not a complete clone.

IV. Unscramble the words to complete the sentences:

There is some variability in the timing of integration of DNA injected into the **LAME______**(1) pronucleus. In some cases, the DNA integrates more or less immediately, so that all cells of the resulting animal will contain the **GESRANTNE_____**(2). Less often several **LECL______**(3) divisions may happen before DNA integration occurs and the final result will be a chimeric **AMINAL______**(4), in which some cells contain the transgene and others do not. Sometimes multiple tandem copies of the transgene **ETARGNITE______**(5) into the same nucleus—such constructs are often unstable and the extra copies are often deleted out over successive **NERATIONSGE ______**(6). Integration of the incoming DNA into the **TOSH ____**(7)cell chromosomes occurs at random. Often, this is accompanied by rearrangements of the surrounding chromosomal **OMOSOMALCHR_______**(8) DNA. This suggests that integration often occurs at the sites of spontaneous chromosomal **AKSBRE______**(9).

V. Range the words in order you hear them (from the video)

manipulate genes	malfunction
common kitchen pest	precisely
similarities	a lot in common
Transparent	neurological disorders

the same yeast unethical

Drosophila melanogaster 50 times more efficient

respond to fleshes C. elegans

VI. Watch the video one more time, summarize the information and present it in 5 key sentences.

Unit 10

Topic: FOOD AND BEVERAGE BIOTECHNOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

foodstuff	харчові продукти
beverage biotechnology	біотехнологія напоїв
microbial species	види мікробів
fermentative starter culture	ферментативна закваска
high throughput techniques	високопродуктивні методи
to monitor	контролювати
to evaluate	оцінювати
flavorome	ароматизатор
brew and distilling	варіння та дистиляція
nutraceutical foods	поживні продукти харчування
biocompatibility	біосумісність

malolactic fermentations	яблучно-молочні бродіння
conventional cultures	звичайні культури
non-*Saccharomyces* yeasts	дріжджі, які не належать до Saccharomyces
lactic acid bacteria	молочнокислі бактерії
inoculation	щеплення
food additive	харчова добавка
enhance digestibility	покращують засвоюваність
lactobacilli	лактобактерії
gastrointestinal tract	шлунково-кишковий тракт
sufficient acid	достатня кількість кислоти
mycotoxins	мікотоксини
biogenic amines	біогенні аміни

II. Read and translate the following text:

1. Fermentation for Food and Beverages

Fermentation is the oldest biotechnology used by human beings to produce safer, more stable, and better foodstuff. Simultaneously, it is one of the most advanced research topics in food technology used to produce innovative beverages and food, and has a high impact in human health. Recently, the use of new microbial species and emerging biotechnologies are opening a lot of new possibilities in the production of food and beverages. The use of alternative microbial species, complex fermentative starter cultures with higher numbers of microorganisms, the development of high throughput techniques to monitor these emerging fermentations and to evaluate the impact in the flavorome, have increased in last years.

Fermentation in food technology includes such topics:

- Fermented foods derived from cereals. Beer fermentation and derived products. Brew and distilling;
- Fermented and functional food, nutraceutical foods and health improver foods;
- Biocompatibility of starter cultures;
- Wine fermentation: Alcoholic and malolactic fermentations, the use of conventional cultures and emerging species as non-*Saccharomyces* yeasts and alternative lactic acid bacteria. Influence on sensory profile, chemical and microbiological stability and wine safety;
- Dairy fermented products, impact in GUT*, in sensory quality, and stability;
- Meat fermented products;
- Fermented vegetables, fruits and juices;
- New fermentation biotechnologies: Mixed multispecies starters. Co-inoculations and sequential inoculations;
- Emerging non-thermal technologies to sanitize and produce safer fermented products and better implanted inoculant starters;
- High throughput techniques to screen microbial populations in fermented foods;

- Metabolomic/foodomic techniques to analyse the impact of microbial communities in fermented foods [18].

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*__Gut__ microbiota are the microorganisms, including bacteria and archaea, that live in the digestive tracts of vertebrates including humans, and of insects. Alternative terms include gut flora (an outdated term that technically refers to plants) and gut microbiome.

2. Microorganisms as food additives

Microorganisms, both bacteria and fungi, are used as additives in meats, milk, cereals, vegetables and fruits to produce fermented products. The fermented foods differ from the starting material in texture, flavor and keeping quality.

Fermentation causes changes in the nutritional content of foods; vitamin and amino acid levels may increase, decrease or remain static, depending on the type of microorganism used and the product fermented. Microorganisms also impart desirable flavors, improve texture and enhance digestibility of foods. Fermentation destroys food spoilage organisms and permits preservation of food. Lactobacilli in cultured milks are used to supplement the normal intestinal flora in individuals suffering from digestive ailments or enteric diseases. Cultured milks are tolerated by lactose-intolerant individuals because of lactose utilization in the gastrointestinal tract by ingested lactobacilli. If sufficient acid is formed, foods which have undergone a lactic acid fermentation, such as fermented sausages or cheese, do not support growth of food poisoning microorganisms. Products which undergo controlled commercial fungal fermentations have been shown not to contain mycotoxins. Histamines and other biogenic amines are present in cheese and other fermented products. Fermentation offers a means of producing safe, nutritious foods with desirable organoleptic qualities and extended storage stability [19].

III. Complete the sentences with the words from the text:

1) Fermentation is one of the most advanced research topics in food technology used to produce innovative beverages and … .
2) Recently, the use … are opening a lot of new possibilities in the production of food and beverages.
3) Wine fermentation: Alcoholic and malolactic fermentations, the use of … as non-Saccharomyces yeasts and alternative … bacteria.
4) … , are used as additives in meats, milk, cereals, vegetables and fruits to produce fermented products.
5) Lactobacilli in cultured milks are used to … .
6) … by lactose-intolerant individuals because of lactose utilization in the gastrointestinal tract by ingested lactobacilli.
7) Products which undergo controlled commercial fungal fermentations have been shown … .
8) … are present in cheese and other fermented products.

IV. Find the English equivalents for:

Мікотоксини, харчові продукти, ароматизатор, заварювання та дистиляція, яблучно-молочні бродіння, молочнокислі бактерії, харчова добавка, лактобактерії, види мікробів.

V. Match the English words with their Ukrainian equivalents:

1)біотехнологія напоїв	a)inoculation
2)високопродуктивні методи	b)conventional cultures
3)поживні продукти харчування	c)yeasts
4)контролювати	d)nutraceutical foods
5)щеплення	e)gastrointestinal tract
6)дріжджі	f)biogenic amines
7)звичайні культури	g)to evaluate
8)шлунково-кишковий тракт	h)biocompatibility
9)біогенні аміни	i)high throughput techniques
10)оцінювати	j)enhance digestibility
11)покращують засвоюваність	k)beverage biotechnology
12)біосумісність	l)to monitor

VI. Match the words with their definitions:

1)fermented products	a) chemical process by which molecules such as glucose are broken down anaerobically
2) beverage	b) a disaccharide, is a sugar composed of galactose and glucose subunits and has the molecular formula C12H22O11
3) lactose	c) rich in beneficial probiotics and have been associated with a range of health benefits — from better digestion to stronger immunity
4) histamines	d) bacteria and other organisms that live inside the intestines
5)fermentation	e) a drink other than water
6) normal intestinal flora	f) is an organism that is microscopic
7) microorganism	g) a chemical found in some of the body's cells - causes many of the symptoms of allergies, such as a runny nose or sneezing

VII. Make up the sentences with the words and phrases:
chemical process, bacteria, beneficial probiotics, fermentation, nutraceutical foods, conventional cultures, stronger immunity, food additives, dairy products, fermentation biotechnologies.

VIII. Translate into English:
1. Ферментація - це хімічний процес, за допомогою якого анаеробно розщеплюються такі молекули, як глюкоза.
2. Бродіння - анаеробний ферментативний окислювально-відновлювальний процес розкладу органічних речовин, переважно вуглеводів, який проходить під впливом живих клітин або виділених із них ферментів.
3. Піноутворення є результатом виділення вуглекислого газу, хоча це не було визнано до 17 століття.
4. Французький хімік і мікробіолог Луї Пастер у 19 столітті використовував термін бродіння у вузькому значенні, щоб описати зміни, викликані дріжджами та іншими мікроорганізмами, що ростуть за відсутності повітря (анаеробно).
5. Луї Пастер також визнав, що етиловий спирт і вуглекислий газ не є єдиними продуктами бродіння.
6. У 1920-х роках було виявлено, що за відсутності повітря екстракти м'язів каталізують утворення лактату з глюкози і що ті самі проміжні сполуки, що утворюються при ферментації зерна, виробляються м'язами.
7. Таким чином з'явилося важливе узагальнення: реакції бродіння не властиві дії дріжджів, але також відбуваються в багатьох інших випадках утилізації глюкози.
8. Вивчення мікроорганізмів називається мікробіологією.
9. Мікроорганізмами можуть бути бактерії, гриби, археї або протисти.
10. В даний час ведеться багато дискусій щодо організації та класифікації життя, зокрема у вивченні мікроорганізмів.
11. Клітини усіх живих організмів поділяються на еукаріотичні — ті, що містять морфологічно відокремлене ядро із генетичною інформацією, та прокаріотичні — ті, які не мають морфологічно відокремленого ядра.
12. До появи мікроскопа живі організми зручно поділяли на два царства: рослинне або тваринне.

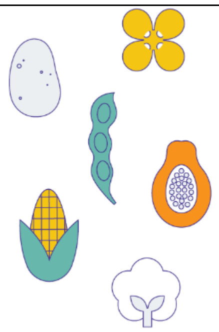
TEXT B

I. Read and translate the text using a dictionary:

What GMO crops are grown and sold in the United States?

Only a few types of GMO crops are grown in the United States, but some of these GMOs make up a large percentage of the crop grown (e.g., soybeans, corn, sugar beets, canola, and cotton). In 2018, GMO soybeans made up 94% of all soybeans planted, GMO cotton made up 94% of all cotton planted, and 92%

of corn planted was GMO corn. In 2013, GMO canola made up 95% of canola planted while GMO sugar beets made up 99.9% of all sugar beets harvested.

	Most GMO plants are used to make ingredients that are then used in other food products, for example, cornstarch made from GMO corn or sugar made from GMO sugar beets.

Corn: Corn is the most commonly grown crop in the United States, and most of it is GMO. Most GMO corn is created to resist insect pests or tolerate herbicides. *Bacillus thuringiensis* (Bt) corn is a GMO corn that produces proteins that are toxic to certain insect pests but not to humans, pets, livestock, or other animals. These are the same types of proteins that organic farmers use to control insect pests, and they do not harm other, beneficial insects such as ladybugs. GMO Bt corn reduces the need for spraying insecticides while still preventing insect damage. While a lot of GMO corn goes into processed foods and drinks, most of it is used to feed livestock, like cows, and poultry, like chickens.

Soybean: Most soy grown in the United States is GMO soy. Most GMO soy is used for food for animals, predominantly poultry and livestock, and making soybean oil. It is also used as ingredients (lecithin, emulsifiers, and proteins) in processed foods.

Cotton: GMO cotton was created to be resistant to bollworms and helped revive the Alabama cotton industry. GMO cotton not only provides a reliable source of cotton for the textile industry, it is also used to make cottonseed oil, which is used in packaged foods and in many restaurants for frying. GMO cottonseed meal and hulls are also used in food for animals.

Potato: Some GMO potatoes were developed to resist insect pests and disease. In addition, some GMO potato varieties have been developed to resist bruising and browning that can occur when potatoes are packaged, stored, and transported, or even cut in your kitchen. While browning does not change the quality of the potato, it often leads to food being unnecessarily thrown away because people mistakenly believe browned food is spoiled.

Papaya: By the 1990s, ringspot virus disease had nearly wiped out Hawaii's papaya crop, and in the process almost destroyed the papaya industry in Hawaii. A GMO papaya, named the Rainbow papaya, was created to resist ringspot virus. This GMO saved papaya farming on the Hawaiian Islands.

Summer Squash: GMO summer squash is resistant to some plant viruses. Squash was one of the first GMOs on the market, but it is not widely grown.

Canola: GMO canola is used mostly to make cooking oil and margarine. Canola seed meal can also be used in food for animals. Canola oil is used in many packaged foods to improve food consistency. Most GMO canola is resistant to herbicides and helps farmers to more easily control weeds in their fields.

Alfalfa: GMO alfalfa is primarily used to feed cattle—mostly dairy cows. Most GMO alfalfa is resistant to herbicides, allowing farmers to spray the crops to protect them against destructive weeds that can reduce alfalfa production and lower the nutritional quality of the hay.

Apple: A few varieties of GMO apples were developed to resist browning after being cut. This helps cut down on food waste, as many consumers think brown apples are spoiled.

Sugar Beet: Sugar beets are used to make granulated sugar. More than half the granulated sugar packaged for grocery store shelves is made from GMO sugar beets. Because GMO sugar beets are resistant to herbicides, growing GMO sugar beets helps farmers control weeds in their fields [20].

II. Answer the questions:

1. What is the most common crop in the United States, and most of it is GMO?
2. What are most GMO corn created for?
3. What are the properties of GMO Bt corn?
4. What is a lot of GMO corn used for?
5. What do you know about GMO soybeans grown in the United States?
6. What was GMO cotton created for?
7. How are GMO meal and cotton husks used?
8. Some GMO potatoes have been developed to resist which pests and diseases?
9. By what time did the ringworm virus nearly wipe out the papaya crop in Hawaii and in the process almost wipe out the papaya industry in Hawaii?
10. What is the name of the GMO papaya, which was created to combat the ring spot virus?
11. How to use GMO canola?
12. Which GMO product is mainly used for feeding cattle, mainly dairy cows?
13. Why were several varieties of GMO apples developed?
14. Which helps farmers control weeds in their fields.
15. What plant is used to make ingredients that are then used in other foods?

III. Make up a plan of the text.

IV. Render the text in a written form.

V. Quiz yourself about foods made from genetically modified crops:

Some food companies have stopped using genetically modified crops as sources for their foods. But if you are like many Americans, you may think you don't know enough about the issue to know whether you agree or disagree with those who pressed for these changes. A May 2000 survey by the International Food Information Council found that only one in five Americans consider themselves informed about foods produced with genetically modified organisms (GMOs). Peter Goldsbrough, a plant scientist and expert in genetically modified crops at Purdue University, has developed nine questions to test your knowledge of genetically modified foods and agricultural biotechnology:

1. Have you eaten foods made from genetically modified crops?
a. Yes.
b. No.
2. Which foods use genetically modified organisms in their production to the largest extent?
a. Cheese.
b. Vegetables.
c. Meat.
3. What are the *current* benefits of having foods made from genetically modified crops?
a. They improve farm profitability and make some farmers' jobs easier.
b. They allow farmers to greatly increase the amount of crops produced.
c. They improve convenience for consumers, e.g. by creating foods with longer shelf lives.
d. They improve the nutritional quality of foods.
e. They cause less damage to the environment than conventional chemical-intensive agriculture.
4. Of the foods we eat, how much contains the genetic material DNA?
a. Less than 5 percent.
b. 20 percent.
c. 50 percent.
d. 80 percent.
e. Nearly 100 percent.
5. Most foods derived from genetically modified crops contain:
a. The same number of genes as food produced from conventional crops.
b. The same number of genes as foods produced from hybrid crops.
c. One or two additional genes.
d. Hundreds of additional genes.
e. No genes at all.
6. What effect does eating genetically modified foods have on your genes?
a. It could cause your own genes to mutate.
b. It could cause your own genes to absorb the excess genes.
c. It has no effect on your genes.
d. The effects on human genetics aren't known.
7. Are foods made from genetically modified crops required to pass human testing?
a. Yes.
b. No.
8. Are foods derived from genetically modified crops required to be tested for possible allergic reactions in people?
a. Yes.
b. No.

9. Are foods derived from genetically modified crops nutritionally superior?

a. Yes, they offer substantial health advantages over foods produced from conventional crops.

b. Yes, they offer some health advantages over foods produced from conventional crops.

c. No, they are neither better nor worse than foods from conventional crops.

d. No, they are slightly less healthful than foods from conventional crops.

e. No, foods produced from genetically modified crops are a known health risk [20].

VI. Check your answers from the Quiz:

1. Answer: a. Yes. "If you live in the United States, it's almost certain that at one time or another you've eaten foods made from genetically modified crops," Goldsbrough says. A large percentage of the corn and soybeans grown in the United States comes from genetically modified plants, and the crops from these plants are made into common food ingredients such as high fructose corn syrup and vegetable oil as well as other food additives. The corn syrup is used in a number of products, including soft drinks, and the vegetable oil is used to fry foods such as fast-food french fries. According to the Grocery Manufacturers of America, this year an estimated 70 percent of the foods on grocery store shelves will have been made or manufactured using genetically modified crops.

2. Answer: a. Cheese. Before the advent of genetically modified organisms, cheese was produced using an enzyme obtained from the stomachs of calves slaughtered for veal. Now genetically modified bacteria produce that same protein. One result of this is that many cheeses are now considered Kosher.

3. Answer: a. They improve farm profitability and make some farmers' jobs easier. Right now, genetically modified crops have made life a little bit easier for the nation's farmers who use them. However, scientists and farmers believe that soon all of the answers will be true: genetically modified crops will create foods that are more nutritious, have longer shelf lives, contain fewer pesticides, and are produced with less damage to the environment.

4. Answer: e. Nearly 100 percent. All plant and animal cells contain DNA, so nearly all food contains genetic material regardless of whether the food has been genetically modified. There are a few exceptions, however. "During the processing of some food products, such as vegetable cooking oils, almost all of the DNA is removed," Goldsbrough says.

5. Answer: c. One or two additional genes. Genetically modified crops contain one or two additional genes than either conventional or hybrid crops.

6. Answer: c. It has no effect on your genes. "Genes in foods are easily digested and there is no evidence that these new genes are going to have any affect on our genes," Goldsbrough says.

7. Answer: b. No. "There are currently no regulations that require human testing of these crops," Goldsbrough says. "The producers are required by the Food and Drug Administration to say where the genes come from and to disclose nutritional properties, but that is as far as the requirements go."

8. Answer: b. No. There are no requirements to test whether genetically modified crops cause allergic reactions. "When Pioneer put genes from brazil nuts into foods and found that they did cause an allergic reaction by using skin tests, they stopped research on that product," Goldsbrough says. So far this system appears to work. When conventional new foods are introduced into the U.S. market –such as kiwi fruit – allergic reactions are common. But after three years of widespread use in the United States, no allergic reactions to genetically modified crops have been reported.

9. Answer: c. No. They are neither better nor worse than foods from conventional crops. "Most of the genetically modified crops currently available are designed to reduce farmers' production costs. Under some circumstances there may be less pesticides used, and there is some indication that genetically modified corn is less likely to be infected with fungal toxins that are natural carcinogens, but the overall health effect of these benefits is minor," Goldsbrough says. "In the future these technologies hold the promise of delivering foods that are nutritionally enhanced. For example, foods might provide essential vitamins or contain natural compounds that can help improve your health."

Source: Peter Goldsbrough: goldsbrough@hort.purdue.edu

TEXT C

I. Read and try to remember:

scientific farming	наукове землеробство
genetic alterations	генетичні зміни
enhancement of genes	посилення генів
crop	сільськогосподарська культура
higher yields	вищі врожаї
hinder productivity	перешкоджать продуктивності
pest-resistant	стійкий до шкідників
nutritional value	харчова цінність
malnourished population	населення, що страждає від недоїдання
consumption	споживання

II. Listen information from the text: "Advantages of GMOs". Then, mark the following statements as true (T) or false (F).

1) Crops can't be engineered to resist unfavorable temperatures or produce higher yields.
2) GMOs have become a very efficient means for farmers to make smaller profits.
3) GMOs are designed to be pest-resistant, eliminating the need to use pesticides, which means more savings.
4) GMOs are able to resist pests and other plant diseases; crop yields will be increased without the farmers having to use pesticides.
5) Due to GMOs using means that starvation will be prevented.

6) GMOs are known to raise the prices of food.
7) GMOs are found to be safe for human consumption.

III. Match the words with the definitions:

1) GMOs	a) the state of local or systemic abnormal physiological functioning of a plant, resulting from the continuous, prolonged 'irritation' caused by phytopathogenic organisms (infectious or biotic disease agents).
2) plant disease	b) is a financial benefit that is realized when the amount of revenue gained from a business activity exceeds the expenses, costs, and taxes needed to ...
3) productivity	c) is the measure of a well-balanced ratio of the essential nutrients carbohydrates, fat, protein, minerals, and vitamins
4) nutritional value	d) a measure of economic performance that compares the amount of goods and services produced (output) with the amount of inputs used to produce those goods and services.
5) profit	e) is any organism whose genetic material has been altered using genetic engineering techniques.

V. Fill in the blanks with the words and phrases from the word bank:

agricultural, means, genes, concerns, up, insects, genetic, experimental

Disadvantages of GMOs

The process of growing GMOs includes the addition of new _____(1) material into a crops genome, and similar to bacterial genetic engineering in agricultural ecology, this ______(2) the introduction of new genes in crops, like corn. _______(3) cultivation of these crops started in the US and Canada in the 1980s and became large scale and commercial in the mid 1990s. Now, research on the effects of large-scale growing of GMOs has revealed various ______(4) on ecosystems with GMO strains, which are believed to have the potential to alter agriculture. Particularly, GM plants had left unwanted or residual effects remaining in the soil for extended periods of time after they were removed, alerting _______(5) regulators. Data shows that despite the absence of the genetically modified plants, their strain persisted for ____(6) to 6 years.

GM crops are said to be dangerous to some insects, as their _____(7) could be deadly to them. This is definitely a serious issue when it comes to certain ______(8) that are useful to the ecosystem, such as butterflies, and are not actually dangerous to crops [21].

VI. Watch / listen to the video and complete the lines. There will be pauses so that you can write down necessary information.

1. Probiotics are l ______ m __________ that have been shown to provide health benefits.

2. Like a fingerprint, no two g ___ m ________ are the same.

3.Beneficial physiological functions:

they help extract n ________ from food.

they educate your i________ s __________ .

they can improve i___________ barrier

they influence your mental health.

4.When you take a probiotic, you're introducing a good bacteria into d__________ t________ , which can promote b __________ microbal activity and limit the o _____________ of bad bacteria.

5. Probiotics interact with our r ________ microbes producing health-promoting m ___________ as they travel throughout gut.

6. Commercial probiotics are from a few micribial groups such as the genus L_____________ or the genus B____________ .

7. Each probiotic shoud be described by a g________, s________ name, s_______ designation.

Chapter 6. Biotechnology and medicine

Unit 11

Topic: BIOTECHNOLOGY AND MEDICINE

TEXT A

I. Read and remember the following words and word-combinations:

living systems	живі системи
phenolics	феноли
saponins	сапоніни
terpenoids	терпеноїди
glycosides	глікозиди
tannins	дубильні речовини
volatile	непостійний, летючий
oils	олії
aseptic conditions	асептичні умови
agrobacterium rhizogenes	агробактерії(альні) ризогени
hairy roots	волохаті коріння
metabolic pathways	метаболічні шляхи
genomics	геноміка
enhance and advance the studies	покращувати та розвивати навчання
hypertension	гіпертонія
fungal β-glucans	β-глюкани грибів
marine sponge	морська губка
shrimp chitin	креветковий хітин
adjuvant activity	допоміжна активність
suppression	пригнічення
plant-based edible vaccine production	виробництво їстівної вакцини на рослинній основі

II. Read and translate the following text:

Production of natural bioactive compounds in biotechnology

Biotechnology uses living systems to develop products and plant biotechnology generates useful products or services, e.g., different bioactive secondary metabolites including alkaloids, flavonoids and other phenolics, saponins, terpenoids, steroids, glycosides, tannins, volatile oils, etc., from plant cells, tissues or organs culture independent of geographical and climatic factors under aseptic conditions. These bioactive compounds are economically important as drugs (pharmaceuticals), flavors, perfumes (fragrances), pigments (dyes), agrochemicals as well as cosmetics, food additives, etc. Different strategies, e.g., genetic transformation of plants with Agrobacterium rhizogenes, hairy roots and others can be applied for the improvement of production of bioactive compounds of secondary metabolic origin.

Recombinant DNA techniques can be used to manipulate metabolic pathways and produce protein pharmaceuticals such as antibodies, and protein hormones.

Bioinformatics and genomics can find application in drug discovery from plant-based products and biotechnological procedures can enhance and advance the studies of medicinal plants.

Molecular biotechnology uses laboratory techniques to study and modify nucleic acids and proteins for applications in areas such as human and animal health, agriculture, and the environment. Herbal extracts are now widely used in the management of chronic diseases like diabetes, hypertension, cancer, etc., as a part of CAM therapy.

Plant-derived immune stimulators diverse small or large molecules (saponins, tomatine, inulin, polysaccharides), fungal β-glucans, complex molecules from marine sponge (α-galactosylceramide), shrimp chitin (chitosan), etc., have established adjuvant activity.

Immunotherapy may be activation immunotherapy or suppression immunotherapy. Vaccines provide immune protection against diseases and plant-based edible vaccine production mainly involves the integration of transgene into the plant cells to produce the antigen protein for specific disease [22].

III. Answer the questions:

1) What useful products or services does plant biotechnology create?
2) What can recombinant DNA methods be used for?
3) What can be used bioinformatics and genomics?
4) For application in which areas does molecular biotechnology use laboratory methods to study and modify nucleic acids and proteins?
5) How are herbal extracts used now?

IV. Find the English equivalents for:

асептичні умови, біотехнологія рослин, ароматизатори, вторинні метаболіти, рослинні клітини, нуклеїнові кислоти, стимулятори імунітету рослинного походження, імунний захист від хвороб.

V. Match the English words with their Ukrainian equivalents:

1) volatile	**a)** метаболічні шляхи
2) tannins	**b)** стимулятори імунітету
3) enhance	**c)** імунотерапія
4) adjuvant	d)дубильні речовини
5) metabolic pathways	**e)** покращувати
6) antigen protein	**f)** застосування
7) application	**g)** нуклеїнові кислоти
8) nucleic acids	**h)** білок-антиген
9) immunotherapy	**j)** допоміжний
10) immune stimulators	**k)** непостійний, летючий

VI. Match the words with their definitions:

1) genomics	a) is a biological preparation that provides active acquired immunity to a particular infectious disease.
2) herbal extract	b) a condition in which the blood vessels have persistently raised pressure
3) vaccine	c) is the set of life-sustaining chemical reactions in organisms
4) chemical reaction	d) is a chemical element and its compounds in the natural state or the result of a manufacturing process
5) substance	e)the study of all of a person's genes (the genome), including interactions of those genes with each other and with the person's environment.
6) metabolism	f) a process in which one or more substances, the reactants, are converted to one or more different substances, the products.
7) hypertension	g) a substance made by extracting a part of a herbal raw material, often by using a solvent such as methanol or water.

VII. Make up the sentences with the words and phrases:

Genes, substances, metabolism, application, recombinant DNA methods, interactions of genes, immunotherapy, vaccine.

VIII. Translate into English:

1. Метаболізм -це сукупність хімічних реакцій, що підтримують життя в організмах.
2. Існує три основні цілі метаболізму: перетворення енергії їжі в енергію, доступну для запуску клітинних процесів; перетворення їжі на будівельні блоки для білків, ліпідів, нуклеїнових кислот і деяких вуглеводів.
3. Реакції, що каталізуються ферментами, дозволяють організмам рости і розмножуватися, підтримувати свої структури та реагувати на навколишнє середовище.

4. *Проміжний* (клітинний, тканинний) метаболізм містить низку фізико-хімічних та біохімічних реакцій, перебіг яких відбувається у клітинах різних органів і тканин.
5. Біотехнологи прагнуть зрозуміти і маніпулювати основними будівельними блоками живих істот, і вони використовують для цього методи молекулярної біології.
6. Біотехнологи вивчають генетичні, хімічні та фізичні властивості клітин, тканин і організмів і визначають практичне використання цих знань.
7. Молекулярна біологія більше зосереджена на генетиці (ДНК і РНК), але включає будь-які біологічні молекули.
8. Біохімія, як правило, більше зосереджується на білках, які функціонують як каталізатор метаболічних шляхів.

TEXT B

I. Read and translate the text:

The difference between pharmaceutical and biotechnology

Pharmaceutical industry. Working with plant and chemical based compounds, pharmaceutical companies work their magic to make medicines that cure or manage diseases, and protect us from infection. Pharmaceuticals include a handful of major companies that dominate the industry. While many of these firms also produce animal health products, livestock feed supplements, vitamins and a host of other goods, this profile will focus solely on their drug products used to treat human illness.

Depending on their size and strategy, pharmaceutical companies may conduct extensive research in-house or they may seek to license promising drugs from academia, other pharmaceuticals, or biotechnology companies. The latter firms are generally smaller than their Big Pharma competitors, and they employ cellular and bimolecular processes to make medicines or diagnose illness.

Biotechnology. Biotechnology is the applied knowledge of biology, it seeks to duplicate or change the function of a living cell so it will work in a more predictable and controllable way. The biotechnology industry uses advances in genetics research to develop products for human diseases and conditions. Several biotech companies also use genetic technology to other ends, like the manipulation of crops. Biopharmaceuticals hold great promise for treating some of the most intractable medical conditions such as cancer and autoimmune disease. Biopharmaceuticals are therapeutic agents intended to treat symptoms and/or underlying causes of a variety of disorders and diseases.

The primary difference between biopharmaceuticals and traditional pharmaceuticals is the method by which the drugs are produced: The former are manufactured in living organisms such as bacteria, yeast and mammalian cells, whereas the latter are manufactured through a series of chemical synthesis.

Biopharmaceuticals are primarily developed in both academic and industrial laboratories. The commercialisation process is often funded by venture capital firms (for academic and start-ups) or drug companies. Prior to sale, drugs are assessed by the Food & Drug Administration (FDA) and other international regulatory agencies for safety and efficacy.

Biotech opportunities largely mirror those in the pharmaceutical industry. The key difference is that biotech firms are much more focused on research because they are still developing their initial products. Biotech firms tend to expand their marketing and sales forces when, and if a viable product nears FDA approval. Biotech companies tend to be located in geographical clusters, often near prominent research universities. The largest concentration of biotech companies in Ireland are in Cork and Dublin as these areas have made an effort to focus on drawing biotech companies by devoting to finding resources for them. Those who choose to work in this industry enjoy the very real satisfaction of knowing that they are working to produce drugs that could make a radical difference in the lives of thousands, even millions, of people [23].

II. Decide if the following statements as true (T) or false (F) according to the text:

1) Pharmaceuticals don't include companies that dominate the industry.
2) In pharmaceutical industry the latter firms are generally smaller than their Big Pharma competitors.
3) Biotechnology is the applied knowledge of biology.
4) The largest concentration of biotech companies in Ireland are in Limerick and Galway.
5) Biopharmaceuticals hold promise for treating some of the most intractable medical condition such as autoimmune disease.
6) The difference between biopharmaceuticals and traditional pharmaceuticals is the plant on which the drugs are produced.
7) Biotech companies often tend to be located near prominent research universities.

III. Translate the paragraph in italics in a written form.

IV. Make up a plan of the text.

V. Render the text in a written form.

TEXT C

.

I. Read and try to remember:

hereditary defect	спадковий дефект
recessive condition	рецесивний стан
expression of the gene	експресія гена
bloodstream	кровотік
airways	дихальні шляхи
bacterial plasmids	бактеріальні плазміди
retroviruses and adenoviruses	ретровіруси та аденовіруси

II. Listen to the text: General principles of gene therapy. Then, mark the following statements as true (T) or false (F).

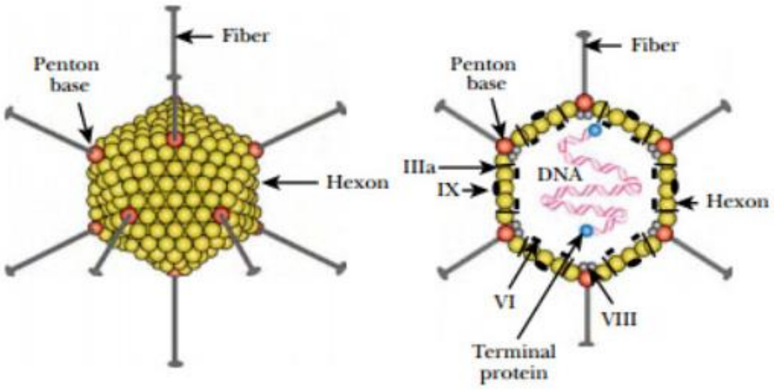
1) It would obviously simplify treatment if the disease mostly affects just one or a few organs.
2) The second step in replacement gene therapy is to identify the genetic defect and to clone a good copy of the gene involved.
3) Delivery of a gene may be performed just in one way.
4) In some cases, cells are removed from the patient, engineered while growing in culture, and then returned to the patient
5) A modified virus is used as the vector in most cases.

III. Unscramble the words to complete the sentences:

Aggressive gene therapy

The original idea behind gene **PYRAHTE**____(1) was curing hereditary defects by replacing defective genes. However, there is no **NEREHNIT**_______(2) reason why gene therapy must only be "defensive" and suppress **FETCED**______(3). We can go on the offensive and provide genes whose products may **ECUR**______(4) a disease even though the genes we use were not responsible for the problem in the first **CEALP**_____(5). The best examples of such aggressive **EGEN**______(6) therapy are not in curing hereditary defects but in the treatment of cancer. Here the objective is to **LILK** ____(7) cancer cells. In fact, *(as shown in Table)*, the majority of gene therapy trials are now directed against cancer.

Aggressive gene therapy uses genes to kill or **ROYSEDT** _______(8) unwanted cells and is especially useful against cancer.



https://istudy.pk/adenovirus-vectors-gene-therapy/

IV. Answer the questions:

1. What is a difference between genetic engineering and gene therapy?

a. Genetic engineering produces inheritable changes, but changes through gene therapy are never inherited.
b. Gene therapy produces inheritable changes, but changes through genetic engineering are never inherited.

c. Changes from both gene therapy and genetic engineering are passed on to subsequent generations.
d. Changes from both gene therapy and genetic engineering are never passed on to future generations.
e. None of the above.

2. Which of the following is the most popular approach to delivering gene therapy?
a. bacterial vectors
b. naked DNA
c. liposomes
d. viral vectors
e. gene gun

3. What disease are the majority of aggressive gene therapy trials directed against?
a. infectious diseases
b. HIV
c. cancer
d. vascular diseases
e. single gene defects

4. Which of the following statements is considered an advantage to using adenoviruses for human gene therapy?
a. They do not cause cancer.
b. The complete DNA sequences are available and almost every gene has a known function.
c. They are easily cultured and can be produced in large quantities.
d. They only cause minor illnesses, if any illness at all.
e. All of the above are advantages [17].

V. Watch / Listen to the video and pick up a correct option.

1. What are the consequences of the misuse and overuse of antibiotics?
a) is making the antibiotics behave in an unpredictable way
b) is improving the resistance of the organism to diseases
c) is reducing the ability of antibiotics to save lives

2. How many sore throats are usually viral?
a) Up to 9 out of 10
b) Up to 10 out of 10
c) Up to 8 out 10

3. Why can antibiotics be ineffective?
a) antibiotics only work against bacteria
b) antibiotics used without a prescription
c) some antibiotics are inappropriate

4. Antibiotic classes work in a variety of ways to inhibit bacteria. Which way has NOT been mentioned.
a) they produce their own clones
b) restrict the ability of the bacteria to multiply

c) desrupt bacterial metabolism

5. What happens to the disease-causing bacteria when exposed to a narrow spectrum antibiotic? Which ONE from these has been mentioned.
a) disease causing bacteria will spread
b) disease causing bacteria will be inhibited
c) disease causing bacteria will be modified

Unit 12

Topic: STEM CELL BIOTECHNOLOGY

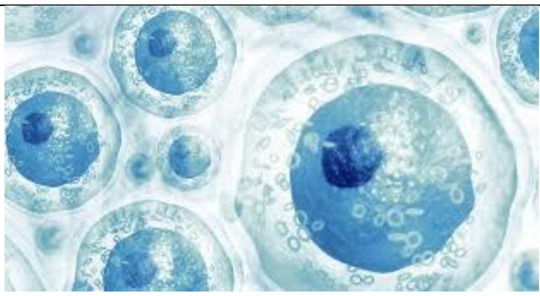
TEXT A

I. Read and remember the following words and word-combinations:

stem cells	стовбурові клітини
raw materials	сировина
bone marrow	кістковий мозок
blood vessels	кровоносні судини
liver	печінка
pluripotency	плюрипотентність
a lung cell	клітина легенів
pancreas	підшлункова залоза
spinal cord	спинний мозок
sickle cell anemia	серповидноклітинна анемія
pluripotent	плюрипотентний
conception to eight weeks' gestation	восьмий тиждень вагітності/визрівання з моменту зачаття
retain	зберігати
repopulate	знову заселити
induced cells	індуковані клітини

II. Read and translate the following text:

Stem cells

 https://www.medicalnewstoday.com/articles/323343	Stem cells are the body's raw materials — cells from which all other cells with specialized functions are generated. Stem cells are present inside different types of tissue. Scientists have found stem cells in tissues, including: the brain, bone marrow, blood and blood vessels, skeletal muscles, skin, the liver.

Stem cells can be thought of as master cells, the raw materials from which a complete individual is crafted. The power of a stem cell lies in its pluripotency – the ability to divide and develop (differentiate) into any one of the 220 various types of cells found in the body. As cells differentiate, they lose this ability: a liver cell, for example, can only renew itself to form more liver cells – it cannot become a lung or brain cell.

Because of this pluripotency, stem cells have great medical potential. They could be used to recreate insulin-producing cells in the pancreas to treat Type I diabetes, to repopulate neurons destroyed due to Parkinson disease or to replace cells lost in spinal cord injuries. In the laboratory, stem cells have been used to successfully treat animals affected with paralysis, muscular dystrophy, Parkinson disease and sickle cell anemia.

Multiple types of stem cells have been identified or developed. Embryonic stem cells (ES cells) were the first category discovered. These cells are fully pluripotent, but only found in young embryos (the stage of human development from conception to eight weeks gestation). Because the process to collect ES cells destroys the embryo, some groups are opposed to their use.

In the tissues of many developed organs, scientists have identified so-called adult stem cells that retain a portion of the ability to differentiate into other cell types. The primary role of adult stem cells is to maintain and repair the tissue in which it is found. For example, bone marrow contains adult stem cells, which can give rise to all the types of blood cells. This is why a bone marrow transplant can repopulate the blood and immune cells in a patient. It appears that adult stem cells may not have the full range of pluripotency found in ES cells, although researchers are exploring techniques to use adult stem cells for certain forms of therapy.

Recent genetic discoveries have identified key genes that are active only in ES cells. Working in the laboratory, scientists have used this information to modify differentiated cells to reactivate these genes, in effect regressing the cells into pluripotent stem cells. These cells are known as induced pluripotent stem (iPS) cells, and early research suggests they behave in much the same way as ES cells. Because iPS cells could be created by reprogramming a patient's own tissues, they lack the ethical concerns posed by ES cells. In addition, because they are a genetic match, therapies using iPS cells would not be rejected by the patient's immune system. While there are a number of technical hurdles that must be overcome before iPS cells are ready for clinical applications, several companies are beginning to explore treatment possibilities [24].

III. Answer the questions:

1) Where are the stem cells present?
2) What is the strength of the stem cell?
3) What can stem cells be used for?
4) What types of stem cells have been identified or developed?
5) What is the ability of so-called adult stem cells?
6) Can a bone marrow transplant restore the patient's blood and immune cells?

IV. Find the English equivalents for:

етичні проблеми, сировина, стовбурові клітини, печінка, знову заселити, кістковий мозок, імунна система, генетично збігатися, подолати, кровоносні судини, певні форми терапії, технічні перешкоди.

V. Match the Ukrainian words with their English equivalents:

1) спинний мозок	**a)** pancreas
2) стовбурові клітини	**b)** a lung cell
3) схрещення ембріонів	**c)** gestation
4) підшлункова залоза	**d)** ability
5) здатність	**e)** embryo crossing
6) клінічне застосування	**f)** spinal cordf
7) вагітність/визрівання	**g)** stem cells
8) клітина легенів	**h)** clinical application

VI. Match the words with their definitions:

1) blood vessels	a) a cylindrical structure that runs through the center of your spine, from your brainstem to your low back.
2) spinal cord	b) a complex organ that controls thought, memory, emotion, touch, motor skills, vision, breathing, temperature, hunger and every process that regulates our body.
3) stem cells	c) is the science that studies the structure of the body
	d) is the hereditary substance in the cell. It carries all

4) brain	information specific to an organism. It is known as DNA (deoxyribonucleic acid) or RNA (ribonucleic acid).
5) genetic material	e) channels that carry blood throughout your body.
6) anatomy	f)the body's raw materials — cells from which all other cells with specialized functions are generated.

VII. Translate into English:

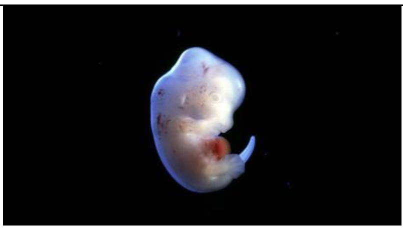
1.Стовбурові клітини є основою для кожного органу і тканинами вашого тіла.
2.Існує багато різних типів стовбурових клітин, які надходять з різних місць в організмі або утворюються в різний час нашого життя.
3. Усі стовбурові клітини можуть самовідновлюватися (робити копії самих себе) і диференціюватися (розвиватися в більш спеціалізовані клітини).
4. Стовбурові клітини сильно відрізняються за тим, що вони можуть і не можуть робити, а також за обставинами, за яких вони можуть і не можуть робити певні речі.
5.Ембріональні стовбурові клітини отримують з внутрішньої клітинної маси бластоцисти, переважно порожнистого клубка клітин, який у людини формується через три-п'ять днів після запліднення яйцеклітини сперматозоїдом.
6. При нормальному розвитку клітини всередині внутрішньої клітинної маси дадуть початок більш спеціалізованим клітинам, які породжують все тіло — усі наші тканини та органи.
7. Ембріональні стовбурові клітини є плюрипотентними, тобто вони можуть дати початок кожному типу клітин у повністю сформованому тілі, але не плаценті та пуповині.
8. Ці клітини неймовірно цінні, оскільки вони забезпечують поновлюваний ресурс для вивчення нормального розвитку та захворювань, а також для тестування ліків та інших методів лікування.
9.Людські ембріональні стовбурові клітини були отримані в основному з бластоцист, створених шляхом запліднення in vitro (ЕКЗ) для допоміжної репродукції.

TEXT B

I. Read and translate the text using a dictionary:

Japan approves first human-animal embryo experiments

The research could eventually lead to new sources of organs for transplant, but ethical and technical hurdles need to be overcome.

 https://www.techexplorist.com/japan-approves-first-human-animal-embryo-experiments/25281/	A Japanese stem-cell scientist is the first to receive government support to create animal embryos that contain human cells and transplant them into surrogate animals since a ban on the practice was overturned earlier this year.

Hiromitsu Nakauchi, who leads teams at the University of Tokyo and Stanford University in California, planned to grow human cells in mouse and rat embryos and then transplant those embryos into surrogate animals. Nakauchi's ultimate goal is to produce animals with organs made of human cells that can, eventually, be transplanted into people.

Japan explicitly forbade the growth of animal embryos containing human cells beyond 14 days or the transplant of such embryos into a surrogate uterus. That month, Japan’s education and science ministry issued newguidelines allowing the creation of human–animal embryos that can be transplanted into surrogate animals and brought to term. Human–animal hybrid embryos have been made in countries such as the United States, but never brought to term. Although the country allows this kind of research, the National Institutes of Health has had a moratorium on funding such work since 2015. Nakauchi’s experiments are the first to be approved under Japan’s new rules, by a committee of experts in the science ministry. He(Nakauchi) planed to grow hybrid mouse embryos until 14.5 days, when the animal’s organs are mostly formed, then do the same experiments in rats, growing the hybrids to near term, about 15.5 days. Later, to grow hybrid embryos in pigs for up to 70 days.

Ethical concerns. *Some bioethicists are concerned about the possibility that human cells might stray beyond development of the targeted organ, travel to the developing animal’s brain and potentially affect its cognition.* Nakauchi says these concerns had been taken into consideration in the experiment design. “We are trying to do targeted organ generation, so the cells go only to the pancreas,” he says.

The strategy that he and other scientists are exploring is to create an animal embryo that lacks a gene necessary for the production of a certain organ, such as the pancreas, and then to inject human induced pluripotent stem (iPS) cells into the animal embryo. iPS cells are those that have been reprogrammed to an embryonic-like state and can give rise to almost all cell types. As the animal develops, it uses the human iPS cells to make the organ, which it cannot make with its own cells.

In 2017, Nakauchi and his colleagues reported the injection of mouse iPS cells into the embryo of a rat that was unable to produce a pancreas. The rat formed a pancreas made entirely of mouse cells. Nakauchi and his team transplanted that pancreas back into a mouse that had been engineered to have diabetes. The rat-produced organ was able to control blood sugar levels, effectively curing the mouse of diabetes.

But getting human cells to grow in another species is not easy. Nakauchi and colleagues announced at the 2018 American Association for the Advancement of Science meeting in Austin, Texas, that they had put human iPS cells into sheep embryos that had been engineered not to produce a pancreas. But the hybrid embryos, grown for 28 days, contained very few human cells, and nothing resembling organs. This is probably because of the genetic distance between humans and sheep, says Nakauchi.

It doesn't make sense to bring human–animal hybrid embryos to term using evolutionarily distant species such as pigs and sheep because the human cells will be eliminated from host embryos early on, says Jun Wu, who researches human–animal chimaeras at the University of Texas Southwestern Medical Center in Dallas. "Understanding the molecular basis and developing strategies to overcome this barrier will be necessary to move the field forward," Wu says. Nakauchi says the approval in Japan will allow him to attack this problem. He will be experimenting with iPS cells at subtly different stages, and trying some genetically modified iPS cells to try to determine what limits the growth of human cells in animal embryos [41].

II. Decide if the following statements as true (T) or false (F) according to the text:

1) A Japanese stem-cell scientist is not the first to receive government support to create animal embryos that contain human cells and transplant them into surrogate animals.
2) Hiromitsu Nakauchi planned to grow human cells in mouse and rat embryos and then transplant those embryos into surrogate animals.
3) His goal is to produce animals with organs made of human cells that can, eventually, be transplanted into people.
4) The National Institutes of Health has had a moratorium on funding such work since 2013.
5) Nakauchi planned to grow hybrid mouse, then do the same experiments in rats and later to grow hybrid embryos in pigs.

6) Some bioethicists are concerned about the possibility that human cells might stray beyond development of the targeted organ.
7) Nakauchi and colleagues announced that they had put human iPS cells into sheep embryos but the hybrid embryos (grown for 28 days) contained very few human cells, and nothing resembling organs.

III. Translate the paragraph in italics in a written form.

IV. Make up a plan of the text.

V. Render the text in a written form.

TEXT C

I. Read and try to remember:

regenerative medicine	регенеративна медицина
biotech products	біотехнологічні продукти
monoclonal antibodies	моноклональні антитіла
compensate	компенсувати
evenly distributed	рівномірно розподілені
regulations and facilities	правила та засоби
‘hubs’ for cell therapy	«хаби» для клітинної терапії
neurodegenerative illnesses	нейродегенеративні захворювання
foetal or induced	фетальні або індуковані плюрипотентні
pluripotent stem cells	стовбурові клітини
bone marrow	кістковий мозок

II. Listen information from the text: “Commercial cell therapies in Europe”. Then answer the questions.

1) Where is the work on regenerative medicine?
2) How do you make most of the medicines that we usually use?
3) What has the second commercial sector been developing since the early 1980s?
4) What do biotech products include?
5) What is cell therapy?
6) How many companies in Europe now develop cell therapy?
7) What is the name of the European Commission's Framework Program 7?
8) Where are most of the cells of cell therapy?
9) For the treatment of which chronic diseases do stem cells have much greater potential?
10) Why is no European firm developing human embryonic stem cell (hESC) cell therapy?

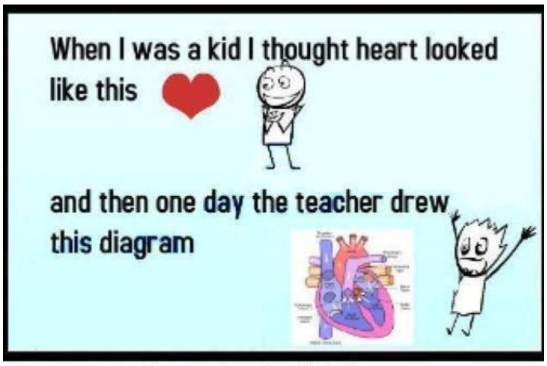
III. Match the words with the definitions:

1) human embryonic stem cells	a)the process of replacing or "regenerating" human cells, tissues or organs to restore or establish normal function.

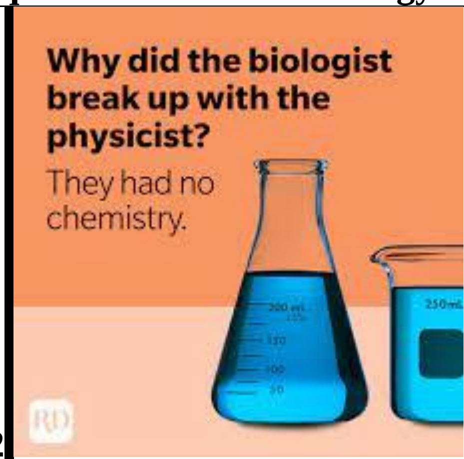
2) cell therapy (also called cellular therapy, cell transplantation, or cytotherapy)	b) products developed through genetic engineering or genome engineering (including products where the engineered DNA molecule is itself the “product,” as in an engineered molecule used as a DNA information-storage medium)
3) regenerative medicine	c) a therapy in which viable cells are injected, grafted or implanted into a patient in order to effectuate a medicinal effect
4) biotech products	d) an organ, tissue or a group of cells removed from one person (the donor) and transplanted into another person (the recipient) or moved from one site to another in the same person.
5) chronic diseases	e) pluripotent cells which give rise to all somatic cell types in the embryo.
6)a transplant	f) conditions that last 1 year or more and require ongoing medical attention or limit activities of daily living or both.

IV. Read and translate some funny quotes about biotechnology:

1



https://www.facebook.com/MedicalHumour



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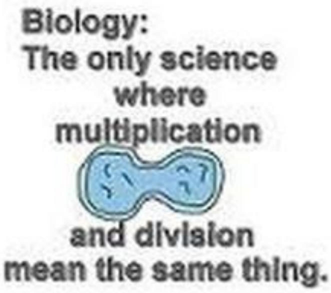

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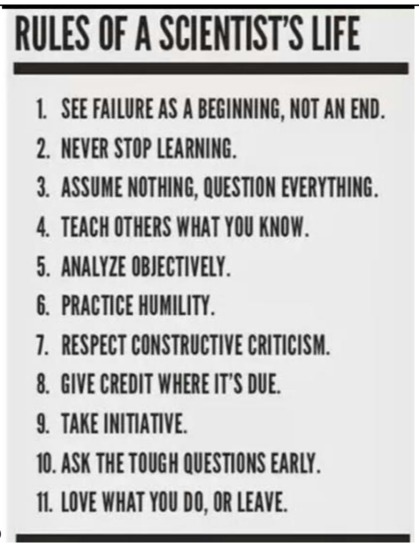

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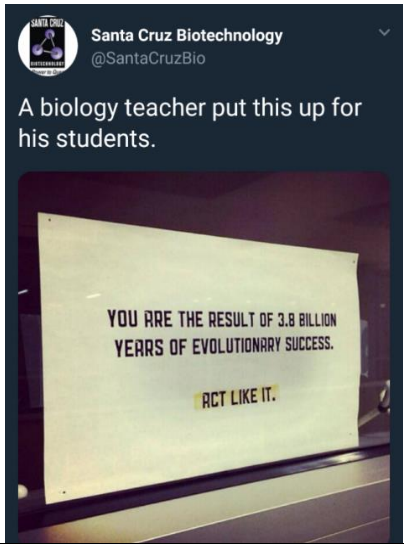

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V.Watch / Listen to the video and answer these questions

1. What can stem sells be used for?
2. What are the types of stem cells?
3. What are adult stem cells?
4. What are embryonic stem cells?
5. Should ethical and social considerations be taken into account while using stem cells?
6. What deseases can be treated by stem cells?
7. What's therapeutic cloning?

Part 4. Scientific responsibility in biotechnology

Chapter 7. Inventions and safety in Biotechnology

Unit 13

Topic: PROTECTION OF BIOTECHNOLOGICAL INVENTIONS

TEXT A

I. Read and remember the following words and word-combinations:

harmonised patent law	гармонізоване патентне право
clarify	уточнити
ethical grounds	етичні підстави
legal certainty	юридична визначеність
key provisions of the Directive	ключові положення Директиви
swift implementation	швидке виконання
gene sequences	послідовність генів
patentability of inventions	патентоспроможність винаходів
chapters dedicated to	розділи присвячені
patent-related inventions	винаходи, пов'язані з патентами
scope of protection	сфера охорони
immediate discussion	негайне обговорення
compulsory cross licensing	примусове перехресне ліцензування
fair access to patented material	справедливий доступ до запатентованого матеріалу
biological origin	біологічне походження
breeding sector	сектор розведення

II. Read and translate the following text:

Protection of biotechnological inventions

In 1998, the EU harmonised patent law relating to biotechnological inventions. This clarifies which inventions are patentable or not on ethical grounds, giving the legal certainty to organisations in the sector that is required to attract the considerable investment that is needed for innovation.

Directive 98/44/EC, the so-called 'Biotech Directive' on the legal protection of biotechnological inventions was adopted in 1998 and implemented by all EU countries.

The Biotech Directive requires regular reporting on particular issues in the field of biotechnology and genetic engineering. To provide information on recent scientific developments and their implications on patent law, the Commission set up an expert group with the mission to provide expertise, analysis and comments on the rapid evolutions in the biotechnological field.

First report on the development and implications of patent law in the field of biotechnology and genetic engineering (2002). This report called for the swift implementation of the 1998 Directive on the legal protection of biotechnological inventions to stop Europe falling behind its competitors in this sector, damaging its overall efforts to become the most competitive economy in the world. The report also addresses key provisions of the Directive, such as the potential patenting of plants and animals and the patenting of elements isolated from the human body or otherwise produced, including stem cells.

Second report on the development and implications of patent law in the field of biotechnology and genetic engineering (2005). This report covers developments and implications of patent law in the field of biotechnology and genetic engineering. It focuses on issues in the area of patents relating to gene sequences and the patentability of inventions relating to stem cells. It also reports on the implementation of the Directive.

Final report of the expert group. The report of the expert group provides expert analysis, views and recommendations on three main subjects directly linked to Directive 98/44/EC on the legal protection of biotechnological inventions. The report consists of three chapters dedicated to the patentability of human stem cells, the patentability of patent-related inventions and the scope of protection for DNA-related inventions. The issues surrounding these subjects were identified by experts as deserving of immediate discussion at the beginning of their work. Please note that this report does not necessarily represent the position of the Commission.

On 3 November the Commission adopted a notice clarifying certain articles of Directive 98/44 on the protection of biotechnological inventions. The Directive focuses on patenting in the biotech industry. The notice states that products created through essential biological processes should be excluded from patentability. Furthermore, it calls for more analysis of compulsory cross licensing between plant variety rights and patenting. The Commission also expands on how the Directive ensures that there is enough fair access to patented material of biological origin. Although a Commission Notice is not legally binding, its aim is to provide more clarity on the issue for the biotech, plant and animal breeding sectors [43].

III. Answer the questions:

1) In what year did the EU harmonize patent legislation on biotechnological inventions?
2) What is the name of Directive 98/44 / EC?
3) On which issues does the Biotechnology Directive require regular reporting?
4) Why did the Commission set up an expert group?
5) In what year was the First Report on the Development and Implications of Patent Law in Biotechnology and Genetic Engineering?
6) What does the Second Report cover?
7) What are the three sections of the final report of the expert group?

IV. Find the English equivalents for:

патентне законодавство, юридичну впевненість, значні інвестиції, етичні міркування, конкурентоспроможна економіка, конкуренти, патентування рослин і тварин, захисту винаходів, матеріал біологічного походження.

V. Match the English words with their Ukrainian equivalents:

1)clarify	a) виконання
2) ethical grounds	b) сфера захисту
3) scope of protection	c) юридична визначеність
4) to focuse on	d) біологічне походження
5) biological origin	e) рослинництво
6) crop production	f) патентоспроможність
7) livestock	g) уточнити
8) implementation	h) етичні підстави
9) patentability	i) тваринництво
10) legal certainty	j) зосередитися на

VI. Match the words with their definitions:

1)biological origin	a) is an organism that is microscopic
2) micro-organisms or microbe	b) that which acts as the source or that which from where something is derived.
3) genetic identity	c) techniques that use living organisms, or parts of them, in order to make or modify products, or to improve or modify certain or all the characteristics of plants, or animals, in order to develop micro-organisms, and organisms intended for specific uses.
4) population	d) measure of the proportion of genes that ar e identical in two populations.

5) biotechnological inventions	e) one who believes that evolution occurs chiefly as a result of natural selection
6) selectionist	f) a person who advocates or adheres to a policy or theory of neutralism
7) neutralist	g) a community of animals, plants, or humans among whose members interbreeding occurs.

VII. Make up the sentences with the words and phrases:

fair access to patented material, biotechnology and genetic engineering, gene sequences, immediate discussion, chapters dedicated to, patentability of inventions.

VIII. Translate into English:

1. Біотехнологічні винаходи стосуються біологічного матеріалу.
2. Біотехнологічний винахід може бути запатентований, якщо він відповідає загальним вимогам патентоспроможності.
3. Це означає, що має бути винахідницький рівень (а не просто відкриття), який є новим і неочевидним, і він повинен мати можливість комерційного використання.
4. Закон про патенти не тільки забезпечує ефективний і відповідний захист біотехнологічних винаходів, а також визначає етичні межі патентоспроможності.
5. Наприклад, тіло людини, включаючи ембріони, не може бути запатентовано.
6. Те саме стосується винаходів, які суперечать державній політиці чи суспільній моралі (наприклад, методи клонування людей).
7. Крім того, Закон про патенти визначає винятки з дії патенту.
8. Наприклад, без дозволу власника патенту можливо:

• проводити наукові дослідження щодо винаходу (звільнення від досліджень);
• мати вільний доступ до генетичного матеріалу рослин для дослідження та подальшого зростання (звільнення селекціонера);
• мати вільний доступ до запатентованого винаходу з метою навчання;
• для фермерів відтворення зібраного матеріалу у власному господарстві (сільськогосподарське звільнення).

TEXT B

I. **Read and translate the text:**

Biotechnological inventions: legal protection

SUMMARY OF:

Directive 98/44/EC — legal protection of biotechnological inventions

SUMMARY

WHAT DOES THIS DIRECTIVE DO?

It harmonises national patent laws regarding biotechnological inventions.

It specifies those inventions which are patentable on ethical grounds and those which are not.

KEY POINTS

- Inventions which concern a product consisting of, or containing, biological material* or a process for the production of such biological material may be patented if they are new, involve an inventive step and can be applied industrially.
- The following are not patentable:
- plant and animal varieties
- essentially biological processes* for producing plants and animals
- the human body at the various stages of its formation and development.
- However, an element isolated from the human body or produced by a technical process may be a patentable invention.
- Inventions may not be patented where their commercialisation would be immoral or against public order. In particular, the following are not patentable:
    - processes for cloning human beings
    - processes that modify the human germ line genetic identity
    - use of human embryos for industrial or commercial purposes
    - processes that may cause suffering to animals when modifying their genetic identity.
- The protection granted by a patent also extends to any biological material derived from the original biological material.
- Where a plant breeder cannot use a plant variety without infringing a patent, they may apply for a compulsory licence for non-exclusive use of the invention, subject to payment of an appropriate royalty.
- The European Group on Ethics in Science and New Technologies evaluates all ethical aspects of biotechnology.

In 2012, the European Commission set up an expert group to examine the technical development and implications of patent law in the field of biotechnology and genetic engineering. The group assists the Commission with its reporting obligations under Directive 98/44/EC.

FROM WHEN DOES THE DIRECTIVE APPLY?

It has applied since 30 July 1998. EU countries had to incorporate it into national law by 30 July 2000. Nowadays, the rules are implemented in the legislation of all EU countries [27].

*** Biological material**: any material containing genetic information and capable of reproducing itself or being reproduced in a biological system.

*** Biological process**: a process for the production of plants and animals is essentially biological if it consists entirely of natural phenomena such as crossing or selection.

II. Decide if the following statements as true (T) or false (F) according to the text:

1. This directive harmonises national patent laws regarding biotechnological inventions.
2. This directive specifies those inventions which aren't patentable.
3. Plant and animal varieties are patentable.
4. The element isolated from the human body or produced by a technical process may be a patentable invention.
5. The European Group on Ethics in Science and New Technologies evaluates few ethical aspects of biotechnology.

III. Make up a plan of the text.

IV. Translate the paragraph in italics in a written form.

V. Render the text in a written form.

TEXT C

I. Read and pronounce correctly:

farm animal breeding	розведення сільськогосподарських тварин
ensure	забезпечити
essential contribution	істотний внесок
sustainable food	стійке харчування
supply chain	ланцюг поставок
species	видів
welfare	добробут
transparency	прозорість
mate	самець/самиця

II.Listen to the information from the text: "What Is Animal Breeding?" and then answer the questions.

1) What is the breeding of farm animals?
2) What provides animal breeding?
3) What is the breeding of farm animals?
4) What is indirectly influenced by breeders of farm animals?
5) Why is Breeding Sensitive to Society?
6) Why does the Code of Good Practice for Breeding and Reproduction of Farm Animals promote?
7) What types of breeding exist?

8) What is important for the breeding industry?

III. Match the words with the definitions:

1)global demand	a) the responsibility to conserve natural resources and protect global ecosystems to support health and wellbeing, now and in the future.
2)environmental sustainability	b) factors that can cause environmental change in the marine environment.
3)food safety(or food hygiene)	c) raise (someone) to a higher position or rank.
4)contribute	d) amount of money, which the subjects of economy plan to spend on goods and services at the different size of income (or in other word - at given prices) in given period.
5)environmental pressure	e) a scientific method/discipline describing handling, preparation, and storage of food in ways that prevent food-borne illness.
6)robust	f) give (something, especially money) in order to help achieve or provide something.
7)promote	g) strong and rich in flavour or smell.

IV. Fill in the blanks with the words and phrases from the word bank:

enimal, robust, environmental, quality, global, pressure, double, growing, source, demand

The need for animal breeding

Global _____(1) for animal products is expected to ______(2) in the next decades due to an increasing global population and _____(3) wealth. Animal products from a great _____(4) of protein that are essential in a healthy and balanced diet. To fulfil this _____(5) demand, global animal production should increase while taking into account issues of _______(6) sustainability, food safety, and ______(7) welfare. The breeding sector can contribute to finding solutions that are cost and resource efficient, diminish or eliminate environmental _____(8), are adaptive to climate change, are beneficial for animal health and welfare, improve food _____(9) and safety, and that meet the needs of citizens, both today and in the future. This requires healthy, ____(10) and efficient animals with improved animal welfare [29].

V. Read and translate ten of the best quotes about Invention.

1) *To invent, you need a good imagination and a pile of junk.*
Thomas A. Edison

2) *A patent, or invention, is any assemblage of technologies or ideas that you can put together that nobody put together that way before. That's how the patent office defines it. That's an invention.*
Dean Kamen

3) *An invention has to make sense in the world it finishes in, not in the world it started.*
Tim O'Reilly

4) *Human subtlety will never devise an invention more beautiful, more simple or more direct than does nature because in her inventions nothing is lacking, and nothing is superfluous.*
Leonardo da Vinci

5) *I don't think necessity is the mother of invention. Invention, in my opinion, arises directly from idleness, possibly also from laziness – to save oneself trouble.*
Agatha Christie

6) *No amount of skillful invention can replace the essential element of imagination.*
Edward Hopper

7) *No one wants to die. Even people who want to go to heaven don't want to die to get there. And yet death is the destination we all share. No one has ever escaped it. And that is as it should be, because Death is very likely the single best invention of Life. It is Life's change agent. It clears out the old to make way for the new*.
Steve Jobs

8) *The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge.*
Seymour Papert

9) *There are no rules. That is how art is born, how breakthroughs happen. Go against the rules or ignore the rules. That is what invention is about.*
Helen Frankenthaler

10) *Without question, the greatest invention in the history of mankind is beer. Oh, I grant you that the wheel was also a fine invention, but the wheel does not go nearly as well with pizza* [31].
Dave Barry

V. Watch the video and contract the content to 10 sentences.

Unit 14

Topic: SAFETY IN BIOTECHNOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

biological warfare	біологічна війна
lethal proteins	лізин (белок с літичною активністю)
habitat	середовище проживання
bacteriocins	бактеріоцини
two strains of bacteria	два штами бактерій
Escherichia coli	Кишкова паличка
colicins	коліцини
colicin plasmids	плазміди коліцину
plague bacterium	бактерія чуми
pesticins	пестицини
fellow bacteria	супутні бактерії
infect	інфікувати
host organism	організм господаря
vertebrates	хребетні
insect pests	комахи-шкідники
higher animals	тварини вищого порядку

II. Read and translate the following text:

Bacteria make lethal proteins to kill other organisms

Before discussing human biological combat, let's remember that biological warfare has been practiced throughout evolutionary history by organisms at all levels on the evolutionary scale. When related bacteria compete for the same habitat or same resources, they often kill each other, using toxic proteins known as bacteriocins. Generally speaking, bacteria are most likely to kill their close relatives because the more closely related two strains of bacteria are, the more likely they will compete for the same resources.

For example, many strains of *Escherichia coli* deploy a wide variety of bacteriocins, referred to as colicins, intended to kill other strains of the same species. The genes for colicins are normally carried on plasmids. The colicin plasmids of *E. coli* have been used as the basis of many plasmids commonly used in molecular biology and genetic engineering.

Yersinia pestis, the plague bacterium, also makes bacteriocins, called pesticins in this case, designed to kill competing strains of its own species. When proteins produced by bacteria act against higher organisms we refer to them as toxins. The difference in terminology between *bacteriocin* and *toxin* is thus really a matter of perspective. Bacteria deploy bacteriocins against their fellow bacteria with the deliberate intention of killing them. In contrast, pathogenic bacteria do not usually "intend" to kill the people they infect. The longer the host organism stays alive, the longer it provides a home for the infecting bacteria. Bacteria also infect insects and make toxins that kill insects but are harmless to vertebrates.

The bacterium *Bacillus thuringiensis* (Bt) has become famous for its production of a toxin that kills insect pests.

Bacteriocins are toxic proteins made by bacteria to kill other related bacteria that are competing for the same natural resources. Bacteria also make proteins that kill insects or higher animals [17].

III. Answer the questions:

1. What do related bacteria do when competing for the same habitat?
2. What are the quantities for?
3. Where are the colicin genes usually contained?
4. Where are colicin plasmids of E. coli commonly used?
5. What are pesticines for?
6. What do we call toxins?
7. What do bacteria use bacteriocins for?
8. Are bacteria harmful to vertebrates?

IV. Find the English equivalents for:

Бактеріоцини, природні ресурси, інфікуючі бактерії, заражати, патогенні бактерії, токсини, перспектива, свідомий намір, знищення інших штамів, конкурувати за ті самі ресурси.

V. Match the English words with their Ukrainian equivalents:

1) habitat	a) супутні бактерії
2) fellow bacteria	b) ворог
3) vertebrates	c) середовище проживання
4) enemy	d) бактерія чуми
5) deliberately spread	e) свідомо поширюється
6) plague bacterium	f) Кишкова паличка
7) *Escherichia coli, colibacillus*	h) хребетні

VI. Match the words with their definitions:

1) bacteriocins	a) the process of infecting or the state of being infected
2) biological warfare	b) he use of bacteria or viruses or toxins to destroy men and animals or food
3) dysentery	c) a substance made from an organism, its products, or a virus
4) infection	d) ribosomally synthesized antibacterial peptides/proteins that either kill or inhibit the growth of closely related bacteria
5) biological assault	e) an acute contagious viral disease, with fever and pustules usually leaving permanent scars
6) smallpox	f) infection of the intestines resulting in severe diarrhea with the presence of blood and mucus in the feces
7) biological agents	g) he use of biological toxins or infectious agents such as bacteria, viruses, insects, and fungi with the intent to kill, harm or incapacitate humans, animals or plants as an act of war

VII. Make up the sentences with the words and phrases:

biological warfare, lethal proteins, plague bacterium, host organism, biological agents, viral disease, toxins, enemy.

VIII. Translate into English:

1. Біологічна війна передбачає не тільки вибір збудника хвороби і, можливо, його модифікацію генетично, а також виробництво та зберігання, зброю та доставку.
2.Звинувачення в використання біологічної війни або розробка біологічних засобів часто робляться як хитрощі пропаганди за відсутності будь-яких реальних доказів.
3.Часто підозрілі спалахи захворювання призводять до звинувачень у біологічній війні.
4. Як наслідок, достовірну інформацію про нібито програми боротьби з мікробами важко з'ясувати.

TEXT B

I. Read and translate the text using a dictionary:

History of human biological warfare

Burning crops was probably the earliest form of warfare aimed at undermining an enemy's survival by biological means. Early in history, the water supply was also a prime biological target for feuding nomads, especially in areas where water was scarce. Presumably tossing dead or rotting animals into waterholes poisoned the drinking water and proved to be reasonably effective in driving the enemy away. Throughout history there have been occasional sporadic attempts to deliberately spread infection for military purposes. However, these have mostly been ineffective or irrelevant.

During the Black Death epidemic of the mid-1300s, the Tartars catapulted plague-ridden corpses over the walls into cities held by their European enemies. Although this is sometimes credited with spreading the plague, in reality, rats and their fleas spread bubonic plague, not contact with corpses. Catapulting bodies into a city may deserve points for enthusiasm, but it doesn't earn an A in microbiology. In medieval Europe, dead or sick animals were hurled over the walls into castles or walled cities to break sieges by spreading disease.

Nonetheless, given the state of hygiene in most medieval towns or castles, there was often little need to provide an outside source of infection. With plague, typhoid, smallpox, dysentery, and diphtheria already around, all that was usually necessary to let nature take its course. Similarly, attempts of white settlers to spread smallpox among the American Indians were not only rather ineffective but also largely irrelevant because smallpox had already spread by itself.

The reason why germ warfare has been of little account until recently is that plenty of dangerous infections were already in circulation. If an army was crowded and unhygienic, some natural disease would undoubtedly attempt a biological assault without waiting for artificial prompting. Until recently, armies, like civilian populations, were so dirty and disease-ridden that practicing germ warfare was rather like trying to kill a shark by drowning it.

Only in our modern disinfected age has spreading disease deliberately become a meaningful threat. Although biological warfare is historically old, it has rarely been effective. This is probably due to the massive effect of natural infectious disease [17].

II. Decide if the following statements as true (T) or false (F) according to the text:

1. Burning houses was probably the earliest form of warfare.
2. Early in history, the water supply was the second biological target.
3. The Black Death epidemic was in the mid-1700s.
4. Attempts of white settlers to spread smallpox among the American Indians were ineffective.
5. Until recently, armies, like civilian populations, were so dirty and disease-ridden that practicing germ warfare was ineffective.

III. Make up a plan of the text.

IV. Translate the paragraph in italics in a written form.

V. Render the text in a written form.

VI. Answer the questions:

1. What can bacterial toxins kill?

a. insect cells
b. human cells
c. other bacterial cells
d. protozoa
e. all of the above

2. Even though biological warfare has been around for hundreds of years, why was it still ineffective?

a. because there were already massive amounts of infectious diseases circulating
b. because there was more hygiene hundreds of years ago
c. because people had already been exposed to the agent and developed immunity
d. biological warfare hundreds of years ago was largely effective at killing mass quantities of people
e. none of the above

3. Which of the following is an important consideration of germ warfare?

a. dispersal
b. persistence of the agent
c. incubation time
d. storage and preparation of the agent
e. all of the above

TEXT C

I. Read and try to remember:

toxic substance	токсична речовина
transmission of signals	передача сигналів
a zinc proteinase	цинкова протеіназа
to cleave proteins	розщеплювати білки
neuromuscular junction	нервово-м'язове з'єднання
contaminated food	забруднена їжа
bacterial lysis	бактеріальний лізис (руйнування живих клітин)
precursor protein	білок-попередник
disulfide bond	дисульфідний зв'язок
a hemagglutinin	гемаглютинін
to clump or agglutinate	зливатися або аглютинувати

II. Listen to the text: “Botox - Botulinum toxin”.

III. In pairs, discuss these questions:

1. Which of the following is used as a live vaccine for smallpox?

a. *Variola* major
b. monkeypox
c. *Variola* minor
d. *Vaccinia* virus
e. none of the above

2. To what virus family do dengue fever and yellow fever belong?

a. Flaviviruses
b. Poxviruses
c. Filoviruses
d. Variola viruses
e. Arenaviruses

3. Which of the following is the most toxic substance of all?

a. ricin
b. mycotoxin T-2
c. enterotoxin B
d. botulinum toxin
e. aconitine

4. Which of the following could be used as a biological agent against agriculture crops?

a. viruses
b. bacteria
c. pathogenic fungi spores
d. prions
e. none of the above

IV. Match the words with the definitions:

1) neuromuscular junction(NMJ)	a) a substance that can be poisonous or cause health effects
2) bacterial lysis	b) a substance, such as a viral protein, which causes haemagglutination.
3) precursor protein	c)is a highly specialized synapse between a motor neuron nerve terminal and its muscle fiber that are responsible for converting electrical impulses generated by the motor neuron into electrical activity in the muscle fibers.
4) a hemagglutinin	d) is an inactive protein (or peptide) that can be turned into an active form by post-translational modification, such as breaking off a piece of the molecule or adding on another molecule.
5) toxic substance	e) a cell death pathway in bacteria frequently caused by cell wall-targeting antibiotics.

V. Read and translate an advertisement about Botox:

https://www.timelessskinsolutions.com/blog/fascinating-facts-about-botox-2018/

VI. Complete these 2 extracts with proper words from the video

1. Bio Safety Level 1 has the ………… bio safety level. It includes the microbes that are non-pathagenic. Laboratory personnel can work with minimum risk in these facilities. BSL 1 do not need special …………t equipment. People can work on open bench tops. These labs are typically used for students and trainee microbiologists. Example BSL organism will include the non-pathogenic ……… of E.coli. However, basic safety ……….. must be followed in theses facilities:

-limited access to people
-wearing lab coat, glove and eye protection
-cleaning and decontamination of area
-no mouth pipetting
-hand washing
- warning signs

Biosafety level 2 is for microbes that are associated with ………. diseases that mean pathogenic or infectious bacteria and……… are included in this level. Examples of BSL 2 microbes may include Staphylococcus and hepatitis virus. BSL 2 labs are expected to have ………. controls than BSL 1. In addition to the ………… laboratory practices, these practices must be followed in BSL2 labs:

-availability of eye wash station
-vaccination to the workers if applicable
-using biosafety cabinet
- trained personnel

Chapter 8. Future of biotechnology

Unit 15

Topic: PERSPECTIVES OF BIOTECNHOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

public perception	суспільне сприйняття
alter an organism	змінити організм
permanently	постійно
multicellular organisms	багатоклітинні організми
imply	мати на увазі
deliberate alteration	навмисна переробка
germline cells	зародкові клітини
cystic fibrosis	кістозний фіброз
alleles in the germline cells	алелі в клітинах зародкової лінії
restricted	обмежено
eugenics	євгеніка
to deliberate	обмірковувати
prize pigs	призові свині
pedigreed dogs	породисті собаки
feasible	здійсненний
clumsy	незграбний
heritable	спадковий
brewing yeasts	пивні дріжджі
biomedical capabilities	біомедичні можливості
DNA sequence	послідовність ДНК
RNA	РНК (рибонуклеїнова кислота)
blueprint	креслення
a faulty gene	несправний ген

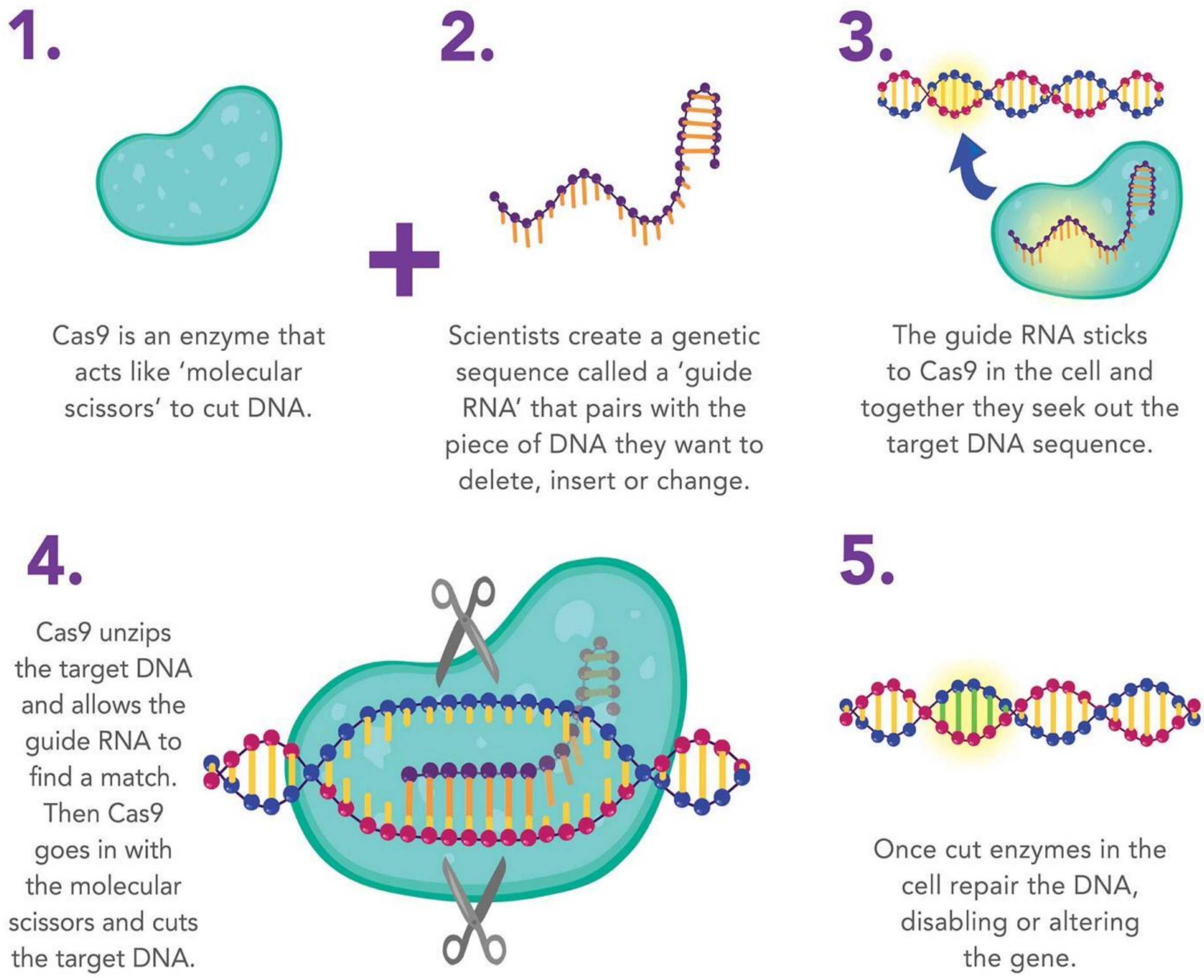
II. Read and translate the following text:

Gene therapy or Genetic engineering?

Genetic engineering

Genetic engineering (also called genetic modification) is a process that uses laboratory-based technologies to alter the DNA makeup of an organism. This may involve changing a single base pair (A-T or C-G), deleting a region of DNA or adding a new segment of DNA. For example, genetic engineering may involve adding a gene from one species to an organism from a different species to produce a desired trait. Used in research and industry, genetic engineering has been applied to the production of cancer therapies, brewing yeasts, genetically modified plants and livestock, and more.

Genetic engineering has changed over the years, from cloning for analysis and laboratory use to truly synthetic biology for understanding and new biomedical capabilities [33].

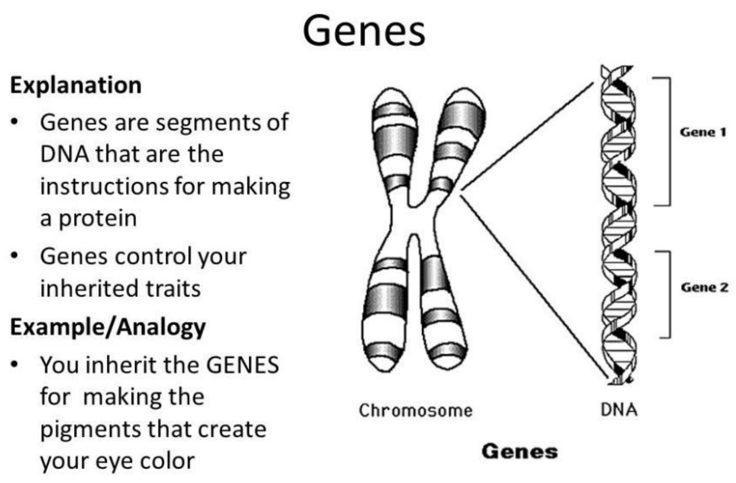


https://www.pirbright.ac.uk/genetic-engineering [34]

Gene therapy or Genetic engineering? Genetic engineering means that we alter an organism permanently so that the changes will be stably inherited. For multicellular organisms this implies deliberate alteration of the DNA in the germline cells. In contrast, gene therapy (occasionally called genetic surgery) is less permanent. The patient is cured, more or less, by altering the genes in only part of the body.

For ex ample, cystic fibrosis patients might be partially cured by introducing the wild-type gene into the lungs. However, these changes are not inherited, and the alleles in the germline cells remain defective. True human genetic engineering is still in the future. At present, genetic engineering is restricted to nonhumans and has resulted in the creation of transgenic plants and animals. Eugenics refers to deliberate improvement of the human race by selective breeding. Early eugenic proposals were based on choosing superior parents by visual inspection or medical screening and breeding them in much the same way as for prize pigs and pedigreed dogs. Today we have reached the position where direct alterations of the human genome at the DNA level are technically feasible, although still clumsy. Genetic engineering may create organisms with changes that are stably inherited. Gene therapy uses genetics to cure a disease but does not alter the germline cells. Consequently, the changes are not heritable.

Understanding Genes

 google.com/search?q=Understanding+Genes&source=lnms&tbm=isch&sa=X&ved=2ahUKEwib5f7ux7j3AhW8hP0HHUZVCeQQ_AUoAXoECAIQAw&biw=1078&bih=510&dpr=1.25#imgrc=UTdyhjwyURtPmM	Genes are made up of DNA, which are blueprints to build proteins that make the body work. Each person typically gets two copies of each gene from their parents. These genes control everyt hing from hair color, height, and unique traits. But genes are not always built correctly.

A small change to them, called a mutation, can alter how proteins are expressed (produced), which impacts the body's ability to function properly. This can alter the way a person breathes, walks or even digests food.

Genes can change as they go through inherited mutations (changes that were passed along from the parents), as they age, or by being altered or damaged by chemicals and radiation.

How Gene Therapy Works.

Gene therapy has been studied for more than 40 years and can help stop or slow the effects of disease on the most basic level of the human body—our genes. Gene therapy is the use of genetic material in the treatment or prevention of disease. Gene therapy aims to be given one-time to target a faulty gene that causes disease. The genetic material that is delivered has instructions to change how a protein—or group of proteins—is produced by the cell. For some diseases, this means making changes to account for too much, not enough, or incorrect essential proteins being produced within cells.

This new genetic material, such as a working gene, is delivered into the cell using a vector. Viruses can be used as vectors because they have evolved to be very good at getting into cells. But scientists have learned how to remove the viral genes and use this same ability to treat or prevent disease. In this case, their goal is to insert the new therapeutic genes into the cell. All viral vectors are tested many times for safety prior to being used. The vector can either be delivered outside the body (*ex-vivo* treatment) or the vectors can be injected into the body (*in-vivo* treatment) [32].

III. Decice if the following statements as true (T) or false (F):

1) Genetic engineering is a process that uses laboratory-based technologies to choose the DNA makeup of an organism.
2) Genetic engineering may involve adding a gene from one species to an organism from a different species.
3) Genetic engineering hasn't changed over the years.
4) True human genetic engineering is still in the future.
5) Eugenics refers to deliberate improvement of the human race without selective breeding.
6) Genes can not change as they go through inherited mutations.
7) Gene therapy aims to be given one-time to target a faulty gene that causes disease.
8) The genetic material that is delivered has instructions to change how a protein is produced by the cell.
9) New genetic material, such as a working gene, is delivered into the cell using a vector.
10) All are not tested being used.

IV. Find the English equivalents for:

біомедичні можливості, здійсненний, пивні дріжджі, незграбний, послідовність ДНК, кістозний фіброз, генна інженерія, різні точки зору, генно модифіковані продукти та їхні споживачі, обмірковувати, спадковий.

V. Match the English words with their Ukrainian equivalents:

1) permanently	a) просте використання
2) multicellular organisms	b) спадковий дефект
3) viral vector	c) відбуватися
4) straightforward use	d) суспільне сприйняття
5) to occur	e) рецесивний стан
6) public perception	f) вірусний вектор
7) hereditary defect	g) багатоклітинні організми
8) deliberate alteration	h) постійно
9) a recessive condition	k) породисті собака
10) pedigreed dogs	l)навмисна зміна

VI. Match the words with their definitions:

1)gene therapy	a) a disease or disorder that is inherited genetically. synonyms: congenital disease, genetic abnormality, genetic disease, genetic disorder, hereditary condition, hereditary disease, inherited disease, inherited disorder.
2) hereditary defect	b) idea of the existence of consciousness as the collective consciousness of individuals united in social groups that are linked by common interests, which fixes the attitude to events or phenomena of public life
3) survey research	c) is a health problem caused by one or more abnormalities in the genome.
4) eugenics	d)when DNA is introduced into a patient to treat a genetic disease.
5) *Ex -vivo gene* therapy	e) is a research method involving the use of standardised questionnaires or interviews to collect data about people and their preferences, thoughts, and behaviours in a systematic manner.
6) a genetic disorder or genetic brain injury (GBI)	f) is the genetic modification of cells outside of the body to produce therapeutic factors and their subsequent transplantation back into patients. Various cell types can be genetically engineered.
7) public perception	g) is the scientifically erroneous and immoral theory of “racial improvement” and “planned breeding,” which gained popularity during the early 20th century.

VII. Make up the sentences with the words and phrases:

straightforward use, hereditary defect, to occur, a recessive condition, deliberate alteration, a general assessment of the desirability of different goals.

VIII. Translate into English:

1. Існує кілька генних методів лікування, доступних для пацієнтів із захворюваннями крові та спадкові захворювання очей.
2. Проте більшість методів генної терапії перебувають у клінічних випробуваннях.
3. Клінічні випробування є необхідним дослідницьким процесом, щоб зрозуміти, як лікування взаємодіє з організмом, і чи є воно безпечним та ефективним, перш ніж воно стане доступним для громадськості.
4. Генна терапія спрямована на захворювання, які є рідкісними і часто небезпечними для життя або виснажливими.
5. На даний момент існує близько 7 000 рідкісних захворювань, від яких загалом страждає приблизно кожна десята людина.
6. Багато з цих рідкісних захворювань викликані простою генетичною мутацією, успадкованою від одного або обох батьків.
7. Очікується, що з генної терапії, яка буде схвалена FDA протягом наступних п'яти років, 45 відсотків зосередиться на лікуванні раку (майже половина), а 38 відсотків — для лікування рідкісних спадкових генетичних захворювань.
8. Деякі з цих спадкових захворювань включають (але не обмежуються ними): гематологічні захворювання (крові), як-от серповидно-клітинна анемія; неврологічні розлади, що вражають головний і спинний мозок; захворювання опорно-рухового апарату (м'язів); розлади сітківки (очі); онкологія (рак), наприклад рак крові.

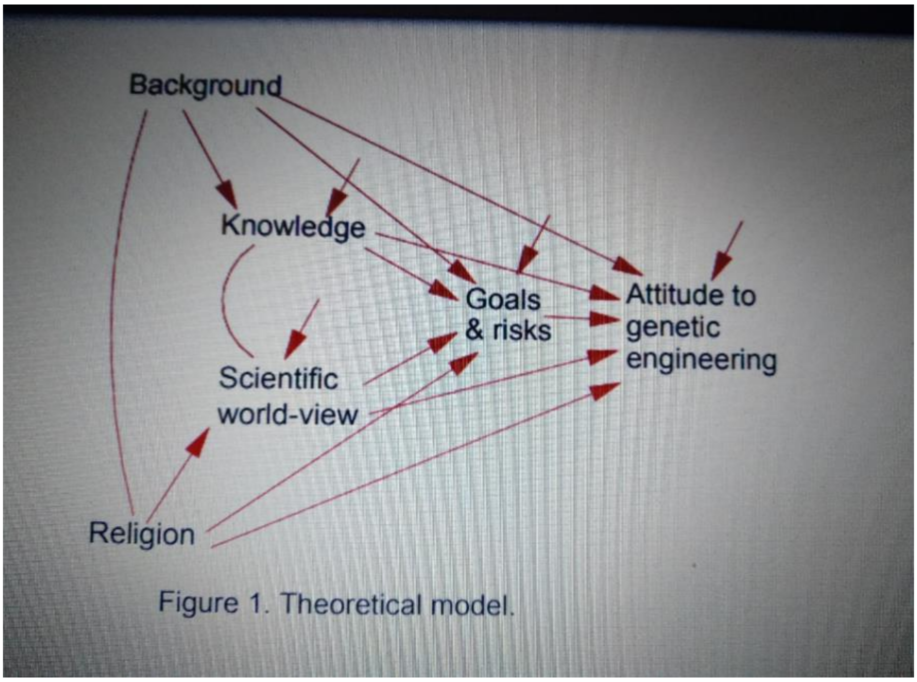
TEXT B

I. Read and translate the text using a dictionary:

Public Perceptions of Biotechnology

Genetic engineering is a particularly important area in which to assess public opinion, because it is a very new technology so that very few political choices about its uses and control have been made, let alone institutionalized. Systematically designed questionnaire data collected from large, nationwide representative samples are the only reliable method available for assessing public attitudes and social differences therein. The International Social Science Survey/ Australia included a module on attitudes towards genetic engineering. The module began by asking people to rate a series of goals for Australian scientists, to get a general assessment of the desirability of different goals.

Jonathan Kelley Director, (International Survey Center Institute of Advanced Studies The Australian National University & Professorial Associate Melbourne Institute of Applied Economic and Social Research The University of Melbourne) proposed that the public's views about genetic engineering could be understood with the aid of a simple model:



Let's consider ***a report of data*** *collected for the Department of Industry, Science and Technology by the International Social Science Survey* / Australia, Australia's leading academic survey, *conducted by researchers at the Australian National University and the University of Melbourne.*

A majority of people (Australians) claim some basic understanding of science. Most also accept what we have called the 'scientific world-view' -- Darwin's theory of evolution and modern astronomy (the 'big bang' and the like). But many others, especially devout Christians, reject the scientific world-view.

The public is broadly supportive of a wide range of genetic engineering projects. The average Australian rates the average genetic engineering project as a ''good idea''. Of the genetic engineering products, they asked about in the survey, the most popular are a treatment for blood cancer, a drug that lowers blood pressure, and cotton that resists insect pests. More than 90% of Australians favour these. Then comes healthier cooking oil, genetically modified viruses to protect farm crops by attacking insect pests, viruses to control imported animal pests, and lean pork. Support is lowest for the genetically engineered tomato but even here a clear majority is in favour, 64% declaring them to be a "good idea" or a "very good idea"

Risks. The survey also asked about the potential risks associated with genetic engineering. The results can be expressed in the form of a worry scale, from zero (''No worry'') to 100 (''Huge worry, terrible and very likely to happen''). The results showed people (Australians) to be a worrying lot, even when the observed risks are quite low: fluorides -- which are added to drinking water to reduce tooth decay in most parts of Australia -- elicited 45 points on the worry scale. Concern with the use of chemical pesticides in farming elicited 65 points on the worry scale.

Use of Genetically Modified Products. The vast majority of Australians would wear clothes made from genetically engineered cotton (77%). The rest are mostly undecided (18%), with only 5% definitely unwilling. Clear majorities would eat genetically engineered cooking oil (60%), tomatoes (61%), and pork (56%) with most of the rest undecided rather than definitely unwilling. Most willing to use genetically engineered products are those who generally support scientific research on agriculture, those less worried about the risks of genetic engineering, those more knowledgeable about it, and those who have a scientific rather than religious world-view.

Benefits and Risks. A clear majority think the benefits of genetic engineering will outweigh the risks. Most of the rest have mixed feelings and fewer than 10% think the risks will outweigh the benefits. People who think the benefits will outweigh the risks tend to be those who:
• favour the goals, especially agricultural benefits; • are less worried than the average about potential costs; • do not particularly fear fluoridation; • are relatively knowledgeable about genetic engineering; • have a scientific world-view. Conversely, those who think the risks will outweigh the benefits -- the minority -- tend to be those who: • are less keen on agricultural goals than most Australians; • are more worried than the average about potential risks; • fear fluoridation; • know little about genetic engineering; and • reject Darwin's theory of evolution and modern astronomy. These results suggest that the Australian public will increasingly perceive genetic engineering's benefits as outwieghing its risks in the future as levels of knowledge increase [35].

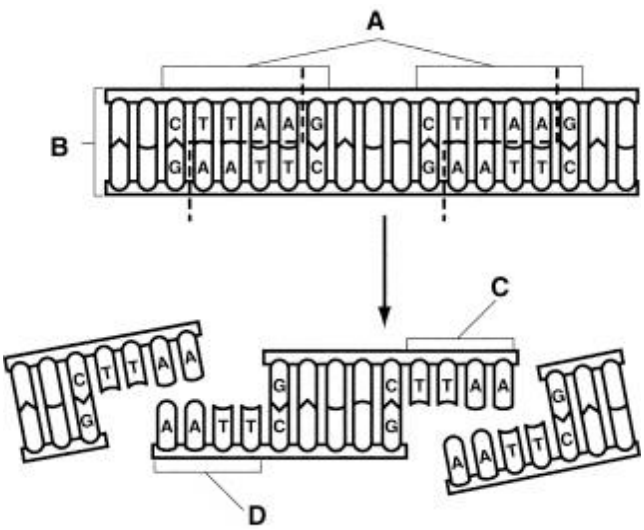
II. Make up a plan of the text.

III.Translate the paragraph in italics in a written form.

IV.Come up with and write 5 questions to the text above.

V. Multiple Choice. Identify the letter of the choice that best completes the statement or answers the question:

1. What does this Figure show?



a. gel electrophoresis
b. DNA sequencing

c. a restriction enzyme cutting sequences of DNA
d. polymerase chain reaction

2. Genetic engineering involves
a. cutting out a DNA sequence.
b. changing a DNA sequence.
c. reinserting DNA into living organisms.
d. all of the above

3. A recombinant plasmid gets inside a bacterial cell by
a. hybridization.
b. radiation.
c. transformation.
d. recombination.

4. The process of making changes in the DNA code of living organisms is called
a. selective breeding.
b. genetic engineering.
c. inbreeding.
d. hybridization.

5. A DNA molecule produced by combining DNA from different sources is known as
a. a mutant.
b. a change
c. strange DNA
d. recombinant DNA.

6. During transformation,
a. a prokaryote is changed into a eukaryote.
b. a cell incorporates foerign DNA from outside the cell.
c. foreign DNA is destroyed
d. a person changes into a wolf

7. Which of the following steps is NOT essential in producing recombinant DNA?
a. Cut out a piece of DNA from a DNA molecule.
b. Insert a piece of DNA from one organism into the DNA another organism.
c. Use a restriction enzyme to cut DNA and form sticky ends.
d. Read the sequences of bases in a piece of DNA.

8. To produce transgenic bacteria that make insulin, which of the following steps did scientists have to take first?
a. Insert the human insulin gene into a plasmid.

b. Extract the insulin from the bacterial culture.
c. Use a restriction enzyme to cut out the insulin gene from human DNA.
d. Transform bacteria with the recombinant plasmid.

9. DNA from a human has been inserted into a bacterial plasmid and reinserted back into the bacterium. The bacterium now contains both human DNA and bacterial DNA. The bacterium is now considered a
a. mutation
b. clone
c. PCR
d. transgenic organism

10. A technique which can be used to seperate DNA fragments of differnt sizes is called
a. PCR
b. Restriction enzyme
c. Gel electrophoresis
d. transformation [36]

TEXT C

I. Read and pronounce correctly:

research effort	дослідницькі зусилля
deciphering	розшифровка
implications of technologies	наслідки технологій
to decipher	розшифрувати
heritable alterations	спадкові зміни
nucleotide sequence of genes	нуклеотидна послідовність генів

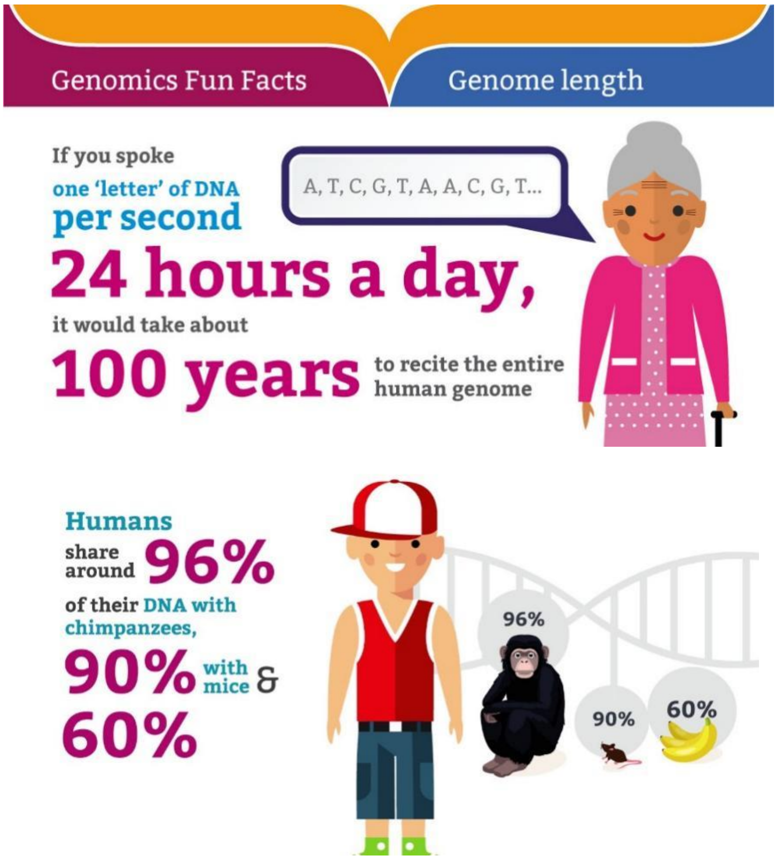
II. Listen to the text: "The Human Genome Project" and feel the gaps from the text.

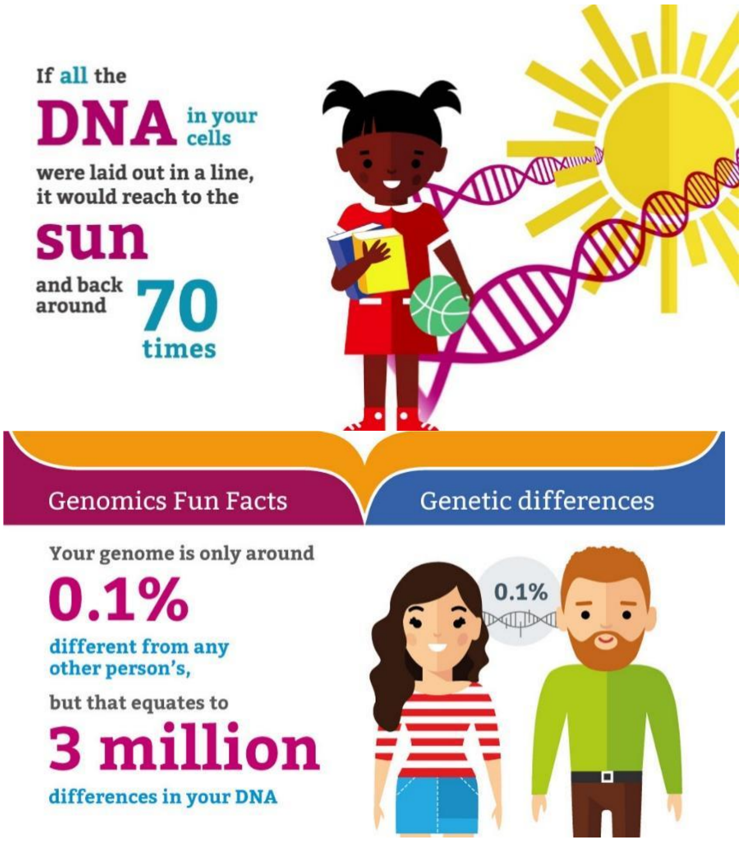
1.The Human Genome Project is an __________ effort aimed at deciphering the chemical makeup of the entire human genetic code (i.e., the genome).
2.The primary work of the project is to develop three _________that will allow scientists to identify genes involved in both rare and common diseases.
3.Another project priority is to examine the ___________implications of new genetic technologies and to educate the public about these issues.
4. Although it has been in existence for less than 6 years, the Human Genome Project already ________that are permeating basic biological research and clinical medicine.
5.The Human Genome Project is an international research project whose primary mission is to __________of the complete human genetic material.
6.This ambitious project __________that the isolation and analysis of the genetic material contained in the DNA can provide scientists with powerful new approaches to understanding the development of diseases.

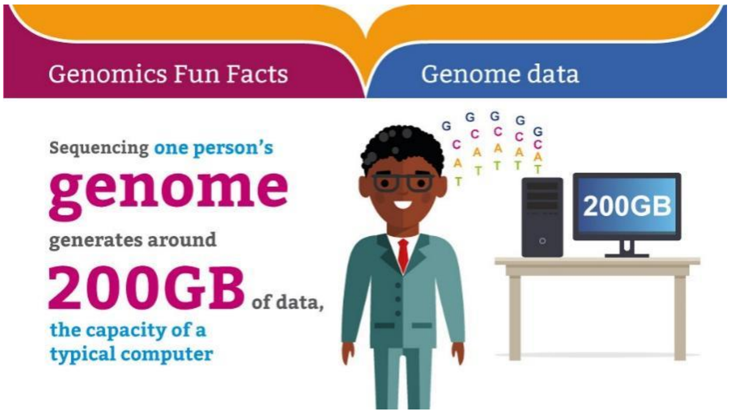
7. Nearly all human medical conditions, _________ , are related to changes in the structure and function of DNA.
8.These disorders include the 4,000 or so heritable “Mendelian” diseases that result from _________; etc.
9. Human Genome Project is ___________ for the enormity of its effort.
10. Given the size of the human genome, researchers must ________ for DNA analysis that can process large amounts of information quickly, cost-effectively, and accurately [37].

III. Read and translate some interesting information about Genome:

- A rough draft of the human genome was completed in June 2000. ...
- Since it began in 1990, the Human Genome Project is estimated to have cost $3,000,000,000.
- The entire human genome requires three gigabytes of computer data storage space.
- Every second, Human Genome Project computers decode 12,000 letters.







https://www.flickr.com/photos/genomicseducation/25783039227

V.Watch / Listen to the video and complete the sentences.

1. Pharma industry is facing dangers, because first…….., second ……, the third reason …… , the fourth point ………. .
2. Empower patients are conscious about …. .
3. Augmented reality is ……. .
4. Custumized personalized medicine …… .
5. 3D printing ……………… .
6. Body sensors ………… .

Unit 16

Topic: FUTURE OF BIOTECHNOLOGY

TEXT A

I. Read and remember the following words and word-combinations:

rapid advances	швидке просування
trial	проба/випробування
unfavorable	несприятливий
resistant to pests	стійкий до шкідників
to increase yields	для підвищення врожайності
sophisticated computers	складні комп'ютери
man-encoded information	інформація, закодована людиною
an ever-finer analysis	більш точний аналіз
nanoscale techniques	нанорозмірні методики
a broad manner	широким способом
poorly defined	погано визначено

II. Read and translate the following text:

Modern biotechnology relies on advances in Molecular Biology and Computer technology

Traditional biotechnology goes back thousands of years. It includes the selective breeding of livestock and crop plants as well as the invention of alcoholic beverages, dairy products, paper, silk, and other natural products. Only in the past couple of centuries has genetics emerged as a field of scientific study. Recent rapid advances in this area have in turn allowed the breeding of crops and livestock by deliberate genetic manipulation rather than trial and error. The so-called green revolution of the period from 1960 to 1980 applied genetic knowledge to natural breeding and had a massive impact on crop productivity in particular.

Today, plants and animals are being directly altered by genetic engineering. New varieties of several plants and animals have already been made, and some are in agricultural use. Animals and plants used as human food sources are being engineered to adapt them to conditions that were previously unfavorable. Farm animals that are resistant to disease and crop plants that are resistant to pests are being developed in order to increase yields and reduce costs. The impact of these genetically modified organisms on other species and on the environment is presently a controversial issue.

Modern biotechnology applies not only modern genetics but also advances in other sciences. For example, dealing with vast amounts of genetic information depends on advances in computing power. Indeed, the sequencing of the human genome would have been impossible without the development of ever more sophisticated computers and software. It is sometimes claimed that we are in the middle of two scientific revolutions, one in information technology and the other in molecular biology. Both involve handling large amounts of encoded information. In one case the information is human made, or at any rate man-encoded, and the mechanisms are artificial; the other case deals with the genetic information that underlies life.

However, there is a third revolution that is just emerging—nanotechnology. The development of techniques to visualize and manipulate atoms individually or in small clusters is opening the way to an ever-finer analysis of living systems. Nanoscale techniques are now beginning to play significant roles in many areas of biotechnology. This raises the question of what exactly defines biotechnology. To this there is no real answer. A generation ago, brewing and baking would have been viewed as biotechnology. Today, the application of modern genetics or other equivalent modern technology is usually seen as necessary for a process to count as "biotechnology." Thus, the definition of *biotechnology* has become partly a matter of fashion. We regard (modern) biotechnology as resulting in a broad manner from the merger of classical biotechnology with modern genetics, molecular biology, computer technology, and nanotechnology. The resulting field is of necessity large and poorly defined. It includes more than just agriculture: it also affects many aspects of human health and medicine, such as vaccine development and gene therapy [17].

III. Answer the questions:

1) What does traditional biotechnology include?
2) What have the latest rapid advances in biotechnology allowed?
3) When did the green revolution?
4) What makes plants and animals change today?
5) Why are animals and plants created that are used as food sources for humans?
6) What is being developed to increase productivity and reduce costs?
7) Is the impact of these genetically modified organisms on other species and the environment controversial?
8) What is the name of the third nascent revolution?
9) What was considered biotechnology a generation ago?
10) How do we consider (modern) biotechnology?

IV. Find the English equivalents for:

наукова революця, досягнення інших наук, обробку великої кількості закодованої інформації, ставати предметом моди, злиття класичної біотехнології з сучасною генетикою, генна терапія.

V. Match the English words with their Ukrainian equivalents

1) man-encoded information	a) складні комп'ютери
2) trial	b) несприятливий
3) impetus	c) швидке просування
4) to shield	d) розробка вакцин
5) unfavorable	e) визнання
6) rapid advances	f) поштовх
7) ill-defined way	g) інформація, закодована людиною
8) sophisticated computers	h) проба/випробування
9) vaccine development	i) заслоняти, захищати
10) recognition	j) погано визначений спосіб

VI. Match the words with their definitions:

1) biocompatible	a) something that makes a process or activity happen or happen more quickly.
2) nanoparticle (or ultrafine particle)	b) the property of absorbing light of short wavelength and emitting light of longer wavelength.
3) encode information	c) a particle of matter that is between 1 and 100 nanometres (nm) in diameter.

4) necessity	d) of a size measurable in nanometers or microns.
5) nanoscale	e) not harmful to living tissue (especially of materials used in surgical implants).
6) impetus	f) the state or fact of being required.
7) fluorescence	g) protect (someone or something) from a danger, risk, or unpleasant experience.
8) to shield	h) to convert (something, such as a body of information) from one system of communication into another especially to specify the genetic code for smth.

VII. Make up the sentences with the words and phrases:
unpleasant experience, harmful to living tissue, vaccine development, genetically modified, advances in biotechnology, genetic engineering, a generation ago.

VIII. Translate into English:

1. Біотехнологія, ймовірно, буде отримувати все більшу увагу та підтримку в найближчі роки як спосіб підтримувати достатнє виробництво в умовах змін у глобальних нормах і політиці, пов'язаних із використанням землі та води або викидами вуглецю.
2. Деякі зміни в навколишньому середовищі можуть створити ситуації, в яких найефективнішим способом підтримувати місцеве виробництво традиційних джерел їжі може бути генетично модифіковані сурогати.
3. Медичні працівники, медична діагностика та персональні пристрої Інтернету речей вже збирають все більший обсяг даних про здоров'я.
4. Ця інформація об'єднується з іншою особистою інформацією, поведінкою, записаною в цифровому вигляді, та кіберіндикаторами, щоб радикально покращити прогнозування нових захворювань, а також результати лікування.
5. Рослини, тварини та мікроорганізми можуть бути обрані та модифіковані для стабілізації навколишнього середовища, зменшення людського впливу чи підвищення продуктивності.
6. Можуть бути розроблені екосистеми для забезпечення виробництва продуктів харчування, матеріалів та навіть енергії способами, які споживають менше прісної води, вимагають менше орних земель і забезпечують продуктивність у раніше непродуктивнх або неефективних сферах.
7. Використання ДНК для кодування та зберігання даних уже є технічно здійсненні та продемонстровані в лабораторії, а ДНК або подібні хімічні полімери ймовірно, будуть використовуватися для зберігання даних в архівних цілях протягом наступних 20 років.

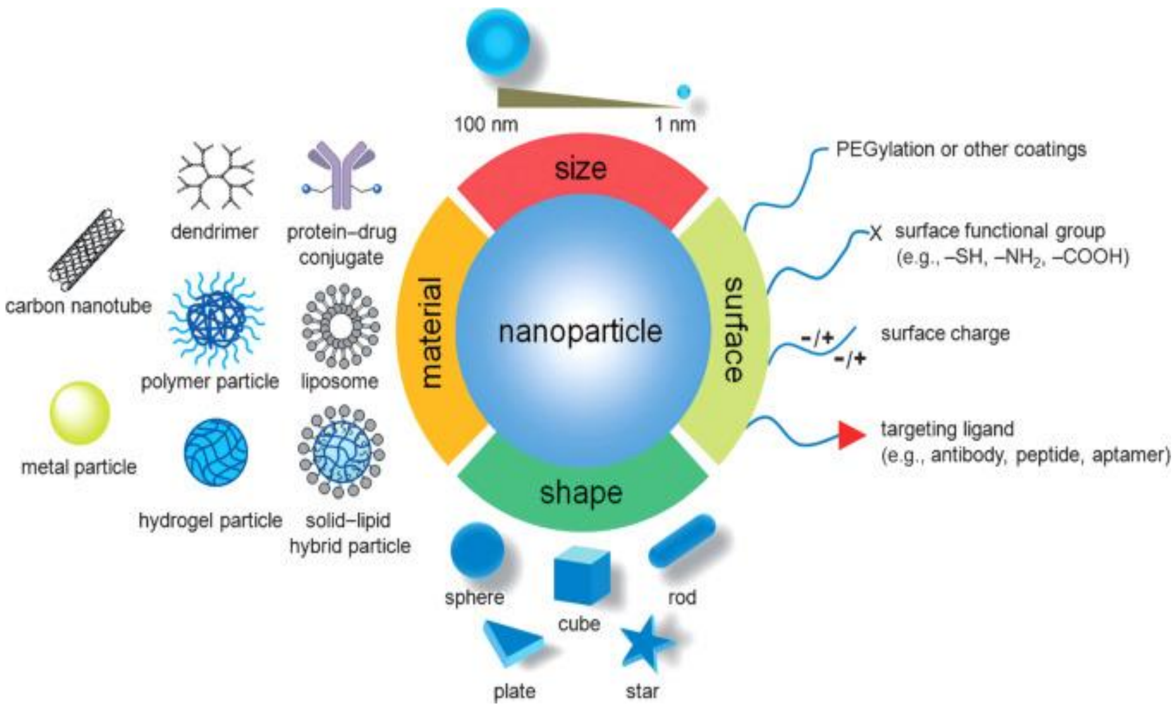
TEXT B

I. Read and translate the text using a dictionary:

Nanobiotechnology. Nanoparticles and their uses

Recently, science has advanced into the area of nanotechnology. As the name indicates, the impetus has come from pursuing practical applications, especially in the fields of electronics and materials science, rather than a quest for theoretical knowledge. Nanotechnology involves the individual manipulation of single molecules or even atoms. Building components atom-by-atom or molecule-by-molecule in order to create materials with novel or vastly improved properties was perhaps the original goal of nanotechnologists. However, the field has expanded in a rather ill-defined way and tends to include any structures so tiny that their study or manipulation was impossible or impractical until recently. At the nanoscale, quantum effects emerge and materials often behave strangely, compared to their bulk properties.

Nanotechnology began with advances in viewing and measuring the incredibly small. It then moved on to building structures at the nanoscale. Simple nanostructures are now being used for a variety of analytical purposes, and a second generation is being developed for clinical use. As their name indicates, nanoparticles are particles of submicron scale—in practice, from 100 nm down to 5 nm in size. They are usually spherical, but rods, plates, and other shapes are sometimes used. They may be solid or hollow and are composed of a variety of materials, often in several discrete layers with separate functions.



https://www.sciencedirect.com/science/article/pii/S0167572917300018

https://www.google.com/search?q=Typical+Layered+Structure+of+Nanoparticles&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjahaHLpbn3AhVItIsKHUiWACwQ_AUoAXoECAEQAw&biw=1078&bih=465&dpr=1.25#imgrc=kVPj6Y6WDdrw9M

Typically, there is a central functional layer, a protective layer, and an outer layer allowing interaction with the biological world. The central functional layer usually displays some useful optical or magnetic behavior. Most popular is fluorescence. The protective layer shields the functional layer from chemical damage by air, water, or cell components and conversely shields the cell from any toxic properties of the chemicals composing the functional layer. The outer layer(s) allow nanoparticles to be "biocompatible." This generally involves two aspects, water solubility and specific recognition. For biological use, nanoparticles are often made water soluble by adding a hydrophilic outer layer. In addition, chemical groups must be present on the exterior to allow specific attachment to other molecules or structures.

Nanoparticles have a variety of uses in the biological arena:
(a) Fluorescent labeling and optical coding
(b) Detection of pathogenic microorganisms and/or specific proteins
(c) Purification and manipulation of biological components
(d) Delivery of pharmaceuticals and/or genes
(e) Tumor destruction by chemical or thermal means
(f) Contrast enhancement in magnetic resonance imaging (MRI)
Nanoparticles are now widely used in a range of biological procedures. These include both analytical and clinical applications.

The main practical objectives of nanobiotechnology are using biological components to achieve nanoscale tasks. Some of these tasks are nonbiological and have applications in such areas as electronics and computing, whereas others are applicable to biology or medicine [17].

II. Choose the right variant.

1. What is nanotechnology?
a. the individual manipulation of molecules and atoms to create materials with novel or improved properties
b. the creation of new terms to describe very small, almost unimaginable, particles in physics
c. the term used to describe the size of cellular components
d. the transition of molecular biology into the physical sciences
e. none of the above

2. Which property is measured with a scanning probe microscope?
a. magnetism
b. electric resistance
c. light absorption
d. temperature
e. all of the above

3. What is considered a weakness of scanning tunneling microscopy (STM)?
a. the inability to move and arrange atoms to create a design

b. the possibility of destroying the surface with the metal tip on the microscope
c. the requirement for a conducting surface to work properly
d. the inability to apply this technology to biology
e. all of the above

4. What is an atomic force microscope?
a. The AFM detects the force between molecular bonds in an object.
b. The AFM detects atoms or molecules by scanning the surface.
c. The AFM uses photons to predict the structures present on any surface.
d. The AFM detects atoms or molecules on a conducting surface.
e. none of the above

5. Which principle is utilized to weigh a single bacterial cell or virus particle?
a. Oscillation frequency is dependent upon the mass applied.
b. It is impossible to weigh a single cell or particle.
c. Oscillation frequency affects the amount of light reflection.
d. Scanning electron microscopy can identify the length and width of a cell, which can further be converted to mass.
e. none of the above

6. What is a potential use of nanoparticles in the field of biology?
a. delivery of pharmaceuticals or genetic material
b. tumor destruction
c. fluorescent labeling
d. detection of microorganisms or proteins
e. all of the above

7. What is an advantage to using a complex, multilayered nanocrystal over a fluorescent dye?
a. They do not bleach during excitation because they have broad absorption peaks.
b. Nanocystals are often brighter than fluorescent dyes.
c. The emission maximum of nanocrystals can be controlled by adjusting the size of the crystal.
d. Nanostructures are longer-lived than fluorescent dyes.
e. All of the above are advantages.

8. Why is chitin the most popular material to construct nanoshells?
a. Chitin is easy to synthesize.
b. Chitin has properties that enable it to bind strongly to DNA, RNA, and other small molecules.
c. Chitin is stable and easy to store at room temperature.
d. Chitin is naturally derived and biodegradable.
e. Chitin is easier to manipulate than the alternative for the creation of nanoshells.

9. How can nanoparticles be used to treat cancer?
a. Nanotubes can create pores in the cancer cells, thus leaking out the cellular components and killing the cell.
b. Some nanoparticles can bind to specific enzymes in cancer cell metabolism to block reactions.
c. Nanoparticles can be designed to absorb radiant energy in the IR spectrum, which produces heat that destroys only the cancer cells because living tissue does not absorb IR energy.
d. Nanoparticles can recruit immune system components directly to the cancer cells.
e. All of the above are uses.

10. Which of the following is a structure that can be created by nanoengineering of DNA?
a. cubical structures
b. nanoscale scaffolds for circuits and nanowires
c. frameworks for mechanical nanodevices
d. cross-shaped DNA to create 2D matrices
e. all of the above

11. How might the behavior of individual DNA molecules be controlled from outside the body?
a. exposure to UV light
b. attachment of a metallic antenna, allowing DNA to be melted with radio waves
c. addition of fluorescent tags
d. using an electrical current to align the DNA molecules
e. none of the above

12. Which cellular component is considered to be a nano(assembler)?
a. chromatin
b. lipids
c. ribosomes
d. DNA
e. mRNA [17]

III. Make up a plan of the text.

IV. Translate the paragraph in italics in a written form.

V. Come up with and write 5 questions to the text above.

TEXT C

I. Read and pronounce correctly:

emerging scientific discipline	нова наукова дисципліна
storage	зберігання
DNA microarrays	мікрочипи ДНК
assessing the function of genomes	оцінка функції геномів
refer to	відноситься до
clogging the analysis	засмічення аналізу
codon bias	зміщення кодонів
consensus sequences	консенсусні послідовності
comparative genomics	порівняльна геноміка

II. Listen to the text: "Bioinformatics and Computer analysis" and feel the gaps from the text.

1**)** As noted before, the use of computers has revolutionized the way in which genetic information has been __________.

2) The term bioinformatics has been coined to describe the ________ of using computers to handle biological information. It encompasses a large number of fields.

3)Bioinformatics includes __________ about biomolecules.

4)By far the greatest achievement of the ________ has been the sequencing of the human genome. The term *bioinformatics* is now used to include analyses associated with DNA microarrays and assessing the function of genomes.

5)At the NCBI home page you can explore _______ many different ways.

6)The _______ contains the gene name and description, its location, a graphical representation of the introns etc.

7) The page also contains links to research papers on the _________.

8) Individual chromosomes can be explored via a ______ that allows you to zoom in and out of various regions.

9)The amount of information generated by the Human Genome Project _______.

10)Data mining refers to the use of computer programs to ________the data.

III. Unscramble the words to complete the sentences:

Nanobiotechnology has now become increasingly important in the field of ENICIDEMNANO_________(1), drug delivery, and immunology. Many new promising technologies and methods for the synthesis of ONANPARTSELCI______(2) are being developed through chemical alteration, LOGICALOIB ________(3)reduction, and scaffolding to increase the applications of nanobiotechnology in health. However, more in-depth research and clinical SLATRI________(4) need to be conducted to advance the applications of nanomedicine. Similarly, moral, LACETIH______(5), regulatory issues and challenges like toxicity and side effects of nanoparticles need to be addressed before the in vivo human use of nanomedicine.

Nanobiotechnology is the ECAFRNTI________(6) of nanotechnology and biotechnology and it includes the application of nanotechnology in the life sciences. This branch of nanotechnology is now widely applicable in:

a. New molecular imaging techniques, which are used to diagnose the disease in early stages and to understand the effects of therapies.
b. Quantitative analytical tools that give an idea of how does the cell act at the molecular level.
c.Physical model of the cell as a machine, which can help us to understand the mechanism of the disease and target it effectively.
d.Better *ex vivo* and improvement in current laboratory techniques.
e. Better drug delivery systems [40].

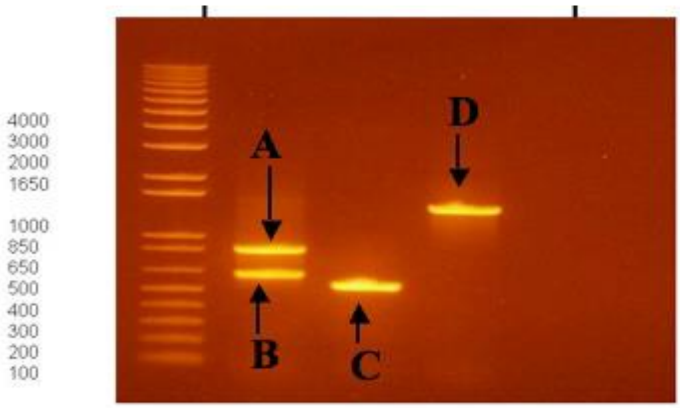
IV. Multiple Choice. Identify the letter of the choice that best completes the statement or answers the question:

1. The microorganisms called prokaryotes are
a. bacteria and viruses.
b. single-celled organisms that lack a nucleus.
c. heterotrophs that contain no DNA.
d. single-celled organisms that form protein clumps.

2. Small circular pieces of DNA found inside bacteria in addition to them chromosome is called
a. DNA
b. a clone
c. RNA
d. a plasmid

3. What does it mean to "clone a gene"?
a. make many copies of the gene
b. remove the gene
c. change the gene
d. destroy the gene

4. Which band of DNA is the smallest?



a. A
b. B
c. C
d. D

5. The two kinds of stem cells are
a. Big and small
b. prokaryote and eukaryote
c. Adult and embryonic
d. Diploid and haploid

6. Which of the following are potential therapeutic uses of embryonic stem cells?
a. replace nerve cells after an accident.
b. regenerate cells of the immune system.
c. repair damage to heart muscle after a heart attack
d. All of the above are potential therapeutic uses of embryonic stem cells.

7. One difference between adult and embryonic stem cells is
a. Adult stem cells can become a limited number of cell types while embryonic stem cells can become any cell type.
b. Adult stem cells can become any cell type while embryonic stem cells can become a limited number of cell types.
c. Adult stem cells are found in embryos while embryonic stem cells are found in adults.
d. There is no difference between embryonic stem cells and adult stem cells.

8. The cells removed from the blastocyst of a developing embryo are called
a. somatic cells
b. gametes
c. the inner cell mass
d. blood cells

9. What is a disadvantage of adult stem cells over embryonic stem cells?
a. They are difficult to grow in large numbers.
b. They can differentiate into a limited number of cell types.
c. They are difficult to locate since there are so few of them.
d. All of the above are disadvantages.

10. What is the difference between DNA and RNA?

a. DNA contains a phosphate group, but RNA does not.

b. Both DNA and RNA contain a sugar, but only DNA has a pentose.

c. The sugar ring in RNA has an extra hydroxyl group that is missing in the pentose of DNA.

d. DNA consists of five different nitrogenous bases, but RNA only contains four different bases.

e. RNA only contains pyrimidines and DNA only contains purines.

11. Watch or listen to the video and retell the content of the video according to the plan.

1. Pharma industry facing 4 dangers
2. Empower patients
3. Augmented reality
4. Custumized personalized medicine
5. 3D printing
6. Body sensors

TEXTS FOR LISTENING:

Unit 1 Text: Biotechnology and the developing world

Successful agriculture holds the answer to the poverty gap between the rich and poor nations. In the developed world agricultural sciences are well developed producing an abundance of high-quality products. Agricultural biotechnology will further improve quality, variety and yield. Will these new plant species, improved by genetic engineering, find their way to the developing countries ensuring higher productivity, greater resistance to disease and be more marketable? It is not yet clear what will happen other than that the affluent nations will become increasingly well endowed with an abundance of food. Worldwide there will be enough food for all, but will it always continue to be disproportionately distributed? Biotechnology developments need high inputs in terms of finance and a skilled workforce – both of which are in short supply in most developing nations. Sadly, there is a growing gap between biotechnology in highly industrialized countries and the biotechnology-based needs of developing countries.

While many developing nations have successfully collaborated in the past with Western biotechnology companies, it is salutary to note that between 1986 and 1991 the percentage of arrangements implemented by US biotechnology companies with developing countries dropped from 20% to 3%! The ability of developing nations to avail themselves of the many promises of new biotechnology will to a large extent depend on their capacity to integrate modern developments of biotechnology within their own research and innovation systems, in accordance with their own needs and priorities.

Unit 2 Text C: Availability of by-products

Not all processes will involve biosystems. In particular, the processes of reverse osmosis and ultrafiltration are finding increasing uses. Reverse osmosis is a method of concentrating liquid solutions in which a porous membrane allows water to pass through but not the salts dissolved in it. Ultrafiltration is a method of separating the high and low molecular weight compounds in a liquid by allowing the liquid and low molecular weight compounds to pass through while holding back the high molecular weight compounds and suspended solids. Some current applications of these technologies include concentration of dilute factory effluents, concentration of dilute food products, sterilisation of water, purification of brackish water and separation of edible solids from dilute effluents.

Waste materials are frequently important for economic and environmental reasons. For example, many by-products of the food industry are of low economic value and are often discharged into waterways, creating serious environmental pollution problems. An attractive feature of carbohydrate waste as a raw material is that, if its low cost can be coupled with suitable low handling costs, an economic process may be obtained. Furthermore, the worldwide trend towards stricter effluent control measures, or the parallel increase in effluent disposal charges, can lead to the concept of waste as a ‘negative cost’ raw material. However, the composition or dilution of the waste may be so dispersed that transport to a production centre may be prohibitive. On these occasions biotechnology may only serve to reduce a pollution hazard.

Unit 3 Text C: Genetic engineering

Genes are the fundamental basis of all life, determine the properties of all living forms of life, and are defined segments of DNA. Because DNA structure and composition in all living forms is essentially the same, any technology that can isolate, change or reproduce a gene is likely to have an impact on almost every aspect of society.

Genetic recombination, as occurs during normal sexual reproduction, consists of the breakage and rejoining of the DNA molecules of the chromosomes, and is of fundamental importance to living organisms for the reassortment of genetic material. Genetic manipulation has been performed for centuries by selective breeding of plants and animals superimposed on natural variation. The potential for genetic variation has, thus, been limited to close taxonomic relatives.

In contrast, recombinant DNA techniques, popularly termed gene cloning or genetic engineering, offer potentially unlimited opportunities for creating new combinations of genes that at the moment do not exist under natural conditions. Genetic engineering has been defined as the formation of new combinations of heritable material by the insertion of nucleic acid molecules, produced by whatever means outside the cell, into any virus, bacterial plasmid or other vector system so as to allow their incorporation into a host organism in which they do not naturally occur, but in which they are capable of continued propagation. In essence, gene technology is the modification of the genetic properties of an organism by the use of recombinant DNA technology. Genes may be viewed as the biological software and are the programs that drive the growth, development and functioning of an organism. By changing the software in a precise and controlled manner, it becomes possible to produce desired changes in the characteristics of the organism.

Unit 4 Text C: The bioreactor

Bioreactors are the containment vehicles of any biotechnology-based production process, be it for brewing, organic or amino acids, antibiotics, enzymes, vaccines or for bioremediation. For each biotechnology process the most suitable containment system must be designed to give the correct environment for optimising the growth and metabolic activity of the biocatalyst.

Bioreactors range from simple stirred or non-stirred open containers to complex aseptic integrated systems involving varying levels of advanced computer control.

Bioreactors occur in two distinct types. In the first instance they are primarily non-aseptic systems where it is not absolutely essential to operate with entirely pure cultures, e.g. brewing, effluent disposal systems; while in the second type, aseptic conditions are a prerequisite for successful product formation, e.g. antibiotics, vitamins, polysaccharides and recombinant proteins. This type of process involves considerable challenges on the part of engineering construction and operation.

The physical form of many of the most widely used bioreactors has not altered much over the past forty years; however, in recent years, novel forms of bioreactors have been developed to suit the needs of specific bioprocesses and such innovations are finding increasingly specialised roles in bioprocess technology.

In all forms of fermentation, the ultimate aim is to ensure that all parts of the system are subject to the same conditions. Within the bioreactor the microorganisms are suspended in the aqueous nutrient medium containing the necessary substrates for growth of the organism and required product formation. All nutrients, including oxygen, must be provided to diffuse into each cell and waste products such as heat, carbon dioxide and waste metabolites removed.

Unit 5 Text C: The use of enzymes

The use of enzymes has many advantages: a) they are of natural origin and therefore should not be toxic; b) they are very specific in their way of acting, so they do not cause undesirable secondary reactions; c) they operate under moderate conditions of temperature and pH and do not require drastic processing conditions that may alter the nature of the food, nor of very expensive equipment; d) they act at low concentrations of enzymes, and f) they are easily inactivated once the desired degree of transformation has been reached.

On the other hand, the main limitation is that some of them are very expensive and cannot be easily obtained; however, it is convenient to take stock of the advantages and disadvantages of carrying out a certain reaction with enzymes, or with other chemical or physical methods. It should be noted that in this sense many technological innovations are making these catalysts cheaper, as is the case of genetic engineering that transforms microorganisms and makes them overproducers of enzymes.

Like any other food additive, sugar enzymes must comply with certain quality specifications, especially in terms of their toxicity, or that of the microorganism that produces it, if it is of microbial origin. Because the enzymes that are used in the industry are not pure (it is very expensive to complete purification), it is necessary to take into account all the extra materials they contain; for this reason, a commercial enzyme preparation is actually a mixture of enzymes, in which one of them predominates in activity[20].

Unit 6 Text C: Photosynthesis

Photosynthesis is a biological process used by many cellular organisms to convert light energy into chemical energy, which is stored in organic compounds that can later be metabolized through cellular respiration to fuel the organism's activities. The term usually refers to oxygenic photosynthesis, where oxygen is produced as a byproduct, and some of the chemical energy produced is stored in carbohydrate molecules such as sugars, starch, glycogen and cellulose, which are synthesized from endergonic reaction of carbon dioxide with water. Most plants, algae and cyanobacteria perform photosynthesis; such organisms are called photoautotrophs. Photosynthesis is largely responsible for producing and maintaining the oxygen content of the Earth's atmosphere, and supplies most of the biological energy necessary for complex life on Earth [25].

Artificial photosynthesis refers to processes that convert direct solar light into sustainable fuels. These processes imitate natural photosynthesis, the process by which plants produce biomass from water and carbon dioxide. In artificial photosynthesis, water is split into hydrogen and oxygen and combined with CO2 to produce hydrocarbons. It comprises 3 approaches: electrochemical conversion with solar power, direct conversion via photo(electro)chemical systems and direct conversion via biological and biohybrid systems (i.e., living photosynthetic cell factories). Around 100 research groups worldwide are working on understanding basic relationships and developing prototypes. Most of the available systems show low solar-to-chemicals conversion efficiencies and need significant improvements in order to serve as industrial-scale production platforms. The goal in the near future is to increase performance to 10% solar-to-hydrogen efficiency. Efforts are aimed at increasing the efficiency to 30% by 2050. Furthermore, artificial photosynthesis could benefit from progress in the field of CO2 capture and from the development of photovoltaic components [24].

Unit 7 Text C: MICROBES

Microbes play a crucial role in our lives. In fact we couldn’t live without them but they could live without us. That is because some fungi and also soil bacteria, called the decomposers, break down dead plants and animals and their waste products into simpler substances, called nutrients.

These nutrients, including carbon dioxide, water, sodium and potassium are returned to the environment so that other living things can use them. This cyclical process by which essential elements are released and reused is known as

recycling. All essential elements such as carbon and nitrogen are cycled through biochemical pathways [30].
Microbes are involved in many processes, such as the carbon and nitrogen cycles, and are responsible for both the production and consumption of greenhouse gases such as carbon dioxide and methane. Microbes could have various positive and negative feedback responses to temperature, but the extent of these is not completely understood. The reason is that microbes live in very diverse communities that interact with other organisms and the environment in complex ways, which makes it difficult to make predictions about the effects of microbes on climate change, but scientists are trying to include microbial activity in climate change models. What is certain is that human activities have helped to increase the production of greenhouse gases by microbes [30].

Unit 8 Text C: Biotech/GM trees

Trees provide man's basic needs for food, fuel, shelter, in industry and pharmaceuticals. Trees are known to effectively and efficiently sequester CO2 and other greenhouse gases and slow down the rate of global warming, hence the current global attention on their care and preservation. Biotechnology and genetic engineering are tools that can contribute to the improvement of crops and trees. Genetically modified (GM) trees are developed to contain useful traits to lower production costs of wood products, and increase productivity. They improve the economics of tree plantations through creation of suitable raw materials, decreased pesticide use, disease resistance, and rehabilitation of degraded lands. GM trees are useful for the lumber, pulp and paper industry; assure quality and nutritious fruits; and improve forest covers [15]. Engineering trees to make them more resilient to changing climates and are better able to defend against pests and diseases is critical to keep our forests and trees healthy.

Unit 9 Text: Dolly the cloned sheep

Cells in an early embryo are totipotent; that is, they possess the ability to divide and give rise to any type of body cell (liver, spleen, brain, etc.). Later on, cells lose this ability. They become committed to generating a particular tissue such as the nervous system or the digestive tract. Most cells in an adult animal can either no longer divide or else only give rise to a particular, specialized type of cell. During development, different genes are expressed in different tissues and others are shut down. So while almost all adult cells retain a complete genome, they don't retain the ability to develop into new individuals.

The cloning of Dolly the sheep showed that it is possible to reset the clock of an adult cell to zero and start development again. In Dolly's case, the trick was to starve cultured udder cells from the donor animal so that both the cell and the DNA stopped dividing (i.e., the cells entered the G0 stage of the cell cycle). What exactly happens to the DNA when the cell is starved is not known. However, there is probably some modification, including demethylation, which converts the DNA back to a form resembling that of an embryonic cell. When the resting G0 nucleus is placed in an egg cell whose own nucleus has been removed, it starts dividing again. The egg is then transplanted into a female animal, where it will develop into an embryo. If all goes well, a baby will be born.

Early in 1996, at the Roslin Institute in Scotland, the world's first cloned animal, Dolly the sheep, was born. The donor nucleus came from a mammary gland cell (also known as the udder) from a pregnant ewe. Since Dolly's birth, a variety of other animals, including cattle, pigs, goats, mice, and cats have been cloned. Dolly herself has been mated and gave birth to a lamb of her own—named Bonnie—during Easter 1998. Strictly speaking, Dolly is not a complete clone. In addition to the nucleus, which contains the majority of the genetic information, animal cells contain a few genes in their mitochondria. In Dolly's case, only the nuclear DNA was cloned. The mitochondrial DNA was provided by the egg cell that received the nucleus.

Following Dolly, the cloned sheep, several mammals have now been cloned. However, the success rate is still low.

Unit 10 Text C: Advantages of GMOs

Genetically modified organisms or GMOs are a product of a form of scientific farming, where crops are administered with chemicals to increase their sizes and yields. It is becoming more and more common in many types of food we see every day. But due to its concept, it has been a topic in heated debates around the world, with proponents and opponents pushing their arguments.

Here is list of Advantages of GMOs:

They offer more useful knowledge for genetics. The mapping of GMO genetic material has increased knowledge about genetic alterations and paved the way for the enhancement of genes in crops to make them more beneficial in terms of production and human consumption. For instance, crops can be engineered to resist unfavorable temperatures or produce higher yields, thus providing a greater level of genetic diversity in regions where climate hinders productivity.

They allow for more profit. GMOs have become a very efficient means for farmers to make larger profits, as it allows them to spend less time on resources. It is also economically efficient in a way that these organisms are designed to be pest-resistant, eliminating the need to use pesticides, which means more savings.

They add more value to crops. Another great reason to grow GMO crops is that these plants will get added nutritional value, especially among those that previously lack the necessary vitamins and minerals. As there are regions around the world that heavily rely on rice or corn, plant genes can be added to such crops to boost their nutritional value, which is particularly helpful in malnourished populations. And because GMOs are able to resist pests and other plant diseases, crop yields will be increased without the farmers having to use pesticides.

They are known to decrease the prices of food. Advanced crops and higher yields certainly mean lower costs, which are a benefit that can be passed to the consumers in the form of cheaper food products. This will be very helpful to families who cannot afford to buy supplies for everyday consumption. This also means that starvation will be prevented.

They yield products that are found to be safe. After precise testing and evaluation of GMOs and other related products, they are found to be safe for human consumption. In fact, study shows that they are even safer compared to traditional crops [21].

Unit 11 Text C: General principles of gene therapy

The most straightforward use of gene therapy is to deal with a hereditary defect due to a single gene and that occurs only when both copies of the gene are defective—that is, a recessive condition. Introducing a single good copy of the gene can then cure the defect. This is sometimes known as replacement gene therapy. Furthermore, it would obviously simplify treatment if the disease mostly affects just one or a few organs. The main steps involved in replacement gene therapy are as follows: a) Identification and characterization of gene; b) Cloning of gene; c) Choice of vector; d) Method of delivery; e) Expression of gene.

The first step is to identify the genetic defect and to clone a good copy of the gene involved. The gene must then be delivered to the patient. This involves choosing a vector together with a suitable method of delivery. In addition, the vector/gene construct must be designed to allow proper expression of the gene, once inside the patient.

Delivery may be performed in a variety of ways. The vector/gene construct may be injected into the bloodstream or other tissue. It may be aerosolized and sprayed into the nose and airways. In some cases, cells are removed from the patient, engineered while growing in culture, and then returned to the patient. This approach is known as *ex vivo* gene therapy because the actual genetic engineering takes place outside the patient. In the laboratory, most manipulations are done with genes carried on bacterial plasmids. Although gene therapy has occasionally been performed directly with plasmid DNA carrying a therapeutic gene, more often specialized delivery systems are used. In most cases a modified virus is used as the vector. Because viruses cause disease, they first need to be genetically disarmed in order to be used in gene therapy. About 70% of human gene therapy trials have used viral vectors. (Two main groups of viruses have been used, retroviruses and adenoviruses). In addition, in a smaller proportion of cases DNA has been delivered inside liposomes or projected into tissues by the gene gun.

In gene replacement therapy, a functional copy of the gene responsible for the hereditary defect is inserted. The most popular approach is for the gene to be carried on an engineered virus vector [17].

Unit 12 Text C: Commercial cell therapies in Europ

Work on regenerative medicine is not only happening in academic laboratories, novel cell-based therapies are also being developed by commercial companies in Europe and across the world.

Most of the medicines we commonly use are made by the pharmaceutical industry and are developed through techniques of traditional chemistry. Since the early 1980s a second commercial sector, the biotechnology or ‘biotech’ industry has been developing novel therapeutics based on biological material. Biotech products include protein drugs made by genetically-engineered cell cultures, monoclonal antibodies (laboratory-made copies of a single human antibody, often for use in cancer treatment) and, most recently, human cell-based therapies. Cell therapies are treatments that use human cells, including stem cells, with the aim of restoring, maintaining, or improving the functioning of human tissues or organs. They may be used to repair or compensate for damage caused by trauma or disease.

There are currently around 50 firms developing cell therapies within Europe. It is difficult to give an exact figure because the cell industry is very dynamic. Companies merge, get bought over, go out of business or change the focus of their scientific work, while new start-up firms can enter the picture at any time. The information on commercial firms discussed here was collected as part of a European Commission Framework Programme 7 project called **Re**generative **Med**icine **i**n **E**urope (REMEDiE) which ran from 2008-2011.

Cell therapy firms are not evenly distributed across Europe; the majority are concentrated in Germany, France and the United Kingdom. These countries all have strong existing infrastructures, including regulations and facilities, for biomedical research and commercialisation and so it is not surprising that they have also become ‘hubs’ for cell therapy within Europe.

Stem cells have much greater potential to treat chronic health conditions affecting large numbers of people including diabetes, heart disease, neurodegenerative and autoimmune illnesses. They are also more complex to work with and can raise greater social and ethical concerns. Almost all the stem cell therapies being developed by European firms involve ‘adult’ stem cells derived from bone marrow or similar tissues. No European firms are developing cell therapies based on human embryonic stem cells (hESC), most probably because this ethically controversial technique is prohibited in some European countries and because such products cannot be patented in Europe. There are a small number of private companies in the United Kingdom and Sweden supplying hESCs for research purposes. Only a few firms in Europe are currently working with foetal or induced pluripotent stem cells [25].

Unit 13 Text C: What is animal breeding?

Farm animal breeding is the activity in farm animal production providing the next generation of farm animals. Animal breeding ensures a continuous improvement of farm animals, generation after generation. Different animal traits are measured and the best animals are used a parent-animals. In this way, breeders provide livestock farmers with a next generation of animals. Farm animal breeders have an essential contribution to a healthy and sustainable food supply chain. There are some important issues in animal **breeding:**

- Farm animal breeding includes all farmed animal species both on land and in water.
- Animal breeding and reproduction is at the top of the animal production pyramid and hence defines the quality of all animals used in agriculture.
- Farm animal breeders indirectly influence food safety and public health, product quality, efficiency, environment, animal health and welfare, and genetic diversity.
- Breeding is society sensitive because it drives changes in the genetic make-up of animals and the use of new technologies (e.g. genomics, computing sciences).
- A Code of Good Practice for Farm Animal Breeding and Reproduction encourages transparency and supports the dialogue of breeders with society.

Sorts of breeding: 1) Cross-breeding: individuals of different breeds or lines are used to mate. 2) Pure breeding: the same breed or lines are used to mate. 3)Inbreeding: two close relatives mate.

Important for the breeding industry is to create a sustainable breeding environment, to reach long term views and condition. Sustainability in animal breeding and reproduction means the extent to which animal breeding and reproduction, as managed by professional organisations, contribute to maintenance and good care of animal genetic resources for future generations.

"A future with a sustainable animal agriculture can be created with the contribution of animal breeding and reproduction"[30].

Unit 14 Text C: Botox - Botulinum toxin

Botulinum toxin is the most toxic substance known. It is made by the anaerobic bacterium, *Clostridium botulinum*, and is the cause of botulism, a severe form of food poisoning. It has been proposed as a biowarfare agent but has actually found its most frequent application in cosmetics, under the name Botox. It is also used to treat a few clinical conditions where a muscle relaxant is needed. Botulinum toxin is a neurotoxin that blocks transmission of signals from nerves to muscles, thus causing muscular paralysis. The incredible potency of botulinum toxin is due to its enzyme activity—it is a zinc proteinase that cleaves proteins of the neuromuscular junction that are required for release of the neurotransmitter acetylcholine. Death is generally due to paralysis of the lungs and respiratory failure.

Clostridium botulinum almost never causes infections but will grow in canned food that has not been thoroughly sterilized. Botulinum toxin then accumulates in the contaminated food and, if ingested, may cause botulism. The bacteria are actually widespread, and traces are often present in food. The problem arises when contaminated food is not sterilized and is stored under anaerobic conditions that allow *Clostridium* to multiply. If the food is not heated thoroughly (which destroys the toxin), poisoning may occur. Botulinum toxin lacks a leader sequence, and instead of being secreted it is released by bacterial lysis. The toxin is synthesized as a single inactive precursor protein. This is then cleaved to give a heavy chain (the binding protein; MW approximately 100,000) plus a light chain (the actual toxin; MW approx 50,000). These are held together by a disulfide bond.

Botulinum toxin is actually produced in a complex with a hemagglutinin, which causes blood cells to clump or agglutinate, and other associated proteins. The genes encoding these components are clustered together in two perons, transcribed in opposite directions…

Terrorists of the Japanese cult Aum Shinrikyo have attempted to use botulinum toxin. Aerosols were dispersed at various sites in Tokyo and at U.S. military installations in Japan on several occasions between 1990 and 1995. The attacks failed, mainly because they used strains of *Clostridium botulinum* that failed to produce toxin [17].

Unit 15 Text C: The Human Genome Project

The Human Genome Project is an ambitious research effort aimed at deciphering the chemical makeup of the entire human genetic code (i.e., the genome). The primary work of the project is to develop three research tools that will allow scientists to identify genes involved in both rare and common diseases. Another project priority is to examine the ethical, legal, and social implications of new genetic technologies and to educate the public about these issues. Although it has been in existence for less than 6 years, the Human Genome Project already has produced results that are permeating basic biological research and clinical medicine. For example, researchers have successfully mapped the mouse genome, and work is well under way to develop a genetic map of the rat, a useful model for studying complex disorders such as hypertension, diabetes, and alcoholism.

The Human Genome Project is an international research project whose primary mission is to decipher the chemical sequence of the complete human genetic material (i.e., the entire genome), identify all 50,000 to 100,000 genes contained within the genome, and provide research tools to analyze all this genetic information. This ambitious project is based on the fact that the isolation and analysis of the genetic material contained in the DNA can provide scientists with powerful new approaches to understanding the development of diseases and to creating new strategies for their prevention and treatment. Nearly all human medical conditions, except physical injuries, are related to changes (i.e., mutations) in the structure and function of DNA. These disorders include the 4,000 or so heritable “Mendelian” diseases that result from mutations in a single gene; complex and common disorders that arise from heritable alterations in multiple genes; and disorders, such as many cancers, that result from DNA mutations acquired during a person’s lifetime.

Although scientists have performed many of these tasks and experiments for decades, the Human Genome Project is unique and remarkable for the enormity of its effort. The human genome contains 3 billion DNA building blocks (i.e., nucleotides), enough to fill approximately one thousand 1,000-page telephone books if each nucleotide is represented by one letter. Given the size of the human genome, researchers must develop new methods for DNA analysis that can process large amounts of information quickly, cost-effectively, and accurately. These techniques will characterize DNA for family studies of disease, create genomic maps, determine the nucleotide sequence of genes and other large DNA fragments, identify genes, and enable extensive computer manipulations of genetic data [37].

Unit 16 Text C: Bioinformatics and Computer analysis

As noted before, the use of computers has revolutionized the way in which genetic information has been gathered and analyzed. The term bioinformatics has been coined to describe the emerging scientific discipline of using computers to handle biological information. It encompasses a large number of fields. Bioinformatics includes the storage, retrieval, and analysis of data about biomolecules. By far the greatest achievement of the bioinformatics revolution has been the sequencing of the human genome. The term *bioinformatics* is now used to include analyses associated with DNA microarrays and assessing the function of genomes.

Because bioinformatics is so widely used, it is important to make genomic data available to researchers. The data from the Human Genome Project are available on the Internet through the National Center of Biotechnology website (http://www.ncbi.nlm.nih.gov/). At the NCBI home page you can explore the human genome many different ways. Using Entrez Gene, a specific gene can be identified by name. The record for each gene contains the gene name and description, its location, a graphical representation of the introns and exons for all the protein isoforms that are known, and a summary of all the information known about the gene. Additionally, the various domains within the protein, such as actin binding sites, are listed with links to explain the domain and its function. Finally, genes and/or regions of DNA from other organisms that are homologous to the gene are shown. The page also contains links to research papers on the gene's function.

The program Map Viewer (http://www.ncbi.nlm.nih.gov/mapview/) is used to browse the human genome without any particular gene in mind. For example, individual chromosomes can be explored via a graphical interface that allows you to zoom in and out of various regions. Another genome browser can be found at http://www.ensembl.org. The amount of information generated by the Human Genome Project is tremendous; therefore, understanding this information without the use of computers is too difficult. Data mining refers to the use of computer programs to search and interpret the data. Many bioinformatics researchers develop programs that search the genomic data banks and sift, sort, and filter the raw sequence data. Data mining programs often process information using the following steps:

1. Selection of the data of interest.
2. Preprocessing or "data cleansing." Unnecessary information is removed to avoid slowing or clogging the analysis.

3. Transformation of the data into a format convenient for analysis.
4. Extraction of patterns and relationships from the data.
5. Interpretation and evaluation.

These programs can be designed to search for related sequences, determine areas of coding and noncoding DNA by looking at codon bias, or search for known consensus sequences, just to name a few applications. Searching for related sequences or similarity searches allows researchers to identify a potential function for a gene. If a gene of unknown function from humans is very similar to a characterized gene from flies, the two encoded proteins may have similar functions. This type of research is called comparative genomics.

ENGLISH-UKRAINIAN DICTIONARY

УМОВНІ СКОРОЧЕННЯ

adj – adjective прикметник

adv – adverb прислівник

n – noun іменник

pl – plural множина

past. p. – past participle дієприкметник минулого часу

pres.p. – present participle дієприкметник теперішнього часу

v – verb дієслово

A

ABO blood group [eɪ-biː-əʊ blʌd gruːp] відмінність крові по групах

accelerant [əkˈsɛlərənt]n прискорювач, каталізатор

accuracy [ˈækjʊrəsi]n точність, правильність, достовірність acetic [əˈsiːtɪk]adj оцтовий

acid [ˈæsɪd]n кислота, кислий, кислотний acidify [əˈsɪdɪfaɪ]v підкислювати

acquired immunity [əˈkwaɪəd ɪˈmjuːnəti]набутий імунітет

activator proteins [ˈæktɪveɪtə ˈprəʊtiːnz] білок-активатор, збудник

additive [ˈædɪtɪv]n додаток, домішка

adhere [ədˈhɪə]v склеюватися, прилипати

adhesive [ədˈhiːsɪv]n речовина, яка зв’язує admixture [ədˈmɪksʧə]n домішка

adverse [ˈædvɜːs]adj побічний, шкідливий

adverse drug reaction (ADR) [ˈædvɜːs drʌg riˈækʃᵊn] побічна реакція препарату

affinity [əˈfɪnɪti]n схожість, спорідненість agent [ˈeɪʤənt]n агент, фактор, засіб

agitation [ˌæʤɪˈteɪʃ(ə)n] бовтання, перемішування

aggressive gene therapy [əˈgrɛsɪv ʤiːn ˈθɛrəpi] агресивна генна терапія

ammonia [əˈməʊ.ni.ə]n аміак

analgesic [ˌænælˈʤɛsɪk]n болезаспокійливий засіб, анальгетик

antidote [ˈæntɪdəʊt]n протиотрута, антидот

anti-infective [ˈænti-ɪnˈfɛktɪv]n протибактеріальний засіб

anti-inflammatory [ˈænti-ɪnˈflæmətəri]n протизапальний засіб antiviral [ˌæntɪˈvaɪrəl]n противірусний засіб

apparent [əˈpærənt]adj очевидний

application [ˌæplɪˈkeɪʃ(ə)n]n застосування, компрес, примочка assay [əˈseɪ]n проба, зразок, аналіз

atomizer [ˈætəʊmaɪzə]n розпилювач, аерозольний інгалятор auxiliary [ɔːgˈzɪljəri]adj допоміжний засіб

B

B cell [biː sɛl] Тип клітини імунної системи, яка виробляє антитіла

balance [ˈbæləns]n ваги

balm [bɑːm]n бальзам; меліса лікарська bark [bɑːk]n кора

base [beɪs]n основа bead [biːd]n гранула
bile-expelling [baɪl-ɪksˈpɛlɪŋ]adj жовчогінний binder [ˈbaɪndə]n речовина, яка зв’язує
biotechnologies [baɪəʊtɛkˈnɒləʤiz] біотехнології
bitter [ˈbɪtə]n,adj гіркота, гіркий
blend [blɛnd]n суміш boil[bɔɪl]v кип’ятити bond [bɒnd]n зв’язок
bubonic plague[bjuːˈbɒnɪk pleɪg] бубонна чума
bud [bʌd] бутон, брунька
buffer [bɒnd]n буферний розчин bulk[bʌlk]n маса
botulinum toxin [botulinum ˈtɒksɪn] ботулотоксин

C

carbohydrate [ˈkɑːbəʊˈhaɪdreɪt]n вуглевод carbonisation [ˌkɑːbənaɪˈzeɪʃən] обвуглювання carrier [ˈkærɪə]n носій
chain [ʧeɪn]n ланцюг, ланцюжок chamomile [ˈkæməˌmaɪl]n ромашка charge [tʃɑːdʒ]n заряд
chromatography [ˌkrəʊməˈtɒgrəfi]n хроматографія
cleanse [klɛnz]v очищати, дезінфікувати coagulation[kəʊˌægjʊˈleɪʃən] коагуляція, згортання
coat [kəʊt]n оболонка
combinatorial screening [kəmˌbaɪnəˈtɔːrɪəl ˈskriːnɪŋ] комбінаторне обстеження
condenser [kənˈdɛnsə]n конденсатор, холодильник conjugate [ˈkɒnʤʊgɪt]adj парний, сполучений conversion [kənˈvɜːʃən]n зміна, перетворення с cure[kjʊə]n лікування, курс лікування
cytochrome - цитохром

D

deactivation [ˌdi æktɪˈveɪʃᵊn] деактивація, відключення
decoction [dɪˈkɒkʃən]n відвар decolorant [diːˈkʌlərənt]n відбілювач
decompose [ˌdiːkəmˈpəʊz]v розпадатися, розкладатися dehydration [ˌdiːhaɪˈdreɪʃən]n зневоднення, дегідрація
deletion [dɪˈliːʃᵊn] вилучення, знищення
density [ˈdɛnsɪti]n густина, густість
depth [dɛpθ]n глибина, інтенсивність derivative [dɪˈrɪvətɪv]adj похідне
develop [dɪˈvɛləp]v виявляти, розроблювати deviation [ˌdiːvɪˈeɪʃən]n відхилення
diluent [ˈdɪljʊənt]n розріджувач, розчинник dimension [dɪˈmɛnʃən]n розмір, величина, об’єм dispense[dɪsˈpɛns]v відпускати ліки dispersion[dɪsˈpɜːʃən]n дисперсія, диспергування dissolution[ˌdɪsəˈluːʃən]n розчинення
distillation [ˌdɪstɪˈleɪʃən]n дистиляція, перегонка diuretic [ˌdaɪjʊəˈrɛtɪk]n сечогінний засіб
dosage [ˈdəʊsɪʤ]n дозування dressing [ˈdrɛsɪŋ]n пов’язка drier[ˈdraɪə]n сушарка

drip [drɪp]v капати, стікати по краплям
duplication [ˌdjuːplɪˈkeɪʃᵊ] дублювання, тиражування

E

edible vaccine [ˈɛdəbᵊl ˈvæksiːn]їстівна, харчова вакцина
emission [ɪˈmɪʃən]n випромінювання, випускання
emollient [ɪˈmɒlɪənt]n пом'якшуюча речовина, пом'якшувач
emulsifier[ɪˈmʌlsɪfaɪə]n емульгатор
enzyme [ˈɛnzaɪm]n фермент, ензим equilibrium [ˌiːkwɪˈlɪbrɪəm]n рівновага
equipment [ɪˈkwɪpmənt]n обладнання, устаткування error [ˈɛrə]n помилка, похибка
ester[ˈɛstə]n складний ефір
estimation [ˌɛstɪˈmeɪʃən]n визначення, оцінювання ether [ˈiːθə]n простий ефір
evaporate[ɪˈvæpəreɪt]v випаровуватися, випаровувати exaggeration [ɪɡˌzædʒ.əˈreɪ.ʃən]n перебільшення exchange [ɪksˈʧeɪnʤ]n обмін
exotoxin [ɛksəʊ ˈtɒksɪn] екзотоксин
expectorant [ɛksˈpɛktərənt]n відхаркуючий засіб
expression vector [ɪksˈprɛʃᵊn ˈvɛktə]векторний ген

F

Fab fragments [fæb ˈfræɡmənts] фрагменти Fab
fat [fæt]n жир
fermentation [ˌfɜːmɛnˈteɪʃən]n ферментація, бродіння fibre [ˈfaɪbə]n волокно
fineness of powder [ˈfaɪnnɪs əv ˈpaʊdə] ступінь подрібнення порошку flame [fleɪm]n полум'я
flask [flɑːsk]n колба
fluctuate [ˈflʌktjʊeɪt]v коливатися, бути нестійким fluid [ˈflu(ː)ɪd]n рідина
formulation [ˌfɔːmjʊˈleɪʃən]n технологія приготування ліків
foxglove[ˈfɒksglʌv]n наперстянка
freeze [friːz]v заморожувати frequency [ˈfriːkwənsi]n частота funnel [ˈfʌnl]n лійка
functional genomics [ˈfʌŋkʃənl ʤi'nomiks]функціональна геноміка

G

Ganciclovir - ганцикловір
gene library [ʤiːn ˈlaɪbrəri] геномна бібліотека
genetic markers [ʤɪˈnɛtɪk ˈmɑːkəz]генетичні маркери
ginseng [ˈʤɪnsɛŋ]n женьшень
goggles [ˈgɒglz]n захисні окуляри
graduate [ˈgrædjʊət]n мірна склянка, мензурка granulation [ˌgrænjʊˈleɪʃən]n грануляція
graph [grɑːf]n діаграма, крива
growth factor [ɡrəʊθ ˈfæktə]фактор росту
grinding [ˈgraɪndɪŋ] розмелювання, розтирання

guanylate cyclase - гуанілатциклаз
guideline [ˈgaɪdlaɪn]n посібник, керівництво

H

hairpin [ˈheəpɪn]шпилька
half-life [hɑːf-laɪf] період напіврозпаду
hazard [ˈhæzəd]n небезпека, шкідливий фактор heat [hiːt]n тепло, теплота
heterogeneity [ˌhɛtərəʊʤɪˈniːɪti]n гетерогенність, неоднорідність holder [ˈhəʊldə]n тримач, штатив
homogeneous [ˌhəʊməˈʤiːniəs]adj гомогенний, однорідний hood [hʊd]n витяжна шафа
hormone [ˈhɔːməʊn] гормон
humidifier [hju(ː)ˈmɪdɪfaɪə]n зволожувач humidity [hju(ː)ˈmɪdɪti]n вологість
hydrolysis [haɪˈdrɒlɪsɪs]n гідроліз hydrous [ˈhaɪdrəs]adj водний, водяний
hypnotic [hɪpˈnɒtɪk]n снодійний засіб
hypodermic [ˌhaɪpəʊˈdɜːmɪk]adj підшкірний

I

ICAM1 (intercellular adhesion molecule) - міжклітинна молекула адгезії
identification [aɪˌdɛntɪfɪˈkeɪʃən]n ідентифікація, розпізнання identity [aɪˈdɛntɪti]n ідентичність, істинність
ignition [ɪgˈnɪʃən]n озоління
immerse [ɪˈmɜːs]v устромляти, занурювати impurity [ɪmˈpjʊərɪti]n забруднення, домішок inactive [ɪnˈæktɪv]adj інертний, пасивний
incorporation [ɪnˌkɔːpəˈreɪʃən] змішування, включення
index [ˈɪndɛks]n показник, коефіцієнт indicate[ˈɪndɪkeɪt]v указувати, позначати infiltrate[ˈɪnfɪltreɪt]v інфільтрувати, насичувати
infusion[ɪnˈfjuːʒən]n вливання, настій
ingredient [ɪnˈgriːdiənt]n інгредієнт, компонент, складова (частина) inhibitor [ɪnˈhɪbɪtə]n затримуючий фактор, інгібітор
initial [ɪˈnɪʃəl]adj початковий, вихідний, первинний inlet [ˈɪnlɛt]n вхідний отвір, вхід
inscription [ɪnˈskrɪpʃən]n пропис рецепта insolubility[ɪnsɒljʊˈbɪlɪti]n нерозчинність instability [ˌɪnstəˈbɪlɪti] нестійкість, нестабільність installation [ˌɪnstəˈleɪʃən]n установка, пристрій instill [ɪnˈstɪl]v уводити краплями, закапувати intensifier [ɪnˈtɛnsɪfaɪə]n посилювач intensity[ɪnˈtɛnsɪti]n інтенсивність, напруження interaction[ˌɪntərˈækʃən]n взаємодія, взаємозв’язок interfere [ˌɪntəˈfɪə]v заважати, робити перепони intermediate [ˌɪntəˈmiːdiət]adj проміжний продукт intolerance [ɪnˈtɒlərəns]n нестерпність, нестійкість
intoxication [ɪnˌtɒksɪˈkeɪʃən]n інтоксикація, отруєння iodine [ˈaɪəʊdiːn]n йод
irradiate [ɪˈreɪdɪeɪt]n,v опромінювати, випромінювати irreversible [ˌɪrɪˈvɜːsəbl]adj необоротний
isolate [ˈaɪsəleɪt]v ізолювати, виділяти

isoform [ɪzoufʼəm]ізоформа

J

jumping gene [ˈʤʌmpɪŋ ʤiːn] стрибаючі гени
jar [ʤɑː]n банка, посудина jet [ʤɛt]n струмінь
join [ʤɔɪn]v з’єднувати juice [ʤuːs]n сік
junk DNA [ʤʌŋk diː-ɛn-eɪ] сміттєва ДНК

K

kettle [ˈkɛtl]n казан
kiln [kɪln]v випалювати, сушити knead [niːd]v м’яти, місити
knock-out [ˈnɒkaʊt]v виштовхувач
knockout mice [ˈnɒkaʊt maɪs] піддослідні миші
krypton [ˈkrɪptɒn]n криптон

L

laboratory [ləˈbɒrətəri] лабораторія
label [ˈleɪbl]n етикетка, ярлик, мітка labelling[ˈleɪblɪŋ] етикетування, маркування laxative [ˈlæksətɪv]n проносний засіб
layer [ˈleɪə]n шар, ряд
leak(age)[liːk(eɪʤ)] витік, просочування
levigate [ˈlɛvɪgeɪt]v розтирати на порох, вилуговувати liniment [ˈlɪnɪmənt]n лінімент, рідка мазь linkage[ˈlɪŋkɪʤ]n зв’язок, зчеплення, поєднання
liquid[ˈlɪkwɪd]n рідина
load [ləʊd]n навантаження loop [luːp]n петля
loose[luːs]adj вільний, нещільний lotion [ˈləʊʃən]n примочка, лосьйон
low-molecular [ləʊ-məʊˈlɛkjʊlə]adj низькомолекулярний lozenge[ˈlɒzɪnʤ]n таблетка
lubricant [ˈluːbrɪkənt]n мастильний засіб

M

macrolides [ˈmækrəʊʼliːds] макроліди
maceration [ˌmæsəˈreɪʃən] мацерація, вимочування лікарської сировини
magistral [məˈʤɪstrəl]adj виготовлений за рецептом
marc [mɑːk]n макуха (рослинної сировини) mature [məˈtjʊə]v зріти
measurement [ˈmɛʒəmənt]n вимірювання
medication [ˌmɛdɪˈkeɪʃən] лікарський засіб medicinal [mɛˈdɪsɪnl]adj лікарський
medium [ˈmiːdiəm]n живильне середовище mix [mɪks]v змішувати
moistening [ˈmɔɪsnɪŋ] зволожування mold [məʊld]n форма; пліснява
mucilaginous [məʊld]adj слизовий, клейкий, в’язкий mucus [ˈmjuːkəs]n слиз
multivitamins [ˌmʌltɪˈvɪtəmɪnz]n полівітаміни muscular[ˌmʌltɪˈvɪtəmɪnz]adj м’язовий
mutation [mjuːˈteɪʃᵊn] мутація

N

nanoparticles [nanoˈpɑːtɪkls] наночастинки
neutralize [ˈnjuːtrəlaɪz]v нейтралізувати nitrogenous [naɪˈtrɒʤɪnəs]adj азотний
non-addictive [nɒn-əˈdɪktɪv]adj який не викликає звикання non-aqueous [nɒn-ˈeɪkwɪəs]adj неводний
non-reversible [nɒn-rɪˈvɜːsəbl]adj незворотний non-volatile [nɒn-ˈvɒlətaɪl]adj неліткий nostrum [ˈnɒstrəm]n патентований препарат noxious [ˈnɒkʃəs]adj шкідливий, отруйний nucleus (-i) [ˈnjuːklɪəs (-aɪ)]n ядро
nuclear transplantation [ˈnjuːklɪə ˌtrænsplɑːnˈteɪʃᵊn]атомна трансплантація (пересадка)
nutrient[ˈnjuːtrɪənt]n поживна речовина

O

observation [ˌɒbzə(ː)ˈveɪʃən]n спостереження, вивчення occlusive [əˈkluːsɪv]adj герметичний
occur [əˈkɜː]v виявлятися, зустрічатися odour [ˈəʊdə]n запах
oil[ɔɪl]n олія
ointment [ˈɔɪntmənt]n мазь
oleaginous [ˌəʊlɪˈæʤɪnəs]adj масляний
oral [ˈɔːrəl]adj ротовий, пероральний
overstrain [ˈəʊvəstreɪn]n перевантаження, перенапруження oxidation [ˌɒksɪˈdeɪʃən]n окислення
oxygenase [ˈɒksɪʤən]насичувачи киснем

P

pad [pæd]n подушечка
pain-killer [peɪn-ˈkɪlə]n засіб проти болю particle [ˈpɑːtɪkl]n частка
pellet [ˈpɛlɪt]n кулька, пілюля, гранула penetrate[ˈpɛnɪtreɪt]v проникати
percolation [ˌpɜːkəˈleɪʃən]n перколяція, проціджування, просочування
peroxide [pəˈrɒksaɪd]n перекис
petrolatum [ˌpɛtrəˈleɪtəm]n вазелін
pharmaceutics [ˌfɑːməˈsjuːtɪks]n технологія лікарських форм
pharmacy[ˈfɑːməsi]n фармація, аптека
phlogistic [flɒˈʤɪstɪk]adj запальний pill [pɪl]n пігулка
pilot [ˈpaɪlət]adj дослідний, експериментальний plant [plɑːnt]n рослина
plantain[ˈplæntɪn]n подорожник plaster [ˈplɑːstə]n пластир
poisonous [ˈpɔɪznəs]adj отруйний, токсичний polarity [pəʊˈlærɪti]n полярність
pollutant [pəˈluːtənt]n забруднююча речовина pollute [pəˈluːt]v забруднювати
porosity [pɔːˈrɒsɪti]n пористість
potent [ˈpəʊtənt]adj сильнодіючий
potentiate [pəʊˈtɛnʃieɪt]v потенціювати, посилювати дію powder [ˈpaʊdə]n порошок
precipitate [prɪˈsɪpɪtɪt]n осад, осаджувати
precipitation [prɪˌsɪpɪˈteɪʃən]n випадіння осаду, преципітація

phenol [ˈfiːnɒl] фенол
[pri(ː)ˈkɜːsə]n попередник
preparation [ˌprɛpəˈreɪʃən]v приготування
prepare [prɪˈpeə]v готувати
prescription [prɪsˈkrɪpʃən]n рецепт preservative [prɪˈzɜːvətɪv]n консервант
procedure [prəˈsiːʤə]n процедура, метод proof [pruːf]n перевірка, випробування, проба property [ˈprɒpəti]n якість
protection [prəˈtɛkʃən]n захист protective [prəˈtɛktɪv]adj захисний
pulverize [ˈpʌlvəraɪz]v утирати, розтирати на порошок pump [ˈpʌlvəraɪz]n насос, помпа
purgative [ˈpɜːgətɪv]n проносний засіб purification [ˌpjʊərɪfɪˈkeɪʃən]n очищення

Q

quality [ˈkwɒlɪti]n якість
quantify [ˈkwɒntɪfaɪ]v визначати кількість
quantum confinement [ˈkwɒntəm kənˈfaɪnmənt] розмірне квантування
qualitative[ˈkwɒlɪtətɪv]adj якісний quantitative [ˈkwɒntɪtətɪv]adj кількісний
quantity[ˈkwɒntɪti]n кількість, величина quenching[ˈkwɛnʧɪŋ]n гашення
quinquina [kwɪŋˈkwaɪnə]n хінне дерево

R

rack [ræk]n підставка, штатив radiate [ˈreɪdɪɪt]v випромінювати
radioscopy [ˌreɪdɪˈɒskəpi]n рентгеноскопія
range [reɪnʤ]n галузь, зона, інтервал, діапазон, межа rare [reə]adj рідкий, розряджений
rarefaction [ˌreərɪˈfækʃən]n розрідження
rate [reɪt]n швидкість, темп, норма, коефіцієнт
ray [reɪ]n промінь
reabsorption [ˌriːəbˈsɔːpʃ(ə)n] n реабсорбція, зворотне усмоктування reach [riːʧ]v проникати, досягати
reactivity [ˌriːækˈtɪvɪti]n реакційна здатність reading [ˈriːdɪŋ] n відлік, показання (приладу) recover [rɪˈkʌvə]v відновлювати
reduce [rɪˈdjuːs]v зменшувати, відновлювати reflect [rɪˈflɛkt]v відбивати
refrigeration [rɪˌfrɪʤəˈreɪʃən]n охолодження, замороження regulation [ˌrɛgjʊˈleɪʃən]n регламентація, установлення стандартів relative [ˈrɛlətɪv]adj відносний
reliability [rɪˌlaɪəˈbɪlɪti]n надійність, вірогідність remedy [ˈrɛmɪdi]n лікарський засіб
remove [rɪˈmuːv]v виводити, усувати requirement [rɪˈkwaɪəmənt]n вимога
research [rɪˈsɜːʧ]n дослідження, вивчення residue [ˈrɛzɪdjuː]n осад, залишок
resin [ˈrɛzɪn]n смола
resolution [ˌrɛzəˈluːʃən]nрозчинення, розщеплення retain [rɪˈteɪn]v утримувати, зберігати
ring [rɪŋ]n кільце, цикл

rinse [rɪŋ]v полоскання, полоскати root [ruːt]n коріння
rotate [rəʊˈteɪt]v обертати route [ruːt]n спосіб вживання rub [rʌb]v розтирати

S

safety [ˈseɪfti]n безпека, надійність sage [seɪʤ]n шавлія
saline[səˈlaɪn]n сольовий розчин salt [sɒlt]n сіль
saltpeter [ˈsɔːltˌpiːtə]n селітра sample [ˈsɑːmpl]n проба, зразок
sampler [ˈsɑːmplə]n прилад для отримання зразків sap [sæp]n сік (рослини)
satellite viruses [ˈsætəlaɪt ˈvaɪərəsɪz] віруси-супутники
saturate [ˈsæʧəreɪt]v насичувати, просочувати saturation [ˌsæʧəˈreɪʃən]n насичення
scale [skeɪl]n шкала
score [skɔː]n оцінка, показник screen [skriːn]n екран, щит, фільтр
seal [siːl]n ущільнення, герметизація
sedative [ˈsɛdətɪv]adj заспокійливий, седативний sediment [ˈsɛdɪmənt]n осад
seed [siːd]n насіння select [sɪˈlɛkt]v відбирати
semifluid [ˌsɛmɪˈfluːɪd]adj напіврідкий sensitivity [ˌsɛnsɪˈtɪvɪti]n чутливість
separate[ˈsɛprɪt]v відділяти, виділяти sequence [ˈsiːkwəns]n послідовність set [sɛt]n комплект, набір, серія
settle [ˈsɛtl]v відстоюватися, осідати setup [ˈsɛtʌp]v прилад, приладдя shake [ʃeɪk]v сколихувати, збовтувати shape [ʃeɪp]n форма
shelf-life [ʃɛlf-laɪf]n термін зберігання (придатності) shell [ʃɛl]n оболонка
shift [ʃɪft]n зміщення, зсув
short-term [ʃɔːt-tɜːm]adj короткочасний sieve [sɪv]n сито
sift [sɪft]v просівати, фільтрувати signature [ˈsɪgnɪʧə]n сигнатура
similarity [ˌsɪmɪˈlærɪti]n схожість, подібність sizing [ˈsaɪzɪŋ]n вимірювання, калібровка slab [slæb]n пластинка, смужка, блок
slurry [ˈslɜːri]n суспензія
soak [səʊk]v усмоктуватися, просочувати(ся) soda [ˈsəʊdə]n сода, вуглекислий натр soften[ˈsɒfn]v пом’якшувати
solid [ˈsɒlɪd]n тверда речовина
solidify [səˈlɪdɪfaɪ]v холонути, твердіти solubility [ˌsɒljʊˈbɪlɪti]n розчинність
solution [səˈluːʃən]n розчин
solvency [ˈsɒlvənsi]n здатність розчиняти solvent [ˈsɒlvənt]n розчинник
source [sɔːs]n джерело
sow-foot [səʊ-fʊt]n мачушник spa [spɑː]n мінеральне джерело space [speɪs]n простір, проміжок
span [spæn]n проміжок часу, інтервал spatula [ˈspætjʊlə]n шпатель, лопаточка
specialties [ˈspɛʃəltiz]n готові лікарські засоби заводського приготування
specification [ˌspɛsɪfɪˈkeɪʃən]n специфікація, технологічні вимоги specimen [ˈspɛsɪmɪn]зразок, проба, препарат
spectroscopy[spɛkˈtrɒskəpi] спектроскопія spectrum (-a) [ˈspɛktrəm (-eɪ)]спектр
spirit [ˈspɪrɪt]adj спиртовий

splitting [ˈsplɪtɪŋ]n розщеплення, розшаровування spot [spɒt]n пляма
spray [spreɪ]v розпиляти, розбризкувати squeeze [skwiːz]n стиснення, здавлювання stability [stəˈbɪlɪti]n стабільність, стійкість stage [steɪʤ]n стадія, фаза, етап
stain [steɪn]n,v барвник, фарбувати, пляма stand [stænd]n штатив, підставка
starch [stɑːʧ]n крохмаль steam [stiːm]n пара stem [stɛm]n стебло
sterilizer[ˈstɛrɪlaɪzə]n стерилізатор
stimulant [ˈstɪmjʊlənt]n стимулятор, подразник
stir [stɜː]n перемішування, збовтування stock[stɒk]n запас
stopper [ˈstɒpə]n,v пробка, закупорювати storage [ˈstɔːrɪʤ]n зберігання
strain [streɪn]n напруження, навантаження, деформація stratification [ˌstrætɪfɪˈkeɪʃən]n розшарування
stratum (-a) [ˈstrɑːtəm (-eɪ)]n шар
strength [strɛŋθ]n сила, міцність, напруженість, концентрація stretch [strɛʧ]v витягати, розтягувати
strict [strɪkt]adj точний, суворий strip [strɪp]n смуга, стрічка
subdue [səbˈdjuː]v послаблювати, пом’якшувати submersion [səbˈmɜːʃən]n занурення в рідину subscription [səbˈskrɪpʃən]n пропис (частина рецепта)
substance[ˈsʌbstəns]n речовина
substitute [ˈsʌbstɪtjuːt]n замісник, замінник
suction [ˈsʌkʃən]adj,n відсмоктувальний, відсмоктування sudorific [ˌsjuːdəˈrɪfɪk]n потогінний засіб
sulphurous [ˈsʌlfərəs]adj сірчистий supersound [ˈsjuːpəsaʊnd]n ультразвук
suppository [səˈpɒzɪtəri]n свічка, супозиторій suppress [səˈprɛs]v пригнічувати, гальмувати surface [ˈsɜːfɪs]n поверхня
survey [ˈsɜːveɪ]n обстеження, дослідження suspend [səsˈpɛnd]v підвішувати, затримувати suspension [səsˈpɛnʃən]n суспензія, завись sustain [səsˈteɪn]v витримувати, витерплювати swell [swɛl]v набухати, набрякати
synthesize [ˈsɪnθɪˌsaɪz]v синтезувати

T

tablet [ˈtæblɪt]n таблетка taste [teɪst]n смак
temperate [ˈtɛmpərɪt]adj помірний temporary [ˈtɛmpərəri]adj тимчасовий
tension [ˈtɛnʃən]n тиск, напруга
test [tɛst]n тест, проба, випробування thermal [ˈθɜːməl]adj тепловий, термальний
thermolysis [θɜːˈmɒlɪsɪs]n термоліз, тепловіддача thickness [ˈθɪknɪs]n товщина, шар, щільність thin-layer [θɪn-ˈleɪə]adj тонкошаровий
threshold [ˈθrɛʃˌhəʊld]n поріг, межа, границя tight [taɪt]adj щільний, герметичний
tight-fitting [taɪt-ˈfɪtɪŋ]adj щільно підігнаний timing [ˈtaɪmɪŋ]n хронометраж
tincture [ˈtɪŋkʧə]n настоянка tissue [ˈtɪʃuː]n тканина titrate [ˈtaɪtreɪt]v титрувати
tolerate [ˈtɒləreɪt]v виносити, витримувати tool [tuːl]n інструмент, прилад
toxicant [ˈtɒksɪkənt]n токсигенність

transfer [ˈtrænsfə(ː)]n перенесення, переміщення transformation [ˌtrænsfəˈmeɪʃən]n перетворення transient [ˈtrænzɪənt]adj тимчасовий
tray [treɪ]n лотік, жолоб, піддон
treatment [ˈtriːtmənt]n обробка, лікування triturate [ˈtrɪtjʊreɪt]v розтирати на порошок troche [trəʊʃ]n пастилка, таблетка
tube [tjuːb]n трубка, пробірка turbidity [tɜːˈbɪdɪti]n помутніння

U

ultraviolet detector [ˈʌltrəˈvaɪəlɪt dɪˈtɛktə] ультрафіолетовий детектор
undiluted [ʌndaɪˈljuːtɪd]adj нерозбавлений, нерозведений unfit [ʌnˈfɪt]adj непридатний, непідходящий uniformity[ˌjuːnɪˈfɔːmɪti]n однорідність, уніфікація
unit [ˈjuːnɪt]n одиниця (вимірювання), апарат, прилад unstable [ʌnˈsteɪbl]adj нестійкий, нестабільний
use [juːz]v вживати, використовувати

V

vaccination [ˌvæksɪˈneɪʃᵊn] вакцинація
value [ˈvæljuː]n величина, показник valve [vælv]n клапан
vaporize [ˈveɪpəraɪz]v випаровуватися vehicle [ˈviːɪkl]n транспортний засіб
velocity [vɪˈlɒsɪti]n швидкість
venom [ˈvɛnəm]n отрута
vent [vɛnt]adj вентиляційний, вихідний отвір
verification [ˌvɛrɪfɪˈkeɪʃən]n перевірка, контроль, підтвердження vessel [ˈvɛsl]n посудина
vial [ˈvaɪəl]n пробірка, ампула, флакон virulent [ˈvɪrʊlənt]adj отруйний, вірулентний viscosity [vɪsˈkɒsɪti]n в’язкість, тягучість volume [ˈvɒljʊm]n обсяг
vomitive [ˈvɒmɪtɪv]n блювотний засіб

W

wall [wɔːl]n стінка
warning [ˈwɔːnɪŋ]n осторога, попередження wash [wɒʃ]v мити, промивати
waste [weɪst]n відходи
waterproof [ˈwɔː.tə.pruːf]adj водонепроникний wave [weɪv]n хвиля
wavelength [ˈweɪvlɛŋθ]n довжина хвилі wax [wæks]n віск
weigh [weɪ]v зважувати weight [weɪt]n маса, вага welding [ˈwɛldɪŋ]n зварювання
wet [wɛt]v змочувати, зволожувати wormwood [ˈwɜːmwʊd]n полин гіркий

X

xanthenen ксантен xanthinen ксантін xenon [ˈzɛnɒn]n ксенон
X-rays [ˈɛksˈreɪz]n рентгенівські промені xylenen ксилол
xylose [ˈzaɪləʊs] ксилоза

Y

yeast [jiːst] n дріжджі
yeast prion [jiːst prion] дріжджові пріони
yield [jiːst] n вихід yperite n іприт

Z

zeolite [ˈziːəʊlaɪt] n цеоліт zero [ˈzɪərəʊ] n нуль
zinc [zɪŋk] n цинк
zipper [ˈzɪp.ər] n затискач zirconium [zɜːˈkəʊnjəm] n цирконій zoosterols n зоостерини
zyme n фермент, ензим zymohexase n альдолаза
zymolysis n ферментативний гідроліз

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Some Bioinformatics Websites:

■ GenBank and linked databases

❍ http://www.ncbi.nlm.nih.gov/Entrez/

❍ http://www.ncbi.nlm.nih.gov/mapview/

❍ http://www.ncbi.nlm.nih.gov/genome/guide/human/

■ Institute for Genomics Research (TIGR)

❍ http://www.tigr.org/tdb

■ Genome Database (GDB) (human genome)

❍ http://www.gdb.org

■ European Bioinformatics Institute (including EMBL and Swissprot)

❍ http://www.ebi.ac.uk/

■ Flybase (*Drosophila* genome)

❍ http://flybase.bio.indiana.edu:82

■ RCSB Protein Data Bank

❍ http://www.rcsb.org/pdb/

■ PIR Protein Information Resource (PIR)

❍ http://www-nbrf.georgetown.edu

Інформаційні ресурси:

https://www.youtube.com/watch?v=RrTCjp2015M
https://www.youtube.com/watch?v=XXu15NlOuGo
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Навчальний посібник «Biotechnology» предназначений для здобувачів вищої освіти факультету хімічних та біофармацевтичних технологій, які вивчають дисципліну «Іноземна мова фахового спрямування». Посібник складається з чотирьох частин, до кожного з яких належить по два розділи. Кожний розділ включає автентичний лексичний матеріал та систему мовних та умовно-мовленнєвих вправ для формування мовної компетенції.

Навчальне видання

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