КАЗАНСКИЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ

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English for Biotechnology

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Данное учебно-методическое пособие предназначено для студентов 1 курса, изучающих дисциплину «Иностранный язык» по направлению «Биотехнические системы и технологии (Медицинское оборудование: физические принципы и приборостроение)» и Биотехнические системы и технологии (Медицинская томография: физические принципы и приборостроение). Учебно-методическое пособие состоит из 10 самостоятельных блоков для изучения специальных текстов по разным темам, каждый из которых включает в себя упражнения на закрепление лексики и развитие навыков говорения. В конце представлен глоссарий по специальности. Пособие составлено на английском языке согласно требованиям профиля подготовки и имеет практическую профессиональную направленность. В пособии использованы материалы энциклопедий, словарей и справочников. Специфика пособия заключается в комплексном подходе к изложению материала: в нем представлены не только аутентичные тексты, направленные на углубление профессиональной лексики, но также даются разнообразные задания на фиксацию и отработку полученных знаний.

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ОТ АВТОРОВ

Настоящее учебно-методическое пособие предназначено для студентов естественнонаучных факультетов, в первую очередь – для биотехнологов, овладевших базовыми знаниями английского языка и приступающих к чтению, пониманию, переводу оригинальной научно-технической литературы широкого физико-математического профиля.

Главной целью учебно-методического пособия является формирование иноязычной коммуникативной компетенции студентов в сфере будущей профессиональной деятельности, развитие умений понимания и навыков свободного чтения специального текста, развитие навыков свободно ориентироваться в терминологической системе данной специальности.

Пособие состоит из 10 связанных друг с другом тем для изучения бакалаврами – биотехнологами. Каждая тема включает в себя полный спектр материалов и заданий для выполнения: аутентичные тексты из современных научных журналов и интернет-ресурсов, глоссарий, упражнения на закрепление лексической базы, упражнения на развитие и совершенствование навыков говорения на английском языке. При отборе материала учитывалась его познавательная ценность.

Все темы идентичны по структуре, даны ясные формулировки заданий, что позволяет с легкостью достичь искомой цели.

СОДЕРЖАНИЕ

UNIT 1 WHAT IS BIOTECHNOLOGY?

Intro

Task 1. Discuss your ideas in pairs and give feedback to the class.

1. What is biotechnology?
2. What types of biotechnology do you know?
3. What do you know about DNA?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

minuscule	[ˈmɪnəskjuːl]
pharmaceutical	[fɑːməˈsjuːtɪkəl]
harness	[ˈhɑːnɪs]
nutrients	[ˈnjuːtrɪənts]
stimulate	[ˈstɪmjʊleɪt]
agriculture	[ægrɪˈkʌlʧə]
cell	[sel]
deoxyribonucleic	[diˌɒksiˌraɪbəʊnjuːˈkleɪɪk]
acid	[ˈæsɪd]
enzyme	[ˈenzaɪm]
multifaceted	['mʌltɪ'fæsɪtɪd]

Task 3. Study the active vocabulary.

1. cell, n **–** клетка; секция; полость; *living cell* – живая клетка*;* жизнеспособная клетка*; cell wall* – клеточная стенка*; клеточная* *оболочка; stem cell* – стволовая клетка. No other organelles were observed in the *cells* even though many sections were examined.

cellular, *adj* **–** клеточный; цитологический; ячеистый; сотообразный; пористый; сетчатый*; cellular agriculture* – мясное скотоводство клеточно-генетического направления*; cellular texture* – клеточное строение. Both replication and environmental interaction take place at the *cellular* level.

2. **harness** ['hɑ:nɪs], v – использовать; ставить на службу. Engineers are finding new ways to *harness* the sun's energy to heat homes. It will contain systems and components to *harness* and utilize the forces of nature. Biotechnology *harnesses* cellular and biomolecular processes to develop technologies and products that help improve our lives and the health of our planet.

3. minuscule [ˈmɪnəskjuːl], adj **–** минускульный; маленький; микроскопический. Nanotechnologists have already, by moving the atoms about, made the smallest switches that herald the time when microscopic computers or *minuscule* robots will be produced. This proves to be a structure of *minuscule* tubes whose diameter is nonetheless sufficient to allow aquatic animalcules to pass through them.

4. ingest [ɪn'ʤest], v – глотать, проглатывать, усваивать, впитывать. She claims that the average person *ingests* considerably more calories than is necessary or desirable. The drug is more easily *ingested* in pill form.

5. manipulate [mə'nɪpjuleɪt], v – управлять, манипулировать, воздействовать, влиять. The mechanical arms are *manipulated* by a computer.

6. yield [ji:ld], n – урожайность; продукт; урожай; доход; выход (продукции); полезная продуктивность. *Yield* losses can range from 30 to 90 percent. *Crop yield* – урожайность, урожайность культур, выход продукции с единицы площади. Agricultural biotechnology focuses on developing genetically modified plants to increase *crop yields*.

7. DNA, deoxyribonucleic acid [diˌɒksiˌraɪbəʊnjuːˌkleɪɪk], n – дезоксирибонуклеиновая кислота, ДНК. Recombinant *DNA* is a *DNA* molecule containing *DNA* that originated from two or more sources. The men will undergo voluntary *DNA* testing of their saliva.

8. viability ['vaɪə'bɪlɪtɪ], n – эффективность, целесообразность, жизнеспособность; *economic viability* – экономическая эффективность; рентабельность. The loss of one gene alone does not alter *viability*, but double mutants are lethal. However, high seed *yield* provides a competitive price for an effective distribution to farmers and seed *yield* determines the *economic viability* of seed producers. Several innovations have resulted, but progress has been hampered by the lack of attention to questions of *economic viability*.

9. enzyme ['enzaɪm], n - энзим; фермент. *Enzymes* are essential to the body's functioning. *An enzyme* in the saliva of the mouth starts the process of breaking down the food.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. Various molecular and <u>(l, l, c, l, e, a, r, u)</u> mechanisms give rise to epilepsy, and epilepsy genes fall into several distinct categories.

2. Medical biotechnology is the use of living <u>(c, l, l, s ,e)</u> and other cell materials to better the health of humans.

3. <u>(c, u, l, t, a, g, i, r, u, a, l, r)</u> biotechnology focuses on developing genetically modified plants to increase crop yields or introduce characteristics to those plants that provide them with an advantage growing in regions that place some kind of stress factor on the plant.

4. Biotechnology is the use of biological systems found in organisms or the use of the living <u>(a, n, i, s, m, s, o, r, g)</u> themselves to make technological advances and adapt those technologies to various fields.

5. Biotechnology is particularly vital when it comes to the development of <u>(u, m, i, l, s, c, u, n, e)</u> and chemical tools, as many of the tools biotechnology uses exist at the cellular level.

6. Biotechnology (s, a, r, s, s, e, e, n, h) cellular and biomolecular processes to develop technologies and products that help improve our lives and the health of our planet.

7. Environmental biotechnology is the technology used in waste treatment and (l, l, o, u, p, o, t, i, n) prevention that can more efficiently clean up many wastes compared to conventional methods.

8. Environmental engineers introduce nutrients to stimulate the activity of bacteria that already exists in the soil at a waste site or add new bacteria to the soil. The bacteria help in digesting the waste right at the site, thereby turning it into harmless (y, p, d, b, u c, t, o, s, r).

9. In some of the cases, the practice involves scientists identifying a characteristic, finding the (e, g, e, n) that causes it, and then putting that gene within another plant so that it gains that desirable characteristic, making it more durable or having it produce larger yields than it previously did.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

What is Biotechnology?

Biotechnology is the use of biological systems found in organisms or the use of the living organisms themselves to make technological advances and adapt those technologies to various fields. These include applications in multiple fields, from agricultural practice to the medical sector. It does not only include applications in fields that involve the living but also any other field where the information obtained from the biological aspect of an organism can be applied.

Biotechnology is particularly vital when it comes to the development of minuscule and chemical tools, as many of the tools biotechnology uses exist at the cellular level.

According to the Biotechnology Innovation Organization, "Biotechnology is technology based on biology – biotechnology harnesses cellular and biomolecular processes to develop technologies and products that help improve our lives and the health of our planet. We have used the biological processes of microorganisms for more than 6,000 years to make useful food products, such as bread and cheese, and to preserve dairy products."

Types of Biotechnology:

1. Medical Biotechnology. Medical biotechnology is the use of living cells and other cell materials to better the health of humans. Primarily, it is used for finding cures as well as getting rid of and preventing diseases. The science involved includes the use of these tools for research to find different or more efficient ways of maintaining human health, understanding pathogens, and understanding human cell biology. Here, the technique is used to produce pharmaceutical drugs as well as other chemicals to combat diseases. It involves the study of bacteria, plant & animal cells, to first understand the way they function at a fundamental level.

It heavily involves the study of DNA (Deoxyribonucleic acid) to get to know how to manipulate the genetic makeup of cells to increase the production of beneficial characteristics that humans might find useful, such as the production of insulin. The field usually leads to the development of new drugs and treatments, novel to the field.

2. Agricultural Biotechnology. Agricultural biotechnology focuses on developing genetically modified plants to increase crop yields or introduce characteristics to those plants that provide them with an advantage growing in regions that place some kind of stress factor on the plant, namely weather, and pests.

In some of the cases, the practice involves scientists identifying a characteristic, finding the gene that causes it, and then putting that gene within another plant so that it gains that desirable characteristic, making it more durable or having it produce larger yields than it previously did.

3. **Industrial Biotechnology**

Industrial biotechnology is the application of biotechnology for industrial purposes that also include industrial fermentation. Applying the techniques of modern molecular biology, it improves efficiency and reduces the multifaceted environmental impacts of industrial processes including paper and pulp, chemical manufacturing, and textile.

It includes the practice of using cells such as microorganisms, or components of cells like enzymes, to generate products in sectors that are industrially useful, such as food and feed, chemicals, detergents, paper and pulp, textiles, biofuels, and biogas.

In the current decade, significant progress has been made in creating genetically modified organisms (GMOs) that enhance the diversity of applications and the economic viability of industrial biotechnology.

It is also actively advancing towards lowering greenhouse gas emissions by using renewable raw materials to produce a variety of chemicals and fuels and moving away from a petrochemical-based economy.

4. Environmental Biotechnology

Environmental biotechnology is the technology used in waste treatment and pollution prevention that can more efficiently clean up many wastes compared to conventional methods and significantly reduce our dependence on methods for land-based disposal.

Every organism ingests nutrients to live and produces byproducts as a result. But different organisms need different types of nutrients. Some bacteria also thrive on the chemical components of waste products.

Environmental engineers introduce nutrients to stimulate the activity of bacteria that already exists in the soil at a waste site or add new bacteria to the soil. The bacteria help in digesting the waste right at the site, thereby turning it into harmless byproducts.

After consuming the waste materials, the bacteria either die off or return to their normal population levels in the environment. There are cases where the byproducts of the pollution-fighting microorganisms are themselves useful.

(https://www.conserve-energy-future.com/biotechnology-types-examples-applications)

Task 6. True/False statements

1. Biotechnology uses biological systems and living organisms to advance technology in various fields, including agriculture and medicine.

2. Medical biotechnology involves using living cells and cell materials to improve human health, often leading to the development of new pharmaceutical drugs.

3. Agricultural biotechnology can involve transferring genes from one plant to another to confer desirable traits such as increased yield or resistance to stresses.

4. Biotechnology is only concerned with the application and modification of non-living materials, without any involvement of living organisms or cells.

5. The field of biotechnology has only existed for the past 100 years and has not influenced food production, such as in the making of bread and cheese.

6. Medical biotechnology primarily focuses on creating artificial human limbs and does not involve the manipulation of DNA to develop new drugs or treatments.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases.

Молекулярная биология, существовать на клеточном уровне, здоровье человека, медицинские препараты, урожайность культур, промышленное брожение, микроорганизмы, борющиеся с загрязнением окружающей среды; экономическая рентабельность, возобновляемое сырьё, традиционный метод, буйно разрастаться, генетический состав, производство инсулина.

Task 8. Match each word in A with its synonyms in B and translate them.

A	B
1. minuscule	a) use
2. ingest	b) cure
3. harness	c) consume
4. drug	d) tiny
5. yield	e) garbage
6. technology	f) output
7. waste	g) innovation
8. viability	h) feasibility

Task 9. Match these words with their opposites.

1. beneficial	a) unusual
2. reduce	b) improbability
3. novel	c) homogeneous
4. viability	d) increase
5. multifaceted	e) unfavourable
6. conventional	f) old
7. minuscule	g) regression
8. development	h) gigantic

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Biological, industrial, cellular, environmental, beneficial, cellular, molecular, different, efficient.

Task 11. Translate the following nouns and give the corresponding verbs.

Strength, pollution, prevention, application, production, development, consumption, manipulation.

Speaking

Task 12. Discuss the questions.

1. Biotechnology helps us to improve our lives and the health of our planet. Do you agree with the statement? Prove your point of view.
2. Do you agree with the following statement: Biotechnology contributes only to agriculture and medicine. Why? Why not?
3. Genetically manipulated foods is safe for people. Do you agree with the statement? Prove your point of view.

Task 13. Make a presentation on one of the topics:

1. Biotechnology and its branches of application.
2. Biotechnology is the technology of the future.

Task 14. Prepare the rendering of the text.

UNIT 2 BIOPHYSICS: THE BRIDGING SCIENCE

Intro

Task 1. Discuss your ideas in pairs and give feedback to the class.

1. What do you know about biophysics?
2. How does biophysics differ from biology and physics?
3. Why is biophysics important for modern medicine?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

microbial	[maɪˈkrəʊbɪəl]

chemistry	[ˈkemɪstrɪ]
niche	[nɪʧ]
therapy	[ˈθerəpɪ]
algae	[ˈælgiː] [ˈælʤiː]
measure	[ˈmeʒə]
dialysis	[daɪˈælɪsɪs]
defibrillator	[diːˈf(a)ɪbrɪleɪtə]
biophysicist	[bɪəˈfɪzɪsɪst]
auditory	[ˈɔːdɪtərɪ]
diagnostic	[daɪəgˈnɒstɪk]
flourescent	[flʊ(ə)ˈres(ə)nt]
crucial	[ˈkruːʃəl]
unique	[juːˈniːk]
technique	[tek’niːk]
prosthetic	[prɔs’θetɪk]

Task 3. Study the active vocabulary.

1. algae [ˈælgiː], n – водоросли; *blue-green algae* – сине-зеленые водоросли; *yellow-green algae* – золотистые водоросли. The fact of recovery of *algae* from permanently frozen sediments may suggest their resistance to both primary and long-term freezing. The mucilaginous sheath of *blue-green algae* has been considered as a potential microenvironment for bacteria.

2. blueprint, n **–** план, схема, проект, основы. The chromosomes of the nucleus are perceived as being the *blueprints* - the idea - upon which the body is constructed. By changing the tomato's genetic *blueprint*, scientists can alter the rate at which it ripens.

3. cutting-edge, adj. – передовой, современный, самый современный. Sophisticated, *cutting-edge* laboratory experiments are crucial to providing these data - now and in the future. *Cutting-edge design/technology*.

4. **dialysis** [daɪ'æləsɪs], n – диализ. *Dialysis* is a process of separating substances from liquid by putting them through a thin piece of skin-like material, especially to remove waste substances from the blood of someone whose kidneys are not working correctly. *Kidney dialysis – диализ почек.* She has to visit the hospital once a week for *kidney dialysis*.

5. fluorescent [flʊəˈres(ə)nt], adj. – флуоресцентный, флюоресцентный, светящийся*; fluorescent tag* – флюоресцирующая метка. Many biological substances are *fluorescent* under UV light. Using *fluorescent tags*, biophysicists have been able to make cells glow like a firefly under a microscope.

6. valve, n – клапан, вентиль, заслонка*; heart valve* – сердечный клапан. They turned off the main water *valve* to the house. Prosthetic *heart valves* have prolonged the lives of millions of people.

7. **magnetic resonance imaging (MRI),** n **–** магнитно-резонансная томография. *MRI* is a system for producing electronic pictures of the organs inside a person's body, using radio waves and a strong magnetic field.

8. pacemaker, n **–** электрокардиостимулятор; синусовый узел сердца; лидер, задающий темп; *heart pacemaker* – кардиостимулятор. Both patients in whom permanent *pacemakers* were implanted were in class two, although they otherwise enjoyed a normal life.

9. prosthesis [prɒsˈθiːsɪs] (pl. **prostheses** [prɒsˈθiːsɪz]**),** n – протез, протезирование*; biological prosthesis* – биологический протез; биопротез; *valve prosthesis* – протез сердечного клапана. The antimicrobial silver coating of medical *prostheses* is regarded as a means of reducing the risk of bacterial colonization after implantation.

Prosthetic, adj – протезный; *prosthetic device* – протез; *prosthetic cardiac valve* – искусственный клапан сердца. *Prosthetic devices* are often a medical necessity.

10. sequence, n, v – последовательность равномерных звеньев; последовательность; строить последовательность. To discover the order in which nucleotides (= chemical substances) are combined within DNA: Researchers *sequenced* the full genome of a rat. He invented a technique to determine the *sequence* of base pairs in DNA.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1.Biophysics has also been critical to understanding (m, h, a, c, s, b, o, i, e, n, i, c) and applying this information to the design

2. Physical scientists use mathematics to explain what happens in nature. Life scientists want to understand how biological (y, e, t, s, m,s, s) work.

3. In short, biophysicists are at the (r, n, f, f, o, t, e, r, r) of solving age-old human problems as well as problems of the future.

4. Biophysics continues to be essential to the (p, t, d, e, l, n, m, v, o, e, e) of even safer, faster, and more precise technology to improve medical imaging and teach us more about the body's inner workings.

5. Environmental biophysics measures and models all aspects of the environment from the (h, t, s, a, r, e, e, o, r, s, t, p) to deep ocean vents.

6. Both patients in whom permanent (r, a, c, e, k, a, m, p, e, s) were implanted were in class two, although they otherwise enjoyed a normal life.

7. Advances in medical (c, e, n, e, c, i, s) mean that people are living longer.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

Biophysics: the bridging science

Biophysics is the field that applies the theories and methods of physics to understand how biological systems work. Biophysics has been critical to understanding the mechanics of how the molecules of life are made, how different parts of a cell move and function, and how complex systems in our bodies – the brain, circulation, immune system, and others – work. Biophysics is a vibrant scientific field where scientists from many fields including math, chemistry, physics, engineering, pharmacology, and materials sciences, use their skills to explore and develop new tools for understanding how biology – all life – works.

Physical scientists use mathematics to explain what happens in nature. Life scientists want to understand how biological systems work. These systems include molecules, cells, organisms, and ecosystems that are very complex. Biological research in the 21st century involves experiments that produce huge amounts of data. How can biologists even begin to understand this data or predict how these systems might work?

This is where biophysicists come in. Biophysicists are uniquely trained in the quantitative sciences of physics, math, and chemistry and they are able tackle a wide array of topics, ranging from how nerve cells communicate, to how plant cells capture light and transform it into energy, to how changes in the DNA of healthy cells can trigger their transformation into cancer cells, to so many other biological problems.

Biophysicists work to develop methods to overcome disease, eradicate global hunger, produce renewable energy sources, design cutting-edge technologies, and solve countless scientific mysteries. In short, biophysicists are at the forefront of solving age-old human problems as well as problems of the future.

Data Analysis and Structure. The structure of DNA was solved in 1953 using biophysics, and this discovery was critical to showing how DNA is like a blueprint for life. Now we can read the sequences of DNA from thousands of humans and all varieties of living organisms. Biophysical techniques are also essential to the analysis of these vast quantities of data.

Computer Modelling. Biophysicists develop and use computer modeling methods to see and manipulate the shapes and structures of proteins, viruses, and other complex molecules, crucial information needed to develop new drug targets, or understand how proteins mutate and cause tumors to grow.

Molecules in Motion. Biophysicists study how hormones move around the cell, and how cells communicate with each other. Using fluorescent tags, biophysicists have been able to make cells glow like a firefly under a microscope and learn about the cell's sophisticated internal transit system.

Neuroscience. Biophysicists are building computer models called neural networks to model how the brain and nervous system work, leading to new understandings of how visual and auditory information is processed.

Bioengineering, Nanotechnologies, Biomaterials. Biophysics has also been critical to understanding biomechanics and applying this information to the design of better prosthetic limbs, and better nanomaterials for drug delivery.

Imaging. Biophysicists have developed sophisticated diagnostic imaging techniques including MRIs, CT scans, and PET scans. Biophysics continues to be essential to the development of even safer, faster, and more precise technology to improve medical imaging and teach us more about the body's inner workings.

Medical Applications. Biophysics has been essential to the development of many life-saving treatments and devices including kidney dialysis, radiation therapy, cardiac defibrillators, pacemakers, and artificial heart valves.

Ecosystems. Environmental biophysics measures and models all aspects of the environment from the stratosphere to deep ocean vents. Environmental biophysicists research the diverse microbial communities that inhabit every niche of this planet, they track pollutants across the atmosphere, and are finding ways to turn algae into biofuels.

(https://www.biophysics.org/what-is-biophysics)

Task 6. True/False statements

1. Biophysics applies the theories and methods of chemistry to understand how biological systems work.

2. Biophysicists are uniquely trained in the quantitative sciences of physics, math, and chemistry.

3. The structure of DNA was solved in 1953 using biophysics.

4. Biophysicists do not work on developing new drug targets or understanding how proteins mutate and cause tumors to grow.

5. Biophysics has been critical to the development of kidney dialysis, radiation therapy, and artificial heart valves.

6. Environmental biophysics measure and model all aspects of nanotechnology.

7. Biophysicists are gaining new insights into how visual and auditory information is processed.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases.

Материаловедение, растительная клетка, возобновляемые источники энергии, передовые технологии, флюоресцирующая метка, нейронные сети, диагностическая визуализация, компьютерная томография, исследование методом позитронно-эмиссионной томографии, сердечный клапан, почечный диализ, транзитная система.

Task 8. Match each word in A with its synonyms in B.

A	B
1. blueprint	a) shine
2. technique	b) plan
3. inner	c) approach
4. crucial	d) internal

5. glow	e) key
6. sophisticated	f) construction
7. information	g) advanced
8. structure	h) data
9. cutting-edge	i) complex

Task 9. Match these words with their opposites.

1. internal	a) inactive
2. vibrant	b) inaccurate
3. sophisticated	c) external
4. precise	d) minor
5. critical	e) simple
6. cutting-edge	f) disorder
7. sequence	g) conventional

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Environmental, vibrant, complex, quantitative, fluorescent, sophisticated, prosthetic, diagnostic, vast

Task 11. Translate the following nouns and give the corresponding verbs.

Understanding, movement, functionality, development, prediction, communication, transformation, eradication, production, solution, analysis

Speaking

Task 12. Discuss the questions.

1. What field of biophysics is more innovational now?
2. How biophysics differs from other medical sciences?
3. What computer models help to model the brain and nervous system work?

Task 13. Make a presentation on one of the topics:

1. Biophysics in our daily life.
2. Types of CT scans in medicine.
3. The future of biophysics and its impact on society.

Task 14. Prepare the rendering of the text.

UNIT 3 CAREER IN BIOTECHNOLOGY

Intro

Task 1. Discuss your ideas in pairs and give feedback to the class.

1. What are career opportunities in biotechnology?
2. What are advantages of a career in biotechnology?
3. What are disadvantages of a career in biotechnology?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

husbandry	[ˈhʌzbəndrɪ]
enzyme	[ˈenzaɪm]
chemical	[ˈkemɪkl]
genetic	[dʒɪˈnetɪk]

tissue	[ˈtɪʃuː]
yield	[jiːld]
enhancement	[ɪnˈhɑːnsm(ə)nt]
vaccine	[ˈvæksiːn]
genome	[ˈdʒiːnəʊm]
virology	[vaɪˈrɒlədʒɪ]
sewage	[ˈsuːɪdʒ]
reagent	[rɪˈeɪdʒ(ə)nt]
tissue	[ˈtɪʃuː]

Task 3. Study the active vocabulary.

1. animal husbandry, n – животноводство. *Animal husbandry* is controlled cultivation, management, and production of domestic animals, including improvement of the qualities considered desirable by humans by means of breeding.

2. conservation, n – сохранение, заповедник, консервирование, охрана окружающей среды. *Conservation biology* – природоохранная биология; биология охраны природы. *Conservation* efforts include both land and species protection. *Conservation* of genetic resources is one important field of study in conservation biology.

3. contamination [kənˌtæmɪˈneɪʃ(ə)n], n – загрязнение; контаминация. Pesticides are sometimes responsible for *contamination* of watercourses.

4. fuel, n – топливо, горючее. Today's vehicles use two kinds of *fuel* – petrol and diesel.

biofuel [ˈbaɪəʊfjuː(ə)l], n **–** биотопливо, биологическое топливо. We must take care to maintain the balance between the development of *biofuels* and food security, especially in these critical times.

fossil fuels – горючие полезные ископаемые; ископаемые виды топлива; ископаемое топливо. Most global energy needs today are provided by *fossil fuels*.

5. genetic [dʒɪˈnetɪk], adj – генетический. *Genetic change* – генетическое изменение, *genetic diseases* – генетические заболевания, *genetic engineering* – генная инженерия, *genetic diversity* – генетическое разнообразие, генетическое многообразие; *genetic defect* – генетический дефект, генетическое отклонение; Probably, in species with a worldwide distribution, *genetic* changes may occur as populations adapt to new regions.

Genetics, n – генетика. *Molecular genetics* – молекулярная генетика; *applied genetics* – прикладная генетика. *Genetics* is the study of how, in all living things, the characteristics and qualities of parents are given to their children by their genes. It's difficult to keep track of all the new discoveries in *genetics*. New biotechnologies and advances in *molecular genetics* are essential to the understanding of the genetic structure of species.

geneticist [dʒɪˈnetɪsɪst], n – генетик. Clinical psychologists, *geneticists*, and neurobiologists have all contributed to the effort. And we documented the public fears - or hopes - that *geneticists* will soon acquire the awesome power to determine the human future.

6. genome [ˈdʒiːnəʊm], n – геном, совокупность генов*; entire genome* — полный геном; *fragmented genome* – фрагментированный геном; Genome is the complete set of genetic material of a human, animal, plant, or other living thing. They sequenced the human *genome*.

genomic [dʒɪˈnoʊmɪk], adj – геномный; *genomic DNA* – геномная ДНК*; genomic gene* – геномный (хромосомный) ген*; genomic library* – геномная библиотека, библиотека генов*; genomic mutation* – численная хромосомная мутация, геномная мутация. *Genomic* - relating to the complete set of genetic material of a human, animal, plant, or other living thing. Recently, new *genomic* resources and databases from genome projects have simplified the molecular analysis of the wheat genome. A *genomic library* is a collection of the total genomic DNA from a single organism. *Genomic mutations* - lead to the appearance of new genomes or parts thereof by the addition or loss of entire chromosomes.

7. inherit, v – унаследовать, перенять. She *inherited* her good eyesight from her mother.

8. sewage [ˈsuːɪdʒ], n – сточные воды, канализация, нечистоты; *to treat sewage* – очищать сточные воды; *treated sewage* – обработанные сточные воды, очищенные сточные воды. Bacteria are added to help break down the *sewage*. Jobs are available with environmental and conservation (*sewage* and waste treatment, fuel, pollutant degradation) companies.

9. tissue [ˈtɪʃuː], n – *ткань;* (*human tissue, plant tissue, brain/lung/muscle/fat tissue). Tissue* is a group of connected cells in an animal or plant that are similar to each other, have the same purpose, and form the stated part of the animal or plant. Soft tissue, such as flesh, allows X-rays through. We use this test to confirm the absence or presence of genetically modified plant material in a sample of seed or *plant tissue*.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. The most profitable industry is the (H, p, r, m, a, e, c, a, i, t, u, s, l, a, c) industry.
2. All (r, g, d, s, u) are poisons in nature, affecting all organ systems and tissues, but especially the central nervous system, brain, reproductive system, liver and kidneys.
3. Soon our cars will run on (b, o, f, i, u, l, e).
4. If the position involves using live organisms and biomolecular processes within a biotechnological discipline, it's likely to be a (t, s, i, b, i, g, t, o, o, l, c, e, o, n, h) role.
5. The human (m, o, n, e, g, e) contains approximately three billion chemical base pairs.

6. Vaccination and biosecurity cannot fully prevent outbreaks, so the development of (s, e, a, d, e, s, i) resistant salmon strains is a very attractive option.

7. Agricultural biotechnology focuses on developing genetically modified plants to increase crop (l, e, d, i, s, y).

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

Career in Biotechnology

Biotechnologists use their knowledge of biological science and technology to create and develop innovative products designed to improve the quality of human life.

They study the chemical, genetic and physical attributes of cells, tissues and organisms in order to develop new technologies, processes and products that will address some of the biggest problems facing society.

The role involves manipulating living organisms or their components to design or enhance vaccines, medicines, energy efficiency or food productivity and safety.

Specialization usually includes the following areas of biotechnology: biochemistry, cancer studies, genetics, molecular biology, microbial sciences, pharmacology, stem cell research, virology.

Job titles vary and won't always be advertised as biotechnologist. Other job titles include research assistant, genomic technologist and bioprocessing engineer. If the position involves using live organisms and biomolecular processes within a biotechnological discipline, it's likely to be a biotechnologist role.

Biotechnologists can be found in a range of industries including pharmaceuticals, healthcare, biofuels, agriculture, conservation, animal husbandry and food production.

Examples of activities one might undertake include environmental, medical and health, industrial, agricultural biotechnology, biofuels, marine and aquatic biotechnology.

Environmental – detecting and controlling pollution and contamination in the environment, industrial waste, and agricultural chemicals, creating renewable energy, and designing biodegradable materials to reduce humanity's ecological footprint.

Medical and health – using live organisms or biomolecular processes to develop and improve treatments and drugs, identify inherited diseases, cure certain disorders, and even lead to organ regeneration.

Industrial – using cloning and enzyme production to preserve and enhance the taste in food and drink and developing enzymes to remove stains from clothing at lower washing temperatures.

Agricultural biotechnology – improving animal feed and genetically modifying crops to increase resistance to pests and improve productivity.

Biofuels – using organic compounds to reduce the cost of biorefining reagents and put biofuels on an equal footing with fossil fuels and creating chemicals from renewable biomass to reduce greenhouse gas emissions.

Marine and aquatic biotechnology – increasing the yields of farmed fish and designing disease-resistant strains of oysters and vaccines against certain viruses that can infect fish.

Large private biotech companies tend to advertise positions with a focus on medical, pharmaceutical and biochemical disciplines, while small and medium-sized enterprises often advertise positions using a different job title.

Jobs are available with biotechnology and genetic engineering firms; food and drink manufacturers; environmental and conservation (sewage and waste treatment, fuel, pollutant degradation) companies; government and charity research institutes; horticulture and agriculture organisations (food and drink science); NHS and private hospitals; pharmaceutical and chemical companies; clinical research companies (genetics, disease detection, therapy, etc.); universities and research institutions.

Task 6. True/False statements

1. Job titles do not vary and will always be advertised as biotechnologist.
2. Biotechnologists develop innovative products designed to improve the quality of human life.
3. Biofuels are used to reduce the cost of bio-refining reagents.
4. There are few jobs with this direction.
5. Biotechnology Graduates can get job opportunities only in private sector units.
6. The biotechnology industry is rapidly growing, which offers various job opportunities in the biotechnology industry.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases.

Живые организмы; улучшать качество жизни человека; эффективность использования энергии; исследование стволовых клеток; принимать меры по борьбе с загрязнением; биоразлагаемые материалы; экологический след; наследственная болезнь; производство ферментов; наравне с; линия, устойчивая к болезням; регенерация органов; органические соединения.

Task 8. Match each word in A with its synonyms in B.

A	B
1. enhance	a) people
2. assistant	b) oceanic
3. conservation	c) gardening
4. marine	d) apprentice
5. contamination	e) illness

6. position	f) improve
7. yield	g) announce
8. disease	h) pollutant
9. material	i) preservation
10. humanity	j) job
11. advertise	k) production
12. horticulture	l) substance

Task 9. Match these words with their opposites.

1. enhance	a) similar
2. efficiency	b) inflow
3. preservation	c) public
4. reduce	d) limited
5. disorder	e) worsen
6. emission	f) inefficiency
7. different	g) health
8. available	h) increase
9. private	i) destruction

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Genetic, genomic, environmental, efficient, industrial, different, agricultural, difficult, biodegradable, ecological, inherited (disease), innovative.

Task 11. Translate the following nouns and give the corresponding verbs.

Study, development, manipulation, design, enhancement, improvement, identification, reduction

Speaking

Task 12. Discuss the questions.

1. Do you agree with the statement that Biotechnology is a rapidly evolving sector that offers both exciting opportunities and unique challenges. Why? Why not?

2. Biotech professionals have the opportunity to make significant contributions to society. Do you agree with the statement? Prove your point of view.

3. The interdisciplinary nature of Biotech can make the work intellectually stimulating and varied. What is meant by this statement? What are the advantages and disadvantages of the profession?

4. There are many career opportunities in biotechnology. What biotechnology careers in your opinion are currently in high demand, and likely still will be in the future?

Task 13. Make a presentation on the topic:

Biotechnology Career paths and Biomedical Engineering

Task 14. Prepare the rendering of the text.

UNIT 4 PHYSICS AND MEDICINE

Intro

Task 1. Discuss your ideas in pairs and give a feedback to the class.

1. What role does physics play in medicine?
2. What modern technologies are currently used in hospitals?
3. What biotechnologies will we use in the future?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

minuscule	[ˈmɪnəskjuːl]
techniques	[tek'ni:k]
revolutionize	[reve'lu:fanaiz]
utilizes	[juitalaiz]
categorize	[kategaraiz]
physiological	[fizialodzIkl]
physician	[fizin]
revise	[rIvaiz]
specialized	[spe alaiza]
linear	[linia (r)]
emission	[I'mijn]
pharmaceutical	[ˌfɑ:məˈsju:tɪkəl]
quantitative	[kwontitativ]
microbubbles	['makrau'babl]

Task 3. Study the active vocabulary.

1. **branch,** n – ветка, филиал, отделение, отрасль. Medical physics is a *branch* of applied physics that utilizes physical sciences to prevent, diagnose, and treat human diseases.

2. **sub-group,** n – подгруппа. Medical physics can be categorized into multiple *sub-groups*.

3. **primarily,** adv. - главным образом. Medical physics *primarily* focuses on ionizing radiation measurement.

4. **revise,** v- перерабатывать, исправлять. ...introduced in the *revised* edition of Nysten's medical dictionary.

5. **preservation,** n - сохранение. Physics applied to the knowledge of the human body, to its *preservation* and to the cure of its illnesse.

6. **setup,** n - учреждениях. They primarily work in clinical *setups* or in academic and research institutions.

7. **hazard,** n - риск, источник опасности. The key roles of medical physicists include the application of medical physics tech-

niques for the diagnosis of human diseases and the protection of patients from ionizing and non-ionizing radiation *hazards*.

8. **brachytherapy** [brækiˈθerəpi]**,** n - лечение рака, при котором очень маленькие радиоактивные предметы помещаются внутрь опухоли или рядом с ней. The treatments mostly include *brachytherapy*, wherein a radiation source is placed inside the body.

9. **conduct,** v - проводить. Medical physicists specialized in nuclear physics mostly *conduct* functional imaging of patients using positron emission tomography (PET).

10. **labele,** v - прикреплять ярлык. Biological substances *labeled* with radioactive markers.

11. **obtain,** v – получать. Cross-sectional X-ray images *obtained* upon repeated scanning are digitally stacked to generate high-resolution.

12. **perfusion,** n - Перфузия, акт переливания жидкости поверх или через ткань определенного органа. During the *perfusion* procedure, a contrasting agent is administered, and repeated imaging of the affected region is performed at an interval of 3 – 5 seconds for 30 seconds.

13. **non-invasive,** adj – относящиеся к любому медицинскому тесту или лечению, которые не разрезают кожу и не проникают в какие-либо области тела. Magnetic resonance imaging (MRI) is a powerful *non-invasive* medical imaging technique that uses a strong, static magnetic field.

14. **cerebral blood,** n - Кровоснабжение головного мозга. The modalities commonly used for quantitative MRI include arterial spin labeling for *cerebral blood* flow measurement and diffusion tensor imaging for microstructural analysis.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. The results are interesting due to the use in this case of a <u>(i, a, s, o, n, n, v, n, i, e, v)</u> __-_______ method.

2. The filter paper in the dish which had held no larvae was also (d, a, b, l, l, l, e, e) with a 'zero'.

3. A further study, therefore, is planned to reassess these children, after an interval, with myocardial (f, s, p, e, i, o, r, u, n) scans and exercise testing.

4. In the literature, works on revision generally operate within the context of consistency (v, p, s, e, r, e, r, n, a, o, i, t) .

5. Finally, we ran the same (t, u, e, p, s) for nonlinear laser field strengths.

6. This is the same data that we used to (n, o, u, d, c, c, t) the factor analysis that we reported earlier.

7. Several are intimately linked to growing (z, a, a, r, s, d, h) as pressure for new housing encroaches upon floodplains and old water meadows.

8. His (d, r, e, e, b, b, l, a, c, r, o, o) ______ ___ circulation is infarcted.

9. The coronary vasculature is visible and there is a lack of adherent (s, s, i, u, e, t).

10. She decided to work in clinical (t, u, p, s, s, e,).

11. Additionally, the values of the performance index (b, t, i, e, o, d, a, n) are usually smaller than those determined by the penalty function method.

12. Neurology is a (r, a, n, h, c, b) of medicine.

13. (c, h, b, p, y, r, a, a, r, y, t, h, e) is a form of radiation therapy where a sealed radiation source is placed inside or next to the area requiring treatment.

14. She's known (r, m, a, l, y, i, i, r, p) as a novelist but she also writes poetry.

15. As part of the research project, the students organized a (g, r, s, b, p, u, u, o) to analyze and compare the political systems of different countries.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

The Role of Physics in Medicine

By Dr. Sanchari Sinha Dutta, Ph.D.Reviewed by Danielle Ellis, B.Sc.

The application of physics principles, methods, and techniques in clinical practice and research has revolutionized the entire medical science field to improve human health and overall wellbeing.

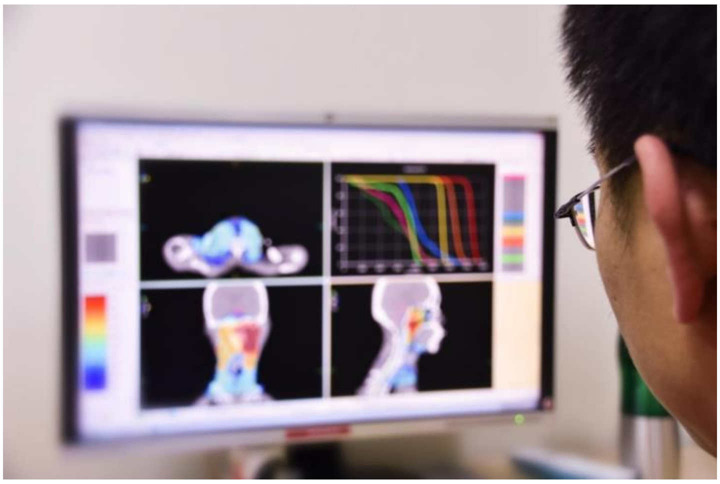

Image Credit: Nuttawut Yeenang/Shutterstock.com

What is Medical Physics?

Medical physics is a branch of applied physics that utilizes physical sciences to prevent, diagnose, and treat human diseases. Medical physics can be categorized into multiple sub-groups: medical imaging physics, radiation oncology physics, non-ionizing medical radiation physics, nuclear medicine physics, medical health physics, and physiological measurements.

Medical physics primarily focuses on ionizing radiation measurement, magnetic resonance imaging, and applying physics-based technologies (lasers and ultrasound) in medicine.

The term "medical physics" was first introduced by Félix Vicq d'Azir, a French physician, anatomist, and the general secretary of the Royal Society of Medicine, in Paris in 1778. In 1814, the most appropriate definition of medical physics was introduced in the revised edition of Nysten's medical dictionary. In this edition, medical physics was defined as *"physics applied to the knowledge of the human body, to its preservation and to the cure of its illnesses."*

What is Medical Physics?

Key Roles of Medical Physicists?

Medical physicists are healthcare professionals who have specialized training in applying physics concepts and technologies in medicine. They primarily work in clinical setups or in academic and research institutions. The key roles and responsibilities of medical physicists include the application of medical physics techniques for the diagnosis and treatment of human diseases and the protection of medical staff and patients from ionizing and non-ionizing radiation hazards.

Medical physicists specialized in radiation therapy are primarily involved in providing radiation treatments for cancer patients in collaboration with oncologists and other therapists. The treatments mostly include brachytherapy, wherein a radiation source is placed inside the body, or external beam radiation therapy, wherein linear accelerator-generated radiation is carefully delivered to affected tissues.

Medical physicists specializing in medical imaging are engaged in developing and maintaining various imaging techniques, including x-ray, computed tomography scan (CT-scan), and magnetic resonance imaging.

Medical physicists specialized in nuclear physics mostly conduct functional imaging of patients using positron emission tomography (PET), gamma camera, and biological substances labeled with radioactive markers (radiopharmaceuticals).

X-Ray and CT Scan

In X-rays, signals generated from a narrow X-ray beam transverse the affected area of interest to create planer images. Similarly, cross-sectional X-ray images obtained upon repeated scanning are digitally stacked to generate high-resolution, three-dimensional, or four-dimensional computed tomography (CT) images to analyze dynamic processes.

Tests for Ureteric Calculi: Radiograph, CT and Ultrasound

Besides providing quantitative and reproducible anatomical images, CT can produce high-quality functional information through dynamic perfusion scanning. During the perfusion procedure, a contrasting agent is administered, and repeated imaging of the affected region is performed at an interval of 3 – 5 seconds for 30 seconds. These images are subsequently stacked to form four-dimensional images. This technique is very useful in analyzing hemodynamic parameters, including blood flow and blood volume.

Magnetic Resonance Imaging

Magnetic resonance imaging (MRI) is a powerful non-invasive medical imaging technique that uses a strong, static magnetic field, magnetic gradients, and computer-induced radio waves to produce high-quality three-dimensional images of tissues and organs. The magnetic field applied to the body realigns the body's photons with that field. Subsequently, radio waves stimulate photons, and MRI sensors are used to detect energy (signal) released from photons.

In quantitative MRI, contrast differences between two tissues are maximized on a single image by utilizing the relaxation time differences of two tissues. The images are weighted based on the properties of one tissue. The modalities commonly used for quantitative MRI include arterial spin labeling for cerebral blood flow measurement and diffusion tensor imaging for microstructural analysis.

Ultrasound

Ultrasound is a high-frequency sound wave that generates non-invasive images of different tissues and organs. The difference in mechanical properties at the interface of different organs/tissues causes ultrasound reflection. These reflections are measured to generate ultrasound images.

The main advantages of ultrasound over other medical imaging techniques (CT and MRI) are cost-effectiveness and real-time imaging at the bedside. Contrast enhancing agents, such as microbubbles, are used in ultrasound for functional imaging. Besides disease diagnosis, ultrasound is used for therapeutic purposes. For instance, high-intensity focused ultrasound removes affected tissues inside the body without damaging surrounding healthy tissues. In addition, ultrasound is used for targeted drug delivery.

Image Credit: Production Perig/Shutterstock.com

Nuclear Medicine

In nuclear medicine, radioactive probes are used to observe physiological processes. The probes are also used for targeted delivery of therapeutic doses. A very small amount of radioactive probe is administered to the body during the procedure. The probe is subsequently absorbed by the organ/tissue under investigation. The radiation emitted from the probe due to decay is detected by a gamma camera, which generates digital signals for analyzing the functional state of the organ.

A gamma camera generates two-dimensional images when it remains stationary. In single-photon emission computed tomography, the camera is rotated to generate axial slices of the target organ. These slices can be used in PET scans to generate three-dimensional images.

Radiotherapy

Radiation therapy involves the delivery of ionizing radiation inside the body to destroy and eliminate cancer cells. For deep-seated tumors, high-energy photons are used. For superficial tumors, high-energy electrons are used. In addition, charged particles, including protons, are used in radiotherapy.

During the entire treatment procedure, medical imaging is performed to ensure safe and targeted delivery of the radiation and to assess radiation-induced changes in the anatomy.

https://www.news-medical.net/health/The-Role-of-Physics-in-Medicine.aspx

Task 6. True/False statements

1. The treatments mostly include brachytherapy, wherein a radiation source is placed outside the body, or external beam radiation therapy, wherein linear accelerator-generated radiation is carefully delivered to affected tissues.
2. Radiation therapy involves the delivery of ionizing radiation inside the body to destroy and eliminate cancer cells.
3. Medical physics primarily focuses on ionizing radiation measurement, magnetic resonance imaging, and applying physics-based technologies (lasers and ultrasound) in medicine.
4. Ultrasound is a low-frequency sound wave that generates non-invasive images of different tissues and organs.
5. High-intensity focused ultrasound removes affected tissues inside the body with damaging surrounding healthy tissues.
6. During the perfusion procedure, a contrasting agent is administered, and repeated imaging of the affected region is performed at an interval of 3 – 5 seconds for 30 seconds.
7. In quantitative MRI, contrast differences between two tissues are minimized on a single image by utilizing the relaxation time differences of two tissues.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases

Общее благополучие, произвести революцию во всей области науки, измерение ионизирующего излучения, линейный ускоритель частиц, контрастные усиливающие вещества, удалять пораженные ткани, поперечный рентгеновский луч.

Task 8. Match each word in A with its synonym in B.

A	B
1. transverse	a) on the surface
2. disease	b) section
3. superficial	c) crosswise
4. branch	d) dimension
5. measurement	e) illness

Task 9. Match these words with their opposites.

1. enhancing	a) deep
2. transverse	b) trouble
3. well-being	c) health
4. disease	d) degradation
5. superficial	e) longitudinal

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Various, magnetic, biological, reproducible, contrasting, different, superficial.

Task 11. Translate the following nouns and give the corresponding verbs.

Measurement, perfusion, reflection, enhancing, radiation, imaging.

Speaking

Task 12. Discuss the questions.

1. What modern physics methods are employed in medical diagnostics, and how do they enhance the accuracy and efficiency of patient examinations?
2. How does physics play a role in the development of new medical treatment technologies, and what prospects are opened up through contemporary physics research?
3. What challenges and issues exist in the intersection of physics and medicine, and how can these barriers be overcome for further advancements in both scientific fields and healthcare?

Task 13. Make a presentation on the topic:

Innovative Applications of Physics in Advancing Medical Diagnostics and Treatment Technologies

Task 14. Prepare the rendering of the text.

UNIT 5 MEDICAL IMAGING TECHNOLOGIES

Intro

Task 1. Discuss your ideas in pairs and give a feedback to the class.

1. How does an X-ray machine work, and why is it helpful for doctors to see inside the human body?
2. Can you explain what an ultrasound is and give an example of when a doctor might use it to help a patient?

3. If you were a scientist creating a new kind of medical imaging device, what would it do, and how could it benefit patients?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

imaging	[ɪˈmɪdʒ.ɪŋ]
radiology	[ˌreɪ.diˈɒl.ə.dʒi]
endoscopy	[enˈdɒs.kə.pi]
diseases	[dɪˈziːz]
electrocardiograph	[ˌiˌlektrəˈkɑːdiəgrɑːf]
fluoroscopy	[flʊəˈrɒskəpɪ]
non-invasive	[nɔn-ɪnˈveɪsɪv]
beneficial	[ˌbenɪˈfɪʃl]
fracture	[ˈfræktʃər]
frequently	[ˈfriːkwəntlɪ]
enhancing	[ɪnˈhɑːnsɪŋ]
technologies	[technologies]
angiography	[ænʤɪˈɒgrəfɪ]

Task 3. Study the active vocabulary.

1. medical imaging, n - медицинская визуализация (работа с рентгенографическими и томографическими изображениями). *Medical imaging* is a central part of the improved outcomes of modern medicine.

2. injury, n **–** рана, травма, повреждение. … presents a diagnosis of the disease or *injury* and determines the best treatment options for the patient.

3. intrusive [ɪnˈtruːsɪv]**,** adj – навязчивый. ... allow doctors to diagnose injuries and diseases without being *intrusive*.

4. improve outcomes – улучшить результаты. Medical imaging is a central part of the *improved outcomes* of modern medicine.

5. ultrasound, adj – ультразвук, УЗИ. *Ultrasound*, using ultrasonic vibrations to create images, represents one of the safest forms of medical imaging.

6. tactile imaging, n – тактильная визуализация. *Tactile imaging* is one of the types of medical imaging procedures.

7. beneficial, adj – выгодный, полезный, хороший. Other *beneficial* medical imaging procedures include nuclear medicine functional imaging techniques…

8. fracture, n – перелом. … scans to see how well your body is responding to a treatment for a *fracture* or illness.

9. sparingly [ˈspeərɪŋlɪ]**,** adv. **-** осторожно, используя только очень небольшое количество чего-либо. …but because of ionizing radiation, they must be used *sparingly*.

10. cellular mutation - клеточная мутация. Ionizing radiation carries with it risk of cancers, cataracts, *cellular mutation* and abnormal development in fetuses.

11. abnormal development - аномальное развитие. Ionizing radiation carries with it risk of cancers, cataracts, cellular mutation and *abnormal development* in fetuses.

12. fetuse, n - зародыш, эмбрион. Ionizing radiation carries with it risk of cancers, cataracts, cellular mutation and abnormal development in *fetuses*.

13. enhance, v - улучшать, усиливать. In a number of medical imaging technologies artificial intelligence (AI) is *enhancing* the ability to interpret and analyze results.

14. blood vessels, n - кровеносные сосуды. Angiography - which involves imaging a patient's *blood vessels* and heart. Medical imaging allows doctors to better assess patients' bones, organs, tissue and *blood vessels* through non-invasive means.

15. tumor, n – опухоль. The procedures help determine whether surgery would be an effective treatment option; locate *tumors* for treatment and removal…

16. joint, n - сустав ... direct doctors dealing with *joint* replacements or the treatment of fractures…

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. An important question is to determine what specific features of their tasks (n, e, e, a, h, n, c) children's understanding of the experimenter's intentions.
2. In fact, there are a number of similarities between normal blood vessels and the structures found in these benign infantile (u, r, o, m, t , s).
3. Because of (i, n, j, o, t) flexibility, the manipulators are difficult to calibrate kinematically.
4. Moreover, recycling can be economically (n, f, c, l, e, b, e, a, i, i) in developing countries.
5. Serious stair (j, s, r, i, n, e, i, u) can be prevented by improved stair design.
6. His problems include (s, v, e, t, n, i, i, r, u) voices and are such as to require therapy.
7. The houses have raised terraces, but they are (y, s, g, a, r, l, p, i, n) used and do not divide life from the ground.
8. Willingness to pay for (s, o, t, u, d, l, n, r, a, u) in normal pregnancy.
9. During the pregnancy, the woman underwent regular ultrasound scans to monitor the development of her (u, e, t, f, s).
10. (l, a, e, c, u, l, r, l) (t, n, t, a, i, u, m, o)____ ____ is a crucial process in the development of all living organisms.

11. By utilizing (d, i, m, e, l, a, c) (g, m, g, i, n, a, i) ____ ____ technologies, healthcare professionals were able to accurately diagnose and plan for treatment of a patient with a rare form of cancer.

12. By using advanced imaging techniques and 3D visualization, doctors were able to visualize and analyze the (d, l, o, o, b) (s, l, s, e, s, v, e) __ ___ in a patient's body, providing crucial information for diagnosis and treatment planning.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

Medical imaging (radiology)

Medical imaging, also known as radiology, is the field of medicine in which medical professionals recreate various images of parts of the body for diagnostic or treatment purposes. Medical imaging procedures include non-invasive tests that allow doctors to diagnose injuries and diseases without being intrusive.

Medical imaging is a central part of the improved outcomes of modern medicine. Different types of medical imaging procedures include:

- X-rays
- Magnetic resonance imaging (MRI)
- Ultrasounds
- Endoscopy
- Tactile imaging
- Computerized tomography (CT scan)

Other beneficial medical imaging procedures include nuclear medicine functional imaging techniques, such as positron emission tomography (PET) scans. Other uses of medical imaging include scans to see how well your body is responding to a treatment for a fracture or illness.

Medical imaging technologies

Technologies used in medical imaging include those belonging to the field of radiography. X-ray and CT scans are powerful tools, but because of ionizing radiation, they must be used sparingly. Ionizing radiation carries with it risk of cancers, cataracts, cellular mutation and abnormal development in fetuses. MRIs -- including nuclear magnetic resonance (NMR) -- offer reduced risks and no ionizing radiation. Ultrasound, using ultrasonic vibrations to create images, represents one of the safest forms of medical imaging.

The use of surface-mounted sensors to measure electrical activity is another safe form of medical imaging and is used in electroencephalography (EEG) and electrocardiography (ECG) -- though these technologies produce a change over time graph rather than a graphical image.

In a number of medical imaging technologies artificial intelligence (AI) is enhancing the ability to interpret and analyze results. Computer vision is being used to visually diagnose conditions not yet visible to the human eye.

Who uses medical imaging?

A radiographer -- also known as a medical imaging technologist or radiology technologist -- is responsible for administering medical imaging procedures. Radiographers are university-trained with thorough knowledge of the body's structure and how it is affected by different diseases and injuries. They can specialize in the procedures mentioned above -- including MRIs and CT scans -- as well as in areas such as:

- Angiography - which involves imaging a patient's blood vessels and heart.
- Mobile radiography - which is the use of special machines to perform imaging procedures on patients that are too sick to travel to a hospital.
- Fluoroscopy - which is an x-ray that examines the patient's internal body and displays moving images on a screen, like a movie.

- Trauma radiography - which frequently involves work in emergency departments.

Radiographers perform medical imaging procedures at the request of a radiologist. Radiologists are doctors trained to diagnose and treat diseases and injuries using medical imaging technologies. Radiologists are also responsible for treating diseases -- such as cancer and heart disease -- using radiation or minimally invasive, image-led surgery.

Once the procedures are complete, the radiographer presents the images to the radiologist. The radiologist then analyzes the results, presents a diagnosis of the disease or injury and determines the best treatment options for the patient.

Importance of medical imaging

Medical imaging allows doctors to better assess patients' bones, organs, tissue and blood vessels through non-invasive means. The procedures help determine whether surgery would be an effective treatment option; locate tumors for treatment and removal; find blood clots or other blockages; direct doctors dealing with joint replacements or the treatment of fractures; and assist other procedures involving the placement of devices -- such as stents or catheters -- inside the body.

Overall, medical imaging has improved diagnoses and treatments by greatly reducing the amount of guess work done by doctors, allowing them to more effectively deal with patients' injuries and diseases.

(https://www.techtarget.com/whatis/definition/medical-imaging)

Task 6. True/False statements

1. Medical imaging procedures include invasive tests that allow doctors to diagnose injuries and diseases without being intrusive.
2. Ultrasound, using ultrasonic vibrations to create images, represents one of the dangerous forms of medical imaging.
3. Medical imaging allows doctors to better assess patients' bones, organs, tissue and blood vessels through non-invasive means.

4. Fluoroscopy - which involves imaging a patient's blood vessels and heart.

5. Computer vision is being used to visually diagnose conditions not yet visible to the human eye.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases

Методы функциональной визуализации ядерной медицины, использование ультразвуковых вибраций для создания изображений, использование поверхностных датчиков для измерения электрической активности, повышение способности интерпретировать и анализировать результаты, исследует внутреннее тело пациента и отображает движущиеся изображения, найти сгустки крови или другие закупорки, процедуры медицинской визуализации включают не инвазивные тесты.

Task 8. Match each word in A with its synonym in B.

A	B
1. beneficial	a) fabric
2. fracture	b) advantageous
3. sparingly	c) break
4. enhancing	d) circulatory system
5. blood vessel	e) improving
6. tissue	f) growths
7. tumors	g) economically

Task 9. Match these words with their opposites.

1. injuries	a) regression
2. outcomes	b) integrity
3. beneficial	c) wellness
4. tactile	d) external
5. development	e) non-touch

6. fracture	f) harmful
7. internal	g) causes

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Beneficial, invasive, medical, tactile, sparingly, powerful, ionizing.

Task 11. Translate the following nouns and give the corresponding verbs.

Mutation, development, injuries, treatment, vibration, replacement, radiation.

Speaking

Task 12. Discuss the questions.

1. What are the challenges facing the field of medical imaging (radiology) today and how can technology be improved for more accurate diagnosis?
2. How can access to resources be improved in underserved regions, and what innovations can spread to the increased prevalence of radiology technology?
3. What ethical issues influence the use of advanced technologies in medical imaging, and how does one ensure a balance between innovation and patient privacy?

Task 13. Make a presentation on the topic:

Integrating artificial intelligence into medical imaging: improving diagnostics and developing radiology technologies.

Task 14. Prepare the rendering of the text.

UNIT 6 MAGNETIC RESONANCE IMAGING

Intro

Task* 1. *Discuss your ideas in pairs and give a feedback to the class.

1. What do you know about different ways of studying the internal organs of a person?
2. What do you think about the effect of radio waves on a living organism?
3. What do you know about the planetary model of the atom?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

hydrogen	[ˈhaɪdrədʒən]
multiple	[ˈmʌltɪpl]
ascertain	[ˌæsəˈteɪn]
prosthesis	[ˈprɒs.θə.sɪs]
sought	[sɔt]
magnetic	[mægˈnet.ɪk]
additional	[əˈdɪʃ.ən.əl]
source	[sɔːs]
analysis	[əˈnæl.ə.sɪs]
valve	[vælv]

Task 3. Study the active vocabulary.

1. **axis** [ˈæksɪs]**,** n **–** ось. Another fraction of the electric current is localized near the channel *axis*. *Axial spin* – осевой спин.

2. **spin,** v **-** крутить(ся), вертеть(ся). If something spins or you *spin* something, it turns around and around quickly.

3. **field strength –** напряженность поля.

4. deflection, n **–** отклонение. In this device, the r coordinate oscillation is generated by a conventional galvo-scanner *deflecting* the beam out of the optical axis.

5. from head to toe – с головы до ног. The dog was covered in mud *from head to toe*.

6. increment [ˈɪŋkrɪm(ə)nt]**,** n **–** приращение. During color-discrimination testing, responses to the spectral *increment* were re-warded.

7. coil, n - виток, кольцо, катушка. This avoided the use of compensating field *coils*. *Receiver coil* – приемная катушка.

8. aerial [ˈeərɪəl]**,** n **–** антенна. Each station has two *aerials*, one to transmit and one to receive.

9. section, n – сечение*. Sectional image* **–** изображение по-перечного сечения.

10. disease, n **-** болезнь, заболевание. The number of breath-less people is increasing as patients with all types of cardio-respiratory *disease* live longer.

11. circumstance [ˈsɜːkəmst(ə)ns]**,** n **–** обстоятельства**.** I think she coped very well under the *circumstances*.

12. pathology, n **–** патология. The more accurate definition of *pathology* will improve diagnosis and should reduce hospital admis-sions.

13. frequency, n **-** частота, повторяемость. The *frequency* of attacks seems to have increased recently.

14. alignment, n **-** выравнивание по линии, формирование блока. First, what sorts of representations are being aligned; and sec-ond, how is this *alignment* achieved?

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian

1. Several devices that have been successful in modern surgery in-clude hip replacements, contact and intraocular lenses, heart <u>(c, e, e, r, a, a, p, m, k)</u> and so on.

2. The (e, o, i, t, s, n, s) have been photographed so that the lateral surface of the brain faces upwards with the ventrolateral edge of the brain to the left.

3. Most modern (r, a, a, i, e, l, s) will work internally and do not have to be attached externally to a chimney stack or the roof.

4. This result demonstrates that the ion energy (n, n, e, t, r, c, m, i) due to the application of the magnetic field is not dependent on the ion charge state.

5. A wave washed over him (m, h, o, o, o, f, r, t, t, e, e, a) ____ ____ __ ___.

6. The electrical pulses are directed through a copper (i, o, l, c), shaped in a figure eight, which is placed against the human's scalp.

7. The earth (I, n, s, s, p) on its axis.

8. Conventional (p, s, s, s, o, e, e, t, r, h) cannot achieve the latter form as the digits' motion is fixed.

9. (d, r, o, g, h, e, y, n) is the first element of the periodic table.

10. The (q, e, e, u, y, f, r, c, n) of light is responsible for what color we see it.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

Magnetic resonance imaging

Abi Berger, science editor

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Magnetic resonance imaging (MRI) uses the body's natural magnetic properties to produce detailed images from any part of the body. For imaging purposes the hydrogen nucleus (a single proton) is used because of its abundance in water and fat.

The hydrogen proton can be likened to the planet earth, spinning on its axis, with a north-south pole. In this respect it behaves like a small bar magnet. Under normal circumstances, these hydrogen proton "bar magnets" spin in the body with their axes randomly aligned.

When the body is placed in a strong magnetic field, such as an MRI scanner, the protons' axes all line up. This uniform alignment creates a magnetic vector oriented along the axis of the MRI scanner. MRI scanners come in different field strengths, usually between 0.5 and 1.5 tesla.

When additional energy (in the form of a radio wave) is added to the magnetic field, the magnetic vector is deflected. The radio wave frequency (RF) that causes the hydrogen nuclei to resonate is dependent on the element sought (hydrogen in this case) and the strength of the magnetic field.

The strength of the magnetic field can be altered electronically from head to toe using a series of gradient electric coils, and, by altering the local magnetic field by these small increments, different slices of the body will resonate as different frequencies are applied.

When the radiofrequency source is switched off the magnetic vector returns to its resting state, and this causes a signal (also a radio wave) to be emitted. It is this signal which is used to create the MR images. Receiver coils are used around the body part in question to act as aerials to improve the detection of the emitted signal. The intensity of the received signal is then plotted on a grey scale and cross sectional images are built up.

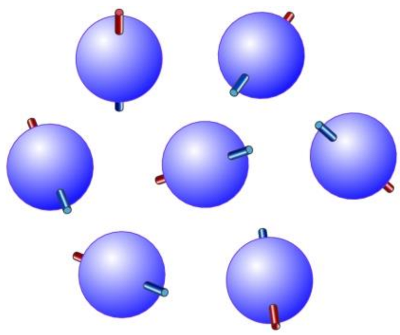
Multiple transmitted radiofrequency pulses can be used in sequence to emphasise particular tissues or abnormalities. A different emphasis occurs because different tissues relax at different rates when the transmitted radiofrequency pulse is switched off. The time taken for the protons to fully relax is measured in two ways. The first is the time taken for the magnetic vector to return to its resting state and the second is the time needed for the axial spin to return to its resting state. The first is called T1 relaxation, the second is called T2 relaxation.

An MR examination is thus made up of a series of pulse sequences. Different tissues (such as fat and water) have different relaxation times and can be identified separately. By using a "fat suppression" pulse sequence, for example, the signal from fat will be removed, leaving only the signal from any abnormalities lying within it.

Most diseases manifest themselves by an increase in water content, so MRI is a sensitive test for the detection of disease. The exact nature of the pathology can be more difficult to ascertain: for example, infection and tumour can in some cases look similar. A careful analysis of the images by a radiologist will often yield the correct answer.

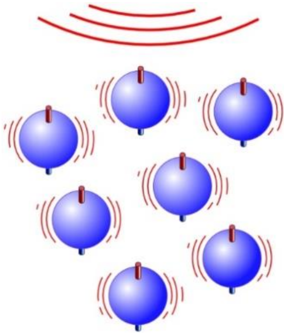
There are no known biological hazards of MRI because, unlike x ray and computed tomography, MRI uses radiation in the radiofrequency range which is found all around us and does not damage tissue as it passes through.

Pacemakers, metal clips, and metal valves can be dangerous in MRI scanners because of potential movement within a magnetic field. Metal joint prostheses are less of a problem, although there may be some distortion of the image close to the metal. MRI departments always check for implanted metal and can advise on their safety. Safety information is also available on the internet on http://kanal.arad.upmc.edu/MR_Safety/



Figure

The hydrogen proton can be likened to the planet earth, spinning on its axis, with a north-south pole. In this respect it behaves like a small bar magnet. Under normal circumstances, these hydrogen proton "bar magnets" spin in the body with their axes randomly aligned.



Figure

When the body is placed in a strong magnetic field, such as an MRI scanner, the protons' axes all line up. This uniform alignment creates a magnetic vector oriented along the axis of the MRI scanner.

(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1121941)

Task 6. True/False statements

1. When the body is placed in a strong magnetic field the protons' axes all line up.
2. MRI is a danger to the human body.
3. Pacemakers, metal clips, and metal valves can be dangerous in MRI scanners.
4. Receiver coils are needed to emit a signal.
5. The hydrogen proton spins on its axis.
6. Different tissues (such as fat and water) have different relaxation times.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases

Выстроиться (в ряд), время релаксации, в этом плане, стержневой магнит, поперечное сечение, небольшие приращения, различные ткани.

Task 8. Match each word in A with its synonym in B

A	B

1. axis	a) rise
2. antenna	b) twist
3. increasing	c) shift
4. deflection	d) core
5. spin	e) dish
6. deformation	f) affect
7. influence	g) strain

Task 9. Match these words with their opposites.

1. coil	a) intended
2. random	b) scalar
3. biological	c) shell
4. vector	d) sliding
5. nucleus	e) synthetic
6. attrition	f) perpendicular
7. horizontal	g) straight

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Magnetic, biological, difficult, different, local, special, natural

Task 11. Translate the following nouns and give the corresponding verbs.

Strength, head, critic, length, apology, vapor, sympathy

Speaking

Task 12. Discuss the questions.

1. What is MRI used for and what diseases can be detected with its help?
2. How can the strength alter the magnetic field?

3. What does a hydrogen proton look like and how does it behave in a magnetic field?

Task 13. Make a presentation on the topic.

Electromagnetic physics in medicine

Task 14. Prepare the rendering of the text.

UNIT 7 MOLECULAR BIOLOGY

Intro

Task 1. Discuss your ideas in pairs and give a feedback to the class.

1. What do you know about molecular biology? What does molecular biology study?
2. What kind of work do molecular biologists do?
3. What do you know about genes and proteins?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

array	[əˈreɪ]
enzyme	[ˈenzaɪm]
molecule	[ˈmɒl.ɪ.kjuːl]
molecular biology	[məˌlek.jʊ.lə baɪˈɒl.ə.dʒi]
nucleic acid	[njuːˌkleɪ.ɪk ˈæs.ɪd]
polymerase	[pəˈlɪ.mᵊr.eɪz]
perception	[pəˈsep.ʃᵊn]
vital	[ˈvaɪ.tᵊl]
yielding	[ˈjiːldɪŋ]

Task 3. Study the active vocabulary.

1. blotting, n - блоттинг, процесс переноса макромолекул; промокание. Macromolecule *Blotting* & Probing - Some processes, like northern blotting, Southern blotting, eastern blotting, and western blotting, are useful for transferring RNA or DNA proteins into a blotting membrane.

2. chain, n - цепь, последовательность. PCR or Polymerase *Chain* Reaction - It is one of the highly vital techniques that are utilized in molecular biology.

3. gene, n - ген. Proteins are useful for performing a huge array of functions that happen within a living cell**,** whereas molecular biology of the *gene* comprises the info that is needed for making more proteins.

4. genesis, n - генезис. If you don't know "What is molecular biology" then you should know it is a division of biology that deals with the study of biological components and their interactions besides a collection of processes that are developed because the *genesis* of the field has authorized scientists to learn a lot about the processes of molecules.

5. plasmid, n - плазмид. The DNA which codes for a specific protein gets copied or cloned through the use of PCR into some expression vector known as a *plasmid*.

6. protein, n - белок. Expression Cloning - Expression cloning is helpful to scientists in understanding the functions of the *protein*.

7. probing, n - зондирование, исследование. Macromolecule Blotting & *Probing* - Some processes, like northern blotting, Southern blotting, eastern blotting, and western blotting, are useful for transferring RNA or DNA proteins into a blotting membrane.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. This is a book for architects, structural engineers and architectural historians - and also for anyone interested in the (n, e, e, s, i, g, s) of structural form.

2. No other organelles were observed in the (e, l, c, l) even though many sections were examined.

3. High pressure studies of energy transfer and strongly coupled bacteriochlorophyll dimers in photosynthetic (r, t, n, i, o, e, p) complexes.

4. Electronics companies produce an (a, a, r, y, r) of products that rely on fiber networks.

5. It permits simulation of the coupled dynamics of valence electrons and ionic cores in a (o, e, c, l, m, l, e, u) or a material.

6. To date, studies on seeds have failed to provide an (m, z, e, n, y, e) as a transitional developmental marker between the dormant and germinating states.

7. The synthetic polymer is a plastic composed of long (h, i, c, a, s, n) of molecules.

8. In later stages of evolution, a group of enzymatic proteins, nucleic acid polymerases, has been selected to catalyse (c, e, i, n, c, u, l, i, d, c, a) _________ _____ replication.

9. Method of controlling surface roughness involves (o, i, n, p, b, r, g) the surface with laser radiation and recording photoluminescence intensity using photosensitive devices.

10. An alternative strategy has been to use the (o, e, r, s, a, p, l, m, y, e) complex isolated from virusinfected cells to screen for antiviral compounds.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1.

What is Termed as Molecular Biology?

If you don't know "What is molecular biology" then you should know it is a division of biology that deals with the study of biological components and their interactions besides a collection of processes that are developed because the genesis of the field has authorized scientists to learn a lot about the processes of molecules. Living things are created from chemicals similar to non-living things. Hence, a molecular biologist studies the method in which a molecule does have an interaction with one another for performing various functions of life.

The Job of the Molecular Biologists

Molecular biologists conduct various experiments for investigating the function, structure, regulation, processing, and evolution of various biological molecules besides their interactions with each other. Hence, they propose micro-level perception into the working of life.

What is the Molecular Biology of the Gene?

Though there are present various types of molecules in living things, the majority of molecular biologists concentrate on proteins and genes. Proteins are useful for performing a huge array of functions that happen within a living cell, whereas molecular biology of the gene comprises the info that is needed for making more proteins. This way, molecular biologists study the molecular biology of the gene.

Why is the History of Molecular Biology?

Though molecular biology is hugely important in the modern-day life sciences, it has got its roots in the 1930s and 1940s, and it had turned institutionalized during the 1950s and 1960s too. Hence, it does not seem surprising that numerous philosophical matters that are involved in molecular biology happen to be closely entangled with recent history. There are four aspects of the development of molecular biology, and they are:

- Its origins
- Its classical era
- Its migration into different domains of biology
- Its turn to genomics as well as post-genomics

What is the Central Dogma of Molecular Biology?

The central dogma describes the method by which DNA gets recorded into RNA. After this, it is translated into protein. To understand the functions, structures, and internal controls that happen in individual cells, you need to understand molecular biology well. These processes are important to target new drugs, diagnose disease, and understand cell physiology efficiently.

A few medical therapies, as well as clinical research that arise from molecular biology, get encompassed under gene therapy. However, the utilization of molecular cell biology or molecular biology in medicine is known as molecular medicine.

The central dogma explains that when the info has entered into protein, it fails to get out from it. To put it in detail, it is the transportation of info to nucleic acid from a nucleic acid or to protein from the nucleic acid. However, transfer to nucleic acid from protein or to protein from protein is impossible. The info means the exact determination of the series.

Molecular Biology Techniques

Molecular biology is the area of biology that is related to the method of gene transcription for yielding RNA and change of RNA into proteins. Some techniques that are utilized in molecular biology are:

- **PCR or Polymerase Chain Reaction** - It is one of the highly vital techniques that are utilized in molecular biology. PCR permits only one DNA sequence to get amplified into countless DNA molecules. It is also useful for introducing mutations in the DNA or making familiar restriction enzyme areas. PCR is also useful for determining whether or not a specific fragment does exist in some cDNA libraries. Some kinds of PCR comprise RT-PCR (reverse transcription PCR) and quantitative PCR or QPCR.
- **Expression Cloning** - Expression cloning is helpful to scientists in understanding the functions of the protein. The DNA which codes

for a specific protein gets copied or cloned through the use of PCR into some expression vector known as a plasmid.

- **Macromolecule Blotting & Probing -** Some processes, like northern blotting, Southern blotting, eastern blotting, and western blotting, are useful for transferring RNA or DNA proteins into a blotting membrane.
- **Gel Electrophoresis -** Gel electrophoresis is another vital technique that is utilized in molecular biology. This is used for separating proteins, RNA, and DNA according to their sizes by applying some electric field because the DNA is run via agarose gel.
- **Arrays -** A DNA chip is considered an accumulation of many DNA spots that are mounted on some solid surface, like a microscope slide. It is utilized for quantifying the levels of protein expression all across many numbers of genes. This process is also utilized for genotyping different genomic regions.

(https://www.vedantu.com/biology/molecular-biology)

Task 6. True/False statements.

1. A molecular biologist studies the method in which a molecule does not have an interaction with one another for performing various functions of life.
2. Molecular biologists propose macro-level perception into the working of life.
3. A few medical therapies, as well as clinical research that arise from molecular biology, get encompassed under gene therapy.
4. Molecular biology is the area of biology that is related to the method of gene transcription for yielding RNA and change of RNA into proteins.
5. Some processes, like northern blotting, Southern blotting, eastern blotting, and western blotting, are harmful for transferring RNA or DNA proteins into a blotting membrane.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases.

Белок, фермент, нуклеиновая кислота, жизненно важный, промокание, живая клетка

Task 8. Match each word in A with its synonym in B.

A	B
1. probing	a) receiving
2. mutation	b) change
3. chain	c) understanding
4. perception	d) totality
5. vital	e) research
6. yielding	f) important
7. array	g) consistency

Task 9. Match these words with their opposites.

1. probing	a) insignificant
2. mutation	b) disorder
3. chain	c) loss
4. perception	d) uniqueness
5. vital	e) falsification
6. yielding	f) rejection
7. array	g) constancy

Task 11. Translate the following nouns and give the corresponding verbs.

Perception, yielding, gene, mutation, probing, blotting.

Speaking

Task 12. Discuss the questions.

1) What techniques are used in molecular biology?
2) What is the essence of molecular biology?
3) What is the Central Dogma of Molecular Biology?

Task 13. Prepare a presentation on a given topic.

Nucleic acids and their role in the preservation and realization of hereditary information.

Task 14. Prepare the rendering of the text.

UNIT 8 NANOTECHNOLOGIES IN MEDICINE

Intro

Task* 1. *Discuss your ideas in pairs and give a feedback to the class.

1. What do you know about nanomedicine?
2. What are some of the challenges and ethical considerations surrounding the use of nanotechnology in medicine?
3. In what ways can nanotechnology be utilized to improve surgical procedures and recovery times in the medical field?

Vocabulary Focus

Task* 2. Practice pronunciation of *the* words below. *Check if you know their meaning.

autoimmune	[ˌɔːtəʊɪˈmjuːn]
cantilevers	[ˈkæntəliːvər]

therapeutic	[ˌθerəˈpjuːtɪk]
neurological	[ˌnjʊərəˈlɒdʒɪkəl]
pharmaceutical	[ˌfɑːməˈsuː.tɪkəl]
augmented	[ɔːgˈmentɪd]
sustain	[səˈsteɪn]
diagnose	[ˌdaɪəgˈnəʊz]
biological	[ˌbaɪəˈlɒdʒɪkəl]
cardiac	[ˈkɑːdiæk]
tissue	[ˈtɪs.juː]
cochlear	[ˈkɒkliər]
mechanical	[məˈkænɪkəl]
microscalability	[ˈmaɪkrəʊˌskeɪləˈbɪləti]

Task 3. Study the active vocabulary.

1. diagnosis, n - диагностика, диагноз, оценка, точное определение. She is an expert in the *diagnosis* and treatment of eye diseases. *precise diagnosis* - точный диагноз, *to make / set a diagnosis* — поставить диагноз, *to specify diagnosis* — уточнить диагноз.

2. self-sustaining, adj- самоподдерживающийся, автоматический, работа в режиме самоподдержания. *Self-sustaining reaction* — самоподдерживающаяся реакция, *self-sustaining medium* — устойчивая суспензия.

3. nanoparticle, n - наночастица. The nanoparticle has unique optical and electrical properties. *Nanoparticles-labeled* — меченый наночастицами, *nanoparticles physics* — физика наночастиц, *nanoparticles ordering* — упорядочение наночастиц.

4. scalability [ˌskeɪləˈbɪləti]**,** n- масштабируемость; масштабирование. The result demonstrates the *scalability* of the system.

5. core-shell, n - прослойка; оболочка. These results open the way to develop a new type of *core–shell* micro-transducers for radioacoustic imaging applications**.**

6. augment [ɔːgˈment]**,** n- увеличение, приращение, прибавление, шаг; *to augment one's power [one's influence]* — укрепить свою власть [своё влияние]. The pressure *augmented*.

7. insolubility [ɪnˈsɒljʊˈbɪlɪtɪ]**,** n - нерастворимость, неразрешимость. *Chemical insolubility* — нерастворимость химиката. The application of polymers has been limited by their virtual *insolubility* in organic solvents and water.

8. biocompatibility, n- биологическая совместимость, биосовместимость. Inorganic nanostructures *biocompatibility*.

9. insulate, adj**,** v- изолированный, разобщенный; изолировать, обособлять, разобщать. *Insulate by a tape* — изолировать лентой, *insulate from heat* — теплоизолировать. Seals have layers of fat which *insulate* their bodies against cold.

10. cochlear, adj- улитковый, кохлеарный. *Cochlear part* — улитковая часть, *cochlear turn* — улитковый завиток. The maps the team created should make a huge difference to the sound quality of *cochlear* implants.

11. acquisition [ˌækwɪˈzɪʃ(ə)n]**,** n- приобретение, сбор, овладение. *Acquisition of language* — овладение языком, *data acquisition* — сбор данных. The *acquisition* of a fortune was the study of all.

12. spatial, adj- пространственный. *Spatial disorientation* — потеря пространственной ориентации, *spatial model* — пространственная модель. We are temporal and *spatial*.

13. applicability, n- применимость, пригодность. *Criterion of applicability* — критерий применимости, *domain of applicability* — область применимости, *complete applicability* — полная применимость. Four strains of mice were used in the experiments to establish the general *applicability* of the results obtained.

14. infrared-emitting, излучающий инфракрасное излучение. *Infrared light emitted diode* — инфракрасный светодиод.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. John is an executive with a company that schedules and manages MRIs and other (g, a, d, o, i, n, c, t, s, i) tests.
2. (g, e, g, i, n, T, r, t, a) these health problems clearly involves different strategies for men and women.
3. A particularly distinguishing characteristic of mural painting is that the architectural elements of the given space are harmoniously (t, o, r, d, a, p, e, r, i, o, c, n) into the picture.
4. (m, t, r, e, a, t, e, n, t) aims to preserve as much heart muscle as possible.
5. (e, s, i, t, u, s) taken from his lungs showed extensive fibrosis.
6. (y, s, a, c, a, l, i, b, t, i) is critical as ERP, especially in today's stage, when the pharmacies are increasing rapidly.
7. Unless live (t, i, s, a, c, q, u, o, i, o, n, i) is performed, evidence is extracted from the seized digital devices at the forensic laboratory.
8. Medical nanodevices could (m, u, g, a, n, t, e) the immune system by finding and disabling unwanted bacteria and viruses.
9. (k, a, m, e, c, r, a, p, e) periodically delivers pulses that affect the myocardium and cause it to shrink at a certain frequency.
10. (t, a, s, i, p, l, a) selection also operates among simpler organisms.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

Nanomedicine - the application of nanoparticles in the diagnosis and treatment of autoimmune diseases and cancers - is a relatively new field. Developments include self-sustaining systems and nanoparticles for imaging and cancer targeting. Frost & Sullivan believes the following research will change the way healthcare providers diagnose, test and treat patients.

Self-Sustaining Biohybrid System

Advancements in nanotechnology have improved the mechanical and biological designs of hybrid biodevices. However, most commercial devices still require an additional power supply. Device scalability to a cost-effective micro/nanosize remains a challenge, presenting the need for reliable, self-sustainable biohybrid systems that can be incorporated into the physiological environment for diagnostic purposes.

Researchers from the City University of Hong Kong have accepted that challenge, coming up with a self-sustaining biohybrid system that collects energy from cardiac muscle tissue. Their device, the Cell Generator, is based on the premise of piezoelectricity. To create energy, a 3-D-engineered network of piezoelectric cantilevers made up of cardiac cells uses vibrations from contracting cardiac muscle cells. When the muscle cells contract, cantilevers are depressed and convert that kinetic energy into electricity.

A thin layer of polydimethylsiloxane (PDMS) coats the cantilever surface to improve biocompatibility while insulating the device from excess electricity. Theoretically, the PDMS also facilitates biocompatibility with different biological cells and tissues. The system design permits the conversion of small piezoelectric signals to applicable outputs, making it self-sustaining and energy efficient. The materials make microscalability possible, allowing for diverse application in diagnostic and therapeutic tools for neurological diseases such as epilepsy, and in cochlear implants, pacemakers and other microbiorobotic devices with low power consumption.

Although the device has not been proven in vivo, it appears promising.

Light-Emitting Particles for Biological Imaging

Disadvantages of whole-body diagnostic imaging tools such as magnetic resonance imaging (MRI) and ultrasound include low sensitivity, acquisition speed and spatial resolution. Other imaging techniques, including fluorescence, are able to capture images with high sensitivity, but are only effective for single cells (sorry married cells, no high-resolution photos for you). A simple, non-invasive, sensitive technique with in vivo applicability is an unmet need.

The Massachusetts Institute of Technology recently developed shortwave infrared-emitting, iridium arsenide-based quantum dots for diverse functional imaging applications. Injecting the particles into a living organism and applying a photo wavelength of 1000 to 2000 nm creates a high-resolution image of the organism's internal body structures.

This technique makes it possible to image physiologic processes that are otherwise too fast to be detected by common imaging methods. The emitted light frequency can be accurately tuned by controlling the composition and size of the particles, enabling vivid images and videos to be captured—even during motion. The technique is highly sensitive and can even distinguish between different blood cells. It is promising for therapeutic purposes and general research but not yet applicable on the human body. The researchers are working on a version that can be used on humans.

Molecular Magnet-Enabled Nanoparticles to Target Cancer

For human body tissue imaging with externally applied magnetic fields, it is necessary to use adequate magnetic particles. There is a pressing need for a cancer diagnostic device that is stable, easy to manufacture and free of side effects.

A research team from Yokohama City University in Japan has developed magnetic metal- complex-conducting copolymer core-shell nanoassemblies for single-drug anticancer platforms.

By adopting a one-step self-assembly technique employing smart conducting polymers, the team established that it is possible for compact particles to address the challenge of insolubility in water, enabling the delivery of the anticancer pharmaceuticals in the body. The composite nanomaterial consists of two polymers—polypyrroles and polycaprolactones—that are biodegradable and not cytotoxic. In contrast to iron salen, the core-shell has no polymer addition and the metal-complex has enhanced magnetism. This has resulted in more efficient magnetic drug delivery, higher contrast in MRI, augmented hyperthermal effect and restrained release at acidic pH conditions.

The Road Ahead

Demand for cancer and autoimmune disease therapeutics is increasing because today's widely used techniques are not 100% effective.

Frost & Sullivan believes that technologies for the diagnosis and treatment of illnesses must be cost effective and accurate, with fast results that ensure early detection of diseases. The key challenges are the unknown, potentially harmful side effects. The materials and diagnostic techniques have mostly only been proven in a lab setting and have not yet been tested in real time or been subject to clinical trials.

(https://aabme.asme.org/posts/nanotechnology-in-biomedicine?fbclid=)

Task 6. True/False statements

1. Nanomedicine is a relatively new field.

2. Fluorescence imaging techniques are effective for capturing high-resolution images of single cells and married cells.

3. The technique developed by MIT can distinguish between different blood cells.

4. Developments in nanotechnology include self-sustaining systems and nanoparticles for imaging and cancer targeting.

5. The self-sustaining biohybrid system collects energy from cardiac muscle tissue.

6. Whole-body diagnostic imaging tools like MRI and ultrasound have high sensitivity, acquisition speed, and spatial resolution.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases

Наномедицина, наночастицы, источник энергии, диагностические цели, мышечная ткань, сердечные клетки, биосовместимость, кардиостимулятор, чувствительность, неудовлетворенная потребность, коротковолновый, физиологические процессы, яркие изображения, кровяные клетки, побочные эффекты, медикаменты, биоразлагаемый.

Task 8. Match each word in A with its synonym in B.

A	B
1. disease	a) radiating
2. cell	b) expansion
3. insolubility	c) unit
4. emitting	d) illness
5. tissue	e) territorial
6. scalability	f) undecidability
7. spatial	g) material

Task 9. Match these words with their opposites.

1. light-emitting	a) unsteady
2. scalability	b) light-absorbing
3. insolubility	c) inapproapriate
4. vivid	d) decrease
5. augment	e) dark
6. applicable	f) solubility
7. stable	g) reduction

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Biological, applicable, conversing, invasive, spatial, diagnostic, pharmaceutical, physiological, neurological.

Task 11. Translate the following nouns and give the corresponding verbs.

Image, conversion, composition, applicability, treatment, consumption, invasion, provider, manufacture, delivery, detection.

Speaking

Task 12. Discuss the questions.

1. What new nanotechnological developments in medicine have you heard about?
2. What do you think will be the role of nanomedicine in cancer treatment in the future?
3. What are the societal and public health implications of the widespread adoption of nanomedical technologies, and how can we ensure that such innovations are accessible to all segments of the population?

Task 13. Make a presentation on the topic:

1. Applications of Nanotechnology in Cancer Diagnosis and Treatment
2. The Role of Nanomedicine in Regenerative Medicine and Tissue Engineering
3. Ethical Considerations in Nanomedicine Research and Development

Task 14. Prepare the rendering of the text.

UNIT 9 MEDICAL IMAGING AND PHYSICS

Intro

Task 1. Discuss your ideas in pairs and give a feedback to the class.

1. How would you explain the term “medical imaging”? What does it stand for?

2. What is the role of Physics in medical imaging? How do these terms interact?

3. How would you denote the key principle of physics applied in medical imaging?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

medical imaging	[ˈmedɪk(ə)l ˈɪmɪdʒɪŋ]
physics	[ˈfɪzɪks]
intertwined	[ˌɪntəˈtwaɪnd]
diagnosis	[ˌdaɪəgˈnəʊsɪs]
capture	[ˈkæptʃə]
interpret	[ɪnˈtɜːprɪt]
visualize	[ˈvɪʒ(j)ʊəlaɪz]
tissue	[ˈtɪʃuː]
crucial	[ˈkruːʃ(ə)l]
computed tomography	[kəmˈpjuːtɪd təˈmɒgrəfɪ]
magnetic resonance imaging	[mægˈnetɪk ˈrez(ə)nəns ɪˈmɪdʒɪŋ]
positron emission tomography	[ˈpɒzɪtrɒn ɪˈmɪʃ(ə)n təˈmɒgrəfɪ]

single-photon emission computed tomography	[ˈsɪŋg(ə)l ˈfəʊtɒn ɪˈmɪʃ(ə)n kəmˈpjuːtɪd təˈmɒgrəfɪ]
optimization	[ˌɒptɪmaɪˈzeɪʃən]
technique	[tekˈniːk]
absorption	[əbˈzɔːpʃn]
algorithm	[ˈælgərɪð(ə)m]
nuclei	[ˈnjuːklɪaɪ]

Task 3. Study the active vocabulary.

1. intertwine [ɪntəˈtwaɪn]**,** v**–** сплетаться; переплетаться. The problems of crime and unemployment are closely *intertwined.*

2. medical condition – заболевание, состояние здоровья. ... a note from my doctor avouching that my *medical condition* did indeed disqualify me from gym class.

3. capture, v – захватить (изображение, нейтроны, и т.д.). This nucleus has *captured* the slow-moving neutrons.

4. detection, n – обнаружение, выявление. Early *detection* can often lead to a cure.

5. **computed tomography (CT) –** компьютерная томография КТ. *CT* scans can be used to identify disease or injury within various regions of the body.

6. positron emission tomography (PET) – позитронно-эмиссионная томография (ПЭТ). *Positron Emission Tomography (PET)* is an imaging technique that provides functional information.

7. single-photon emission computed tomography (SPECT) - Однофотонная эмиссионная компьютерная томография (ОЭКТ). A *SPECT* scan is a type of imaging test that uses a radioactive substance and a special camera to create 3D pictures.

8. absorption, n **-** поглощение, абсорбция. Vitamin C increases the *absorption* of iron from food.

9. rotate, v – вращаться, перемещаться по кругу. The Earth *rotates* on its axis once every 24 hours.

10. mathematical algorithm - математический алгоритм. *Mathematical algorithm* is a way to solve a problem by breaking it into the most efficient steps.

11. atomic nuclei – атомное ядро. Scientists observed polarization of *atomic nuclei*.

12. emit, v – испускать, излучать, выделять. The factory has been *emitting* black smoke from its chimneys, which is against the law.

13. transducer [trænzˈdjuːsə]**,** n – датчик, преобразователь. An ultrasound *transducer* converts electrical energy into mechanical (sound) energy and back again, based on the piezoelectric effect.

14. wave propagation – распространение волн. *Wave propagation* is considered in multidimensional reciprocal space.

15. radiopharmaceutical, n - радиоактивный медицинский препарат. *Radiopharmaceuticals* can be used as diagnostic and therapeutic agents.

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. The challenge has come from what was supposed to be the heart of the mechanistic world view - from (p, s, h, y, c, i, s).
2. Figure 1 shows the incoming and outgoing (r, i, d, a, t, i, n, o, a) as a function of temperature.
3. ___ (u, d, c, m, p, o, e, t) ___ (y, o, o, g, r, h, p, t, m, a) of the head may rule out an intracranial tumour.
4. The (t, i, e, n, r, a, n, l) structure may be compared to a sponge, though the apertures cannot in general be perceived.
5. Vitamin C increases the (b, a, o, r, s, p, t, o, n, i) of iron from food.
6. It might be prudent to get a virus (r, d, e, c, t, e, o, t) for the network.
7. The kettle (e, t, e, d, t, m, i) a shrill whistle.

8. The whole trip was planned with (m, a, t, m, a, c, l, h, e, t, i) precision.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

What Is the Relationship between Medical Imaging and Physics?

Medical imaging and physics are closely intertwined fields that have revolutionized the diagnosis and treatment of various medical conditions. Medical imaging relies heavily on the principles of physics to capture, process, and interpret images of the human body.

Medical imaging refers to the use of various imaging modalities to visualize the internal structures, organs, and tissues of the human body. It plays a crucial role in the early detection, diagnosis, and monitoring of diseases and injuries. Some of the commonly used medical imaging modalities include X-ray imaging, computed tomography (CT), magnetic resonance imaging (MRI), ultrasound imaging, and nuclear medicine imaging techniques such as positron emission tomography (PET) and single-photon emission computed tomography (SPECT).

Physics plays a fundamental role in medical imaging providing the theoretical framework and mathematical models necessary for the development and optimization of imaging techniques. The physics underlying medical imaging involves the interactions between various forms of energy (such as X-rays, sound waves, or magnetic fields) and the human body.

One of the key principles of physics used in medical imaging is the absorption and scattering of radiation. X-ray imaging, for example, relies on the ability of X-rays to penetrate different tissues in the body and be absorbed differently depending on their density. This differential absorption is what enables the creation of X-ray images. The intensity of the X-ray beam after passing through the body is detected specialized detectors, and the information is transformed into an image using advanced mathematical algorithms.

Similarly, CT imaging utilizes X-rays and advanced computational techniques to generate detailed cross-sectional images of the body. In CT, an X-ray source and detectors rotate around the patient, capturing a series of X-ray projections from multiple angles. These projections are then reconstructed using mathematical algorithms to create high-resolution 3D images.

MRI, on the other hand, harnesses the properties of magnetic fields and radiofrequency pulses to create detailed images of the body's soft tissues. It exploits the phenomenon of nuclear magnetic resonance (NMR), where certain atomic nuclei (such as those of hydrogen) can absorb and emit electromagnetic radiation when subjected to a specific magnetic field. By manipulating the magnetic field and detecting the radiofrequency signals emitted the patient's tissues, an MRI scanner generates detailed images. The physics behind MRI imaging involves principles such as magnetic resonance, spin physics, pulse sequences, and image reconstruction.

Ultrasound imaging relies on the properties of sound waves to produce images of the body's internal structures. Ultrasound machines emit high-frequency sound waves that penetrate the body and bounce back when they encounter different tissues or structures. The echoes of these sound waves are then detected by the ultrasound transducer and processed to create real-time images. The physics of ultrasound imaging involves wave propagation, reflection, and the Doppler effect, which is used to measure blood flow and assess tissue motion.

Nuclear medicine imaging techniques, including PET and SPECT, utilize radiopharmaceuticals that emit gamma rays or positrons. These radioactive tracers are injected into the patient's body and accumulate in specific organs or tissues of interest. The emitted radiation is then detected by specialized cameras and the data is processed to create functional images that provide insight into the metabolic activity or structure of the target organ.

In addition to these main imaging modalities, physics also plays a crucial role in image processing and analysis. Various techniques, such as image filtering, segmentation, registration, and pattern recognition, rely on mathematical models and algorithms derived from physics. These techniques are used to enhance image quality, extract relevant features, and aid in the interpretation of medical images.

Moreover, physics is essential for radiation safety in medical imaging. With the use of ionizing radiation in techniques like X-ray imaging and CT, it is crucial to ensure that both patients and medical professionals are exposed to the lowest possible doses while still obtaining diagnostically useful images. Physics-based dose calculation models and optimization algorithms are employed to strike a balance between image quality and radiation dose during imaging procedures.

Task 6. True/False statements

1. Medical imaging and physics are absolutely contradictory fields that have revolutionized the diagnosis of various medical conditions.
2. CT imaging utilizes X-rays and advanced computational techniques to generate detailed cross-sectional images of the body.
3. MRI, on the other hand, harnesses the properties of protons and electrons to create detailed images of the body's bones.
4. Ultrasound imaging relies on the properties of radiopharmaceuticals' utilization to produce images of the body's internal structures.
5. Various techniques, such as segmentation, pattern recognition, image filtering, and registration, rely on mathematical models and algorithms derived from physics.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases

Атомное ядро, ядерный магнитный резонанс, основной принцип, ультразвуковая визуализация, радиационная безопасность, наименьшая возможная доза, вращаться вокруг пациента, использовать рентгеновские лучи, проникать в ткани пациента.

Task 8. Match each word in A with its synonym in B.

A	B
1. utilize	a) thickness
2. tissue	b) fabric
3. radiofrequency	c) impression
4. density	d) undergo
5. reflection	e) parceling
6. be exposed	f) use
7. segmentation	g) high frequency

Task 9. Match these words with their opposites.

1. radiation	a) diminish
2. heavily	b) misuse
3. enhance	c) separate
4. structure	d) untwist
5. exploit	e) collection
6. rotate	f) disorganisation
7. accumulate	g) lightly

Task 10. Think of nouns corresponding to the following adjectives and participles and translate them into Russian.

Mathematical, imaging, medical, internal, radioactive, magnetic.

Task 11. Translate the following nouns and give the corresponding verbs.

Utilization, rotation, exploitation, reflection, emission, provision

Speaking

Task 12. Discuss the questions.

1. What are the challenges facing the field of medical imaging (radiology) today and how can technology be improved for more accurate diagnosis?
2. How can access to resources be improved in underserved regions, and what innovations can spread to the increased prevalence of radiology technology?
3. What ethical issues influence the use of advanced technologies in medical imaging, and how does one ensure a balance between innovation and patient privacy?

Task 13. Make a presentation on the topic:

Justification of medical exposure in diagnostic (medical) imaging.

Task 14. Prepare the rendering of the text.

UNIT 10 PHYSICS AND NUCLEAR MEDICINE

Intro

Task 1. Discuss your ideas in pairs and give a feedback to the class.

1. How would you define the term “Nuclear medicine”?
2. What other diagnostic imaging methods apart from PET and SPECT do you know?
3. Which radioisotopes are commonly used in the field of nuclear medicine?

Vocabulary Focus

Task 2. Practice pronunciation of the words below. Check if you know their meaning.

therapeutic	[ˌθerəˈpjuːtɪk]
healthcare	[ˈhelθ keə(r)]
radiopharmaceutical	[ˈreɪdiəʊˌfɑːməˈsuːtɪkəl]
injection	[ɪnˈdʒekʃ(ə)n]
inhalation	[ɪnhəˈleɪʃ(ə)n]
conservation	[kɒnsəˈveɪʃ(ə)n]
cardiovascular	[ˌkɑːdɪəʊˈvæskjʊlə]
scintillation	[sɪntɪˈleɪʃ(ə)n]
semiconductor	[ˌsemɪkənˈdʌktə]
sophisticated	[səˈfɪstɪkeɪtɪd]
three-dimensional	[ˌθriːdɪˈmenʃ(ə)n(ə)l]
tungsten	[ˈtʌŋst(ə)n]
scattered	[ˈskætəd]

***Task 3.* Study the active vocabulary**

1. crucial, adj – решающий, ключевой. It was *crucial* to perform an immediate operation on the injured man.

2. therapeutic [ˌθerəˈpjuːtɪk], adj - терапевтический, лечебный. Some claim that the herb has *therapeutic* value for treating pain.

3. healthcare [ˈhelθ keə(r)], n – здравоохранение. It comes down to a gross inefficiency in the *healthcare* system.

4. visualize [ˈvɪʒ(j)ʊəlaɪz], v - отчетливо представлять себе, визуализировать. With this machine, ultrasound can be *visualized*.

5. assess, v – оценивать. We need to *assess* whether or not the system is working.

6. functioning [ˈfʌŋkʃənɪŋ], n - функционирование, работа. The medulla oblongata is the most vital part of the brain because it contains centers controlling breathing and heart *functioning*.

7. utilize [ˈjuːtɪlaɪz], v – использовать. We must consider how best to *utilize* what resources we have.

8. administer, v - назначать, применять, давать *(лекарство)*. She used an eye dropper *to administer* medication to the eyes.

9. inhalation [ɪnhəˈleɪʃ(ə)n], n - вдыхание, ингаляция, вдох, аспирация. The man was treated for smoke *inhalation* after having been rescued from fire.

10. decay, n - распад, разложение, гниение, упадок. Almost every thing which corrupts the soul *decays* the body. The corpse was in an advanced state of *decay*. Radioactive **decay** of uranium

Task 4. Fill in the gaps in the sentences below by rearranging the jumbled letters. Translate the sentences into Russian.

1. The negotiations with the company had reached a (c, r, c, l, u, i, a) stage.
2. We must consider how best to (u, t, z, e, i, l, i) what resources we have.
3. This is no doubt related to the increased interest in gas centrifuges as a means of separating uranium (i, s, s, t, p, e, o, o).
4. Doctors consider their treatment a success when no (c, a, c, r, o, u, n, e, s) cells remain.
5. Alternative options, such as (i, m, p, n,t, t, o, n, l, a, a, i) of stents, need to be evaluated.
6. At this point, the victim would be carrying a large amount of cash and can be (t,a, g, e, e, d, r, t) for the theft of these funds.
7. The athletes had taken pills to stimulate their (m, e, a, t, i, c, b, o, l) rate.

Reading

Task 5. Skim the text to find out what the author says about the issues you discussed in Task 1

What Is the Role of Physics in Nuclear Medicine?

Physics plays a crucial role in the field of nuclear medicine, which involves the use of radioactive substances for diagnostic imaging and therapeutic purposes. Through the application of various physics principles and techniques, nuclear medicine enables healthcare professionals to diagnose and treat various medical conditions.

Nuclear medicine combines elements of physics, chemistry, and medicine to visualize and assess the functioning of organs and tissues within the body. It utilizes radioactive materials known as radiopharmaceuticals, which are essentially substances that emit gamma rays, positrons, or single photon emissions. These radiopharmaceuticals are then administered to a patient either orally, through injection, or inhalation.

One of the key techniques employed in nuclear medicine is positron emission tomography (PET). In PET imaging, positron-emitting isotopes, such as fluorine-18 (^18F), are incorporated into radiopharmaceuticals. These radiopharmaceuticals are then administered to the patient, and the positrons emitted from the decay of the isotopes interact with electrons in the body. This interaction leads to the production of two gamma photons moving in opposite directions due to the conservation of momentum.

PET scanners consist of multiple detectors surrounding the patient. When the gamma photons are detected, the scanner records their position and timing. By detecting the pairs of photons moving in opposite directions, the scanner can create a three-dimensional image of the distribution of radiopharmaceuticals within the body. This image helps in visualizing and quantifying the metabolic activity of organs and tissues, aiding in the diagnosis and staging of various diseases, including cancer, cardiovascular disorders, and neurological conditions.

The various components of a PET scanner, including detectors, electronics, and data processing algorithms, all have a basis in physics. Detectors, typically made of scintillation crystals or semiconductor materials, convert the gamma photons into electrical signals. These signals are then amplified, processed, and reconstructed into images using sophisticated algorithms.

Another important application of nuclear medicine is single-photon emission computed tomography (SPECT). SPECT imaging involves the administration of radiopharmaceuticals that emit single gamma photons, which are detected by a gamma camera rotating around the patient. The signals from the gamma camera are analyzed to reconstruct a three-dimensional image of the distribution of radiopharmaceuticals within the body.

The physics behind SPECT imaging is grounded in the principles of gamma ray detection, collimation, and tomographic imaging. Collimators, made of dense materials such as lead or tungsten, are used to allow only the gamma rays emitted in a specific direction to reach the detector. This helps to eliminate scattered radiation and improve the spatial resolution of the images. The gamma camera detects the photons and converts them into electrical signals, which are then processed and reconstructed into images using similar principles as in PET imaging.

In addition to diagnostic imaging, nuclear medicine also encompasses various therapeutic applications. One such example is targeted radionuclide therapy, also known as radiopharmaceutical therapy. This involves the administration of radiopharmaceuticals that deliver radiation directly to cancerous cells or tissues, resulting in their destruction.

Radiopharmaceutical therapies rely on the principles of radiobiology and physics to ensure effective treatment while minimizing harm to healthy tissues. By selecting specific isotopes with suitable properties, such as the emission of particulate radiation like alpha particles or beta particles, the radiation can be localized to the targeted cells, delivering a higher dose of radiation to cancerous cells and sparing healthy tissues.

Furthermore, nuclear medicine techniques such as gamma knife radiosurgery and brachytherapy utilize physics principles to deliver focused radiation to specific regions. Gamma knife radiosurgery uses multiple intersecting beams of gamma radiation to treat deep-seated brain tumors or lesions, while brachytherapy involves the implantation of radioactive sources within or near the tumor site. Both techniques rely on precise planning using imaging modalities, dose calculation, and radiation delivery verification.

It is worth mentioning that physics is also integral to the development and improvement of radiopharmaceuticals used in nuclear medicine. The production, purification, and labeling of radiopharmaceuticals require a deep understanding of nuclear physics, radiochemistry, and pharmacokinetics. Newer research and development efforts focus on producing more efficient and precise radiopharmaceuticals, enhancing image quality, and reducing patient radiation exposure.

Task 6. True/False statements

1. Physics involves the use of radioactive substances for diagnostic imaging and therapeutic purposes.
2. Nuclear medicine combines elements of biology, mathematics, and medicine to visualize and assess the functioning of organs.
3. Radiopharmaceuticals are substances that perceive gamma rays, positrons, or single photons.
4. PET and SPECT are absolutely equipollent methods of diagnostic imaging.
5. Radiopharmaceutical therapies ensures effective treatment while minimizing harm to healthy tissues.

Task 7. Look through the text carefully and find English equivalents for the following Russian phrases.

Применение радиоактивных частиц, позволяет медицинским специалистам диагностировать и лечить заболевания, оценивать функционирование внутренних органов и тканей, многочисленные датчики, минимизировать вред для здоровых тканей; несколько пересекающихся лучей гамма-излучения; производство, очистка и маркировка радиофармпрепаратов.

Task 8. Match each word in A with its synonym in B.

A	B
1. nuclear	a) shimmer
2. assess	b) estimate
3. scintillation	c) injury
4. application	d) adequate
5. scanner	e) biological
6. leison	f) OCR device
7. effective	g) use

Task 9. Match these words with their opposites.

1. diagnose	a) decrease
2. minimize	b) concealment
3. detect	c) neglected
4. amplify	d) overlook
5. emission	e) decline
6. development	f) conceal
7. targeted	g) maximize

Task 10. Think of nouns corresponding to the following adjectives and translate them into Russian.

Radioactive, diagnostic, nuclear, opposite, multiple, metabolic, cancerous.

Task 11. Translate the following nouns and word combinations and give the corresponding verbs.

Role, medical condition, radiopharmaceuticals, gamma rays, key technique, scanner, signals.

Speaking

Task 12. Discuss the questions.

1. What are the challenges facing the field of medical imaging (radiology) today and how can technology be improved for more accurate diagnosis?
2. How can access to resources be improved in underserved regions, and what innovations can spread to the increased prevalence of radiology technology?
3. What ethical issues influence the use of advanced technologies in medical imaging, and how does one ensure a balance between innovation and patient privacy?

Task 13. Make a presentation on the topic:

Radiation safety measures in diagnostic nuclear medicine.

Task 14. Prepare the rendering of the text.

SUPPLEMENTARY READING

TEXT 1

History of Biotechnology

Biotechnology is a branch of Biology that deals with the usage of living organisms to make helpful products to aid human life. It also deals with the development of techniques to solve problems and to improve the living standard of mankind.

Genetic engineering is a technique developed by biotechnology, that is being used to produce therapeutic proteins. Natural sciences and engineering sciences can be applied to achieve products and services based on the use of organisms, that's what biotechnology is based on.

Plant cultivation is probably the first form of biotechnology. Humans have been working with nature for thousands of years to make their lives better. We've harnessed biological processes, starting with the first agricultural communities.

In the history of agriculture, farmers have inadvertently changed the genetic makeup of their crops by introducing them to new environments and breeding them with other plants. Throughout hundreds of years, one of the first forms of genetic engineering was developed.

Humans have been using the technique of selective breeding for thousands of years to increase the yield of crops and livestock for their food. In selective breeding, organisms with desirable characteristics are crossed to produce offspring that are the same as the parents.

Scientists in the early 20th century made a better understanding of microbes. This improved understanding led to the discovery of ways to make products. During WWI, Chaim Weizmann first used a pure microbiological culture in an industrial process, producing acetone, to make explosives.

Over the last six thousand years, humans have been making wine, beer, and cheese. Biotechnology has led to the development of antibiotics, and it continues to develop even more. When Alexander Fleming discovered the mold Penicillium, he was one of the first scientists to isolate penicillin from the mold.

In 1940, the first antibiotics were created when researchers used the chemical compound known as penicillin to cure someone infected with a deadly bacterial infection. Recombinant insulin became the first product made using genetic engineering to secure approval from the US. FDA was approved in 1982.

Recombinant versions of growth hormones, clotting factors, clot-dissolving medications, and other genetically engineered protein medications are available to help individuals who need them.

Today, biotechnology is not what was meant by those processes that began emerging in the 1960s and 1970s. One of the first biotech companies was founded by a drug company called "Genentech" in 1976.

Paul Berg and his colleagues pioneered modern genetic engineering with their work on bacteria in the 1970s. Genetic engineering is thought of as having been born in 1971.

Herbert W. Boyer and Stanley N. Cohen significantly advanced the new technology of genetic engineering in 1972 by transferring genetic material into a bacterium, allowing it to replicate the foreign material.

A factor influencing the biotechnology sector's success is stronger patent laws worldwide, as well as a need for drugs to improve aging, and ailing, US. Population.

On June 16, 1980, the United States Supreme Court ruled that genetically modified microorganisms could be patented in the case of Diamond V. Chakrabarty. This decision was a big boost for the biotechnology industry.Karoly Ereky was an agricultural engineer. He is believed to be the "father" of the field.

The term fusion of biology and technology was created by him in 1919. He claimed that biology could be used to turn raw materials into useful products. (https://eduinput.com/introduction-to-biotechnology/)

TEXT 2

Main milestones in the history of Biotechnology

The history of biotechnology is actually directly linked to that of human beings. Thus, even before being considered a scientific discipline, it was part of our ancestors' daily lives.

History of biotechnology timeline: the beginnings

According to the United Nations' Convention of Biological Diversity in 1992, biotechnology is "any technological application that uses biological systems and living organisms or their derivatives for the creation or modification of products or processes for specific uses."

Following this definition, we can say the history of biotechnology practically runs parallel to the history of human beings.

Some of the main discoveries of practical uses of biotechnology include:

- Agricultural practices linked to crop rotation, seed selection, crossing, etc. These are no doubt the most primitive manifestations of what would later evolve into a particular field of study within biotechnology.
- Animal domestication and, as a consequence, their employment in the production of nourishment and other tasks, is also a very rudimentary manifestation of biotechnological techniques.
- Bread, wine or beer production are all practices directly linked with biotechnological science. Every operation related with fermentation and the use of yeast and food conservation in particular all clearly indicate biotechnology practices. Thus, even if the theoretical basis was unknown, the technique of producing beer can be dated back to the Sumerian civilization, almost 2,000 years b.C.

This long initial stage of biotechnology comprises thousands of years where practical and increasingly sophisticated knowledge has been accumulated, although still not seen through a scientific approach.

The history of biotechnology between the 15th and 19th centuries

During this particularly fruitful stage in the history of biotechnology, numerous scientific discoveries took place that started to organize and systematize previous knowledge. Besides, a scientific foundation was set for a great variety of biological phenomena, upon the basis of direct observation and experimentation.

In this regard, we could cite the following main milestones in the history of biotechnology timeline during that period:

- Invention of the microscope in 1590, by Hans and Zacharias Janssen
- Start of the systematic study of cells, building from the first cell description by Robert Hooke (1665)
- Advent of biology as an independent discipline (ca. 1802)
- Discovery of proteins and first studies about enzymes (1830 – 18339
- Publication of the theory of the evolution of species by Darwin (1859)
- Works about genetics by Gregor Mendel, from experimenting with chickpeas (mid-19th century)
- Friedrich Miescher manages to isolate DNA for the first time (1869)
- Progressive advancements in knowledge around genetics (end of 19th century)

Biotechnology in the 20th century

In an analogue manner to other scientific fields, the 20th century represented an enormous advancement for the history of biotechnology.

Thus, apart from the fact that the term “biotechnology” started being used again, we can highlight the following discoveries throughout the century:

- Developments in the use of industrial fermentation

- Numerous findings and advancements in genetics and DNA during the first part of this century. This responds to the work of scientists such as Sutton, T.H. Morgan, Belozersky, Beadle, Tatum, R. Franklin or Watson and Crick (double helix), among many others.
- Subsequently, the complete genetic code of DNA was deciphered (1961 – 1966) and the first experiments in genetic engineering took place (1972 – 1973)
- The first biotechnology company in history was founded in the United States in 1976: Genetic Engineering Tech (Genentech)
- Creation of the first transgenic mouse (1982)
- Development of the technique for Polymerase Chain Reaction (PCR) in 1983
- The whole century saw significant advances in biotechnological applications for plants and agriculture. In fact, the first production of transgenic plants dates to 1984.
- In 1982, the Human Genome project is born, culminating in 2003
- Successful cloning of a mammal (Dolly the sheep) in 1997

Now, the field of biotechnology is particularly promising, as scientists are deepening their knowledge around the advancements made in the last century and opening new pathways that hadn't been explored before (https://cempeducation.com/news/history-biotechnology/).

TEXT 3

Types of Biotechnology

Biotechnology is a branch of Biology that deals with the usage of living organisms to make helpful products to aid human life. It also deals with the development of techniques to solve problems and to improve the living standard of mankind.

There are the following types of biotechnology based on their applications in different fields:

Gold Biotechnology (Bioinformatics)

Bioinformatics is also known as computational biology, as it uses a computer to solve biological problems. It is used to create a database in genetics. For example, it is being used in structural genomics.

Blue Biotechnology

Blue biotechnology deals with the utilization of sea resources to create products for mankind. It is mostly used in the combustion and refining industries.

Green Biotechnology

Green biotechnology is used in agriculture, for example in the domestication of plants using micropropagation techniques. It is the next phase of the green revolution.

It can be used to fight hunger and disease by using technologies that allow plants to grow in conditions that are more favorable to them. It makes them resistant to biotic and abiotic stresses.

Red Biotechnology

It deals with health-related fields. Red biotechnology has applications in health maintenance and preservation in the medical and pharmaceutical industries.

The production of medicines, vaccinations, regeneration therapies, the development of new diagnostics, and new research techniques are all part of this branch.

The development of new hormones, stem cells, and antibodies are among the many other things that have been done in the field of science.

White Biotechnology

White biotechnology, also known as industrial biotechnology, is biotechnology that's used in industries. White biotechnology is an emerging field of production that uses fewer resources to produce a product.

In recent years, biotechnology has been playing an important role in manufacturing, as it can decrease energy consumption and environmental pollution.

Yellow Biotechnology

Yellow biotechnology refers to the use of biological methods to produce wine, cheese, and other foods like yogurt, and beer. The method of fermentation is used to create a variety of products.

It is the application of pesticides to insects. Various other approaches include approaches for the control of harmful insects, characterization, and use of active ingredients or genes of insects for research, and various other approaches.

Gray Biotechnology

Gray biotechnology involves environmental applications and deals with the maintenance of biodiversity and the removal of pollutants from the environment.

Brown Biotechnology

Brown biotechnology involves the management of arid land areas, water management, regenerative agriculture, and desert restoration.

An important use of brown biotechnology is the development of seeds that resists extreme environmental conditions of arid regions, related to the innovation, creation of agriculture techniques, and management of resources.

Violet Biotechnology

It deals with all the legal and ethical issues surrounding genetic engineering, there are those in support and against biotechnology.

Dark Biotechnology

The use of living organisms for bioterrorism is being dealt with under the umbrella of dark biotechnology. Bioterrorism or biological warfare uses viruses, bacteria, and other microbes to kill people and animals and contaminate crops, water, and food. Dark biotechnology means using bacteria and viruses to make people sick and die (https://eduinput.com/introduction-to-biotechnology/).

TEXT 4
Examples of Biotechnology

"Biotechnology is the key to solving many of the world's most pressing problems, from food security to climate change to disease."

Bill Gates

Examples of Medical Biotechnology:

Vaccines. Vaccines are chemicals that stimulate the body's immune system to better fight pathogens when they attack the body. They achieve this by inserting attenuated (weakened) versions of the disease into the body's bloodstream. It causes the body to react as if it was under attack from the nonattenuated version of the disease. The body combats the weakened pathogens and, through the process, takes note of the cell structure of the pathogens and has some cells that 'remember' the disease and store away the information within the body.

When the individual becomes exposed to the actual disease, the body of the individual immediately recognizes it and quickly forms a defence against it since it already has some information on it. This translates to quicker healing and less time being symptomatic. The attenuated disease pathogens are extracted using biotechnological techniques such as growing the antigenic proteins in genetically engineered crops. An example is the development of an anti-lymphoma vaccine using genetically engineered tobacco plants made to exhibit RNA (a similar chemical to DNA) from malignant (actively cancerous) B-cells.

Antibiotics. Strides have been made in the development of antibiotics that combat pathogens for humans. Many plants are grown and genetically engineered to produce the antibodies. The method is more cost-effective than using cells or extracting these antibodies from animals as the plants can produce these antibodies in larger quantities.

Examples of Agricultural Biotechnology

Pest Resistant Crops. Biotechnology has provided techniques for the creation of crops that express anti-pest characteristics naturally, making them very resistant to pests, as opposed to having to keep dusting them and spraying them with pesticides. An example of this would be the fungus Bacillus thuringiensis genes being transferred to crops.

The reason for this is that the fungus produces a protein (Bt), which is very effective against pests such as the European corn borer. The Bt protein is the desired characteristic scientist would like the plants to have, and for this reason, they identified the gene causing Bt protein to express in the fungus and transferred it to corn. The corn then produces the protein toxin naturally, lowering the cost of production by eliminating the cost of dusting the crop with pesticide.

Plant and Animal Breeding. Selective breeding has been a practice human have engaged in since farming began. The practice involves choosing the animals with the most desirable characteristics to breed with each other so that the resulting offspring would also express these traits.

Desirable characteristics included larger animals, animals more resistant to disease, and more domicile animals, all geared to making the process of farming as profitable as possible.

This practice has been transferred to the molecular level with the same purpose. Different traits are selected among the animals, and once the genetic markers have been pointed out, animals and plants with those traits are selected and bred for those traits to be transferred.

A genomic understanding of those traits is what informs the decisions on whether the desired traits will express or get lost as recessive traits that do not show.

Such information provides the basis for making informed decisions enhancing the capability of the scientists to predict the expression of those genes. An example is its use in flower production, where traits such as color and smell potency are enhanced.

Examples of Industrial Biotechnology:

Biocatalysts. Biocatalysts have been developed by the industrial biotechnology companies such as enzymes, to synthesize chemicals. Enzymes are proteins produced by all organisms. The desired enzyme can be manufactured in commercial quantities using biotechnology.

Fermentation. The crop’s sugar can be fermented to acid, which can then be used as an intermediate to produce other chemical feedstocks for various products. Some plants, such as corn, can be used in place of petroleum to produce chemicals.

Microorganisms. Microorganisms find their use in chemical production for the design and manufacture of new plastics/textiles and the development of new sustainable energy sources such as biofuels.

Examples of Environmental Biotechnology:

Bioremediation. Bioremediation refers to the application of biotechnical methods which help in developing enzyme bioreactors that will not only pretreat some industrial and food waste components but also allow their efficient removal via sewage system without using solid waste disposal mechanisms (https://www.conserve-energy-future.com/biotechnology-types-examples-applications).

TEXT 5

Pros and cons of Biotechnology (Part I)

Biotechnology is a vast and ever-growing field that merges the concept of biology with the fundamentals of technology for the benefit of mankind.

Biotechnology has helped in producing better medicines and vaccines to combat pathogens, high-yield crops that are easily harvested and can be grown in a variety of climates, Vitamin A enriched rice and more.

However, there are some issues with biotechnology which has raised concerns. Most of these concerns have to do with exploiting biotechnology for illegal practices.

Now we will look at Pros and Cons of biotechnology in detail and how they can affect the world we live in.

Advantages of Biotechnology

1. Improvement in Nutritional Quality of Crops

Since the start of biotechnology, crops have been improved in the aspect of their nutritional quantity and quality.

Crops are enhanced with important nutrients and vitamins providing the consumer with much-needed nutritional benefits for a healthy and balanced diet.

This has improved the dietary quality of food resulting from biotechnology practices. Eating a diet that fulfills all the nutritional needs also helps to take care of malnourished children in remote areas.

Nutritionally enhanced diet will allow the food security organizations to distribute food in smaller quantities to a greater number of people.

This is because a person can then eat less and still be able to receive the right amount of nutrition.

2. Preservation of Resources

Biotechnology has increased the lifespan of our food supplies. It has also increased the preservation lifespan of salting food along with use of freezing and drying of food products.

The crops and food products have an extended expiry date, as the crops are more resistant to ripening than they previously were.

3. Elimination and minimizing waste products

The carbon footprint being left by humans is quite extensive. In 2006, USA produced 251 million tons of trash which is equivalent to five pounds of trash per day!

Biotechnology helps to create biodegradable products which don't have that much of an environmental footprint as of conventional products.

Products such as biodegradable plastics have been very helpful in reducing land pollution and number of landfills due to reduced use of regular plastics.

Biodegradable plastics decompose and get absorbed into the natural environment.

It is also beneficial that while they decompose, they don't cause any harmful effects to the surrounding soil.

The creation of biodegradable materials from biotechnology has helped humans to more efficient in managing landfills. The diversion from conventional plastics has considerably reduced the carbon footprint of the planet.

4. Genetic Screening

Biotechnology has allowed more efficient detection of genetic abnormalities by making it easier to genetically screen vulnerable and high-risk groups for the threat of developing inherited diseases.

This can be done using the maternal or paternal chromosome to predict the likelihood of the newborn having congenital abnormalities.

Genetic screening uses chromosomes, genes, or proteins to identify these abnormalities.

5. Drug Designing

New innovative drugs have been manufactured through the use of biotechnology, which were previously considered impossible.

Synthetic human Insulin is one of the most common examples of using biotechnology to improve human life.

Through genetic engineering of the bacterium E.Coli; scientists have been able to make a vast amount of synthetic human insulin at a low cost and treat diabetic patients.

6. Human Genome Project (HGP) (1990-2003)

Using biotechnology, scientists began the Human Genome Project with the objective of mapping out the entire genome of humans by determining base pairs which make up the human DNA.

It was the world's largest collaborative science project.

This project was vital as it became easier for us to identify disease progression and pathophysiology making it easier for us to treat these diseases.

For example, we can enter the genome of a fetus and identify the gene which predisposes the baby to cancer, and parents can then choose to have it removed.

This brings us to the next advantage of biotech, *designer babies*.

7. Designer baby as Biotech Applications

This is a term used very commonly when referring to or talking about biotechnology.

Biotechnology has made it easier to identify and treat inherited diseases by causing the alteration of the genome (DNA) of the child before it is born.

This way the child is born free of inherited abnormalities which may have caused difficulties throughout her life.

Parents can specifically detect and identify genes and eventual physical characteristics they want to alter so they can have their 'designer baby' (https://www.environmentbuddy.com/environment/20-pros-and-cons-of-biotechnology).

TEXT 6

Pros and cons of Biotechnology (Part II)

Disadvantages of Biotechnology

1. Blight in Crops

The implementation of biotechnology has led to unfortunate development of blight in crops.

Blight is a type of condition where there is chlorosis (loss of chlorophyll-green color) of leaves.

This may lead to withering, or death of tubers and leaves since the plant would not be able to carry out adequate photosynthesis.

2. Lack of Genetic Diversity

Biotechnology, although beneficial in terms of crop yield and production, offers no genetic diversity within populations.

This genetic diversity is very crucial in the long-term survival of plant and animal species.

Larger the gene pool, the greater the chance that a particular species can survive due to its ability to cope with environmental changes and other pathogens.

If something unpredictable was to occur, an entire crop or all species can be driven towards extinction! If there is genetic diversity, there would at least be **one** species capable of resisting that unpredictable change!

3. A Field of Uncertainty

Although, over the past few decades we have learned and discovered a lot concerning biotechnology, we still have many concerns which haven't been answered.

What will occur if we mess with the genetics to treat diseases, can we develop *super-bugs*? What will happen to the environment if crops are genetically altered?

Should these actions have negative consequences, coming generations will be paying the price for our actions.

Even right now, as the Coronavirus rampages across the world as a Pandemic, there is a wide number of people who believe that it may have been sourced from genetic engineering. They may not be wrong!

4. Human life may become a commodity!

Complementary DNA, also known as cDNA, which is genetically engineered, is an entity that can be patented.

Obtaining such DNA and altered DNA sequences which can be sold as a profit opens the door to many ethical questions concerning human life.

It also highlights the immorality associated with the purpose of making money from human lives, like ‘playing god’.

As of now, the USA Supreme Court has thus barred DNA manipulation and its products to be patented.

5. Gene Manipulation

The knowledge that genes can be manipulated to produce enhanced animals, humans, and plants has led to humans using such methods more frequently out of greed.

The use of biotechnology to make children better with the parent’s preferred phenotype has become common, even if they are not at risk of developing any underlying diseases.

This has led to the banning of designer babies in countries such as the United Kingdom.

6. Reduction in Human Genetic Biodiversity

If we keep on changing the genes of humans to what we prefer them to be, eventually there will be no such thing as genetic diversity as we will be eradicating it.

This will reduce the gene pool of humans in various populations and these populations will become susceptible to dangerous diseases that may cause widespread deaths.

See, right now we have sufficient genetic diversity which is why the Coronavirus Pandemic is much more hurtful to some populations as compared to others.

But if all of us had the exact same ‘preferable’ genes, the whole world could’ve gotten sick!

7. Used for Destruction – Biowarfare (Coronavirus)

Yes, biotechnology is very beneficial for us if it is in the right hands.

It can easily be used as a weapon of mass destruction by making poisonous crops, developing harmful and toxic medicines, and even weaponizing existing pathogens to become more infectious and considerably more dangerous.

Therefore, the governments all around the world must work in solidarity to keep constant surveillance of biotechnology around the world and prevent it from being used or being stolen by people that may have ill-fated ideas with it.

A highly believed conspiracy theory suggests that Coronavirus was made through genetic engineering and introduced through bats into the Chinese population.

This suggests why surveillance on biotech should be increased to avoid unprecedented consequences like a Coronavirus Pandemic.

Conclusion- Should we Apply Biotechnology?

Considering these pros and cons of Biotechnology, it is imperative to say that Biotech is a very interesting field which could have far-reaching advantages.

However, considering that even making a single mistake could be harmful to several generations ahead, scientists need to be extremely careful with applying biotechnology.

Biotechnology is obviously still in its infancy and can be used to make changes that may lead to the next big revolution, the pros and cons of every application of biotechnology should be weighed, not only 10, but 100 times before a biotech product or application reaches the markets (https://www.environmentbuddy.com/environment/20-pros-and-cons-of-biotechnology).

TEXT 7

Biomedical Engineer

A biomedical engineer operates at the intersection of engineering, biology, and medicine, crafting innovative solutions to improve healthcare and patient outcomes. This dynamic field melds engineering principles with biological sciences to design and develop medical devices, diagnostic equipment, and advanced therapies. Biomedical engineers are pivotal in advancing medical technology, from creating artificial organs and prosthetics to developing sophisticated imaging systems and regenerative tissue treatments. Their work not only enhances clinical practices but also contributes to the scientific understanding of complex biological systems, embodying a blend of technical expertise, creative problem-solving, and a deep commitment to improving human health.

What does a Biomedical Engineer do?

Biomedical Engineers are at the forefront of healthcare innovation, merging principles from engineering with biological and medical sciences to develop technologies that improve patient care. They design and create equipment, devices, computer systems, and software used in healthcare, from artificial organs to advanced diagnostic machines. Their role is a complex fusion of problem-solving, creativity, and technical expertise, aimed at advancing medical technology and improving the quality of life for patients.

Types of Biomedical Engineers

Biomedical engineering is an interdisciplinary field that merges the principles of engineering with the complexities of biological systems to improve healthcare. Within this domain, various types of biomedical engineers specialize in distinct aspects of health and medicine, each contributing uniquely to the advancement of medical technology and patient care. These specializations allow for a diverse range of career paths, with each type of biomedical engineer playing a pivotal role in the development, implementation, and optimization of medical devices, systems, and interventions. From creating artificial organs to developing sophisticated imaging technology, the work of biomedical engineers is integral to modern medicine.

Clinical Engineer

Clinical Engineers are specialists who apply their knowledge of engineering and biological systems in a healthcare setting. They work directly within clinical environments to implement and maintain medical equipment, ensuring safety and efficacy. Their role often involves collaborating with medical staff to tailor technologies to specific clinical needs and training personnel on the proper use of medical devices. Clinical Engineers are critical in hospitals and clinics where the integration of technology into patient care is essential for diagnosis, treatment, and monitoring.

Biomaterials Engineer

Biomaterials Engineers focus on the development and testing of materials used in medical applications, such as implants, prosthetics, and tissue engineering. They must understand the interactions between biological systems and synthetic or natural materials to create products that are biocompatible and perform effectively within the body. Their work is pivotal in the design of materials that can mimic or replace biological tissues, and they often collaborate with researchers and clinicians to bring these innovations from the lab to clinical use.

Biomechanical Engineer

Biomechanical Engineers combine principles of mechanics with an understanding of human anatomy and physiology to solve problems related to movement and function. They work on a wide range of projects, from designing orthopedic implants and prosthetic limbs to analyzing human motion and developing rehabilitation devices. Their expertise is crucial in creating technologies that restore or enhance the mobility of patients, making them indispensable in the fields of orthopedics, sports medicine, and rehabilitation.

Medical Imaging Engineer

Medical Imaging Engineers specialize in the development and improvement of imaging technologies such as MRI, CT scans, ultrasound, and X-rays. They work on enhancing image quality, reducing exposure to radiation, and advancing image processing techniques. Their role is essential in the early detection and diagnosis of diseases, as well as in guiding therapeutic procedures. Medical Imaging Engineers often collaborate with radiologists and physicists to ensure that imaging technologies are safe, accurate, and accessible.

Biomedical Signal Processing Engineer

Biomedical Signal Processing Engineers focus on the analysis of biological signals, such as ECG, EEG, and EMG. They develop algorithms and systems to extract meaningful information from these signals for diagnosis and monitoring purposes. Their work is critical in creating devices that can interpret complex physiological data in real time, leading to advancements in patient monitoring systems, diagnostic devices, and even brain-computer interfaces.

Biomedical Research Engineer

Biomedical Research Engineers are involved in the scientific investigation of biological and health-related problems. They conduct experiments, analyze data, and develop new theories and technologies to address medical challenges. Their work often takes place in research institutions, universities, and industry labs, contributing to the foundational knowledge that drives innovation in medical technology. These engineers are at the forefront of discovering new treatments, devices, and diagnostic tools that can lead to improved patient outcomes.

What's it like to be a Biomedical Engineer?

Stepping into the role of a Biomedical Engineer is to stand at the crossroads of medicine and engineering, embodying the fusion of healthcare advancement with innovative technology. It's a profession that demands a unique blend of scientific knowledge, engineering expertise, and a passion for improving patient care. Biomedical Engineers are the architects behind medical device design, the innovators who enhance biomedical imaging, and the problem-solvers who develop solutions for complex biological challenges (https://www.tealhq.com/career-paths/biomedical-engineer).

TEXT 8

Role of Biophysics in Interdisciplinary Science (Part I)

Biophysics is an interdisciplinary science that applies approaches and methods traditionally used in physics to study biological phenomena. Biophysics covers all scales of biological organization, from molecular to organismic and populations. Biophysical research shares significant overlap, molecular biochemistry, physical chemistry, physiology, nanotechnology, bioengineering, computational biology, biomechanics, developmental biology and systems biology. Scientists in this field conduct research concerned with understanding the interactions between the various systems of a cell, including the interactions between DNA, RNA and protein biosynthesis, as well as how these interactions are regulated. A great variety of techniques are used to answer these questions.

Fluorescent imaging techniques, as well as electron microscopy, X-ray crystallography, NMR spectroscopy, atomic force microscopy (AFM) and small-angle scattering (SAS) both with X-rays and neutrons (SAXS/SANS) are often used to visualize structures of biological significance. Protein dynamics can be observed by neutron spin echo spectroscopy. Conformational change in structure can be measured using techniques such as dual polarization interferometry, circular dichroism, SAXS and SANS. Direct manipulation of molecules using optical tweezers or AFM, can also be used to monitor biological events where forces and distances are at the nanoscale.

Molecular biophysicists often consider complex biological events as systems of interacting entities which can be understood e.g. through statistical mechanics, thermodynamics, and chemical kinetics. By drawing knowledge and experimental techniques from a wide variety of disciplines, biophysicists are often able to directly observe, model or even manipulate the structures and interactions of individual molecules or complexes of molecules.

In addition to traditional (i.e. molecular and cellular) biophysical topics like structural biology or enzyme kinetics, modern biophysics encompasses an extraordinarily broad range of research, from bioelectronics to quantum biology involving both experimental and theoretical tools. It is becoming increasingly common for biophysicists to apply the models and experimental techniques derived from physics, as well as mathematics and statistics, to larger systems such as tissues, organs, populations and ecosystems. Biophysical models are used extensively in the study of electrical conduction in single neurons, as well as neural circuit analysis in both tissue and whole brain.

Most biophysical research has been carried out by physicists with an interest in biology; therefore, there must be a way by which scientists educated in physics and physical chemistry can find their way into biology and become familiar with problems that may be open to a physical interpretation.

The biophysicist possesses the ability to separate biological problems into segments that are amenable to exact physical interpretation and to formulate hypotheses that can be tested by experiment. The primary tool of the biophysicist is an attitude of mind. To this might be added the ability to use complex physical theory to study natural objects – for example, that involved in the X-ray diffraction techniques used to determine the structure of large molecules such as proteins. The biophysicist usually recognizes the utility of new physical tools – e.g., nuclear magnetic resonance and electron spin resonance – in the study of specific problems in biology.

The development of instruments for biological purposes is an important aspect of a new area – applied biophysics. Biomedical instrumentation is probably most widely used in hospitals. Applied biophysics is important in the field of therapeutic radiology, in which the measurement of dose is critical to treatment, and in diagnostic radiology, particularly with techniques involving isotope localization and whole body scanning to aid in tumor diagnosis. As aids in diagnosis and patient care, computers are of increasing importance. Automation of the chemical analyses routinely carried out in hospitals will soon be a reality. The opportunities for the applications of biophysics seem limitless because the lengthy delay between the development of a research instrument and its application means that many scientific instruments based on physical principles already known will be shown to have important potential for medicine (https://thefinancialdaily.com/role-of-biophysics-in-interdisciplinary-science).

TEXT 9

Role of Biophysics in Interdisciplinary Science (Part II)

Interdisciplinary Work: The biophysical approach is unified by a consideration of biological problems in the light of physical concepts, so that biophysics is, perforce, interdisciplinary. Biophysics may be thought of as the central circle in a two-dimensional array of overlapping circles, which include physics, chemistry, physiology, and general biology. Relations with chemistry are mediated through biochemistry and chemistry; those with physiology, through neurophysiology and sensory physiology. Biology, which may be viewed as a general subject pervading biophysical study, is evolving from a purely descriptive science into a discipline increasingly devoted to understanding the nature of the prime movers of biological events. The evolution of biology in these directions has received great impetus from the biophysical and biochemical discoveries of the 20th century. An understanding of the physical principles governing biological effects is the proper end of biophysics.

Areas of Study: The content and methods of biophysics are illustrated by examining several notable contributions to science. Protein Structure: Within two days after the initial publication of Wilhelm Röntgen's discovery of X rays in 1895, a surgeon in Scotland used X-rays to observe a needle as he extracted it from the palm of an unfortunate seamstress. Although this medical application resulted in the development of radiological diagnosis and treatment of disease by radiation, physical aspects of Röntgen's discovery also provided the means for elucidating the structure of proteins and other large molecules. The laws governing the diffraction of-X rays were discovered by the two Braggs, Sir William and Sir Lawrence, who were father and son.

At the Cavendish Laboratory the group that formed around Bernal, a man of wide public and scientific interests, included the Nobel Prize winners Max Perutz and John Kendrew, who in 1937 began to use-X rays to analyze two proteins fundamental to life, myoglobin and hemoglobin, both of which function in the transport of gases in the blood. Twenty-two years passed before the structures of these proteins were established; the significance of the work is that it provided the basis for an understanding of the mechanism of the action of enzymes and other proteins, an active and fruitful subject of modern investigation.

The nerve impulse: Important aspects of biophysics have been derived from physiology, especially in studies involving the conduction of nerve impulses. One important scientific product of World War-II – the development of vastly improved electronics – largely resulted from radar devices that had been used primarily for locating aircraft. Another product, the atomic bomb, was constructed by way of nuclear reactors that could, in peace time, provide an abundant supply of radioactive isotopes, which are now of great value not only in biophysical research but also in biochemistry and medicine. These two disparate advances were important to the work of two Nobel Prize winners, Alan Hodgkin and Andrew Huxley, who showed how the flow of sodium and potassium across the membranes of nerves can be coupled to produce the action potential, a brief electrical event that initiates the action potential, which propagates the nervous signal.

A model of the nerve axon proposed by Hodgkin and Huxley grew from a 19th-century confluence of ideas. Julius Bernstein, an experimental neurophysiologist, used physical chemical theories to develop a membrane theory of nervous conduction; Hodgkin's initial experiments were designed to test specific predictions of the Bernstein hypothesis.

Early in 1938 Hodgkin learned of the important results of a newly developed technique that allowed examination of the time course of nervous conduction. After World War-II, Hodgkin, joined by Huxley, again took up the research. They presented their explanation of the mechanism of nervous conduction in five scientific papers between October 1951 and March 1952.

Biological membranes: The availability of radioactive isotopes provided the technology necessary for understanding how molecules are transported across biological membranes, which are the very thin boundaries of living cells; the environment maintained by membranes in cells differs from the external environment and permits cellular function. The Danish physiologist August Krogh laid the groundwork in this subject; his pupil, Hans Ussing, developed the conceptual means by which the transport of ions (charged atoms) across membranes can be identified. Ussing's definition of active transport made possible an understanding, at the cellular level, of the way in which ions and water are pumped into and out of living cells to regulate the ionic composition and water balance in cells, organs, and organisms. The molecular mechanism by which these processes occur, however, remains to be discovered.

In addition to the function of transport, membranes also are utilized as templates on which such molecules as enzymes, which must function in a sequential fashion, can be kept in the requisite order. Although great progress has been made in understanding the mechanisms by which specific atoms are assembled into large biological molecules, the principles involved in the assembly of molecules into membranes, which are organized structures of a higher degree of complexity than large molecules, are not yet very well understood. There is reason to believe that the incorporation of a molecule into a membrane endows it with properties that differ from those of a molecule in solution. A primary task of biophysics is to understand the physical character of these cooperative interactions that are essential to life.

Sensory communication: The above comprise a few specific examples of the scope of biophysics. One area, difficult to discuss in specific terms, is that of sensory communication. Because stimuli, particularly those of a visible or auditory nature, can easily be specified in exact physical terms, they have excited the interest of physical scientists since before 1850. Modern electronic techniques make it relatively easy to distinguish true signals from noise; in addition, computers make possible the performance of significant experiments concerning the complex relationship between stimulus and action. Quantitative analysis of sensory response is very difficult, however, because it involves a synthesis of the action of many cells. Biophysics is the application of the principles of physics (the science that deals with matter and energy) to explain and explore the form and function of living things. The most familiar examples of the role of physics in biology are the use of lenses to correct visual defects and the use of X-rays to reveal the structure of bones (https://thefinancialdaily.com/role-of-biophysics-in-interdisciplinary-science).

TEXT 10

Role of Biophysics in Interdisciplinary Science (Part III)

Computerized axial tomography (CAT scan): An X-ray technique in which a three-dimensional image of a body part is put together by computer using a series of X-ray pictures taken from different angles along a straight line.

Electron microscope: A microscope that uses a beam of electrons to produce an image at very high magnification. Laser: A device that uses the movement of atoms and molecules to produce intense light with a precisely defined wavelength.

Magnetic resonance imaging (MRI): A technique for producing computerized three-dimensional images of tissues inside the body using radio waves.

Positron-emission tomography: A technique that involves the injection of radioactive dye into the body to produce three-dimensional images of the internal tissues or organs being studied. Ultracentrifuge: A machine that spins at an extremely high rate of speed and that is used to separate tiny particles out of solution, especially to determine their size.

X ray: A form of electromagnetic radiation with an extremely short wavelength that is produced by bombarding a metallic target with electrons in a vacuum.

X-ray diffraction: A technique for studying a crystal in which X-rays directed at it are scattered, with the resulting pattern providing information about the crystal's structure. Principles of physics have been used to explain some of the most basic processes in biology such as osmosis, diffusion of gases, and the function of the lens of the eye in focusing light on the retina. (Osmosis is the movement of water across a membrane from a region of higher concentration of water to an area of lower concentration of water. Diffusion of gases is the random motion of gas particles that results in their movement from a region of higher concentration to one of lower concentration.) The understanding that living organisms obey the laws of physics – just as nonliving systems do – has had a profound influence on the study of biology. The discovery of the relationship between electricity and muscle contraction by Luigi Galvani (1737-1798), an Italian physician, initiated a field of research that continues to give information about the nature of muscle contraction and nerve impulses. Galvani's discovery led to the development of such instruments and devices as the electrocardiograph (to record the electrical impulses that occur during heartbeats), electroencephalograph (to record brain waves), and cardiac pacemaker (to maintain normal heart rhythm).

The use of a wide array of instruments and techniques in biological studies has been advanced by discoveries in physics, especially electronics. This has helped biology to change from a science that describes the vital processes of organisms to one that analyzes them. For example, one of the most important events of this century – determining the structure of the DNA molecule – was accomplished using X-ray diffraction. This technique has also been used to determine the struc-

ture of hemoglobin, viruses, and a variety of other biological molecules and microorganisms.
Focus on the Field: While some colleges and universities have dedicated departments of biophysics, usually at the graduate level, many do not have university-level biophysics departments, instead having groups in related departments such as biochemistry, cell biology, chemistry, computer science, engineering, mathematics, medicine, molecular biology, neuroscience, pharmacology, physics, and physiology. Depending on the strengths of a department at a university differing emphasis will be given to fields of biophysics (https://thefinancialdaily.com/role-of-biophysics-in-interdisciplinary-science).

GLOSSARY

A

Amino acid

Any Organic compound containing both an amino group and a carboxylic group, bound as essential components of a protein molecule.

Angiography

A diagnostic X-ray imaging procedure used to see how blood flows through the blood vessels and organs of the body. This is done by injecting special dyes, known as contrast agents, into the blood vessel and using x-ray techniques such as fluoroscopy to monitor blood flow. Examples include coronary angiography (heart), cerebral angiography (brain), and peripheral angiography (hands, arms, feet and legs).

Antibiotic

Chemical substance formed as a metabolic by-product in bacteria or fungi and used to treat bacterial infections. Antibiotics can be produced naturally, using microorganisms, or synthetically.

Antibody

A protein produced by the body's immune defense system that can bind to foreign molecules and eliminate them.

Artificial Intelligence (AI)

A feature where machines learn to perform tasks, rather than simply carrying out computations that are input by human users. Early applications of AI included machines that could play games such as checkers and chess, and programs that could reproduce language.

B

Biodegradable

Capable of being broken down by the action of microorganisms or enzymes.

Bioengineering

The application of concepts and methods of engineering, biology, medicine, physiology, physics, materials science, chemistry, mathematics and computer sciences to develop methods and technologies to solve health problems in humans.

Bioinformatics

The branch of biology that is concerned with the acquisition, storage, display and analysis of biological information. Analysis of biological information includes statistical and computational methods to model biological processes.

Biomedical Imaging

The science and the branch of medicine concerned with the development and use of imaging devices and techniques to obtain internal anatomic images and to provide biochemical and physiological analysis of tissues and organs.

Biosensor

Device in which powerful recognition systems of biological chemicals (enzymes, antibodies) are coupled to microelectronics to enable low-level detection of substances such as sugars and proteins in body fluids, pollutants in water and gases in air.

Biotechnology

Commercial techniques that use living organisms, or substances from these organisms, to make or modify a product, and including techniques used for the improvement of the characteristics of economically important plants and animals and for the development of microorganisms to act on the environment.

Brain-Computer Interface

A system that uses the brain's electrical signals to allow individuals with limited mobility to learn to use their thoughts to move a computer cursor or other devices like a robotic arm or a wheelchair.

C

Cell

The fundamental unit of living organisms. The cell is characterized by an outer wall or membrane which is selectively permeable to nutrients, water, and other compounds, an inner fluid called cytoplasm, and various structures for the metabolism and reproduction of the cell.

Cell line

A family of cells, grown from a single parent, and generally having identical characteristics.

Chromosome

Any of several threadlike bodies found in a cell which carry genes in a linear order.

Clinical Decision Support System

An interactive software-based system designed to assist physicians and other health professionals as well as patients with diagnostic and treatment decisions and reminders. The system compiles and analyzes medical information from raw data, health observations, and other medical information sources.

Cloning

The process of producing many copies of a biological material, usually a certain sequence of DNA or type of cell. Because reproduction is asexual, the progeny are genetically identical to the original ancestor.

Computational Modeling

The use of mathematics, statistics, physics, and computer science to study the mechanism and behavior of complex systems by computer simulation. A computational model contains numerous variables that characterize the system being studied. Simulation is done by adjusting these variables and observing how the changes affect the outcomes predicted by the model.

Computed Tomography

A computerized X-ray imaging procedure in which a narrow beam of X-rays is aimed at a patient and quickly rotated around the body, producing signals that are processed by the machine's computer to generate cross-sectional images—or "slices"—of the body. These slices are called tomographic images and contain more detailed information about the internal organs than conventional X-rays.

Contrast agent

A substance used to enhance the imaged appearance of structures, processes or fluids within the body in biomedical imaging.

Culture

The propagation of microorganisms or of living tissue cells in media conducive to their growth; the product of such propagation; also, tissue culture.

D

Diagnostic

A product used to diagnose a disease or medical condition. Both monoclonal antibodies and DNA probes are useful diagnostic products.

DNA (deoxyribonucleic acid)

The biological molecule that is the genetic basis of heredity in every living cell. Each inherited characteristic is determined precisely by the information found in the DNA code. The molecule itself is a linear chain of repeating deoxynucleotide units.

DNA sequence

The order of nucleotide bases in the DNA molecule.

Drug Delivery Systems

Engineered technologies for the targeted delivery and/or controlled release of therapeutic agents.

E

Electroencephalography (EEG)

The recording of electrical activity along the scalp resulting from current flowing within the neurons of the brain. EEG can be used to diagnose epilepsy and other disorders associated with altered brain electrical activity.

Electromagnetic Radiation

A kind of radiation including visible light, radio waves, gamma rays, and x-rays, in which electric and magnetic fields vary simultaneously. The different forms are differentiated by their wavelength and energy. For instance, visible light has relatively long wavelengths and less energy compared to x-rays or gamma rays with short wavelengths and high energy.

Endoscope

A thin illuminated flexible or rigid tube-like optical system used to examine the interior of a hollow organ or body cavity by direct insertion. Instruments can be attached for biopsy and surgery. Similar technology is used in a laparoscope.

Enzyme

A functional protein that catalyzes a chemical reaction but is itself neither consumed nor altered. Enzymes control the rate of metabolic processes in an organism; they are, for instance, the active agents in the fermentation process.

Ex vivo

A Latin phrase translating to "out of the living" that, in the medical sciences, refers to experiments conducted on tissues or organs that have been removed from a living organism.

Fermentation

A biochemical process which generates energy by converting a raw material such as glucose into simpler products such as ethanol. No oxygen is required. Used in the production of products such as alcohols, acids, and cheese by the action of yeasts, molds, and bacteria.

F

Fluorescence

The emission of light by a substance that has absorbed light or other electromagnetic radiation. The absorbed and emitted light are usually different wavelengths and therefore produce different colors.

G

Gene

The basic unit of heredity; a segment of DNA coding for a specific protein.

Gene therapy

The insertion of a gene into a patient in a way that corrects a genetic defect.

Gene transfer

The use of genetic or physical manipulation to introduce foreign genes into host cells to achieve desired characteristics in progeny.

Genetic code

The biochemical basis of heredity consisting of codons (base triplets along the DNA sequence) that determine the specific amino acid sequence in proteins. Under normal conditions, the code is not ambiguous-each codon always designates the same amino acid.

Genetic engineering

A technology used to alter the hereditary material of a living cell. Genetic engineering can be used to make cells that can produce more or different chemicals or perform completely new functions.

Genome

The basic chromosome set of an organism - the sum total of its genes.

Genotype

The genetic constitution of an individual or group of cells, plants or animals.

H

Hormones

The "messenger" molecules for the body that help coordinate the actions of various tissues; they produce a specific effect on the activity of cells remote from their point of origin.

Hybrid

The offspring of genetically dissimilar parents. Hybrids can be made within a species (crossing two types of peach trees) or across species (fusing two different cell types in vitro).

Hydrocarbon

All organic compounds that are composed only of carbon and hydrogen.

I

Immunology

Study of all phenomena related to the body's response to antigenic challenge (i.e. immunity, sensitivity, and allergy).

Implantable Devices

Man-made medical devices implanted in the body to replace or augment biological functions. Such devices range from those that provide structural support, such as a hip replacement to those that contain electronics, such as pacemakers. Some implants are bioactive such as a drug-eluting stent used to open a blocked artery.

Interferon - A protein which helps the human body resist and defeat infections.

In vitro

Outside the living organism and in an artificial environment. Literally, "in glass."

In vivo

Within the living organism. Literally, "in life."

Insulin

A hormone that stimulates cell growth via glucose uptake by cells. Many companies are now producing human insulin using genetic technology.

Ionizing Radiation

A type of electromagnetic radiation that can strip electrons from an atom or molecule – a process called ionization. Ionizing radiation has a relatively short wavelength on the electromagnetic spectrum. Examples of ionizing radiation include gamma rays, and X-rays. Lower energy ultraviolet, visible light, infrared, microwaves, and radio waves are considered non-ionizing radiation.

L

Laparoscope

A thin, lighted telescope-like viewing instrument that is inserted through a small incision or natural orifice to examine and operate on abdominal and pelvic structures. Similar technology is used in an endoscope. “Laparo” is derived from the Greek root for abdomen and pelvis; however, devices similar to laparoscopes are used for other parts of the body such as thoroscopes for chest surgery.

Laser Doppler Imaging

A technique used to measure the total local microcirculatory blood perfusion including the perfusion in capillaries, arterioles, venules and shunting vessels. The technique is based on the emission of a scanning beam of laser light and the Doppler shift that occurs when light particles hit moving blood cells.

Leukocytes - The white cells of blood.

Library

A set of cloned DNA fragments.

M

Machine Learning (ML)

An approach to AI in which a computer algorithm (a set of rules and procedures) is developed to analyze and make predictions from data that is fed into the system. Machine learning-based technologies are routinely used every day, such as personalized news feeds and traffic prediction maps.

Magnetic Resonance Imaging (MRI)

A non-invasive imaging technology used to investigate anatomy and function of the body in both health and disease without the use of damaging ionizing radiation. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects changes in protons found in the water that makes up living tissues.

Magnetic Resonance Spectroscopy (MRS)

A non-invasive analytic imaging technique used to study metabolic changes in diseases affecting the brain, including tumors, strokes, and seizures. The technique is also used to study the metabolism of other organs. MRS complements MRI as a non-invasive means for the characterization of tissue, by providing measure of the concentration of different chemical components within the tissue.

Mammography

An X-ray imaging method used to image the breast for the early detection of cancer and other breast diseases. It is used as both a diagnostic and screening tool.

Metabolism

The sum of the physical and chemical processes involved in the maintenance of life and by which energy is made available.

Microbial herbicides/pesticides

Microorganisms that are toxic to specific plants/insects. Because of their narrow host range and limited toxicity, these microorganisms may be preferable to their chemical counterparts for certain pest control applications.

Microbiology

Study of living organisms that can be seen only under a microscope.

Microorganism

An organism that is a fungus, prokaryote, protist or virus.

Mitochondria

Structures in higher cells that serve as the "powerhouse" for the cell, producing chemical energy.

Molecular genetics

Study of how genes function to control cellular activities.

Molecular Imaging

A discipline that involves the visualization of molecular processes and cellular functions in living organisms. With the inclusion of a biomarker, which interacts chemically with tissues and structures of interest, many imaging techniques can be used for molecular imaging including ultrasound, x-rays, magnetic resonance imaging, optical imaging, positron emission tomography, and single photon emission computed tomography.

N

Nanoparticle

Ultrafine particles between 1 and 100 nanometers in size. The size is similar to that of most biological molecules and structures. Nanoparticles can be engineered for a wide variety of biomedical uses including diagnostic devices, contrast agents, physical therapy applications, and drug delivery vehicles. A nanoparticle is approximately 1/10,000 the width of a human hair. Nanoparticles are generally 1000 times smaller than microparticles.

Nanotechnology

The manipulation of matter with at least one dimension sized from 1 to 100 nanometers. Research areas include surface science, molecular biology, semiconductor physics, and microfabrication. Applications are diverse and include device physics, molecular self-assembly, and precisely manipulating atoms and molecules.

Nuclear Medicine

A medical specialty that uses radioactive tracers (radiopharmaceuticals) to assess bodily functions and to diagnose and treat disease. Diagnostic nuclear medicine relies heavily on imaging techniques that measure cellular function and physiology.

Nucleic acid

A linear polymer of nucleotides; a generic term for either DNA or RNA.

O

Optical Imaging

A technique for non-invasively looking inside the body, as is done with x-rays. Unlike x-rays, which use ionizing radiation, optical imaging uses visible light and the special properties of photons to obtain detailed images of organs and tissues as well as smaller structures including cells and molecules.

Organic compounds

Chemical compounds based on carbon chains or rings, which contain hydrogen, and also may contain oxygen, nitrogen, and various other elements. All biomolecules are organic, e.g. DNA, RNA, cell wall constituents, lipids and enzymes.

Organism

Any biological entity, cellular or non-cellular, with capacity for self-perpetuation and response to evolutionary forces.

P

Pathogen

Any disease-producing agent or microorganism.

pH

A measure of the acidity or basicity of a solution; on a scale of 0 (acidic) to 14 (basic): for example, lemon juice has a pH of 2.2 (acidic), water has a pH of 7.0 (neutral), and a solution of baking soda has a pH of 8.5 (basic).

Pharmaceuticals

Products intended for use in humans, as well as in vitro applications to humans. Pharmaceuticals include drugs, vaccines, diagnostics, and biological response modifiers.

Photon

A particle of light or electromagnetic radiation. The energies of photons range from high-energy gamma rays and x-rays to low-energy radio waves.

Polymer

A long-chain molecule formed from smaller repeating structural units, e.g. DNA, peptides, and proteins.

Polymerase

General term for enzymes that carry out the synthesis of nucleic acids.

Positron Emission Tomography (PET)

PET scans use radiopharmaceuticals to create 3 dimensional images. The decay of the radiotracers used with PET scans produce small particles called positrons. When positrons react with electrons in the body they annihilate each other. This annihilation produces two photons that shoot off in opposite directions. The detectors in the PET scanner measure these photons and use this information to create images of internal organs.

Precision medicine

In contrast to a one-size-fits-all approach, in which disease treatment and prevention strategies are developed for the average person, precision medicine can give doctors and researchers the ability to predict more accurately which treatment and prevention strategies will work best in an individual.

Pure culture

In vitro growth of only one type of microorganism.

Protein

A linear polymer of amino acids, the products of gene expression. Proteins function usually as catalysts, facilitating chemical reactions without being altered themselves.

R

Radiation

The emission of energy as electromagnetic waves or as moving subatomic particles, especially high-energy particles that cause ionization.

Rehabilitation Engineering

The use of engineering science and principles to develop technological solutions and devices to assist individuals with disabilities and aid the recovery of physical and cognitive functions lost because of disease or injury.

Replication

Reproduction or duplication, as of an exact copy of a strand of DNA.

RNA (ribonucleic acid)

A nucleic acid that assists in translating the genetic message of DNA into the finished protein. It has three basic forms- messenger RNA, transfer RNA, and ribosomal RNA.

S

Single Photon Emission Computed Tomography (SPECT)

A nuclear medicine imaging technique using gamma rays. SPECT imaging instruments provide 3 dimensional images of the distribution of radioactive tracer molecules that have been introduced into the patient's body. The 3D images are computer generated from a large number of images of the body recorded at different angles by cameras that rotate around the patient.

Spectroscopy

the branch of science concerned with the investigation and measurement of spectra produced when matter interacts with or emits electromagnetic radiation.

Stem Cell

An undifferentiated cell of a multicellular organism that is capable of giving rise to more of the same cell type indefinitely, and has the ability to differentiate into many other types of cells that form the structures of the body.

Substrate

Material acted on by an enzyme.

T

Toxin

A poisonous substance, often a protein, which can harm cells.

Transduction

The process by which foreign DNA becomes incorporated into the genetic complement of the host cell.

Transformation

The transfer of genetic information by DNA separated for the cell.

U

Ultrasound

A form of acoustic energy, or sound, that has a frequency that is higher than the level of human hearing. As a medical diagnostic technique, high frequency sound waves are used to provide real-time medical imaging image inside the body without exposure to ionizing radiation. As a therapeutic technique, high frequency sound waves interact with tissues to destroy diseased tissue such as tumors, or to modify tissues, or target drugs to specific locations in the body.

V

Vaccine

A preparation that contains an antigen consisting of whole disease-causing orgainsms (killed or weakened), or parts of such organisms, and is used to confer immunity against the disease that the organisms cause. Vaccine preparations can be natural, synthetic, or derived by recombinant DNA technology.

Virus

An infectious agent that requires a host cell for it to replicate. It is composed of either RNA or DNA wrapped in a protein coat.

W

Wild type

The form of an organism that occurs most frequently in nature.

X

X-rays

A form of high energy electromagnetic radiation that can pass through most objects, including the body. X-rays travel through the body and strike an x-ray detector (such as radiographic film, or a digital x-ray detector) on the other side of the patient, forming an image that represents the "shadows" of objects inside the body.

Y

Yeast

A general term for single-celled fungi that reproduce by budding. Some yeasts can ferment carbohydrates (starches and sugars), and thus are important in brewing and baking.

https://www.nibib.nih.gov/science-education/glossary
https://btlj.org/data/articles2015/vol1/1_1/1-berkeley-tech-l-j-0253-0258.pdf

Appendix 3

English presentation words and phrases

Presentation starting phrases	• *I'd like to start by…* • *Today, I'm here to discuss…* • *Let's begin with a look at…* • *Good morning/afternoon/evening, my name is…* • *It's a pleasure to be here today to talk about…* • *Let's dive straight into…* • *I would like to kick off with…* • *Firstly, let's consider…* • *Have you ever wondered about…* • *Thank you for joining me as we explore…* • *Today's focus will be on…* • *Let's set the stage by discussing…* • *The topic at hand today is…* • *To start, let's examine…* • *I want to begin by highlighting…*
Key presentation phrases	• *Moving on to the next point, we see...* • *Delving deeper into this topic, we find...* • *An important aspect to consider is...*

	• *It leads us to the question of...* • *Another critical point to remember is...* • *To illustrate this point, let me share...* • *On the other hand, we also have...* • *Furthermore, it's critical to note that...* • *Let's take a moment to examine...* • *As an example, let's look at...* • *The evidence suggests that...* • *Contrary to popular belief...* • *It's also worth noting that...* • *Digging into this further, we discover...* • *Expanding on this idea, we can see...* • *Turning our attention to...* • *The data indicate that...* • *To clarify, let's consider...* • *To highlight this, let's review...* • *Putting this into perspective, we can infer...*
Phrases for presentation flow	• *Moving forward, let's consider...* • *With that said, let's turn our attention to...* • *Now that we've discussed X, let's explore Y...* • *Building upon this idea, we can see that...* • *Transitioning to our next point, we find...* • *Shifting gears, let's examine...* • *Let's now pivot to discussing...* • *Following this line of thought...* • *Linking back to our earlier point...* • *Let's segue into our next topic...* • *It brings us neatly to our next point...* • *To bridge this with our next topic...* • *In the same vein, let's look at...* • *Drawing a parallel to our previous point...* • *Expanding the scope of our discussion, let's move to...*

	• *Having established that, we can now consider...* • *Correlating this with our next point...* • *Let's transition now to a related idea...* • *With this in mind, let's proceed to...* • *Steering our discussion in a new direction, let's delve into...*
Concluding the presentation	• *To sum up our discussion today...* • *In conclusion, we can say that...* • *Wrapping up, the key takeaways from our talk are...* • *As we come to an end, let's revisit the main points...* • *Bringing our discussion to a close, we find...* • *In the light of our discussion, we can infer...* • *To synthesize the main points of our discourse...* • *To recap the primary themes of our presentation...* • *As we conclude, let's reflect on...* • *Drawing our discussion to a close, the principal conclusions are...* • *As our dialogue comes to an end, the core insights are...* • *In wrapping up, it's essential to remember...* • *Summarizing our journey today, we can say...* • *As we bring this presentation to a close, let's remember...* • *Coming to an end, our central message is...*

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Учебно-методическое пособие