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Кафедра іноземних мов

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Методичні вказівки

та навчальні завдання до практичних занять
і самостійної роботи з навчальної дисципліни
«Практичний курс англійської мови»
для здобувачів вищої освіти першого (бакалаврського) рівня
за освітньо-професійною програмою «Біотехнології,
біоробототехніка та біоенергетика» спеціальності 162
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Методичні вказівки та навчальні завдання для практичних занять і самостійної роботи з навчальної дисципліни «Практичний курс англійської мови» для здобувачів вищої освіти першого (бакалаврського) рівня за освітньо-професійною програмою «Біотехнології, біоробототехніка та біоенергетика» спеціальності 162 «Біотехнологія та біоінженерія» денної форм навчання [Електронне видання] / Тарасюк Н. М., Шикун А.В. – Рівне : НУВГП, 2023. – 45 с.

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Передмова

Методичні вказівки та навчальні завдання для практичних занять і самостійної роботи з дисципліни «Практичний курс англійської мови» для здобувачів вищої освіти першого бакалаврського рівня за освітньо-професійною програмою «Біотехнології, біоробототехніка та біоенергетика» спеціальності 162 «Біотехнологія та біоінженерія» денної форм навчання мають на меті допомогти студентові у його практичній та самостійній роботі над розвитком комунікативної компетентності.

Для досягнення зазначеної мети передбачається виконання таких завдань:

- оволодіння найбільш уживаною лексикою у межах даної інженерної тематики;
- отримання уявлення про основні граматичні категорії мови, яка вивчається відповідно до інженерної тематики; розпізнавання відомого лексичного і граматичного матеріалу під час читання і застосування його у процесі усного спілкування та письма;

У результаті вивчення навчальної дисципліни студент повинен

знати: граматичні структури, що є необхідними для гнучкого передання відповідних понять, а також для розуміння професійної інформації; мовні форми, властиві для розмовних регістрів професійного мовлення; лексичні одиниці для інженерного тезаурусу .

вміти:

-*аудіювання:* розуміти обговорення проблем професійно-орієнтованого характеру;

-*читання*: розуміти автентичні тексти, пов'язані з напрямом інженерії; розуміти головні ідеї та знаходити необхідну інформацію в неадаптованій технічній літературі за фахом; здійснювати ознайомлювальне та пошукове читання неадаптованих технічних текстів для отримання інформації;

- *говоріння*: реагувати на основні ідеї та розпізнавати суттєво важливу інформацію під час обговорень, що пов'язані з професією; чітко аргументувати свої позиції відносно актуальних тем в професійному житті;

-*письмо*: оволодіти професійними вміннями письмового мовлення;

Кожен урок починається з необхідного глосарію спеціальних термінів. Перший урок містить етапи для кращого розуміння тексту, яких варто дотримуватися при опрацюванні текстів із інших уроків. Післятекстові завдання дозволяють перевірити розуміння прочитаного. Кожен урок закінчується вправами для коретного оформлення писемного висловлювання та логічно зв'язаної усномовленнєвої форми спілкування на смислово-синтаксичному рівні. Вкінці даного навчально-методичного видання містяться додаткова граматична інформація та глосарій термінів нанотехнології.

The term "Biotechnology". The term "Nanotechnology". Genetic engineering.

Тема 1. The term "Biotechnology"

Speaking.Task 1. ln pairs, discuss the following questions
Why did you choose this specialty?
What field of biotechnology are you going to study in future?
Say in your words what biotechnology is.

ESSENTIAL VOCABULARY

Absence *noun* – the state of being away from a place or person.
Antibiotic *noun* – a medicine (such as penicillin or its derivatives) that inhibits the growth of or destroys microorganisms.
Bioconversion *noun* – the conversion of one chemical compound, or one form of energy, into another by living organisms.
Deal with *phrasal verb* – when you deal with something or someone that needs attention, you give your attention to them, and often solve a problem or make a decision concerning them.
genetic manipulation
Interferon *noun* – a protein released by animal cells.
Hazardous *adjective* – risky; dangerous ● *We work in hazardous conditions. It is hazardous to personal safety.*
Hormone *noun* – a regulatory substance produced in an organism and transported in tissue fluids such as blood or sap to stimulate specific cells or tissues into action
Marine *adjective* – relating to or found in the sea.
Pharmaceutical *adjective* – relating to medicinal drugs, or their preparation, use, or sale.
Rare *adjective* – (of an event, situation, or condition) not occurring very often ● *A rare genetic disorder.*
Solution *noun* – a liquid mixture in which the minor component (the solute) is uniformly distributed within the major component.
Stem cell *noun* – an undifferentiated cell of a multicellular organism
Technique *noun* – a way of carrying out a particular task, especially the execution or performance of an artistic work or a scientific procedure.

Transgenic *adjective*– relating to or denoting an organism that contains genetic material into which DNA from an unrelated organism has been artificially introduced.

Vocabulary focus. Task 2. Match (1-6) to the descriptions (a-f).

1. bioconversion	a. a group of atoms bonded together
2. molecule	b. the conversion of one chemical compound, or one form of energy, into another by living organisms
3. stem cell	c. relating to or denoting an organism that contains genetic material into which DNA from an unrelated organism has been artificially introduced
4. transgenic	d. an undifferentiated cell of a multicellular organism
5. interferon	e. a liquid mixture in which the minor component (the solute) is uniformly distributed within the major component
6. solution	f. a protein released by animal cells

Grammar. **Key structures**

Normal sentence pattern
Complement answers the question what and whom
Cells lack a nucleus.
Cell*s subject* ***lack*** *verb* ***a nucleus*** *complement*
Modifier answers the question when, where, how
Most energy occurs in cyclic photophospholyration.

The Structures of Simple Present Tense

POSITIVE FORMS (+) :

- Subject (I, You, We, They) + V_1 (First Form of Verb)
- Subject (He, She, It) + VERB – S / ES / IES
-

NEGATIVE FORMS (-) :

- Subject (I, You, We, They) + do not / don't + V_1 (First Form of Verb)
- Subject (He, She, It) + does not / doesn't + V_1 (First Form of Verb)

QUESTION FORMS (?) :

- Do + Subject (I, You, We, They) + V_1 (First Form of Verb)
- Does + Subject (He, She, It) + V_1 (First Form of Verb)

Reading techniques

Step 1

Goal: Prereading preparation.

Look carefully at anything that can give you information on the reading: table of contents, the introduction to the story, the title, subheadings within the story, glosses, vocabulary. Try to find some of this type of information:

- what kind of text it is (fairy tale, report?);

example, if you have decided the text is a drama, think about what you expect from a drama. If

Step 2: Skimming.

Goal: To get the general meaning (gist) of the story without trying to decode exactly what each word means.

Read the whole text through silently **twice** as outlined below. Do not use a dictionary! (To help you resist the temptation to decode the reading word-for- word, you should time yourself, allowing **no more than two minutes per paragraph**.)

1. Your **first** reading will help orient you further to the content and make you comfortable with what you don't understand in it. Focus on what does make sense (cognates, compound words, logical relationships between words and whole phrases), and skip what you don't understand, trying to go with the flow.

2. Your **second** reading will give you a much better feeling for the content. You will notice that some passages that were unclear during your first reading are starting to clear up, since what comes at the end often helps you to understand the beginning.

After completing these two readings, stop and make a **mental summary** of what you have understood. Now invent a sentence summarizing what you think the story is (or might be) about. You might write something like: This story deals with X (love, for instance), and Y happens. . . .

Step 3: Scanning.

Goal: To extract specific pieces of information.

You will extract certain basic facts by **scanning** it:
Read through the text again **very quickly**, scanning for the things listed below.
WHO (both names and descriptive nouns,); ***WHEN*** (both dates and others); ***WHERE.***

Step 4: Decoding.

Goal: Thorough comprehension.

After you have skimmed and scanned, there will still be stretches of text that offer vocabulary or grammatical difficulties you can't overcome easily. In those cases, intensive reading (detailed, word-by-word decoding) is necessary. So, now read the text again, this time slowing down and decoding these sections, i.e. carefully analyzing each word unit. Remember to think about structure as well as vocabulary when you are working. For example:

- establish logical relationships by finding connectors (for ex. although, if, in addition, etc.)
- identify to what or whom a word or group of words refers
- locate important words in the phrase or sentence, like the subject, main verb (and the parts of the main verb), important pronouns, etc.

Now you should be able to paraphrase the author, but not necessarily evaluate the ideas. When you are finished reading, try to retell events in the text in your mind.

Step 5. Global understanding.

Goal: To understand and critically evaluate the "why" of the text.
Some examples of questions you should ask yourself after all your readings:

- Why did the author put this remark or description in this place and not in another?
- What is the meaning of a fact alone? in relation to other facts in the text?
- Why did the author write the text? What did he put emphasis on?

Reading. Task 3. Read the text using reading techniques.

The term "Biotechnology"

The term "biotechnology" consists of two parts. Bio is a Greek word for "life" and technology gives an indication of human intervention. Biotechnology can be based on the pure biological sciences (genetics, microbiology, animal cell culture, molecular biology, biochemistry, embryology, cell biology). Also its interests can be outside the sphere of biology (chemical engineering, bioprocess engineering, information technology, biorobotics). Biotechnology deals with brewing, manufacture of human insulin, interferon, and human growth hormone, medical diagnostics, cell cloning and reproductive cloning, the genetic modification of crops, bioconversion of organic waste and the use of genetically altered bacteria in the cleanup of oil spills, stem cell research and much more.

As a matter of fact, biotechnology is very ancient. Six thousand years ago, micro-organisms were used to brew beers and to produce wine, bread and cheese.Yeast makes dough rise and converts sugars into alcohol. Lactic acid bacteria in milk create cheese and yoghurt. This

application of biotechnology is the directed use of organisms for the manufacture of organic products (examples include beer and milk products). traditional techniques used to breed animals and plants, as well as to the application of bacteria, yeasts and molds to make bread or cheese.

Modern biotechnology came into being during the nineteen seventies. It has often been divided into several categories; every field of this science is sometimes connected with the definite color.

Green biotechnology is biotechnology applied to agricultural processes. An example would be the selection and domestication of plants via micro propagation. Another example is the designing of transgenic plants to grow under specific environments in the presence (or absence) of chemicals. One hope is that green biotechnology might produce more environmentally friendly solutions than traditional industrial agriculture, although this is still a topic of considerable debate.

Red biotechnology is applied to medical processes. Some examples are the designing of organisms to produce antibiotics, and the engineering of genetic cures through genetic manipulation. White biotechnology, also known as industrial biotechnology, is biotechnology applied to industrial processes. An example is using naturally present bacteria by the mining industry in bioleaching; so it is the designing of an organism to produce a useful chemicalor destroy hazardous/polluting chemicals.

White biotechnology tends to consume less in resources than traditional processes used to produce industrial goods.

Blue biotechnology is a term that has been used to describe the marine and aquatic applications of biotechnology, but its use is relatively rare.

Bioinformatics is an interdisciplinary field which addresses biological problems using computational techniques, and makes the rapid organization and analysis of biological data possible.

Bioinformatics plays a key role in various areas, such as functional genomics, structural genomics, and proteomics, and forms a a key component in the biotechnology and pharmaceutical sector.

In conclusion biotechnology can be refered to any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.

Task 4. Answer the questions taking into account key structures.

1) What does the term "biotechnology" consist of?
2) Can you count the areas of biotechnology?
3) Is biotechnology a new science or not? Give facts to prove it.
4) What is classical and modern biotechnology?
5) When did modern biotechnology begin?
6) What is bioinformatics? What is its role?
7) What biotechnology applies to agricultural processes?
8) What can green biotechnology design?
9) What does red biotechnology deal with?
10) What are the examples of industrial biotechnology using?
11) What does blue biotechnology deal with?

Speaking. Writing. Task 5. Read two approaches for writing summaries. Choose one which you like. Look at the summary sample. Write your own summary of the text "Biotechnology". Read your summaries in pairs, compare with your partner's one.

Steps of summary (approach 1)

1: Read the text for its main points.
2. Reread carefully and make a descriptive outline.
3*:* Write out the text's thesis or main point.
4*:* Identify the text's major divisions or chunks. Each division develops one of the stages needed to make the whole main point.
5*:* Try summarizing each part in one or two sentences.
6. Now combine your summaries of the parts into a coherent whole, creating a condensed version of the text's main ideas in your own words.

Steps of summary (approach 2)

1.Read and understand the text carefully.

2.Think about the purpose of the text. Ask what the author's purpose is in writing the text? ...

3.Select the relevant information. ...

4. Find the main ideas - what is important. ...

5. Change the structure of the text. ...

6.Rewrite the main ideas in complete sentences. ...

The summary sample of the text

The German Johannes Gutenberg introduced printing in Europe. His invention had a decisive contribution in spread of mass-learning and in building the basis of the modern society.

Task 6. In pairs, explain the term «biotechnology». Use the language from this section and the phrases in the box. Swap roles and practise again.

I see. So ... 0K. In other words ... So vou mean ... It sounds like it's

Тема 2. The term «Nanotechnology»

Speaking. Task 1. In pairs answer the following questions.
What is the word "nanotechnology"?
What does nanotechnology research?
How many proteins do you know?

ESSENTIAL VOCABULARY
Advanced *adjective* – far on or ahead in development or progress.
Approach *noun* – a way of dealing with a situation or problem ● *We need a whole new approach to the job.*
Approximately *adverb* – used to show that something is almost, but not completely, accurate or exact; roughly ● *A journey of approximately two hours.*
Arbitrary *adjective* – If you describe an action, rule, or decision as arbitrary, you think that it is not based on any principle, plan, or system.
Evolve *verb* – develop gradually.
Impact *noun* – a marked effect or influence.
Nanomaterial *noun* – a material having particles or constituents of nanoscale dimensions, or one that is produced by nanotechnology.

Observe *verb* – take note of or detect (something) in the course of a scientific study.
Toxicity *noun* – the degree of strength of a poison.

Vocabulary focus. Task 2. Look through **nanotechnology glossary** (Appendix 2) and decide which words belong to the following categories: **materials, DNA, methods, techniques, devices, process.**

Vocabulary focus. Task 3. Match (1-6) to the descriptions (a-f).

1. nanomaterial	a. the degree of strength of a poison
2. toxicity	b. a material having particles or constituents of nanoscale dimensions, or one that is produced by nanotechnology
3. impact	c. take note of or detect (something) in the course of a scientific study
4. observe	d. a marked effect or influence
5. phenomenon	e. develop gradually
6. evolve	f. a fact or situation that is observed to exist or happen

Grammar. **The difference between active and passive voice** (more detailed information is in appendix 1)

While *tense* is all about time references, *voice* describes whether the grammatical subject of a clause performs or receives the action of the verb. Here's the formula for the active voice:

[subject]+[verb (performed by the subject)]+[optional object]
e.g. Nanotechnology creates many new materials.

In a passive voice construction, the grammatical subject of the clause *receives* the action of the verb. So, materials, which are *receiving* the action, become the subject. The formula:

[subject]+[some form of the verb *to be*]+[past participle of a transitive verb]+[optional prepositional phrase]

e.g. Many new materials are created by nanotechnology.

Task 4. Fill in the correct form of verbs.

1.The honey bees (keep) in a humidified chamber at room temperature two days ago.

2.The solution (heat) to 90°C for approximately 30 minutes and then allowed to cool yesterday .

3. A structure for nucleic acid already (propose) by Pauling and Corey.

4. Carbohydrates (produce) by green plants in the presence of light and chlorophyll.

5. Up to 90% of the energy in light bulbs (waste) in the form of heat.

Reading. Task 5. Read the text using reading techniques. Find sentences in passive voice. Explain their meaning. Find sentences in active voice, transform into passive if it is possible.

The term "Nanotechnology"

Nanotechnology is the study of manipulating matter on an atomic and molecular scale. Nanotechnology may be able to create many new materials and devices with a vast range of applications, such as in medicine, electronics, biomaterials and energy production. But also nanotechnology raises many concerns about the toxicity and environmental impact of nanomaterials, and their potential effects on global economics.

Nanotechnology is the engineering of functional systems at the molecular scale. In its original sense, nanotechnology refers to the projected ability to construct items from the bottom up, using techniques and tools being developed today to make complete, high performance products.

One nanometer (nm) is one billionth of a meter. By comparison, a DNA double-helix has a diameter around 2 nm. On the other hand, the smallest cellular life-forms, the bacteria of the genus Mycoplasma, are around 200 nm in length. By convention, nanotechnology is taken as the scale range 1 to 100 nm. The lower limit is set by the size of atoms (hydrogen has the smallest atoms, which are approximately a quarter of 1 nm diameter) since nanotechnology must build its devices from atoms and molecules. The upper limit is more or less arbitrary but is around the size that phenomena not observed in larger structures start to become apparent and can be made use of in the nano device.

Two main approaches are used in nanotechnology. In the **"**bottom-up**"** approach, materials and devices are built from molecular components which assemble themselves chemically by principles of molecular recognition. In the "top-down" approach, nano-objects are constructed from larger entities without atomic-level control.

Areas of physics such as nanoelectronics, nanomechanics, nanophotonics and nanoionics have evolved during the last few decades to provide a basic scientific foundation of nanotechnology.

The various applications of NT are listed below:

1. Devices: micromachinery, nano-abacus, nanomotor, nanopore (nanopore sequencing), quantum point contact, synthetic molecular motors, and carbon nanotube actuators.
2. Energy applications of NT.
3. Fullerene is a molecule composed entirely of carbon, in the form of a hollow sphere, ellipsoid, or tube. The fullerene spheres and tubes that have applications in NT are:
   - allotropes of carbon

endohedral fullerenes;
- fullerite;
- graphene (graphene nanoribbon);
- potential applications of carbon nanotubes; and
- timeline of carbon nanotubes.

4. Microscopy: atomic force microscope, scanning tunneling microscope, scanning probe microscope, IBM millipede, and sarfus.
5. Molecular electronics.
6. Molecular NT: Grey goo, mechanosynthesis, molecular assembler,

molecular modeling, nanorobotics (smartdust and utility fog), nanochondria, programmable matter, self reconfigurable, and self-replication.
7.Molecular self-assembly: DNA NT (DNA computing, DNA machine, and DNA origami), self-assembled monolayer, and supramolecular assembly.
8. Nanoelectronics: break junction, chemical vapor deposition, microelectromechanical systems (MEMS), nanocircuits, nanocomputer, nanoelectromechanical systems (NEMS), and surface micromachining.
9. Nanolithography: dip pen nanolithography, electron beam lithography, ion-beam sculpting, nanoimprint lithography, and photolithography.
10. Nanomaterials is the study of materials with morphological features on the nanoscale, and especially those that have special properties stemming from the nanoscale dimensions.
11. Nanomedicine: lab-on-a-chip, nanobiotechnology, nanosensor, and nanotoxicology.
12. Nanoparticles and colloids: nanoparticle, ceramics processing, colloid, colloidal crystal, diamondoids, nanocomposite, nanocrystal, nanostructure (nanocages, nanocomposite, nanofabrics, nanofiber, nanofoam, nanoknot, nanomesh, nanopillar, nanopin film, nanoring, nanorod, nanoshell, nanotube, quantum dot, quantum heterostructure, and sculptured thin film).
13. Quantum computing is a computation using quantum mechanical phenomena, such as superposition and entanglement, to perform data operations.

Task 6. Look through the text and complete the following categories materials, DNA, methods, techniques, devices, process.

Task 7. Are the following statements true or false? Correct the false ones.
1) Nanotechnology is the study of manipulating matter on only molecular scale.
2) Generally, nanotechnology deals with structures sized between 10 to 100 nanometre.
3) Nanotechnology may be able to create many new materials and devices with a vast range of applications.

4) Nanoelectronics is the engineering of functional systems at the molecular scale.
5) Nanotechnology refers to the projected ability to construct items from the bottom up.
6) One nanometer (nm) is one billionth, or 10-9, of a meter.
7) Nanotechnology is taken as the scale range 1 to 100 nm.
8) The upper limit is set by the size of atoms.
9) Four main approaches are used in nanotechnology.
10) Only nanoelectronics have evolved during the last few decades to provide a basic scientific foundation of nanotechnology.

Speaking. Writing. Task 8. Write your own summary of the text «The term «Nanotechnology». Read your summaries in pairs, compare with your partner's one.

Task 9. In pairs, explain the term «nanotechnology». Use the phrases in the box. .

- in other words
- to put in a nutshell
- I mean to say
- for want of a better word
- to put it another way
- after all

Тема 3. Genetic engineering

Speaking. Task 1. What areas of biotechnology do you know?
What does genetic engineering deal with?
Where can biotechnologists apply the products of genetic engineering?
ESSENTIAL VOCABULARY
Accelerate *verb* – increase in rate, amount, or extent.
Application *noun* – the action of putting something into operation.
Benefit *noun* – an advantage or profit gained from something ● *Enjoy the benefits of being a member.*
Carry *verb* – if something carries over or is carried over from one situation to another, it continues to exist or apply in the new situation.

Concern with *verb* – regard it as important to do *something* ● *I was mainly concerned with making something that children could enjoy.*
Consider *verb* – think carefully about (something), typically before making a decision ● *Each application is considered on its merits.*
Decode *verb* – analyse and interpret (a communication or image) ● *A handbook to help parents decode street language.*
Degree *noun* – 1) the amount, level, or extent to which something happens or is present ● *A degree of caution is probably wise*. 2) a unit of measurement of angles, one ninetieth of a right angle or the angle subtended by one three-hundred-and-sixtieth of the circumference of a circle ● *Set at an angle of 45 degrees.* 3) a unit in any of various scales of temperature, intensity, or hardness ● *Water boils at 100 degrees Celsius.*
Disorder *noun* – an illness that disrupts normal physical or mental functions skin disorders.
Factor in *phrasal verb* – to include a particular thing in your calculations about how long something will take, how much it will cost.
Generation *noun* – all of the people born and living at about the same time, regarded collectively.
Genetic engineering *noun* – the deliberate modification of the characteristics of an organism by manipulating its genetic material.
Germ-line *noun* – a series of germ cells each descended or developed from earlier cells in the series.
Hotbed *noun* – an environment promoting the growth of something, especially something unwelcome.
Inheritable *adjective* – capable of being inherited ● *These characteristics are inheritable.*
Insert *verb* – place, fit, or push (something) into something else.
Milestone *noun* – a very important event in the development of smth.
Predisposition *noun* – a liability or tendency to suffer from a particular condition, hold a particular attitude, or act in a particular way.
Screening *noun* – the evaluation or investigation of something as part of a methodical survey.

Vocabulary focus. Task 2. Match (1-6) to the descriptions (a-f).

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

Reading. Task 3. Read the text using reading techniques. Find sentences in passive voice. Explain their meaning. Find sentences in active voice, transform into passive if it is possible.

Genetic engineering

Genetic engineering is the area of biotechnology concerned with the directed alteration of genetic material. Biotechnology has already had countless applications in industry, agriculture, and medicine. It is a hotbed of research. The finishing of the human genome project – a "rough draft" of the entire human genome was published in the year 2000 – was a scientific milestone by anyone's standards. Research is now shifting to decoding the functions and interactions of all these different genes and to developing applications based on this information. The potential medical benefits are too many to list; researchers are

working on every common disease, with varying degrees of success. Progress takes place not only in the development of drugs and diagnostics but also in the creation of better tools and research methodologies, which in turn accelerates progress.

When considering what developments are likely over the long term, such improvements in the research process itself must be factored in. The human genome project was completed ahead of schedule (it usually takes ten years to get from proof-of-concept to successful commercialization). Genetic therapies are of two sorts: somatic and germ-line. In somatic gene therapy, a virus is typically used as a vector to insert genetic material into the cells of the recipient's body. The effects of such interventions do not carry over into the next generation. Germ-line genetic therapy is performed on sperm or egg cells, or on the early zygote, and can be inheritable. Embryo screening, in which embryos are tested for genetic defects or other traits and then selectively implanted, can also count as a kind of germ-line intervention. Human gene therapy, except for some forms of embryo screening, is still experimental. Nonetheless, it holds promise for the prevention and treatment of many diseases, as well as for uses in enhancement medicine.

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

Task 4. Put the words in the right order

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

Task 5. Complete the sentences using the given words from the box in the correct form. Transform into passive voice if it is possible

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

1) Genetic engineering ____ with the directed alteration of genetic material.
2) Germ-line genetic therapy can be_____.
3) Human gene therapy, except for some forms of _____, is still experimental.
4) Research wants to decode the functions and _____ of all these different genes.
5) Genetic therapies are of two sorts: _____ and _____.
6) Researchers are working on every _____ with varying degrees of success.
7) Embryo screening tests _____ for genetic defects or other traits.
8) Single-gene disorders are the first targets for genetic _____

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

Speaking. Writing. Task 7. Write your own summary of the text «Genetic engineering». Read your summaries in pairs, compare with your partner's one.

Task 8. In pairs, discuss the text above. Use the phrases below.

- As said/stated in/by.
- As reported in/by.

- In agreement with.
- On the word of.
- In consonance with.

Тема 4. Comparisons. Applicability of Construction biotechnology. Bioprocesses used in Construction Biotechnology. Environmental biotechnology.

Speaking. Task 1.
What does construction biotechnology deal with?
Where is biotechnology applied for?
ESSENTIAL VOCABULARY
Bioaggregation *noun* – ubiquitous in natural environment and is of great importance in biological wastewater treatment processes.
Bioclogging *noun* – a process to fill in the pores and channels in soil/matrix.
Biogrouting *noun* – similar to chemical grouting where the depth of penetration depends on the size of bacteria used.
Decay *noun* – the state of gradually damaged, worse, or less.
Exponential *adjective*– being an extremely rapid increase.
Proliferation *noun*– rapid increase in the number or amount of something.
Hydrolysis *noun*– a chemical reaction of the interaction of chemicals with water.
Sustainability *noun*– the ability to maintain or support a process continuously over time.
Viscosity *noun*– the resistance of a fluid (liquid or gas) to a change in shape or movement of neighbouring portions relative to one another.

Vocabulary focus. Task 2. Match (1-6) to the descriptions (a-f).

1. bioclogging	a. similar to chemical grouting where the depth of penetration depends on the size of bacteria used
2. biogrouting	b. a process to fill in the pores and channels in soil/matrix

3. viscosity	c. the ability to maintain or support a process continuously over time
4. sustainability	d. the resistance of a fluid (liquid or gas) to a change in shape or movement of neighbouring portions relative to one another
5. exponential	e. a chemical reaction of the interaction of chemicals with water
6. hydrolysis	f. being an extremely rapid increase

Grammar. **UNEQUAL COMPARISON**

Short -1 syllable adjective, **adjectives with two syllables** ending in **–y, -er, -le, -ow (***clev**er** - clever**er***)

Long-2 syllable and more adjective
Short+adv/adj er (than)
More +long+adv/adj (than)
Less+long adv/adj (than)

More/fewer/less+NOUN+than+noun/pronoun
As+many/much /little/few+NOUN + as noun/pronoun

if we need to mention each item, then we must use **than** after the comparative:
*Cloned mice were both **larger in size than** a control group of mice.*

EQUAL COMPARISON

AS...AS

To show that two people, things, etc. are similar, we use the construction as + adjective +as, the same +noun +as +noun
Tom had the same genes as Nick, but was in excellent health.

After **than** and **as** it is more natural to say me/him/her/you/us/them. Compare these sentences:

You are taller than I am. – You are taller than me.

Task 4. Fill in with the correct form of adjectives in brackets.

1. Penguine can dive as (deep) as four hundred meters.
2. The scientists say their method can produce (quick and complete) recovery than current treatments.
3. UNOS says transplant operations in the US used almost as (many) organs from living people as from people who had died.
4. Fimbriae are considerably (short) than flagella and are (numerous).
5. The results showed that the birds that received extra vitamin E did not get infected as (often) as others.

Reading. Task 4. Read the text using reading techniques.

Applicability of Construction Biotechnology

Biotechnology can be applied for the production of construction materials due to four reasons:
– low cost due to use of mining or organic wastes as raw materials;
– lower cost in comparison with the products of chemical industry due to simpler and less energy consuming technology;
– lower toxicity of biomaterials than chemical materials;
– sustainability of the biotechnological production.

Construction Biotechnology is usually applied in geotechnical engineering for bioaggregation, bioclogging, and biocementation of porous soil or fractured rocks in situ by the same reasons but there are important additionally features such as:
– low viscosity of biogrouting and biocementing solutions and deep penetration of this solution into porous soil or fractured rocks;
– ability to control rate of biochemical reactions in situ by the concentration or activity of biomass or enzyme;
– ability for self-multiplication (proliferation) of microbial cells in situ;
– better public acceptance of biotreatment of environment rather than chemical treatment.

Bioprocesses Used in Construction Biotechnology

The following bioprocesses are mainly used in Construction Biotechnology:

1) Exponential growth of biomass interval time Dt.
2) Linear growth or decay of biomass
3) Primary biosynthesis of metabolite P (production of the substance P depends on biomass)
4) Secondary biosynthesis of metabolite P (production of substance P is independent of biomass)
5) Enzymatic hydrolysis, which is decay of oligomer or polymer by the addition of molecule of water between monomer units (M):
6) Coupled oxidation/reduction of two substances, S1 and S2, with the formation of products, P1 and P2.

Task 4. Put the words in the right order.

1. Can biotechnology for be applied the production of construction materials.
2. Enzymatic hydrolysis is of decay oligomer.
3. Exponential is growth of biomass rapid increase.

Task 5. Answer the questions.

1. What are the reasons of biotechnology application?
2. What are additional features of Construction Biotechnology?
3. What bioprocesses mean increase and reduction?

Speaking. Writing. Task 5. A. Write your own summary of the text "Applicability of Construction Biotechnology". Read your summaries in pairs, compare with your partner's one. B. Write your own summary of the text "Environmental Biotechnology, present and future prospects" (p.31 Additional texts). Read your summaries in pairs, compare with your partner's one.

Task 6. Compare nanotechnology, genetic engineering, construction biotechnology, environmental biotechnology using equal and unequal comparisons (applicability, approaches,processes, etc.).

Genetic engineering has as many potential medical benefits as nanotechnology.

Construction biotechnology is more applicable in bioclogging than nanotechnology.

Task 7. Following the next steps "How to prepare for a presentation", create 5 slides to present the topics "How biotechnology can revolutionize the construction industry", "Environmental Biotechnology, present and future prospects".

1. Outline your presentation. ...
2. Practice your presentation ahead of time. ...
3. Read and revise your presentation. ...
4. Take cues from professional speakers. ...

Тема 5. Comparisons. The Stages of Biotechnological Processes. Advances in Construction Biotechnology. Molecular food biotechnology.

Speaking. Task 1.
What stages of biotechnological process do you know?

ESSENTIAL VOCABULARY
Alkali *noun* – a soluble salt obtained from the ashes of plants and consisting largely of potassium or sodium carbonate.
Treatment *noun*-the process of putting a special substance on something or putting it through a special process in order to change its condition.
Assimilation *noun* – the process of becoming similar to others.
Biogrout *noun* –a new ground improvement method based on microbially induced precipitation of calcium carbonate.
Disposal *noun* –the action or process of getting rid of something.
Dissolution *noun* – the process where a solute in gaseous, liquid, or solid phase dissolves in a solvent to form a solution.
Inoculum *noun* – the introduction of microorganisms into a culture medium.
Grinding *noun* – a subset of cutting.
Sieving *noun* – a physical mechanism of particle removal.
Suspend *verb* – to stop something from being active, either temporarily or permanently.

Microbial strain *noun* – a genetic variant or subtype of a microorganism.
Mitigation *noun*– the reduction of something harmful or the reduction of its harmful effects.

Vocabulary focus. Task 2. Match (1-6) to the descriptions (a-f).

1. microbial strain	a. the introduction of microorganisms into a culture medium
2. inoculum	b. a genetic variant or subtype of a microorganism
3. sieving	c. a soluble salt obtained from the ashes of plants and consisting largely of potassium or sodium carbonate
4. alkali	d. a physical mechanism of particle removal
5. dissolution	e. a subset of cutting
6. grinding	f. the process where a solute in gaseous, liquid, or solid phase dissolves in a solvent to form a solution.

The Stages of Biotechnological Process

Any biotechnology includes:
• A preliminary step (upstream processes)
• A cultivation or biogeochemical activity step (core process)
• A posttreatment step (downstream processes)
• Process monitoring and control.

Bioprocesses Used in Construction Biotechnology

Upstream Processes in Construction Biotechnology

Upstream processes include:
• Pretreatment of raw materials
• Preparation of a medium for cultivation
• Selection, isolation, and collection of microbial strains
• Preparation of inoculum.

Upstream: Pretreatment of Raw Materials
Pretreatment of raw materials in Construction Biotechnology includes:
• Crushing, grinding, sieving, and homogenization of the particles;
• Homogenization (mechanical or by ultrasound) of suspended hydrophobic substances;
• Chemical oxidation of hydrophobic substances by hydrogen peroxide or ozone for better dissolution and oxidation;
• Chemical treatment with alkali or acids to hydrolyze and dissolve nutrients for faster assimilation;
• Chemical treatment with alkali or acids to disinfect raw materials;
• Preliminary washing by surfactants to clean up surface from hydrophobic
substances;
• Thermal pretreatment of raw materials for disinfection or faster assimilation;
• Freezing pretreatment of raw biomass for disinfection or faster assimilation after killing of cells by ice crystals.

Downstream Processes
Typical downstream processes include
• Separation and concentration of biomass and products from the culture liquid • Drying/dewatering of the biomass • Packing/disposal of secondary waste

Therefore, bacterial cells are separated from culture liquid, and are concentrated by three ways: • centrifugation with acceleration (centrifugal force) > 5000 g; • membrane filtration with diameter of pores below 0.2 μm; • bacterial cells aggregation and settling of the aggregates by gravity

Different methods are used for separation and concentration of microbial products from the culture liquid. Depending on the product and its application there may be used: • precipitation of exopolysaccharides (cement admixtures) and enzymes by ethanol or salts; • Reverse Osmosis (RO) filtration for concentration of biopolymers; • Adsorption on Granulated Activated Carbon, aluminum oxide, and hydrophobic sorbents; • Flotation—concentration in foam formed by the gas microbubbles; • Evaporation of volatile substances

Advances of Biotechnological Construction Materials

Advances in area of biotechnological construction materials are as follows: 1. admixtures for cement are produced commercially, used widely in practice, and new biotechnological admixtures are developing for industrial use; 2. bioplastic PLA is produced industrially but the construction applications are still in development because of the relatively high cost of this bioplastic; 3. bioplastic PHAs for construction applications is developing in the laboratory scale; 4. biotechnological nanomaterials for construction are studied in laboratory scale; 5. biotechnological preservatives for timber are studied and tested in pilot scale; 6. MICP biocement and biogrout is tested in pilot and field scales, but it is not environmentally friendly material due to production of ammonia/ammonium during biotreatment; 7. different types of biocements and biogrouts different from MICP are tested in pilot and field scales, but low cost and environmentally friendly materials have been tested only in laboratory; 8. biogrouts for soil desaturation and mitigation of soil liquefaction are still in the stages of pilot and field tests; 9. biomimetic 3D construction composites are still the scientific idea; there are no even successful laboratory prototypes.

So, the majority of the construction biotechnological materials for exemption of cement admixtures are not the commercial products yet and are developing and tested on the level of laboratory studies. Therefore, scientific and engineering discipline of construction biotechnology is on the stage of initial development and exponential growth with few commercial applications.

Speaking. Writing. Task 5. A.Write your own summaries of the texts "The stages of biotechnological processes", "Advances of Biotechnological Construction Materials". Read your summaries in pairs, compare with your partner's one. B. Write your own summary of the text "Molecular food biotechnology" (p.33 Additional texts). Read your summaries in pairs, compare with your partner's one.

Task 6. A. Compare downstream and upstream processes using equal and unequal comparisons. B. Compare advances of biotechnological construction materials in recent years. C. Compare construction

biotechnology and molecular food biotechnology (approaches, processes, etc.)

Task 7. Create 5 slides to present topics "Biotechnological processes. Importance, principles and application", "Molecular Food biotechnology".

Additional texts

Environmental biotechnology, present and future prospects

Waste and pollutants are generated by various activities of man, e.g., domestic, agricultural, manufacture, transport, etc. This waste if not properly managed then it may contaminate air, water, and soil. The natural production processes use solar energy and produce materials containing the elements such as C, N, H, O, P and S. All the products are biodegradable. In contrast, synthetic production processes designed by man are inefficient in energy use, utilise as raw materials those elements present on earth, and many of the products of these processes are non-biodegrade. In addition, these processes generate by-products, waste or effluents, which are released in the environment cause damage to ecosystem. To minimise the damaging effects of man made activities on the environment, man is developing technologies to clean up the pollution generated by other technologies. Man is also developing production technologies, which are 'cleaner' and generate less pollution. Both these technological approaches minimise damage to the environment.

Environmental biotechnology uses biotechnological approaches for management of environmental problems. In nutshell, environmental biotechnology is the integration of natural and engineering sciences to achieve the application of organisms, cells, their parts and molecular analogues for products and services. To solve the limitation of environmental engineering approaches and get advantage over it, biological components can be used in place of chemical agents. Biotechnology is emerging field of this era, where biological agents like micro-organisms are playing key role for degradation of organic waste and biotransformation of other hazardous chemical compounds by different types of microbial processes. Biotechnology can play a major role to understand global environmental challenge and also helpful to

treat waste up to permissible limit in low cost. Micro-organisms are present everywhere in nature, by sound knowledge of growth and metabolism patterns of these micro-organisms; one can use these in better way. Here environmental biotechnology will lead the problem solving approaches with the blend of technology, environmental science, engineering and biological agents as micro-organism.

Now a day's xenobiotic compounds are producing more harmful effects on the environment and making environment polluted. Xenobiotic compounds are not natural compounds these are man-made compounds like polythene, plastic, etc. These compounds are very dangerous for environment, human health, animals and vegetation. In chemical processes a high pH waste is generated. It is very difficult to treat such type of waste using microbial treatment process because microorganisms are not generally survive at very high pH (above 10 pH) but some micro-organisms can grow slowly at this pH. Such types of problems can be resolve by the use of biotechnology. Recombinant DNA technology can play major role to modify micro-organisms. Such improved micro-organisms are called genetically modified or Recombinant micro-organisms. Recombinant micro-organisms are developed to meet out such type of problems. For example 'Super Bug' an oil eating bug first time developed using genetic engineering to genetically modify Pseudomonas putida by Dr. Anand Mohan Chakerborty. He named this genetically engineered micro-organism super bug. Super bug was developed for microbial degradation of oil spilled on coastal areas. Organic waste is also generated in large amount. India is agriculture based country so large amount of agrowaste is generated during the harvesting and processing of the crops. Other sources of organic waste are domestic waste, excreta of animals, slaughter house waste, dairy waste, food industries waste, sugar industries waste, tannery waste, paper and pulp industry waste, brewery waste and effluent, distillery effluent.

Molecular food biotechnology

Molecular food biotechnology is an exciting revolutionary scientific discipline based on the ability of researchers to transfer specific units of genetic information from one organism to another. This conveyance of a gene relies on the techniques of genetic engineering (recombinant DNA

technology). The application of science and technology, with molecular biology being one of the more recent developments, has resulted in greatly increased yields per unit of cultivated area, due in great part to production of plants that are resistant to insect predation, fungal and viral diseases, and environmental stresses such as short-term drought, excessive heat, and acidic and alkaline soils. Some biotechnologists now see plants as biofactories or bioreactors that need only water, minerals, sunlight, and the proper combination of genes to produce high-value biomolecules such as enzymes, starches, oils, vitamins, pigments, nutraceuticals, and vaccines for the food and pharmaceutical industries. Biotechnology can also be applied to the production or transformation of food and food ingredients and animal feed by developing microorganisms able to produce chemicals, antibiotics, polymers, amino acids, and various food additives.

The first experiments in which DNA fragments were joined in vitro and the recombinant molecules reintroduced into living cells were performed. The basic information obtained in these early experiments, together with numerous new findings in all fields of bioscience, as well as in chemical, physical, and computer sciences, have led to the development of modern molecular biotechnology. This new field has at least three components: (1) recombinant DNA technology; (2) biomolecular engineering, including metabolic and protein engineering; and (3) molecular bioinformatics, including functional genomics and proteomics.

Types of Experiments

Accurate estimates of the risks associated with different types of experiments are difficult to obtain because of our ignorance of the probability that the anticipated dangers will manifest themselves. Nonetheless, experiments involving the construction and propagation of recombinant DNA molecules using DNAs from 1) prokaryotes, bacteriophages and other plasmids, 2) animal viruses, and 3) eukaryotes have been characterized as minimal, low, moderate and high risks to guide investigators in their choice of the appropriate containment. These designations should be viewed as interim assignments which will need to be revised upward or downward in the light of future experience. The recombinant DNA molecules themselves, as distinct from cells carrying them, may be infectious to bacteria or higher organisms. DNA

preparations from these experiments, particularly in large quantities, should be chemically inactivated before disposal. 1. Prokaryotes, bacteriophages and bacterial plasmids: Where the construction of recombinant DNA molecules and their propagation involves prokaryotic agents that are known to exchange genetic information naturally, the experiments can be performed in minimal risk containment facilities. Where such experiments pose a potential hazard, more stringent containment may be warranted. Experiments involving the creation and propagation of recombinant DNA molecules from DNAs of species that ordinarily do not exchange genetic information, generate novel biotypes. Because such experiments may pose biohazards greater than those associated with the original organisms, they should be performed, at least, in low risk containment facilities. If the experiments involve either pathogenic organisms, or genetic determinants that may increase the pathogenicity of the recipient species, or if the Us documents Biotechnology and Genetic Engineering 148 transferred DNA can confer upon the recipient organisms new metabolic activities not native to these species and thereby modify its relationship with the environment, then moderate or high risk containment should be used. Experiments extending the range of resistance of established human pathogens to therapeutically useful antibiotics or disinfectants should be undertaken only under moderate or high risk containments depending upon the virulence of the organism involved.

2. Animal Viruses: Experiments involving linkage of viral genomes or genome segments to prokaryotic vectors and their propagation in prokaryotic cells should be performed only with vector-host systems having demonstrably restricted growth capabilities outside the laboratory and with moderate risk containment facilities. Rigorously purified and characterized segments of non-oncogenic viral genomes or of the demonstrably nontransforming regions of oncogenic viral DNAs can be attached to presently existing vectors and propagated in moderate risk containment facilities; as safer vector-host systems become available such experiments may be performed in low risk facilities. Experiments designed to introduce or propagate DNA from non-viral or other low risk agents in animal cells should use only low risk animal DNAs as vectors (e.g., viral, mitochondrial) and manipulations should be confined to moderate risk containment facilities.

3. Eukaryotes: The risks associated with joining random fragments of eukaryote DNA to prokaryotic DNA vectors and the propagation of these recombinant DNAs in prokaryotic hosts are the most difficult to assess. A priori, the DNA from warm-blooded vertebrates is more likely to contain cryptic viral genomes potentially pathogenic for many than is the DNA from other eukaryotes. Consequently, attempts to clone segments of DNA from such animal and particularly primate genomes should be performed only with vector-host systems having demonstrably restricted growth capabilities outside the laboratory and in a moderate risk containment facility. Until cloned segments of warm-blooded vertebrate DNA are completely characterized, they should continue to be maintained in the most restricted vector-host system in moderate risk containment laboratories; when such cloned segments are characterized, they may be propagated as suggested above for purified segments of virus genomes. Unless the organism makes a product known to be dangerous (e.g., toxin, virus), recombinant DNAs from cold-blooded vertebrates and all other lower eukaryotes can be constructed and propagated with the safest vector-host system available in low risk containment facilities. Purified DNA from any source that performs known functions and can be judged to be non-toxic, may be cloned with currently available vectors in low risk containment facilities. (Toxic here includes potentially oncogenic products or substances that might perturb normal metabolism if produced in an animal or plant by a resident microorganism.)

4. Experiments to Be Deferred: There are feasible experiments which present such serious dangers that their performance should not be undertaken at this time with the currently available vector-host systems and the presently available containment capability. These include the cloning of recombinant DNAs derived from highly pathogenic organisms (i.e., Class III, IV, V etiologic agents as classified by the United States Department of Health, Education and Welfare), DNA containing toxin genes and large scale experiments (more than 10 liters of culture) using recombinant DNAs that are able to make products potentially harmful to man, animals or plants

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Appendix 1. **Active and Passive Voice**

Tense	**Active voice**	**Passive voice**	**Active sentence**	**Passive equivalent**
Simple present	keep	is kept	I keep the butter in the fridge.	The butter is kept in the fridge.
Present continuous	is keeping	is being kept	John is keeping my house tidy.	My house is being kept tidy.
Simple past	kept	was kept	Mary kept her schedule meticulously.	Mary's schedule was kept meticulously.
Past continuous	was keeping	was being kept	The theater was keeping a seat for you.	A seat was being kept for you.
Present	have	have	I have kept all	All your old

Tense	Active voice	Passive voice	Active sentence	Passive equivalent
perfect	kept	been kept	your old letters.	letters have been kept.
Past perfect	had kept	had been kept	He had kept up his training regimen for a month.	His training regimen had been kept up for a month.
Simple Future	will keep	will be kept	Mark will keep the ficus.	The ficus will be kept.
Conditional Present	would keep	would be kept	If you told me, I would keep your secret.	If you told me, your secret would be kept.
Conditional Past	would have kept	would have been kept	I would have kept your bicycle here if you had left it with me.	Your bicycle would have been kept here if you had left it with me.
Present Infinitive	to keep	to be kept	She wants to keep the book.	The book wants to be kept.
Perfect Infinitive	to have kept	to have been kept	Judy was happy to have kept the puppy.	The puppy was happy to have been kept.
Present Participle &	keeping	being kept	I have a feeling that you may be	I have a feeling that a secret may be being

Tense	Active voice	Passive voice	Active sentence	Passive equivalent
Gerund			keeping a secret.	kept.
Perfect Participle	having kept	having been kept	Having kept the bird in a cage for so long, Jade wasn't sure it could survive in the wild.	The bird, having been kept in a cage for so long, might not survive in the wild.

Appendix 2. **Nanotechnology glossary**

A

Aerogel

A silicon-based foam composed mostly of air. Often called "frozen smoke" or "blue smoke", aerogels have extremely low thermal conductivity, which gives them extraordinary insulating properties. They are the lowest-density solids known on earth.

Alkali metals

A group of soft, very reactive elements that includes lithium, sodium, and potassium.

Alumina

A ceramic material made of aluminum oxide. Alumina is often used as a substrate, or underlying layer, for experiments. Alumina can be mixed with various amounts of titania (titanium dioxide) to change its properties as a substrate.

Aluminum

A silvery-white, metallic element with good conductive and thermal properties.

Amino acids
Simple organic compounds composed of carboxyl (-CO_2^-) and amino (-NH_3^+) groups that are the fundamental building blocks of proteins.

B

Biopolymer
A polymer found in nature. DNA and RNA are examples of naturally occurring biopolymers. See also polymer.

Biosynthesis
The process by which living organisms produce chemical compounds.

Block copolymers
Self-assembled material composed of long sequences of "blocks" of the same monomer unit, covalently bound to sequences of unlike type.

Bottom-up assembly
A methodology by which larger structures are made by assembling many smaller ones (*e.g.*, when nanoparticle building blocks are brought together to create larger assemblies). See also Top-down assembly.

C

Carbon
A nonmetallic element found in all living things. Carbon is part of all organic compounds and, in combined form, of many inorganic substances. Diamonds, graphite, and fullerenes are pure forms of carbon.

Chemical vapor deposition (CVD)
A technique used to deposit thin layers of coatings on a substrate . In CVD, chemicals are vaporized and then applied to the substrate using an inert gas such as nitrogen as a carrier. CVD is used in the production of microchips, integrated circuits, sensors, and protective coatings.

Chemical vapor transport
A technique similar to CVD used to grow crystal structures.

Chemisorption
The process by which a liquid or gas is chemically bonded to the surface of a solid.

Colloids
Very fine solid particles that will not settle out of a solution or medium. Smoke is an example of a colloid, being solid particles suspended in a

gas. Colloids are the intermediate stage between a truly dissolved particle and a suspended solid, which will settle out of solution.

Composite

A material made from two or more components that has properties different from the constituent materials. Composite materials have two phases: matrix (continuous) phase, and dispersed phase (particulates, fibers). For example, steel-reinforced cement is a composite material. The concrete is the matrix phase and the steel rods are the dispersed phase. The composite material is much stronger than either of the phases separately.

Copolymerization

The process of using more than one type of monomer in the production of a polymer, resulting in a product with properties different from either monomer. See monomer, polymer.

CRISPR

A technology in molecular biology that utilizes the Cas9 enzyme's affinity to short palindromic sequences of DNA along with a guiding RNA sequence to target and edit genes within organisms.

Crystallography

The process of growing crystals.

D

DNA (deoxyribonucleic acid)

The molecule that encodes genetic information, found in the cell's nucleus.

DNA bricks

A Lego-like DNA block that is used in DNA technology to build 2D and 3D nanostructures.

DNA cleavage

The cutting or breaking of a DNA strand.

DNA Dendron

A single stranded DNA molecule that branches into several DNA strands, mimicking the high density of DNA on an SNA surface.

DNA origami

A technique in DNA nanotechnology that uses the specificity of DNA interactions to fold DNA scaffolds into complex structures in a facile manner.

DNA recognition
The ability of one DNA molecule to "recognize" and attach to another molecule that has a complementary shape.
DNA replication
The process of making copies of DNA strands prior to cell division using existing DNA as a template for the newly created strands.
DNA structures
DNA frameworks occurring in nature: i.e., double helix, cruciforms, left-handed DNA, multistranded structures. Also, microarrays of small dots of DNA on surfaces.
Dynamic Light Scattering (DLS)
A characterization technique used to determine the size of nanoscale materials in a solution by analyzing the scattering intensity of a laser over time.

E

Electrochemical methods
Experimental methods used to study the physical and chemical phenomena associated with electron transfer at the interface of an electrode and a solution. Electrochemical methods are used to obtain analytical or fundamental information regarding electroactive species in solution. Four main types of electrochemical methods include potentiometry, voltammetry, coulometry, and conductimetry.
Electrophoresis
A method of separating large molecules, such as DNA fragments or proteins, from a mixture of similar molecules by passing an electric current through a medium containing the molecules. Depending on its electrical charge and size, each kind of molecule travels through the medium at a different rate, allowing separation.

F

Ferromagnetic materials
Substances, including a number of crystalline materials, that are characterized by a possible permanent magnetization.
matter by passing emitted fluorescent light through a monochromator to record the fluorescence emission spectrum.
Fluorescent probe
A stain used for tagging and labeling biological cells to detect structures, molecules, or proteins within the cell. Also single-stranded pieces of

DNA, with enzymatically incorporated fluorescent tags, affixed in a microscopic array (DNA microarray).

Forced intercalation (FIT) aptamer

An oligonucleotide which contains a dye that, upon binding to a target molecule, generates an enhanced and detectable fluorescence readout.

G

Gel electrophoresis

A molecular biology technique used to separate biomolecules loaded into a gel. Utilizes electric current to separate biomolecules based on charge, size, and structural differences.

Gene technology

Techniques that allow experimenters to manipulate specific genes within an organism and determine the effect this has on the functioning of the organism.

H

Heterogeneous catalysis

A chemical process in which the catalyst and the reactant are present in separate phases. Usually the catalyst is a solid, the reactants and products are in gaseous or liquid phases, and the catalytic reaction occurs on the surface of the solid.

I

Infrared (IR) spectroscopy

A technique in which infrared light is passed through matter and some of the light is absorbed by inciting molecular vibration. The difference between the incident and the emitted radiation reveals structural and functional data about the molecule.

L

LED (light-emitting diode)

A semiconductor device that converts electrical energy into electromagnetic radiation. The LED emits light of a particular frequency (hence a particular color) depending on the physical characteristics of the semiconductor used. See electroluminescence.

Liquid phase separation

A method of extracting one liquid from another, generally through the use of solvents.

Lithography

The process of imprinting patterns on materials. Derived from Greek, the

term lithography means literally “writing on stone.” Nanolithography refers to etching, writing, or printing at the microscopic level, where the dimensions of characters are on the order of nanometers (units of 10 -9 meter, or millionths of a millimeter).

M

Magnetism
The force of attraction or repulsion between various substances, especially those made of iron and certain other metals. Magnetism is the result of the motion of electrons in the atoms.

Mass spectrometer
A device used to identify the kinds of molecules present in a given substance: the molecules are ionized and passed through an electromagnetic field. The way in which they are deflected is indicative of their mass and identity.

Microcontact printing
A technique that uses a silicone stamp to deposit molecules on surfaces in patterns with microscale features.

Microfluidic device
A device that has one or more channels with at least one dimension less than 1 mm. Common fluids used in microfluidic devices include whole blood samples, bacterial cell suspensions, protein or antibody solutions and various buffers. The small amounts of samples needed and relative inexpensiveness of microfluidic devices make them attractive for biomedical research and creating clinically useful technologies. One of the long term goals in the field of microfluidics is to create integrated, portable clinical diagnostic devices for home and bedside use, thereby eliminating time consuming laboratory analysis procedures.

Molecular imprinting
A process by which functional monomers are allowed to self-assemble around a template molecule and locked into place.

N

Nanocomposites
Materials that result from the intimate mixture of two or more nanophase materials. See composite.

Nanocrystalline materials
Solids with small domains of crystallinity within the amorphous phase. Applications include optical electronics and solar cells.

Nanotechnology
The usage of matter on the nanometer scale to produce structures, systems, and technological devices.

O

Oxidation
Process in which a molecule loses one or more electrons to another component of the reaction.

P

Polymer
A macromolecule formed from a long chain of molecules called monomers; a high-molecular-weight material composed of repeating sub-units. Polymers may be organic, inorganic, or organometallic, and synthetic or natural in origin. See biopolymer.

Polymerase chain reaction
A technique for copying and amplifying the complementary strands of a target DNA molecule.

S

Scanning Probe Microscopy (SPM)
Experimental techniques used to image both organic and inorganic surfaces with (near) atomic resolution. Includes atomic force microscopes and scanning tunneling microscopes.

Scanning Tunneling Microscope (STM)
A scanning probe microscopy instrument capable of revealing the structure of samples. The STM uses a sharp metal tip positioned over a conducting substrate with a small potential difference applied between them. The gap between the tip and substrate surface is small enough so that electrons can tunnel between the tip and the surface. The tip is then scanned across the surface and adjusted to keep a contact current flowing. By recording the tip height at each location a "map" of the sample surface is obtained.

Self-repair
A property of a material where it can correct or fix defects within itself.

Sensor
A device that detects a change in environment or property.

Simulation
A broad collection of methods used to study and analyze the

Synthesis
Any process or reaction for building up a complex compound by the union of simpler compounds or elements.

Synthetic methods
Techniques for the design and creation of new materials in the laboratory.

T

Top-down assembly
The process of removing material from a larger structure to create smaller ones. See also Bottom-up assembly.

U

UV/VIS (Ultraviolet-Visible) Spectroscopy/Spectrophotometry
Method to determine concentrations of an absorbing species in solution. This technique uses light in the visible and adjacent near ultraviolet (UV) and near infrared (NIR) ranges to achieve this quantitative analysis.