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Институт языка и литературы
Кафедра профессионального иностранного языка
для естественнонаучных специальностей

Biological issues through English

Учебно-методическое пособие

«Рекомендовано УМО РАЕ по классическому университету и техническому образованию в качестве учебного пособия для студентов высших учебных заведений, обучающихся по направлению подготовки 06.03.01 «Биология»

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Настоящее учебно-методическое пособие предназначено для студентов-магистрантов, обучающихся по направлениям, связанным с биологией, биотехнологией, химией, спортивной физиологией. Пособие нацелено на подготовку студентов к работе со специальной литературой, обучение устным формам общения по профессиональной научной тематике на материале предложенных тем.

Данное издание призвано помочь магистрантам расширить их активный лексический запас, подготовиться к участию в международных конференциях, усовершенствовать навыки чтения и перевода оригинальной научной литературы, подготовить устное или письменное высказывание по теме научной работы.

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Содержание

Предисловие

Настоящее пособие адресовано студентам-магистрантам, обучающимся по направлению подготовки 06.03.01 «Биология».

Пособие составлено с учетом требований Федерального государственного образовательного стандарта высшего образования. Основная задача при изучении иностранного языка магистрантами – достижение практического владения языком, которое позволит использовать его в научной работе в соответствии с требованиями образовательного стандарта, который включает в себя наличие компетенции: способность осуществлять деловую коммуникацию в устной и письменной формах на государственном языке Российской Федерации и иностранном (-ых) языке (-ах) (УК-4).

Пособие позволяет осуществлять целенаправленную языковую подготовку в естественнонаучных областях с учетом их профессиональной специфики и применять полученные знания и умения в дальнейшей деятельности.

Данное издание содержит лексико-грамматический материал для профессионального общения и чтения научной литературы, способствует формированию у будущих специалистов умения работать самостоятельно (реферирование и аннотирование) с научно-популярными и научными текстами по данной тематике, формирует навыки научно-технического перевода и коммуникативные компетенции.

Пособие основано на авторской методике обучения языку специальности. Данная методика подробно описана и защищена в диссертации «Методика обучения иноязычной терминологии студентов вуза по направлению подготовки «Биотехнология» Требух О.С. в 2014 году. Регулярные занятия по ней позволяют эффективно организовать процесс запоминания профессиональной терминологии и помогают приобрести и автоматизировать навыки использования языка специальности.

Пособие состоит из двух частей. Первая часть содержит 8 тем по направлениям подготовки магистрантов. В каждой теме представлен текст, после которого выведен список лексики общего и терминологического характера. В тему включены как лексические упражнения, так и упражнения на понимание смысла текстов. Также добавлен дополнительный текст, расширяющий терминологический запас и углубляющий знания по специальности. Далее следуют интерактивные упражнения, тренирующие все языковые аспекты, и упражнения на перевод.

Вторая часть включает в себя профессионально-ориентированные научно-популярные и научные тексты для перевода, аннотирования и реферирования.

В учебнике приняты следующие условные сокращения:

- ‘n’ – noun;
- ‘v’ – verb;
- ‘adj’ – adjective;
- ‘adv’ – adverb;
- ‘prep’ – preposition.

PART I
TOPICS FOR READING AND DISCUSSING

Unit 1

Bioethics

What do we mean by "bioethics"?
What role does morality play in science and medicine?
How do you evaluate the costs and the benefits) of progress?
Do you "own" your body?
How do current scientific research methods differ from those in the past?
Where do you draw the line between hurtful and harmful?

1. Read the text about ethical issues in biotechnology and translate it.

Ethical issues in biotech

From the time when the earliest pioneers of medicine took the Hippocratic Oath, the importance of ethical considerations about actions affecting living entities has been recognized by professionals. The general principles are still of fundamental importance: respect for life and the need for a balance of benefit over harm resulting from any intervention.

There are three particular contemporary features that account for the public concern on the threshold of the 21st century. First, much of the current development in biotechnology results from an advanced understanding of the nature of genetics and the ability to perform manipulations in the genomes of plants and animals. Some feel that 'respect for life' implies that there should be no interference with it in this

basic way. Obviously, heart transplants are as radically unnatural as gene transplants, but most people consider them to be ethically acceptable.

Second, the pace of discovery in genetics-based biotechnology is very rapid and there is anxiety that technology will drive developments ahead of proper ethical considerations. The moratorium on human germ-line therapy is an example that there must be ethical restraints on the use of what is technically feasible. Part of the reason for this restriction is uncertainty about the long-term effects of such interventions. There is also uncertainty about the environmental consequences of the genetic manipulation of plants. These issues are scientific questions that need to be answered before we have an adequate basis of knowledge for final ethical decisions.

Third, advanced technology involves processes that are only well understood by the experts who develop and use them. This places considerable power in the hands of the companies that employ these experts. Currently, there is much public suspicion about the reliability and independence of this 'expert' advice. Although some of this suspicion comes from a difficulty in understanding that certain answers cannot be given to complex questions.

There is also much suspicion of transnational corporations, which want to maximize their profits by making users dependent on their products and then controlling availability. But the ethical use of biotechnology should clearly include it being provided only on a fair and just basis.

Vocabulary

anxiety (n)
acceptable (adj)
consequence (n)
consider (v)
drive (v)
employ (v)
ethical decision
harm (n)
Hippocratic Oath
imply (v)
interference with
involve (v)

living entity
long-term (adj)
manipulation (n)
moratorium (n)
perform (v)
public suspicion
rapid (adj)
reliability (n)
respect for life
restraints (n)
restriction (n)

2. Give Russian equivalents for the following words. Use some of them in the sentences of your own.

Earliest pioneers, ethical considerations, in relation to, living entities, general principles, respect for life, contemporary features, account for, nature of genetics, manipulations in the genomes of plants and animals, heart transplants, gene transplants, to be ethically acceptable, genetics-based biotechnology, pace of discovery, drive developments, human germ-line therapy, ethical restraints, long-term effects, environmental consequences, scientific question, adequate basis of knowledge, ethical decision, advanced technology, public suspicion, 'expert' advice, transnational corporations.

3. Translate the sentences into English using the words you have learned.

1) Этот исследователь был главным в этом проекте, и он нес всю ответственность за *последствия*.
2) *Геном* – это совокупность хромосомных наследственных факторов.
3) Испытание на *надёжность* прошло успешно.
4) Пациенту была назначена операция по *пересадке* органа.
5) *Мир живых существ* насчитывает несколько миллионов видов.
6) Больному был назначен *долгосрочный* уход.

7) Феномен генетической *рестрикции* лежит также в основе развития ряда иммунопатологий.

8) Исследователь получил *положительные отзывы* коллег о своих достижениях.

4. Put the words in the right order to make sentences:

1) there are/ that/ of the 21st century three particular contemporary features/ account for the public concern/ on the threshold

2) to be ethically acceptable/ heart transplants/ as gene transplants/ but most people consider them/ are as radically unnatural

3) in genetics-based biotechnology/ the pace of discovery/ is very rapid

4) there must be ethical restraints / what is technically feasible/ on the use of

5) the environmental consequences/ there is also uncertainty/ of the genetic manipulation of plants/ about

6) who develop/ advanced technology/ that are only well understood/ by the experts/ and use them/ involves processes/

7) cannot be given/ to complex questions/ comes from/ some of suspicions/ a difficulty in understanding/ that certain answers/

5. Answer the questions based on the information from the text.

1) When did ethical considerations start to be recognized?

2) What are the general ethics principles?

3) What do some people think about interference in life in its basic way?

4) What anxiety appears in connection with the rapid development of genetic-based biotechnology?

5) What does the example of the moratorium on human germ-line therapy show?

6) What anxiety does public have about the experts?

7) Is there any suspicion about the transnational corporations` activity?

8) What basis should ethics of biotechnology have?

6. Write down the sentences expressing the main ideas of each paragraph of the text.

7. Write a summary of the text in your own words. Orally expand this summary and retell the text.

8. Read and translate the additional text.

Genetically modified foods ethics

Selective breeding has been used since agriculture began, with the development of cultivated crops from wild species and of domestic herds from wild animals. However, it is now possible to carry out gene transfers that could not occur in nature, even gene transfers from the animal kingdom to the plant kingdom.

Some people have characterized this as 'playing God', with the implication that it is ethically unacceptable to interfere with nature. However, human beings are themselves part of nature and many religious people would see the responsible exercise of scientific skills as being the employment of God-given abilities.

One of the major concerns about GM crops is their possible environmental effects. Insect-resistant strains may reduce the use of insecticides, but will genes spread from herbicide-resistant strains to produce 'superweeds'? All interventions in nature run the risk of unanticipated upsets to its balance and, from the time that humans with stone axes began felling trees, agriculture has had significant environmental consequences. Because consequences are difficult to predict accurately, it is important that carefully controlled and monitored trials are used to gain the detailed knowledge on which ethically responsible decisions can be based.

It is predicted that the world population, currently approximately six billion, will rise to approximately eight billion by the year 2020. Present agricultural resources, if their produce was fairly distributed, could sustain approximately 6.4 billion people. Biotechnology offers considerable possibilities to help eliminate the anticipated shortfall. However, there is also considerable concern that small-scale farmers should not be exploited by large international companies.

To these considerations must be added the universal ethical obligation to respect the duty of safety. With regard to food safety, GM products do not seem to raise issues or demand the monitoring of techniques, different to those employed to assess the effects of ordinary foods.

9. Give the definitions to at least five of the following words:

Genetically modified foods, selective breeding, cultivated crops, gene transfers, environmental effects, insecticides, superweeds, herbicide-resistant strains, insect-resistant strains, agricultural resources, small-scale farmers, food safety.

10. Make a plan of this text. Add the key-words to it. Retell this text using your plan.

11. Read the text about Henrietta Lacks' cells which were essential in developing the polio vaccine and were used in scientific landmarks such as cloning, gene mapping and in vitro fertilization.

Henrietta Lacks' 'Immortal' Cells

Medical researchers use laboratory-grown human cells to learn the intricacies of how cells work and test theories about the causes and treatment of diseases. The cell lines they need are "immortal"—they can grow indefinitely, be frozen for decades, divided into different batches and shared among scientists. In 1951, a scientist at Johns Hopkins Hospital in Baltimore, Maryland, created the first immortal human cell line with a tissue sample taken from a young black woman with cervical cancer. Those cells, called HeLa cells, quickly became invaluable to medical research—though their donor remained a mystery for decades.

When the cells were taken, they were given the code name HeLa, for the first two letters in Henrietta and Lacks. Today, anonymizing samples is a very important part of doing research on cells. But that wasn't something doctors worried about much in the 1950s, so they weren't terribly careful about her identity.

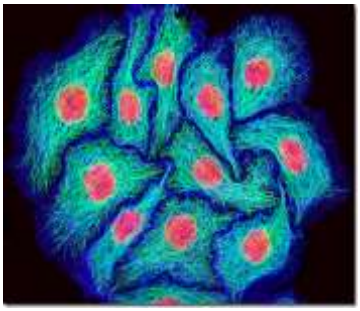
Henrietta Lacks was a black tobacco farmer from southern Virginia who got cervical cancer when she was 30. A doctor at Johns Hopkins took a piece of her tumor without telling her and sent it down the hall to scientists there who had been trying to grow tissues in culture for decades without success. No one knows why, but her cells never died.

Henrietta's cells were the first immortal human cells ever grown in culture. They were essential for developing the polio vaccine. They went up in the first space missions to see what would happen to cells in zero gravity. Many scientific landmarks since then have used her cells, including cloning, gene mapping and in vitro fertilization.

Twenty-five years after Henrietta died, a scientist discovered that many cell cultures thought to be from other tissue types, including breast and prostate cells, were in fact HeLa cells. It turned out that HeLa cells could float on dust particles in the air and travel on unwashed hands and contaminate other cultures. It became an enormous controversy. In the midst of that, one group of scientists tracked down Henrietta's relatives to take some samples with hopes that they could use the family's DNA to make a map of Henrietta's genes so they could tell which cell cultures were HeLa and which weren't, to begin straightening out the contamination problem.

So a postdoc called Henrietta's husband one day. But he had a third-grade education and didn't even know what a cell was. The way he understood the phone call was: "We've got your wife. She's alive in a laboratory. We've been doing research on her for the last 25 years. And now we have to test your kids to see if they have cancer." This wasn't what the researcher said at all. The scientists didn't know that the family didn't understand. From that point on, though, the family got sucked into this world of research they didn't understand, and the cells, in a sense, took over their lives.

This was most true for Henrietta's daughter. Deborah never knew her mother; she was an infant when Henrietta died. She had always wanted to know who her mother was but no one ever talked about Henrietta. So when Deborah found out that this part of her mother was still alive she became desperate to understand what that meant: Did it hurt her mother when scientists injected her cells with viruses and toxins? Had scientists cloned her mother? And could those cells help scientists tell her about her mother, like what her favorite color was and if she liked to dance.



Deborah's brothers, though, didn't think much about the cells until they found out there was money involved. HeLa cells were the first human biological materials ever bought and sold, which helped launch a multi-billion-dollar industry. When Deborah's brothers found out that people were selling vials of their mother's cells, and that the family didn't get any of the resulting money, they got very angry. Henrietta's family has lived in poverty most of their lives, and many of them can't afford health insurance. One of her sons was homeless and living on the streets of Baltimore. So the family launched a campaign to get some of what they felt they were owed financially. It consumed their lives in that way.

For scientists, one of the lessons is that there are human beings behind every biological sample used in the laboratory. So much of science today revolves around using human biological tissue of some kind. For scientists, cells are often just like tubes or fruit flies—they're just inanimate tools that are always there in the lab. The people behind those samples often have their own thoughts and feelings about what should happen to their tissues, but they're usually left out of the equation.

Although it should be strictly underlined that so much of medicine today depends on tissue culture. HIV tests, many basic drugs, all of our vaccines - we would have none of that if it wasn't for scientists collecting cells from people and growing them. And the need for these cells is going to get greater, not less. Instead of saying we don't want that to happen, we just need to look at how it can happen in a way that everyone is OK with.

12. Give your opinion to the questions concerning the problem of HeLa cells.

1) Do you think it was wrong for researchers to obtain Henrietta's cells without her permission? Why or why not?

2) Henrietta Lacks' cells have been instrumental in advancing scientific research, including the polio vaccine, even though her family didn't grant permission to use her cells. Do you

think the family should be compensated in some form? Why or why not?

3) Do you believe you "own" your body? Does it matter that Henrietta was a poor black woman dying of cancer?

4) How would you feel if you were in Deborah Lacks' shoes?

5) What responsibilities do you believe researchers have to their subjects?

13. Give the definition of bioethics. Write a short reflection on the bioethical elements of the situation described in the text.

14. Divide the class into two groups. One group should support the researchers' work about extracting and distributing Henrietta Lacks' cells (HeLa cells) while the other group should argue against the researchers' ideas (possibly by assuming to be a person of Lacks' family).

15. The Tuskegee Experiment is another example of people being used as research subjects without their knowledge or consent. Research the Tuskegee Experiment and write a brief summary about it. Your essay should also include a comparison/ contrast section based on what you learned about HeLa cells, as well as a personal reflection on the ethical issues surrounding these topics. In your essay, offer your thoughts on the phrases "greater good," "risk versus reward," and "human dignity."

16. Read and translate the text.

3D симуляторы лабораторных животных

Лабораторные животные наиболее часто используются в медико-биологических экспериментах, испытаниях на безопасность и в образовательных целях. Исследователи используют животных в попытке понять различные уровни функционирования организма, его болезни и физиологическое состояние, создать новые вакцины и методы для лечения различных заболеваний.

Во всех этих случаях животные подвергаются насилию и боли в той или иной степени, что не является естественной частью их среды обитания. Поэтому мы должны быть заинтересованы в поиске новых альтернатив использования животных в экспериментах, стараться уменьшить число животных, по возможности максимально облегчить их страдания.

Замена использования животных включает в себя методы, в которых животные не используются совсем (абсолютная замена) или методы, в которых применяются ткани и клеточные культуры (относительная замена). При этом часто происходит отказ от методов *in vivo* в пользу методов *in vitro*.

Однако в виртуальной лаборатории студентам не всегда просто научиться, например, изолировать кровеносные сосуды, правильно обращаться с подопытными животными,

работать совместно с другими исследователями. Трудно смоделировать на компьютере акт убийства живого существа и таким образом поставить исследователя перед моральными вопросами так же, как это происходит в реальности, а не на пластиковых моделях или на уже убитых животных.

К сожалению, абсолютная или относительная замена лабораторных животных не всегда возможна. Некоторые важные исследования (по крайней мере, в настоящее время) не могут быть произведены без использования животных. В таких случаях исследователи стараются уменьшить число животных, задействованных в эксперименте. Тщательное планирование эксперимента и применение современных методов статистического анализа данных часто позволяют существенно сократить число подопытных животных, сохраняя при этом значимость окончательного результата.

17. What do you think about using virtual 3D models for laboratory experiments? Give your arguments for and against this problem. Continue filling in the table below and discuss it with your classmates.

Arguments for the virtual using of pet/ organ models in the lab	***Arguments against the virtual using of pet/ organ models in the lab***
1) You can save pets' life. 2) You can use this program many times. 3) …	1) You can't predict the result in the case of new drug testing or so on. 2) A person may behave the other way in real conditions. 3) ...

18. What rules and regulations do the researchers follow today when they want to test a new drug or vaccine? Do you think their ethical standards are effective or not? And why? How do research studies and clinical trials contribute to scientific knowledge? Are the standards the same around the world? Give your opinion.

19. Create a code of ethics regulations for biotechnologists. Write what they should do and what they must not do.

Unit 2

Stem cells

What comes into your mind when you hear the term 'stem cell research'?

Do you know how stem cells are used?

What are your thoughts on stem cell research?

1. Read this text and compare your idea of stem cells and the one given below.

Our future hope?

Stem cells are cells found in most, if not all, multi-cellular organisms. They are characterized by the ability to renew themselves through mitotic cell division and differentiating into a range of specialized cell types. Research in the stem cell field grew out of findings by Canadian scientists Ernest McCulloch and James Till in the 1960s.

The two types of mammalian stem cells are: embryonic stem cells that are found in blastocysts, and adult stem cells that are found in adult tissues. In a developing embryo, stem cells can differentiate into all of the specialized embryonic tissues. In adult organisms, stem cells and progenitor cells act as a repair system for the body, replenishing specialized cells, but also maintain the normal turnover of regenerative organs, such as blood, skin or intestinal tissues.

To ensure self-renewal, stem cells undergo two types of cell division. Symmetric division gives rise to two identical daughter cells both endowed with stem cell properties. Asymmetric division, on the other hand, produces only one stem cell and a progenitor cell with limited self-renewal potential. Progenitors can go through several rounds of cell division before terminally differentiating into a mature cell. It is possible that the molecular distinction between symmetric and asymmetric divisions lies in differential segregation of cell membrane proteins

(such as receptors) between the daughter cells.

Stem cells can now be grown and transformed into specialized cells with characteristics consistent with cells of various tissues such as muscles or nerves through cell culture. However, their use in medical therapies has been proposed.

A stem cell possesses two properties. Self-renewal is the ability to go through numerous cycles of cell division while maintaining the undifferentiated state. Potency is the capacity to differentiate into specialized cell types.

Properties of stem cells can be illustrated in vitro, using methods such as clonogenic assays, where single cells are characterized by their ability to differentiate and self-renew. As well, stem cells can be isolated based on a distinctive set of cell surface markers. However, in vitro culture conditions can alter the behavior of cells, making it unclear whether the cells will behave in a similar manner in vivo. Considerable debate exists whether some proposed adult cell populations are truly stem cells.

Medical researchers believe that stem cell therapy has the potential to dramatically change the treatment of human disease. A number of adult stem cell therapies already exist, particularly bone marrow transplants that are used to treat leukemia. In the future, medical researchers anticipate being able to use technologies derived from stem cell research to treat a wider variety of diseases including cancer, Parkinson's disease, Alzheimer’s disease, spinal cord injuries, Amyotrophic lateral sclerosis and muscle damage, amongst a number of other impairments and conditions. However, there still exists a great deal of social and scientific uncertainty surrounding stem cell research, which could possibly be overcome through public debate and future research, and further education of the public.

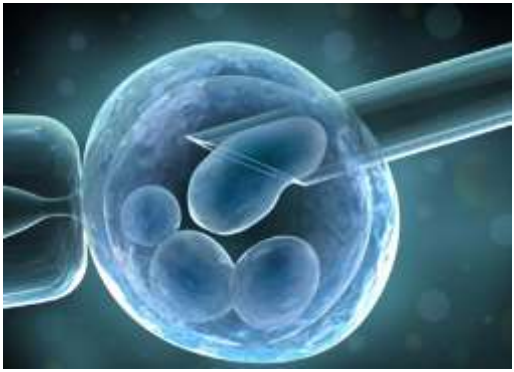
Notes

* *Cancer* - a disease in which cells in the body grow without control, or a serious medical condition caused by this disease.

**Alzheimer's (disease)* - a disease that results in the gradual loss of memory, speech, movement, and the ability to think clearly, and that is common esp. among older people.

* *Parkinson's disease* - is a degenerative disorder of the central nervous system that often impairs the sufferer's motor skills, speech, and other functions.

* *Amyotrophic lateral sclerosis* - a progressive, usually fatal, neurodegenerative disease caused by the degeneration of motor neurons, the nerve cells in the central nervous system that control voluntary muscle movement.



Vocabulary

act (v)
adult stem cells
assay (n)
bone marrow
capacity (n)
life cycle (n)
derive (v)
disease (n)
distinction (n)
division (n)
embryonic stem cells
endow (v)
exist (v)
finding (n)
impairment (n)
in vitro

in vivo
injury (n)
mammalian (adj)
mature (adj)
mature cell
potency (n)
progenitor (n)
property (n)
propose (v)
protein (n)
renew (v)
self-renewal (n)
set (n)
similar (adj)
spinal cord
surface (n)
surround (v)
tissue (n)
transform (v)
turnover (n)
uncertainty (n)
undergo (v)

2. Translate these sentences into English.

1) Терапия *взрослыми стволовыми клетками* активно используется для лечения лейкемии.

2) *Способности* стволовых клеток часто демонстрируют *в пробирке*, используя методы клеточного *анализа*.

3) Ученые наблюдали за стволовыми клетками *в пробирке* и сделали вывод, что *повреждения* стволовых клеток приводят к раковым *заболеваниям*.

4) Многие ученые обещают, что через несколько десятков лет стволовыми клетками можно будет вылечить почти все *болезни* человека.

5) Существуют *различия* в *жизненных циклах* разных клеток.

6) *Эмбриональные стволовые клетки* способны к *делению*, тем самым они восстанавливают те стволовые клетки, которые погибли или были использованы.

7) У взрослых организмов стволовые клетки и клетки-*предшественники* поддерживают нормальную регенеративность органов, например, крови, кожи или кишечной ткани.

8) *В естественных условиях* стволовые клетки, возможно, ведут себя не так, как *в пробирке*.

9) В будущем врачи смогут лечить *повреждения спинного мозга*.

10) *Стволовые клетки млекопитающих* бывают двух типов.

11) Чтобы обеспечить *самообновление*, стволовые клетки подвергаются делению.

12) В исследовании стволовых клеток есть еще много *неопределенностей*.

13) *Свойства* стволовых клеток можно проиллюстрировать методом клоногенного *анализа*.

14) Трансплантация *спинного мозга* используется в лечении лейкемии.

15) Сальные железы выделяют свой секрет на *поверхность* кожи.

16) Мышечная *ткань* обеспечивает двигательную активность животного организма.

17) Стволовые клетки обладают свойствами *самообновления*.

18) Каждая клетка обладает определенным *набором* генов.

19) В результате симметричного деления образуются две *похожие* клетки.

20) *Костный мозг* вырабатывает форменные элементы крови.

21) *Клетки-предшественники* могут пройти несколько этапов клеточного *деления*.

22) *Потенциал* – способность дифференцироваться в различные типы клеток.

3. Give definitions of the following terms:

1) Embryonic stem cells
2) Adult stem cells
3) Symmetric division
4) Asymmetric division
5) Self-renewal
6) Potency

4. Answer the questions based on the information from the text.

1) What ability do stem cells have?
2) Who was the first investigator of stem cells?
3) What are the types of mammalian stem cells?
4) How do stem cells and progenitor cells act in adult organisms?
5) What types of cell division do you know? What is the difference between them?
6) How can stem cells be grown and transformed?
7) What are the properties of stem cells?
8) What is the method of clonogenic assay?
9) Will stem cell therapy cure many diseases or not?
10) Are there any existing adult stem cell therapies?
11) Are all people sure about the necessity of stem cells research?

5. Speak about stem cells. Use the text you have read and expand it with your own information.

6. Study the stem cell research vocabulary below. Match the words similar in meaning from column A to column B.

a. technique	q. use
b. embryo	r. exaggerate
c. single	s. therefore
d. employ	t. method
e. implant	u. hurt
f. admit	v. one
g. hence	w. moral
h. ethical	x. tell
i. harm	y. baby
j. overstate	z. insert

7. Fill in the blank spaces with the correct words. Use the words from the box below:

ethical	overstating	embryos	harmed	admitted
employed	implanted	hence	technique	single

1) Researchers at Advanced Cell Technology (ACT), Inc. have found a new (…) to gather stem cells.

2) They took a single cell from an eight-cell human (…).

3) The removal of a (…) cell isn't a new.

4) It has been (…) in fertility clinics to test for diseases.

5) Doctors and fertility specialists do this before the embryo is (…) in the womb.

6) ACT, Inc. later (…) that scientists removed more than a single cell.

7) (…) the embryos were destroyed.

8) The new process left no embryos alive, and solves no (…) problem.

9) Some U.S. Senators also criticized the experiment, because the company (…) the field.

10) By (…) their results, ACT, Inc. hurt stem cell research.

8. Find the words from the previous exercise in the table below. Time yourself, and see how many words you can find in three minutes.

O	J	W	B	E	S	L	O	Y	K	G	D	H	K	S
F	V	M	U	G	M	V	V	R	O	G	E	A	E	J
E	B	E	S	D	E	B	E	F	F	Y	Y	R	B	K
N	L	S	R	T	E	Y	R	S	U	I	O	M	O	V
Q	J	G	H	S	O	T	S	Y	B	N	L	F	G	U
A	E	C	N	L	T	V	T	P	O	M	P	U	O	I
U	I	P	P	I	B	A	A	I	O	S	M	L	M	A
S	N	M	O	N	S	Z	T	L	M	U	E	P	W	Z
L	E	R	S	G	M	M	I	E	A	D	L	O	K	M
E	T	H	I	C	A	L	N	R	I	A	A	E	N	P
D	E	M	R	A	H	U	G	H	N	N	E	C	K	K
E	U	Q	I	N	H	C	E	T	S	N	G	N	C	N
B	N	A	E	F	J	A	E	X	A	V	Y	E	D	J
C	T	F	W	O	M	D	C	N	D	P	F	H	U	S
X	M	S	U	C	S	V	N	E	B	H	U	R	A	O

9. Read the text and underline the words you came across in the exercises before.

Embryo-Safe Stem Cell Research

Researchers at Advanced Cell Technology, Inc. have found a new technique to gather stem cells. They took a single cell from an eight-cell human embryo, claiming that the process does no harm. The removal of a single cell isn't new, and has been employed in fertility clinics to test for diseases. Doctors and fertility specialists do this before the embryo is implanted in the womb.

Human embryonic stem cell research is controversial because, with the present state of technology, starting a stem cell line requires the destruction of a human embryo and/or therapeutic cloning. Such reproductive cloning can fundamentally devalue human life. Those in the pro-life movement argue that a human embryo is a human life and is therefore entitled to protection.

Contrarily, supporters of embryonic stem cell research argue

that such research should be pursued because the resultant treatments could have significant medical potential. It is also noted that excess embryos created for in vitro fertilization could be donated with consent and used for the research.

Although critics quickly pointed out that all sixteen embryos used in the experiment were destroyed. ACT, Inc. later admitted that scientists removed more than a single cell, and hence their destruction. In addition, scientists developed stem cell lines from only two of the ninety-one cells removed. An official of the United States Conference of Catholic Bishops disapproved of the experiment, saying "it left no embryos alive, and solves no ethical problem."

10. Circle some additional unknown words/ phrases in the article. In pairs/ groups, use your dictionaries to understand the meanings. Write definitions to 3 of them.

11. Answer the questions to check your comprehension.

1) What did Advanced Cell Technique, Inc. do?
2) What do fertility clinics usually do?
3) What is the position of the supporters?
4) And what are the critics doing because of the research?
5) What ethical reasons do critics disapprove of in stem cell research?

12. Which of these statements are true and which are false? Correct any statements that you think are false.

1) Researchers developed a new way to harvest stem cells from human embryos only a few days old.

2) Fertility clinics have used this technique for years.

3) Supporters hope stem cell research will lead to treatments and cures for many illnesses U.S. Bishops criticized the experiment for the usual ethical reasons.

13. Remember how the fragments were used, and complete the sentences using the information from the text.

1) Researchers at Advanced Cell Technology, Inc….

2) Human embryonic stem cell research is controversial because….

3) Supporters of embryonic stem cell….

4) But critics quickly pointed out that…

5) An official of the United States Conference of Catholic Bishops disapproved of the experiment, saying…

14. Work with a partner to summarize the article above in 5-7 sentences.

15. Translate the text about stem cells. Give the text a title.

Стволовые клетки являются той основой («стволом»), из которой развивается «древо» всего организма. На самых ранних стадиях своего развития зародыш полностью состоит из стволовых недифференцированных клеток, затем начинаются этапы дифференцировки, и из них образуются органы и ткани организма. Во взрослом организме стволовые клетки содержатся в небольших количествах в крови и костном мозге и в еще меньших количествах - во всех органах и тканях.

Поскольку эти клетки могут преобразовываться в клетки любых органов и тканей, они играют роль своего рода экстренной помощи: если где-то в организме неполадка, стволовые клетки направляются туда и, преобразуясь в клетки поврежденного органа, способствуют восстановлению его функции.

С возрастом количество стволовых клеток становится все меньше, и, соответственно, восстановительные возможности организма снижаются. Так, когда мы рождаемся, у нас в костном мозге на 10 тыс. кроветворных клеток приходится одна стволовая клетка. У растущих подростков стволовых клеток уже в 10 раз меньше. К 50-ти годам на 0,5 млн обычных клеток приходится 1 стволовая, в 70 лет – 1 стволовая клетка на миллион. Из-за этого возможности человека по регенерации сильно ограничены, в результате страдает способность ткани к физиологической регенерации и к восстановлению после болезни или травмы.

16. Play a role-play game. Look at the following roles and talk about the following:

1) Stem cells for Parkinson’s and Alzheimer's disease.
2) Stem cells for beauty treatments.
3) Stem cells for extending one’s life to 150 years.

Scientist: Stem cells will provide a real chance to cure diseases like cancer, Parkinson’s, and Alzheimer’s. They may also extend life and allow older people a better lifestyle. It’s very important to support new research.

Politician: Stem cells may provide a cure to terrible diseases, but the price is too high-the death of unborn children! And some people will misuse stem cells for less important diseases. Funding for other research is better!

20-something: You're healthy... now. Two of your grandparents developed Alzheimer's early in life, so you could develop the disease, too. Although you're not sure if stem cells will provide an answer, we should invest in additional research.

17. Talk about the following questions in pairs/ groups. Make a report or write an essay on these questions.

1) Is it unethical to collect stem cells if it means that an embryo will be destroyed? Why/ not?

2) Do you think these kinds of experiments are like scientists playing God? Why/ not?

3) What would happen if scientists could cure all diseases some day?

4) If your husband/wife had Alzheimer's, would you want science to find a cure as soon as possible? What if it meant conducting stem cell research?

5) Who is right, those who follow religion or those who follow science? Why?

6) What will happen if stem cell treatment becomes a reality? What about population, the rich and poor, etc.?

Unit 3

AIDS/ HIV

What do you know about AIDS and HIV?

Is there any difference between these viruses?

Do these viruses influence our immune system? Do you know how?

What are the symptoms of these viruses?

1. Read and translate the following text.

Basic things about AIDS and HIV

In 1985, scientists discovered the human immunodeficiency virus (HIV). HIV is a virus that is transmitted from person to person through the exchange of body fluids such as blood, semen, breast milk and vaginal secretions. Sexual contact is the most common way to spread HIV, but it can also be transmitted by sharing needles when injecting drugs, or during childbirth and breastfeeding. As HIV reproduces, it damages the body's immune system and the body becomes susceptible to illness and infection. There is no known cure for HIV infection nowadays.

Acquired immune deficiency syndrome, or AIDS, is a condition that describes an advanced state of HIV infection. With AIDS, the virus has progressed, causing significant loss of white blood cells or any of the cancers or infections that result from immune system damage.

Once inside the body the virus attacks specialized immune system cells known as CD4 cells. The virus attaches to these cells and infects them by injecting HIV nucleic acids (DNA and RNA)

into the cell. New HIV virus then infects other CD4 cells as the cycle repeats itself.

Is HIV and AIDS the same thing?

HIV is the virus which damages the body's immune system. While AIDS defining infections means a person is diagnosed with AIDS. A person can be infected for years without having AIDS. Having HIV infection does not mean you have AIDS. Simply put, HIV and AIDS are not the same thing, but they are related to one another.

Before HIV infection became widespread in the human population, AIDS defining infections were rare, and almost exclusively in individuals with immune suppression, such as chemotherapy and certain types of cancers. AIDS was first recognized in the early 1980s in healthy homosexual men. Adding to the oddity, these men had no recognized cause for immune suppression. An infectious cause of AIDS was suggested by geographic clustering of cases, links among cases by sexual contact, mother-to-infant transmission, and transmission by blood transfusion. Later, isolation of HIV from patients with AIDS strongly suggested that this virus was the cause of AIDS.

Medications can successfully treat many of the symptoms of early symptomatic HIV infection. Antiretroviral therapy slows the growth of the HIV virus in the body. It works very well in reducing the number of HIV particles in the bloodstream. Although people have suppressed levels of HIV, they can still spread the virus to others through sex or sharing needles. Antiretroviral therapy is not a cure for HIV, but the treatment slows disease progression and may strengthen the immune system.

People should never forget that HIV/AIDS is more than a physical ailment; it affects the whole person, emotional and physical. Often our treatments focus on the physical only but the emotional needs addressed as well.

Vocabulary

HIV (human immunodeficiency virus)
AIDS (Acquired immune deficiency syndrome)
antiretroviral therapy
attach (v)
blood transfusion
breastfeeding (n)
clustering (n)
cure (v)
diagnose (v)
exclusively (adv)
fluid (n)
infection (n(
infect (v)
inject (v)
isolation (n)
loss (n)
medications (n)
mother-to-infant
needle
particle (n)
progression (n)
secretion (n)
significant (adj)
suppression (n)
specialize (v)
strengthen (v)
transmit (v)
white blood cells
widespread(adj)

2. Replace the Russian words with the English words using the correct forms. Use proper articles if necessary.

1) *Грудное вскармливание* is very important for babies.
2) *ВИЧ-частицы* may be found in *кровоток.*
3) Many viruses can *распространяться* very quickly.
4) This virus can be transmitted *от матери к младенцу.*
5) Our clinic *специализируется* on HIV therapy.
6) *Эритроциты* plays a great role in the blood circle.
7) *Антиретровирусная терапия* can slow the HIV virus spreading.

3. Translate the following sentences paying attention to the words in italic.

1) Требуется обслуживающий персонал в центр по *переливанию крови.*

2) Хирург обработал края раны антисептиком, чтобы избежать попадания *инфекции* в ткани.

3) Еще в средние века доктора научились готовить вакцины путем разделения антигенов на отдельные белковые *частицы*.

4) Если вы хотите полностью вылечить болезнь, а не просто снять ее симптомы, необходимо пройти полный *курс лечения*.

5) Улучшение методов изучения *рака* поможет врачам *диагностировать* патологию на более ранних этапах.

6) *Переливание крови* сейчас стало вполне обычным и *распространенным* явлением.

7) Чем сильнее *подавлена* иммунная система, тем больше организм *подвержен* риску заболевания *синдромом иммунодефицита человека*.

8) Когда правительство осознало, насколько велик риск возникновения эпидемии, оно начало вести политику *укрепления* здоровья населения и увеличило пропаганду здорового образа жизни. Но в нашем обществе это не привело к *значительным* результатам.

4. Answer the following based on the information from the text.

1) What is AIDS?
2) What is HIV?
3) Is there any difference between them? How are they similar?
4) What are the ways of transition of the virus from one human to another? Do you know any other ways?
5) How does the virus affect the immune system and the body?
6) Who was the first person with AIDS symptoms?
7) Are there any borders for the infection?

8) What are the ways of treatment? Can AIDS be cured?
9) How does antiretroviral therapy work?
10) Is this disease only physical?

5. Find the appropriate definitions to the following words:

1) HIV
2) AIDS
3) Immune system
4) Infection
5) Symptom
6) Antiretroviral therapy

a) detrimental colonization of a host organism by a foreign species.

b) manifestation of a disease, indicating the nature of the disease, which is noticed by the patient.

c) the virus that causes acquired immune deficiency syndrome.

d) medications for the treatment of infection by retroviruses, primarily HIV.

e) the set of cells, and their activity against antigens, or infectious agents, that comprise the body's defense system against disease.

f) a set of symptoms and infections resulting from the damage to the human immune system caused by the human immunodeficiency virus.

6. Read the text again and express the idea of each paragraph in your own questions.

7. Retell the texts from the point of view of:

- a man having acquired immune deficiency syndrome;
- a doctor dealing with these diseases;
- a girl whose boyfriend is ill.

8. Look in the dictionary to find words beginning with EPIDEM~ / VIRU~. Write them down. Make your own sentences with them.

9. Try to complete the blank spaces and provide a definition for each one (you may need a dictionary):

- *Aq _ _ _ _ d Im _ _ n _ D _ f _ _ _ _ _ _ y*

Sy _ d _ _ _ _

- *H _ m _ _n I _ _ _ _ _ _ _ _ _ _ _ _ _ _ y*
- *V _ r _ s*
- *W _ _ _ d H _ _ l _ _ O _ _ _ _ _ z _ _ _ _ n*
- *R _ p r _ d _ _ _ _ v _ H _ _ _ t h*
- *R_dR_bb_n*

10. Predict whether the statements described in the text below are true or false:

1) AIDS is now on the decrease.
2) AIDS is accelerating.
3) AIDS has now been a major world health problem for 23 years.
4) North America is the world's worst hit region.
5) China has experienced an explosion in AIDS cases.
6) It's easier for a woman to contract AIDS than a man.

11. Read the text and give it a title.

On November 24, 2004 the United Nations warned that the world was facing a "unique development challenge" with acceleration in the spread of AIDS. New data revealed there are nearly 40 million HIV sufferers worldwide. Of these 3 million will die of AIDS this year, a record toll in the 23-year history of the killer virus.

The report says Sub-Saharan Africa remains by far the worst-affected region in the world. In South Africa 5.3 million people are infected, with "no sign yet of a decline in the epidemic." India has the second largest number of HIV sufferers in the world (5.1 million), while East Asia has seen a 56 percent increase in HIV cases, mainly attributable to an explosive rise in China. Women now constitute over half of all new cases contracting HIV/AIDS due to poor sexual education, the sex trade, unprotected sexual intercourse, and a greater natural susceptibility to contract the virus than men.

However, if you are diagnosed with HIV, your physical health is not the only issue you have to deal with. Along with the physical illness are mental health conditions that may come up. Mental health refers to the overall well-being of a person, including a person's mood, emotions, and behavior.

HIV/AIDS can have a major impact on many parts of human life. People with HIV and those close to them are subject to many things that may affect their mental health.

Many people are surprised when they learn that they have been diagnosed with HIV. Some people feel overwhelmed by the changes that they will need to make in their lives. It is normal to have strong reactions when you find out you are HIV positive, including feelings such as fear, anger, and a sense of being overwhelmed. Often people feel helpless, sad, and anxious about the illness.

Although the society doesn't forget people affected with this devastating disease. The red ribbon, a ribbon colored red, is the symbol of solidarity of people living with HIV/AIDS.

The Red Ribbon Project was created by the New York artists in 1991. The artists wished to create a visual symbol to demonstrate compassion for people living with AIDS and their caregivers. The color red was chosen for it as the connection to blood and the idea of passion - not only anger, but love, like a valentine. First worn publicly by Jeremy Irons at the 1991 Tony Awards, the ribbon soon became renowned as an international symbol of AIDS awareness, becoming a politically correct fashion accessory on the lapels of celebrities. The Red Ribbon continues to be a powerful force in the fight to increase public awareness of HIV/AIDS and in the lobbying efforts to increase funding for AIDS services and research.

12. In pairs/groups write down questions based on the article. Ask your partner the questions.

13. Use a dictionary to find more associations/ collocations of the words: compassion, red ribbon.

14. Briefly talk about:

- The present-day situation in spreading of AIDS.
- Mental health conditions of an infected person.
- Red Ribbon project history.

15. Write a letter to the President of the Russian Federation or the Minister of Health explaining your concerns for AIDS victims and what you feel the leader of the free world should do.

16. Translate this text into Russian using the words from the unit you have studied.

Продолжительность жизни ВИЧ-инфицированных пациентов со временем может изменяться по двум причинам: постоянно разрабатываются новые лекарственные средства и методы лечения, а ВИЧ, в свою очередь, вырабатывает устойчивость к лекарствам. В отсутствие антиретровирусной терапии смерть пациента наступает в течение одного года с момента постановки диагноза СПИД. Считается, что ВИЧ-инфицированный, получающий терапию, может прожить несколько десятилетий без развития СПИД. Однако стоимость лечения может составлять от 385 до 619 тысяч долларов США.

Значительное влияние на качество и продолжительность жизни оказывают побочные эффекты от приема лекарственных препаратов. Особенности развития ВИЧ-инфекции зависят от многих факторов, в том числе: от количества CD4 лимфоцитов и числа копий вирусной РНК на момент начала лечения, возраста пациента, уровня доступной медицинской помощи, приверженности больного лечению и появления резистентных штаммов вируса.

Большинство пациентов умирают от оппортунистических инфекций или опухолей, связанных с нарушением работы иммунной системы. Клинические симптомы значительно отличаются между пациентами и зависят от многих факторов, среди которых: восприимчивость организма хозяина к инфекции, иммунный статус пациента, качество оказываемой медицинской помощи, сопутствующие инфекции, а также штамм вируса, которым инфицирован пациент.

17. Role-play dialogue.

You came to the blood transfusion center. You are going to donate blood. Ask the doctor about the measures they take to prevent everybody to catch HIV. Your goal is to be as confident as possible about your safety. The doctor's aim is to assure you that only in their center they take maximum care about donors.

18. Write a composition or make a presentation based on the following:

You are the doctor sent to some high school to tell students about the measures to prevent catching HIV. Prepare your speech to tell them as much as possible.

Unit 4

Cancer

What exactly is cancer?

Do you know any statistics about cancer?

What forms of cancer are most common in your country or area (liver cancer, prostate cancer, pancreatic cancer, skin cancer, or other)?

Do you know the most common forms of cancer treatment, both traditional and non-traditional therapies?

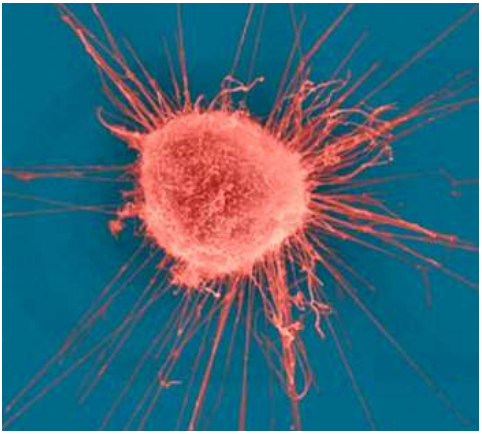
Are there any cultural norms on how people deal with cancer?

1. Read and translate the text.

A devastating disease

Cancer (medical term: malignant neoplasm) is a class of diseases in which a group of cells display uncontrolled growth (division beyond the normal limits), invasion (intrusion on and destruction of adjacent tissues), and sometimes metastasis (spread to other locations in the body via lymph or blood). These three properties of cancers differentiate them from benign tumors, which are self-limited, do not invade or metastasize. Most cancers form a tumor but some, like leukemia, do not. The branch of medicine concerned with the study, diagnosis, treatment, and prevention of cancer is oncology.

Cancer may affect people at all ages, even fetuses, but the risk increases with age. Cancer causes about 13 % of all deaths. Cancers can affect all animals.



Nearly all cancers are caused by abnormalities in the genetic material of the transformed cells. These abnormalities may be due to the effects of carcinogens, such as tobacco smoke, radiation, chemicals, or infectious agents. Other cancer-promoting genetic abnormalities may be randomly acquired through errors in DNA replication, or are inherited, and thus present in all cells from birth. The heritability of cancers is usually affected by complex interactions between carcinogens and the host's genome.

Genetic abnormalities found in cancer typically affect two general classes of genes. Cancer-promoting oncogenes are typically activated in cancer cells, giving those cells new properties, such as hyperactive growth and division, protection against programmed cell death, loss of normal tissue boundaries, and the ability to enter in adjust tissue. Tumor suppressor genes are then inactivated in cancer cells, resulting in the loss of normal functions in those cells, such as accurate DNA replication, control over the cell cycle, orientation and adhesion within tissues, and interaction with protective cells of the immune system.

Diagnosis usually requires the histological examination of a tissue biopsy made by a pathologist. Most cancers can be treated and some cured, depending on the specific type, location, and stage. Once diagnosed, cancer is usually treated with a combination of surgery, chemotherapy and radiotherapy.

In conclusion it should be said that cancer is one of the most complex and devastating diseases that claim the life of many humans. Today there are one in three people worldwide who are affected by cancer, and almost 60 % of these people will almost certainly die.

Vocabulary

abnormality (n)
acquire (v)
activate (v)
adhesion (n)
adjacent tissues
affect (v)
be caused (v)
biopsy (n)
carcinogen (n)
cell cycle
chemicals (n)
complex (adj)
concern (v)
destruction (n)
differentiate (v)
display (v)
division (n)
DNA replication
examination (n)
form (v)
genome (n)
heritability (n)
host (n)
inherit (v)
interaction (n)
intrusion (n)
invade (v)
invasion (n)
lymph (n)
malignant (adj)
metastasis (n)
metastasize (v)
neoplasm (n)
prevention (n)
property (n)
spread (v)
tumor (n)
uncontrolled growth
via (prep)

2. Complete the sentences using the words from the vocabulary list.

1) The medical term for ‘cancer’ is _____.
2) Uncontrolled growth, invasion and metastasis _____ cancer from benign tumor.
3) Cancer cells spread to other locations via _____ or _____.
4) Tobacco smoke, radiation, chemicals are _____.
5) Cancer-promoting oncogenes are ____ in cancer cells, while tumor suppressor genes are _____.
6) Pathologist makes _____.
7) With the help of a combination of surgery, chemotherapy and radiotherapy cancer can be _____.

3. Match Russian equivalents to these English word combinations.

Oncogenes	Неконтролируемый рост
Transformed cell	Утробный плод
Oncology	Люди всех возрастов
Benign tumor	Запрограммированная гибель клетки
Heritability	Пагубный для здоровья
Uncontrolled growth	Трансформированная клетка
Fetuses	Аномалии генетического материала
Inherited	Трансформирующий ген, онкоген
Devastating	Гиперактивный рост и деление
Tumor suppressor gene	Подавляющий опухоль ген
Due to	Унаследованный
Histologic examination	Наследуемость
Abnormalities in the genetic material	Благодаря
Infectious agent	Потеря нормальных границ ткани
People at all ages	Доброкачественная опухоль
Hyperactive growth and division	Онкология
Programmed cell death	Инфекционный агент
Loss of normal tissue boundaries	Гистологическое обследование

4. Give definitions of the following terms:

1) Intrusion
2) Destruction
3) Division
4) Metastasis
5) Examination

5. Answer the following based on the information from the text.

1) What is the definition of the term ‘cancer’?
2) What is the medical term for ‘cancer’?

3) Do all types of cancer form a tumor?
4) What is oncology?
5) Who can be affected by cancer?
6) What causes cancer?
7) How can abnormalities in the genetic material appear?
8) What do genetic abnormalities affect?
9) How do cancer-promoting oncogenes influence cells?
10) What information did you read about tumor suppressor genes?
11) What does diagnosis usually require?
12) Can cancer be treated or cured and how?
13) What are the statistics of cancer?

6. Which of these statements are true and which are false? Correct any statements that you think are false.

1) When a person has cancer, he can control the growth of infected cells.
2) Leukemia is a form of cancer.
3) Mostly children have cancer.
4) Cancer cannot affect different animals.
5) Abnormalities in the genetic material can be the reason of cancer.
6) Cancer can never be inherited.
7) The host's genome do not influence on the cancer heritability.
8) Cancer-promoting oncogenes do not endow cells with new properties.
9) Tumor suppressor genes are activated in cancer cells.
10) Pathologist makes the histological examination.
11) It is impossible even to treat cancer.
12) Cancer is of the mildest diseases and can be treated with aspirin.

7. Put the words in the correct order to make sentences or questions.

1) differentiate/ uncontrolled growth, invasion/ benign tumor/ and metastasis/ cancer/ from.
2) of getting/ with age/ does/ the risk/ cancer/ increase?
3) can/ all/ cancers/ affect/ animals.
4) due to/ maybe/ abnormalities/ in the genetic material/ of carcinogens/ of the transformed cells/ the effects
5) and/ the heritability of cancers/ is/ by carcinogens/ the host's genome/affected?
6) diagnosis/ usually/ the histological examination/ requires/ of a tissue biopsy/ of cancer.

8. Make a detailed plan of the text. Add some key-words if necessary.

9. Retell the text with your own words using your plan.

10. Find the origin and history of the term 'cancer'. Tell it to your group mates.

11. In one minute write down all of the different words you associate with the word 'sunshine'. Share your words with your partner/ group and talk about your associations.

12. In pairs/ groups, decide which of these statements you agree with. Explain your reasons.

1) The sun is good for you.
2) You must wear sun block / sunscreen every time you go outside.
3) Being in the sun is bad because it causes wrinkles and makes you look older.
4) Sun tanned skin doesn't look good.

5) Buying vitamin D supplements is a waste of time. The sun is free.

6) People worry too much about UV rays.

7) Sunshine is dangerous in areas where there is a hole in the ozone layer.

8) People who sunbathe are crazy.

9) Feeling the warmth of the sun on your skin is one of life's greatest pleasures.

10) Our bodies need sunshine.

13. Look at the article's title in the next exercise and guess whether these sentences are true or false:

1) Scientists have told us for many years that sunshine is healthy.

2) Researchers say there is a link between studying and cancer.

3) Doctors and scientists have changed their minds about UV rays.

4) Vitamin C is called the "sunshine vitamin".

5) Vitamin D may prevent 30 deaths for each one caused by skin cancer.

6) Sunscreen might not be so necessary now.

7) Our bodies need five hours a day in direct sunlight.

8) There is less cancer in sunnier parts of the world.

14. Read this article and translate it. Pay attention to the underlined phrases and put the words in the correct order.

Sunshine may prevent cancer

Scientists have years for us told many that the sun can harm our health. Researchers have produced many studies that link exposure to the sun to cancer. Doctors about us warn continually the dangers of ultraviolet (UV) rays. Well, all of this might now change. Doctors and scientists may soon be telling us the opposite.

New research suggests that sunshine bodies is for our necessary. Our skin absorbs the UV rays and produces vitamin D, also known as the ‘sunshine vitamin’.

Dr. Edward Giovannucci of Harvard University says that vitamin D contains many anti-cancer benefits. He believes vitamin D might help to prevent of 30 % more deaths than caused by skin cancer. It might now put the time to be sunscreen away. Doctors may soon recommend us to spend fifteen minutes a day in direct sunlight. They say this will allow our skin to produce the vitamin D we need. Researchers highlight the fact that there are fewer people with cancer in the world parts of sunnier.

15. Match the following synonyms from the article. Use them in our own sentences.

harm	aka
studies	includes
exposure	damage
suggests	urge
also known as	contact
contains	a quarter of an hour
prevent	point out
fifteen minutes	reports
recommend	stop
highlight	indicates

16. Look at the words below. With your partner, try to remember exactly how they were used in the text:

Many years, link, UV, opposite, necessary, also known as, Harvard University, benefits, deaths, direct, produce, sunnier.

17. Look in your dictionaries to find collocations, different meanings and synonyms for the words 'sun' and 'shine'. Share them with your partners.

Make questions using the words you found. Ask your partner/group your questions.

18. In pairs / groups write down questions about sunshine.

- Ask other classmates your questions and make notes about their answers.
- Make a mini-presentation to your class about your ideas of sunshine and the answers your group mates gave to your questions.

19. Read this dialogue in pairs. Translate it.

A: Hey, you look great. Did you just get back from vacation?
B: No. Why?
A: What do you mean why? It's the middle of winter and everyone else is as white as a ghost. You look like you've been lying on a beach somewhere.

B: Alright, I'll tell you. But I don't want to hear any of your negativity. I've been hitting the tanning salon once a week.
A: I don't see anything wrong with that. I'd actually like to try it. What's it like?

B: The place I go you have to pay by the minute. It costs about 75 cents per minute and you really just need to go for one, twelve-minute session per week. You can get 20 % off if you buy their $25 VIP card.

A: What do you think about the safety of them?

B: Many experts warn of the cancer causing risks of tanning. They say that overexposure to UVA and UVB rays cause genetic mutations that lead to skin cancer. I try to play it fairly safe and make sure I don't go too often. I also don't go in for longer than 12 minutes.

A: That's a good idea. How long do some people go?

B: Some people seem to get addicted to it. I've met several people who go 5 times a week and tan for 20 minutes per session. I'd personally be afraid to do that much, not only because of the cancer risk, but also because of the pre-mature aging of the skin.

A: Are there any health benefits associated with tanning indoors?

B: Your skin does absorb some vitamin D from the UVB rays, but many experts say that the risks outweigh the benefits.

20. Learn this dialogue by heart or make your own dialogue based on the same topic using the studied vocabulary.

21. Translate this text.

Витамин Д, солнце, рак и загар

Витамин Д, или кальциферол, - это общее название для животного витамина Д3 и растительного витамина Д2. Название «кальциферол» происходит от слов: calcium и ferro (нести). Недостаток витамина Д вызывает сходное с рахитом заболевание, характеризующееся всеми симптомами недостатка кальция в организме: повышенной нервной возбудимостью, беспокойством, нарушением мышечного тонуса, слабыми подёргиваниями мышц, отложением камней

в почках, кариесом, остеомаляцией (размягчением костей).

Организм может черпать готовый витамин Д3 из пищи. Однако не пища является основным источником кальциферола. Витамин способен синтезироваться в коже человека под влиянием ультрафиолетовых лучей солнца. Всемирно известный биохимик А. Ленинджер говорит, что если лицо ребёнка ежедневно хотя бы в течение 30 минут будет находиться под прямыми солнечными лучами, этого достаточно для обеспечения минимума суточной потребности в витамине Д. Солнце необходимо человеку в любом возрасте и при любом заболевании. Всё дело в дозе облучения.

Солнечный спектр включает ультрафиолетовые лучи. А они при длительном воздействии небезопасны. Но солнечные лучи, профильтрованные через обычное стекло, т. е. лишенные ультрафиолетовой части спектра, полностью теряют канцерогенную активность. Экспериментальные исследования указывают на возможность радиозащитного действия загара. Вместе с этим солнечные лучи повышают адаптационные возможности организма, укрепляют иммунную систему. Ультрафиолетовое излучение стимулирует кроветворение, улучшает усвоение железа.

22. Play a role play game "The Universe". This game is to discuss and decide what part of the universe is the most important. Team up with classmates who have been assigned the same role to develop your roles and discuss ideas and "strategies" before the role play begins.

Introduce yourself to the other role players before the role play begins.

Role A – **Sun**

Some of your benefits:

You are the center of the universe. There can be no life without you. You give warmth, light and energy.

Write why you are better than the moon and earth.

Role B – **Moon**

Some of your benefits:

You are mysterious. You control the movement of the earth's oceans. You will not die one day like the sun. After the earth dies, people will live on you.

Why you are better than the sun and earth.

Role C – **Earth**

Some of your benefits:

You are the most important part of the universe. The most beautiful creatures and things live on you. Without earth there is nothing.

Why you are better than the moon and sun.

23. Make an information sheet about the benefits and dangers of UV rays or write a for-and-against essay.

24. Write a "thank you" letter to the sun. Explain how important you think the sun is and what part it plays in your everyday life. Read your letter to your group mates. Compare the things you wrote about.

Unit 5

Nanotechnology

How do you think scientists can work with and make things that are a billionth of a meter wide?

What is nanotechnology? Do you know of any examples of it?

When do you think nanotechnology will be a widely used part of our life?

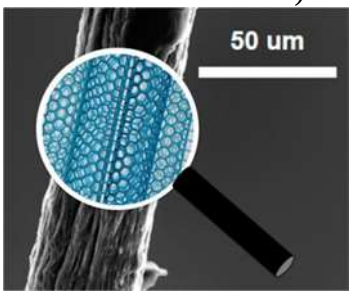
How might nanotechnology help medicine?

Why do you think people are interested in nanotechnology?

1. Read this text and compare your knowledge of nanotech with the information given below.

Nanotechnology

Nanotechnology (sometimes shortened to "nanotech") 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 1/10 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.

Vocabulary

advanced (adj)
approach (n)
approximately (adv)
atomic (adj)
biomaterials (n)
device (n)
evolve (v)
impact (n)
issue (n)
manipulate (v)
molecular (adj)
molecular recognition
nanoelectronics (n)
nanoionics (n)
nanomaterials (n)
nanomechanics (n)
nanometer (n)
nanophotonics (n)
nanotechnology (n)
observe (v)
phenomenon (n)
raise (v)
scientific foundation
toxicity (n)

2. Find Russian equivalents to English and learn this vocabulary. Make your own sentences with any 5 of them.

Atomic and molecular scale, vast range of applications, toxicity, environmental impact, potential effects, engineering of functional systems, in its original sense, by comparison, cellular life-form, by convention, upper limit, "bottom-up" approach, molecular recognition, "top-down" approach, atomic-level control.

3. Translate these sentences paying attention to the words in italics.

1) Журнал «Нано Дайджест» собрал наиболее интересные достижения ученых в сфере *нанотехнологий*.

2) *Нанометр* — единица измерения длины в метрической системе, равная одной миллиардной части метра.

3) *Токсичность* оказывает вредное действие на организм человека, животных и растений.

4) Огромный вклад науки в духовную жизнь общества бесспорен.

5) В настоящее время развивается такая область химии, как *молекулярный* дизайн.

6) Одним из преимуществ интернет–исследования является *высокая эффективность*.

7) *Наблюдать* за нано-объектами можно различными способами.

8) Чтобы подтвердить эту теорию, необходимо *научное обоснование*.

4. Which of these statements are true and which are false? Correct any statements that you think are false.

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.

5. Write out the sentences expressing the main ideas of paragraph of the text.

6. Speak about nanotechnology. Use this text and expand it with your own information.

7. Take any noun from the text. Use a dictionary to build up more associations/ collocates of each word.

For example: Nanomaterial → molecular scale – nanometer – DNA double helix...

8. Look at the words below. With your partner, try to give definitions of these words:

- silver nanoparticles
- stress response
- nano-titanium dioxide
- carbon nanotubes
- organic food

9. Imagine what could we do with these nano-sized things? Complete this table with your partner. Change partners and share what you wrote.

	A good idea (why / not)?	*Uses*
Camera		
Apples		
Television		
Voice recorders		
Money		
Medicine		

10. Play Pros and Cons game. One group strongly believes scientists will solve all of the world's problems one day; the other group strongly believes they won't. Give your arguments and win your opponents!

11. Imagine scientists have created a nano-motor. What are the best uses for it? Rank these and share your rankings with your partner. Put the best at the top. Share your rankings with your group mates.

- Surgery
- More powerful computers
- Weapons
- Miniaturization of household goods
- Space travel
- e-Commerce and shopping
- Transport
- Robots

*12. The title of the article below is **Scientists Make Molecule-Sized Electric Motor**. Guess if (a)-(h) statements below are true or false.*

a. Scientists have made the second-smallest motor ever invented.

b. The motor was made with just a single molecule.

c. The molecule in the motor has a width of a millionth of a meter.

d. The motor is 200 times smaller than the current world-record holder.

e. Scientists can also make molecules create movement from light.

f. Dr. Sykes' creation is the third molecule device to be accepted as a motor.

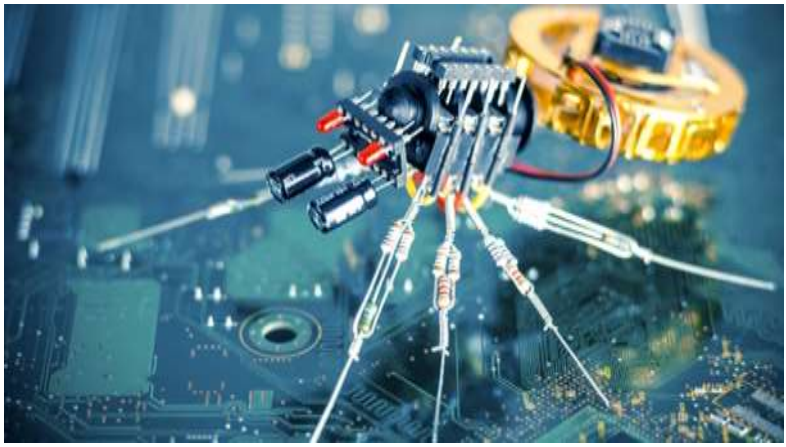
g. Dr Sykes' molecule motor spins at a rate of 50 times a second.

h. Next, Dr Sykes will make cog wheels for the world's smallest watch.

13. Read and translate the article.

Scientists Make Molecule-Sized Electric Motor

Scientists have made the smallest electric motor ever created. It is a feat of scientific genius that most of us could never even try to understand. Dr. Charles Sykes and his team from America's Tufts University created the motor from a single molecule just a billionth of a meter wide. Dr Sykes is in contact with the Guinness Book of World Records to have his motor recognized as the smallest ever. The current world-record holder is a 200-nanometre-long nano-tube made from carbon. Dr Sykes' creation is an incredible 200 times smaller. Naturally, the researchers hope their creation has uses for mankind. It will be used to power the tiniest machines ever built, and be used by doctors in nano-surgery and robotic surgery.



It is the first time an electric motor has been made from a single molecule. Scientists can make molecules convert energy from light and chemical reactions into movement, but Dr Sykes' invention is the first to be classed as a motor – something that can continually generate power. There is some mind-boggling science behind Sykes' device. A combination of chemicals and metals produces the miniscule motor that rotates 50 times a second. Dr Sykes was excited about the future of his discovery, saying: "The next thing to do is to get the thing to do work that we can measure - to link it to other molecules, lining them up next to one another so they're like miniature cog-wheels."

14. Look at the words in the box below. With your partner, try to recall how they were used in the text:

feat	team	just	carbon
200	built	time	convert
classed	50	measure	wheels

15. Match the following synonyms from the article.

1. created	a. transform
2 recognised	b. applications
3. current	c. tiny
4. uses	d. accepted
5. surgery	e. made
6. single	f. connect
7. convert	g. present
8. classed	h. operations
9. miniscule	i. labelled
10. link	j. sole

16. Match the following word combinations from the article to make phrases. (Sometimes more than one choice is possible.)

1. the smallest electric	a. behind Sykes' device
2. a feat of scientific	b. record holder
3. just a billionth of	c. the tiniest machines
4. The current world-	d. of his discovery
5. used to power	e. genius
6. chemical	f. wheels
7. some mind-boggling science	g. motor ever created
8. excited about the future	h. to one another
9. lining them up next	i. a metre wide
10. they're like miniature cog-	j. reactions

17. Look back at the article and write down some questions you would like to ask the class about the text. Share your questions with other group mates. Ask your partner your questions.

18. Search the Internet and find out more about Dr Sykes' nanotechnology device. Share what you discover with your partner(s) in the next lesson.

19. Translate the text into English using the words you have learned.

Наночастицы

Современная тенденция к миниатюризации показала, что вещество может иметь совершенно новые свойства, если взять очень маленькую частицу этого вещества. Частицы размерами от 1 до 100 нанометров обычно называют «наночастицами». Так, например, оказалось, что наночастицы некоторых материалов имеют очень хорошие каталитические и адсорбционные свойства. Другие материалы показывают удивительные оптические свойства.

Удается добиться взаимодействия искусственных наночастиц с природными объектами наноразмеров — белками, нуклеиновыми кислотами и др. Тщательно очищенные наночастицы могут самовыстраиваться в определённые структуры. Такая структура содержит строго упорядоченные наночастицы и также зачастую проявляет необычные свойства.

20. Make a poster about nanotechnology. Show your work to your group mates in the next lesson. Did you all have similar things?

21. Write a magazine article about any nanotechnology achievement interesting to you. Include imaginary interviews with scientists who are excited about it. Read what you wrote to your group mates. Write down any new words and expressions you hear from your partners.

Unit 6

Proteins

Do you know the difference between micro molecules and macromolecules?

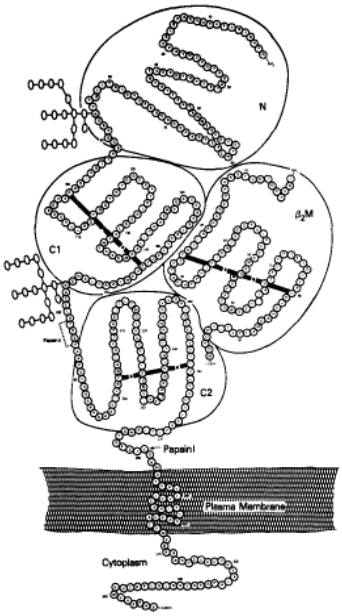
How big is the molecule of protein?

Why are proteins so important for living organisms? What are their functions?

1. Read and translate the text.

What are proteins?

Proteins are linear, unbranched polymers constructed from 20 different α-amino acids that are encoded in the DNA of the genome. All living organisms use the same 20 amino acids and the same genetic code. Proteins are large molecules with molecular weight ranging from 10 to 50 kdal for single-chain proteins. Multichain proteins of 150 to 200 kdal are frequently encountered.



Proteins serve a wide range of functions in living organisms. They are involved in the following processes:

- enzymatic catalysis - all known enzymes are proteins;
- transport and storage of small molecules and ions;
- systematic movements - both striated and smooth muscle are composed chiefly of protein, as are structures involved in the motility of certain free-living cells;

- the structure of skin and bone -collagen, the most abundant protein in body, gives these structures high tensile strength;
- the immune defense system - antibodies are specialized proteins recognizing self and nonself;
- hormonal regulation - some hormones are proteins; the cellular receptors that recognize hormones and neurotransmitters are proteins;
- control of genetic expression - repressor molecules in bacteria are proteins that suppress certain DNA sequences; protein initiation and termination factors serve in the transcription phases of gene function.

Proteins show an exquisite specificity of biologic function – a consequence of the uniqueness of the three-dimensional structural shape, or conformation, of each protein. In humans, disease states are often related to the altered function of a protein. This is due to an anomaly in the structure of the protein, which in turn may be due to a deficiency in its synthesis.

Amino acids. The fundamental units of protein polymers are α-amino acids. They are composed of an amino group, a carboxyl group, a hydrogen atom, and a distinctive side chain, all boned to a carbon atom. One of the 20 amino acids, proline, is an imino acid, not an α-amino acids as are the other 19. A few other amino acids are found in a number of proteins but are not coded for in DNA; they are derived from one or another of the 20 fundamental amino acids after these have been incorporated into the protein chain (post-translational modification).

Peptides and polypeptides. The peptide bond is the bond formed between the α-carboxyl group of one amino acid and the α-amino group of another. It is formed by removal of the elements of water. The process is highly endergonic and requires the concomitant hydrolysis of high-energy phosphate bonds. The peptide bond is a planar structure with the two adjacent α-carbons, a carbonyl oxygen, and α-amino-N and its associated H atom, and the carbonyl carbon all lying in the same plane. The –CN – bond has a partial double-bond character that prevents

rotation about the bond axis. The linking together of many amino acids by peptide bonds produces polypeptide chains. Amino acids, when in polypeptide chains, are customarily referred to as residues. Protein polypeptide chains are typically more than 100 amino acid residues long. Smaller peptides, however, are common and often have important biologic roles. By convention, peptide structures are written from left to right, starting with the amino acid residue having a free α-amino group (the so-called N-terminal amino acid) and ending with the residue having a free α-carboxyl group (the C-terminal). Either the three-letter abbreviations of the single-letter abbreviations are used.

Vocabulary

abundant (adj)
acids (n)
bond (n)
catalysis (n)
cellular (adj)
chiefly (adv)
endergonic (adj)
enzymatic (adj)
genetic (adj)
hormonal (adj)
incorporate (v)
multichain (n)
muscle (n)
neurotransmitters (n)
peptide (n)
proteins (n)
polymers (n)
repressor (n)
serve (v)
smooth (adj)
storage (n)
tensile (adj)
three-dimensional (adj)
typically (adv)
weight (n)

2. Find Russian equivalents to English and learn this vocabulary. Make your own sentences with any 5 of them.

Unbranched polymers, α-amino acids, living organisms, multichain proteins, enzymatic catalysis, systematic movements, high tensile strength, exquisite specificity, structural shape, due to an anomaly, the fundamental units, a carboxyl group, high-energy phosphate bonds, a partial double-bond character.

3. Answer the following questions based on the information from the text.

1) What are proteins?
2) How many amino acids are used in living organisms?
3) What is molecular weight of proteins?
4) What processes are they involved in?
5) What do proteins show?
6) Why are disease states often related to the altered function of a protein?
7) What are the fundamental units of protein polymers?
8) How many amino acids are they composed of?
9) What is the peptide bond?
10) How are peptide structures written?

4. Which of these statements are true and which are false? Correct any statements that you think are false.

1) Proteins are linear, unbranched polymers constructed from 20 different α-amino acids that are encoded in the DNA of the genome.
2) All living organisms use the same 30 amino acids and the same genetic code.
3) Proteins are tiny molecules with molecular weight ranging from 10 to 50 kdal for single-chain proteins.
4) Multichain proteins of 150 to 200 kdal are not infrequently encountered.
5) Proteins serve a narrow range of functions in living organisms.
6) The cellular receptors that recognize hormones and neurotransmitters are proteins.
7) They are composed of an amino group, a carboxyl group, a hydrogen atom, and a distinctive side chain, all boned to an oxygen atom.
8) A few other amino acids are found in a number of proteins but are not coded for in DNA.

9) The peptide bond is the bond formed between the α-carboxyl group of one amino acid and the α-amino group of another.

10) Protein polypeptide chains are typically more than 120 amino acid residues long.

5. Write out the sentences expressing the main ideas of each logical part of the text.

6. Speak about proteins. Use the text above and expand it with your own information.

7. Give definitions of the word combinations given below:

Enzymatic catalysis, α-amino acids, multichain proteins, DNA, peptide bond, protein polypeptide chains.

8. Translate the text into English.

Что такое белки?

Белки - это материал для построения клеток, тканей и органов для синтеза ферментов, пептидных гормонов, гемоглобина и т. д. Белки имеют ни с чем несравнимое значение в питании человека: прежде всего они служат «строительным материалом» для всего организма, кроме того, белки отвечают за основные обменные и регуляторные функции в организме.

Белки служат основой для создания тканей, например мышечных волокон. Белки выполняют транспортные функции в обменных системах организма, например гемоглобин (переносчик кислорода в крови) - сложный белок.

Также белки управляют функциями организма. Некоторые важнейшие гормоны - белки, например инсулин. Белки участвуют в энергетическом обмене, в процессах пищеварения, обеспечивают защиту организма (токсины, антитела - тоже белки) и выполняют многие другие функции. Белки образуют также соединения, обеспечивающие

иммунитет к инфекциям, участвуют в процессе усвоения жиров, углеводов, минеральных веществ и витаминов.

В химическом смысле белки - это очень большие молекулы, состоящие из остатков аминокислот. Наиболее важные свойства белков определяются тем, какие аминокислотные остатки (аминокислоты) его составляют. То есть белок, особенно как продукт питания, ценен не сам по себе: ценны аминокислоты, его составляющие.

Аминокислоты - разновидность органических кислот. Всего аминокислот, встречающихся в организмах, более 100 видов, и все они так или иначе участвуют в обменных процессах. Однако не все аминокислоты могут быть найдены в составе белков. Белки строятся только из 22 аминокислот, это, можно смело сказать, важнейшие из всех аминокислот.

9. Read and translate the text.

Amino acids

The fundamental units of protein polymers are α-amino acids. They are composed of an amino group, a carboxyl group, a hydrogen atom, and a distinctive side chain, all bonded to a carbon atom (the α -carbon). Table 9-1 lists the 20 amino acids according to their side chains.

One of the 20 amino acids, proline, is an imino acid, not an α -amino acid as are the other 19. A few other amino acids are found in a number of proteins but are not coded for in DNA; they are derived from one or another of the 20 fundamental amino acids after these have been incorporated into the protein chain (post-translational modification). The derived amino acids are 4-hydroxyproline, 5-hydroxylysine, e-N-methyl-lysine, 3-methyl-histidine, γ -carboxyglutamate, desmosine, and isodesmosine.

With the exception of glycine, all amino acids contain at least one asymmetric carbon atom and are, therefore, optically active. Irrespective of the direction of rotation of plane polarized light, which can be levo- or dextro-, the only optically active amino acids that are incorporated into proteins are of the L-

configuration. D-Amino acids are found in bacterial products (e.g., in cell walls) but are not incorporated into proteins via the ribosomal protein synthesizing system.

Amino acids are amphoteric molecules—that is, they have both basic and acidic groups. Monoamino-monocarboxylic acids exist in aqueous solution as dipolar molecules (zwit-terions). The α-carboxyl group is dissociated and negatively charged. The α-amino group is protonated and positively charged. Thus, the overall molecule is electrically neutral.

At high concentrations of hydrogen ion (low pH), the carboxyl group accepts a proton and becomes uncharged, so that the overall charge on the molecule is positive. At low concentrations of hydrogen ion (high pH), the amino group loses its proton and becomes uncharged; thus the overall charge on the molecule is negative.

Some amino acids have side chains containing dissociating groups. Those of Aspartic and Glutamic are acidic; those of Histidine, Lysine, and Arginine are basic. Two others, Cysteine and Tyrosine, have a negative charge on the side chain when dissociated. Whether or not these groups are dissociated depends upon the prevailing pH and the pK_a of the dissociating groups. These dissociating amino acids also exist in solution as zwitterions.

10. Make questions to each paragraph.

11. Match the following English words and word combinations from the article with Russian equivalents.

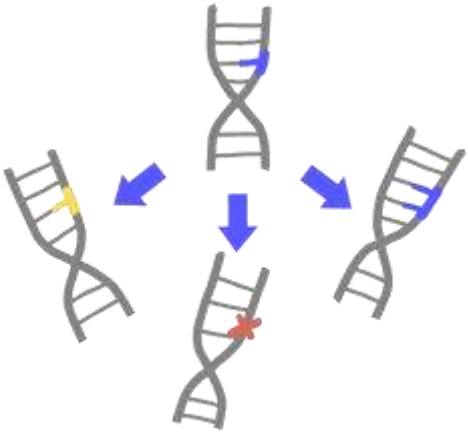
1. amino acids	a) амфотерные молекулы
2. a hydrogen atom	b) заряд
3. chain	c) диссоциирующие группы
4. amphoteric molecules	d) аминокислоты
5. uncharged	e) низкие концентрации
6. low concentrations	f) атом водорода
7. charge	g) цепь
8. dissociating groups	h) раствор
9. solution	i) ион водорода
10. hydrogen ion	j) не имеющий заряда

12. Write a summary of the text in your own words. Orally enlarge this summary and retell the text.

13. With your group mates make a presentation about proteins and amino acids.

Unit 7

Mutations



What words and images come to mind when you hear the words mutation or mutant?

Are there any types of mutations that you know?

Can you give some examples of unusual or fictional mutations?

What is your opinion about mutations? Can they be helpful and useful or only dangerous and harmful?

1. Read and translate the text.

The force of evolution

Mutation has been the source of many Hollywood movies, but it is really a simple process of a mistake made in a DNA sequence as it is being copied. In other words, mutations are DNA copying errors. When they happen in egg and sperm, they are the source of new alleles that can be passed to offspring. The whole human family is one species with the same genes.

Mutation creates slightly different versions of the same genes called alleles. These small differences in DNA sequence can make every individual unique.

They account for the variation we see in human hair color, skin color, height, shape, behavior, and susceptibility to disease. Individuals in other species vary too, in both physical appearance and behavior.

Genetic variation is useful because it helps populations change over time. Variations that help an organism survive and reproduce are passed on to the next generation. Variations that hinder survival and reproduction are eliminated from the population.

This process of natural selection can lead to significant changes in the appearance, behavior, or physiology of individuals in a population in just a few generations. We often refer to a mutation as a genetic variation itself. This approach can be useful when it comes to a gene associated with a disease: the disease allele carries a mutation, a DNA change that compromises a protein function. However, this approach gives mutation a bad name.

In contrast to variations that cause disease, there are many more examples of variations that are neither good nor bad, but just different — like blood types and eye color. Just like with disease alleles, the process of mutation creates these more neutral variations. But with these neutral variations it can be impossible to tell which allele is the "normal" one that existed first and which is the "mutant" — and the distinction is often meaningless. Mutation creates variations in protein-coding portions of genes that can affect the protein itself. But even more often, it creates variations in the "switches" that control when and where a protein is active and the amount of protein made. Radiation, chemicals, byproducts of cellular metabolism, free radicals, ultraviolet rays from the sun — these agents damage thousands of nucleotides in each of our cells every day. They affect the nucleotides themselves: converting one base to another, knocking a base off its backbone, or even causing a break in the DNA strand.

Most of the time mutation is reversed. DNA repair machines are constantly at work in our cells fixing mismatched nucleotides and splicing broken DNA strands back together. Yet some DNA changes remain. If a cell accumulates too many changes — if its DNA is so damaged that repair machinery cannot fix it — it either stops dividing or self-destructs. If any of these processes go wrong, the cell could become cancerous. One 2017 study claimed that 66% of cancer-causing mutations are random, 29% are due to the environment (the studied population spanned 69 countries), and 5% are inherited.

Scientists single out four classes of mutations. They are (1) spontaneous mutations (molecular decay), (2) mutations due to error-prone replication bypass of naturally occurring DNA damage (also called error-prone translesion synthesis), (3) errors introduced during DNA repair, and (4) induced mutations caused by mutagens. Scientists may also deliberately introduce mutant sequences through DNA manipulation for the sake of scientific experimentation.

Humans on average pass 60 new mutations to their children but fathers pass more mutations depending on their age with every year adding two new mutations to a child.

Thus, mutation plays an important role in evolution; it is the ultimate source of all genetic variations. Mutation is important as the first step of evolution because it creates a new DNA sequence for a particular gene, creating a new allele. Mutation acting as an evolutionary force by itself has the potential to cause significant changes in allele frequencies over very long periods of time. But if mutation were the only force acting on pathogen populations, then evolution would occur at a rate that we could not observe.

Vocabulary

account (v)
allele (n)
byproducts (n)
cellular metabolism (n)
distinction (n)
eliminate (v)
exist (v)
for the sake of
frequency (n)
hinder (v)
inherited (adj)
molecular decay
natural selection
offspring (n)
random (adj)
reversed (adj)
splice (v)
susceptibility (n)
ultraviolet rays
vary (v)
accumulate (v)
associate (v)
cancerous (adj)
compromise (v)
DNA strand (n)
error-prone (adj)
fix (v)
free radicals
give a bad name
induced (adj)
mismatched (adj)
mutagen (n)
nucleotide (n)
on average
rate (n)
self-destruct (v)
survive (v)
ultimate source
unique (adj)

2. Find the appropriate definitions to the following words:

1) DNA
2) Mutation
3) DNA strand
4) Nucleotides
5) Natural selection
6) Chromosome

a) four building blocks of DNA.
b) a change in the nucleotide sequence of the genome of an organism, virus, or extrachromosomal DNA.

c) the differential survival and reproduction of individuals due to differences in phenotype.

d) the chemical name for the molecule that carries genetic instructions in all living things.

e) a long DNA molecule with part or all of the genetic material of an organism.

f) polymers or chains of deoxynucleoside monophosphates that are linked together by phosphodiester bonds.

3. Translate these sentences paying attention to the words in italics.

1) *Аллели* определяют направление развития конкретного признака.

2) В смертельно опасной ситуации желание жить часто разделяет тех, кто *выживает*, и тех, кто гибнет.

3) *Ультрафиолетовые лучи* способствуют синтезу у растений некоторых витаминов, пигментов, а у животных и человека — витамина D.

4) Благодаря бактериям и *их продуктам жизнедеятельности* почва обогащается азотом и другими соединениями.

5) *В среднем, потомство* собаки в одном помете (dropppings) составляет 3–8 щенков.

6) Живые клетки способы к регулируемому процессу *саморазрушения*.

7) *Для естественного отбора* не нужно ни воздействия радиации, ни химических мутагенов.

8) Несовпадающие нуклеотиды могут способствовать увеличению тринуклеотидных (trinucleotide) повторов при генетических заболеваниях.

4. Read the sentences and say if they are true to the text or false. Correct the mistakes.

a) Mutations are RNA copying errors.
b) Mutations are the source of new alleles.
c) All differences in DNA sequence make every individual beautiful.
d) Mutation always has a bad name.
e) Mutation creates variations in protein-coding portions of genes that never affect the protein.
f) Radiation, chemicals, byproducts of cellular metabolism and free radicals have no effect on nucleotides in our cells.
g) Mutation is reversed, but some DNA changes remain.
h) Most of our mutations are inherited.
i) The number of passed mutations depends on the father's age.

5. Work with a partner to summarize the text above in 10-15 sentences.

6. Watch a videoclip, "Beneficial mutations do happen". This clip shows that not all mutations are bad. The two views presented in the video clips helps establish a balanced perspective about mutations and sets the stage for correct thinking about mutations as they relate to adaptations and evolution of species.

7. Study different types of mutations given below. Find Russian equivalents. Add more types of mutations if possible. Search for more details about these mutations and report about them to the class.

a) *Point mutation* is a change in single nucleotide of DNA.
b) *Nonsense mutation* is a point mutation in a sequence of DNA that results in a premature stop codon
c) *Missense mutation* is a point mutation in which a single nucleotide change results in a codon that codes for a different amino acid.

d) *Frameshift mutation* is a genetic mutation caused by indels (insertions or deletions) of a number of nucleotides in a DNA sequence that is not divisible by three.

e) *Insertion mutation* is the addition of one or more nucleotide base pairs into a DNA sequence.

f) *Deletion mutation* is a mutation (a genetic aberration) in which a part of a chromosome or a sequence of DNA is left out during DNA replication.

g) *Inversion mutation* happens when a segment of a chromosome is reversed end to end.

h) *Substitution* is a type of mutation where one base pair is replaced by a different base pair.

i) *Nondisjunction* means that a pair of homologous chromosomes has failed to separate or segregate at anaphase so that both chromosomes of the pair pass to the same daughter cell.

8. Check the knowledge you gained, also use the facts you knew and solve the quiz about mutations.

1. What mutation has occurred here?

T-G-A-C-C-A → T-G-A-G-C-A

a) substitution b) deletion
c) insertion d) frameshift

2. Which of the following would result in a frameshift mutation?

a) insertions only b) substitution only
c) deletion only d) insertions and deletions

3. What type of chromosomal mutation has occurred?

Original

Replicated

a) substitution b) insertion

c) deletion d) nondisjunction

4. Which mutations will most likely cause a protein to be non-functional?

a) point b) inversion
c) deletion d) all of the above

5. A mutation in which only one nucleotide is altered is called a

a) frameshift mutation b) deletion mutation
c) point mutation d) insertion mutation

6. DNA molecule segment is TTACGCAAG.
The mutated DNA segment is TTCGCAAG.
This is an example of ___ mutation.

a) substitution b) deletion
c) insertion d) inversion

7. The rearrangement of whole blocks of genes that involve changes to a triplet resulting in a different amino acid is

a) translocation b) gene mutation
c) deletion d) missive substitution

8. A mutation is defined as:

a) a change in the cell's structure
b) anything that changes in an embryo
c) any change in the physical features of a human
d) a change in the DNA sequence

9. Original ATTTGAGCC → Mutated ATTGAGCC. This is the example of a

a) insertion- frameshift
b) deletion- substitution
c) deletion -frameshift
d) all of the above

10. What mutation has occurred here? T-G-A-C-C-A → T-G-A-G-C-A

a) substitution b) deletion
c) insertion d) frameshift

11. Why are insertion and deletion (frameshift) mutations so harmful?

a) They change all of the codons from the mutation on down the line, which changes the amino acid sequence.
b) They insert things that an organism doesn't need.
c) They often delete things that organisms need.
d) Insertion and deletions are not any more harmful than substitution mutations.

12. Identify the DELETION mutation form the following: ATG CCA AAT

a) ATG TCA AAT b) ATG CCT AAA T
c) ATC CA AT d) ATG CCA AAT

13. Identify the SUBSTITUTION mutation form the following: ATG CCA AAT

a) ATG TCA AAT b) ATG CCT AAA T
c) ATC CA AT d) ATG CCA AAT

14. The survival of a species depends on its ability to adapt to changes in the environment. Which statement correctly describes a way that mutations increase the likelihood that a species will survive in a changing environment?

a) Mutations are the cause of disease in the species.
b) Mutations are not harmful when they occur in somatic cells.
c) Mutations are always passed on to subsequent generations.
d) Mutations are a source of variation in the species.

15. Which of these is a mutagen?

a) fiberglass dust b) lead and mercury
c) vitamin C d) all of the above

16. Genetic mutations can be...

a) beneficial, harmful, or neutral
b) beneficial only
c) harmful only
d) neutral only

17. Would a mutation in the DNA of a skin cell be passed on to an organism's offspring?

a) Yes, because any change to the DNA is passed on to the offspring.
b) Maybe. Sex cells only use half of the body's genetic code. It might get the copy of a gene that wasn't mutated.
c) No. Only mutations that occur in the gametes (sex cells) are passed on to the offspring.
d) Without knowing the animal, it would be hard to tell whether or not the mutation would be passed on.

18. A change in a single nucleotide in a gene sequence is called a...

a) point mutation b) single error
c) mono mutation d) isolated mutation

9. Work with a partner. Match the WH- words with the answers.

1 When	A three years
2 Where	B scientists
3 What	C DNA strand
4 Which	D in December 1980
5 Who	E in Florida
6 Why	F the largest one
7 How many	G to prevent disease
8 How much	H 5.5 million dollars
9 How long	I about 5 symptoms

10. Make a possible question for each pair. Practice in pairs.

Example: When did the DNA Testing start? In December 1980.

11. Two colleagues are talking about a new study. Complete the questions.

A Kazan State Technological University has started the research about the influence of free radicals on our DNA.
B Oh! _____ is this university located?
A In Kazan, Tatarstan.
B ___ ___ from Moscow is it?
A It's about 800 km.
B ___ ___ the first research of free radicals?
A No, it's not.
B _____ of the researches was the first?
A The first experiment regarding a free radical reaction was reported in 1894.
B Oh! It's long time ago! And now, _____ do they want to finish the study?
A They hope in October 2026.
B Good luck to them!

12. Read the additional text and translate it.

Mutations and Disease

DNA is constantly subject to mutations, accidental changes in its code. Mutations can lead to missing or malformed proteins, and that can lead to disease.

We all start out our lives with some mutations. These mutations inherited from your parents are called germ-line mutations. However, you can also acquire mutations during your lifetime. Some mutations happen during cell division, when DNA gets duplicated. Still other mutations are caused when DNA gets damaged by environmental factors, including UV radiation, chemicals, and viruses.

Few mutations are bad for you. In fact, some mutations can be beneficial. Over time, genetic mutations create genetic diversity, which keeps populations healthy. Many mutations have no effect at all. These are called silent mutations.

But the mutations we hear about most often are the ones that cause disease. Some well-known inherited genetic disorders include cystic fibrosis, sickle cell anemia, Tay-Sachs disease, phenylketonuria and color-blindness, among many others. All of these disorders are caused by the mutation of a single gene.

Most inherited genetic diseases are recessive, which means that a person must inherit two copies of the mutated gene to inherit a disorder. This is one reason that marriage between close relatives is discouraged; two genetically similar adults are more likely to give a child two copies of a defective gene.

Diseases caused by just one copy of a defective gene, such as Huntington's disease, are rare. Thanks to natural selection, these dominant genetic diseases tend to get weeded out of populations over time, because afflicted carriers are more likely to die before reproducing.

Scientists estimate that every one of us has between 5 and 10 potentially deadly mutations in our genes-the good news

is that because there's usually only one copy of the bad gene, these diseases don't manifest.

Cancer usually results from a series of mutations within a single cell. Often, a faulty, damaged, or missing p53 gene is to blame. The p53 gene makes a protein that stops mutated cells from dividing. Without this protein, cells divide unchecked and become tumors.

13. Make WH- questions covering the text above.

14. Watch the video clip, "One wrong letter" from the full video, Cracking the Code. This clip is a gripping tale of two families (twin brothers) whose lives are tragically impacted by Tay-Sachs' disease. Talk about genetic screening that exists for certain populations for diseases like Sickle Cell disease. Make a dialogue or monologue about any disease caused by genetic mutation.

15. Find some interesting facts about mutations and speak out them to your class.

16. Translate the text into English using the words you have studies and your own words.

Как меняются живые организмы?

Эволюция — это процесс, посредством которого популяции организмов меняются на протяжении поколений. В основе этих изменений лежат генетические вариации, которые могут возникать в результате мутаций генов или генетической рекомбинации — процесса, при котором генетический материал перестраивается, когда клетка готовится к делению. Эти изменения часто меняют активность гена или функцию белка, что может привнести в организм различные черты. Если признак полезен и помогает выживать и размножаться, генетическая изменчивость с большей вероятностью будет передана следующему поколению. Именно этот процесс известен как естественный отбор.

Со временем, по мере того как поколения животных с этой чертой продолжают размножаться, эта особенность становится все более распространенной в популяции. Иногда популяция становится настолько разнообразной, что считается новым видом. Но не все мутации ведут к эволюции. Только наследственные мутации, которые происходят в яйцеклетках или сперматозоидах, могут передаваться будущим поколениям и потенциально способствовать эволюции. Некоторые мутации происходят в течение жизни только в некоторых клетках организма и не являются наследственными, поэтому в таких случаях естественный отбор не играет никакой роли. Кроме того, многие генетические изменения не влияют на функции гена или белка и не являются полезными или вредными. Некоторые различия, вносимые мутациями, способны помочь организмам выжить в одной обстановке, но не приспособлены для другой.

17. Creative thinking.

a) Remember the X-Men movie or Teenage Mutant Ninja Turtles. With your group decide what is a possible mutation and what is fantasy.

b) Watch the video clip, «Mermaid syndrome». Analyze that some mutations are so unusual that they may appear to be fictional. Find them and report to your group.

c) With your partner create a mutated creature, describe it. Answer the questions, if any, about its traits and appearance. Finally, your group should guess what might be a real mutation, and what is absolutely impossible.

18. Basing on the questions write an essay about mutations. Express your opinion.

- What is mutation?
- Do you think mutation is a good thing?
- What are people worried about who oppose mutations?

- Do you think genetically mutations could harm the humanity?
- Do you think it is essential to mutate to have an evolutionary shift?
- Can new mutated animals, creatures be dangerous for human?
- Scientists can engineer mutations to create new food, new animal and even a new perfect human. – Is this a good idea?
- Would you like to have any designed mutations in your children?

Unit 8

Vaccination

What is vaccine?
Have you been vaccinated? Against what diseases?
Is vaccination and immunizations the same thing?

1. Read and translate the text.

Issues of Vaccination

Why should you get vaccinated? These are the reasons why vaccinations are so important for you and your loved ones.

Vaccinations are one of the most important medical interventions ever devised by mankind. They help keep many millions of people protected against some of the most devastating diseases ever to plague human beings.

In fact, they have been so effective that some diseases that were once feared are now extinct. Here we briefly explain the importance of vaccinations and offer some reasons why you really should always get vaccinated.

Vaccines are one of the most effective medical measures available to keep you fit and healthy for most of your precious life.

They are convenient, usually free to get, and will help you stave off some of the most horrible diseases known to mankind.

Vaccines teach your immune system how to create antibodies that protect you from diseases. It's much safer for your immune system to learn this through vaccination than by catching the diseases and treating them. Once your immune system knows how to fight a disease, it can often protect you for many years.

What are the disadvantages of vaccines?

The main disadvantage of vaccines is their potential side effects. They can cause, for example, temporary headaches, fatigue or loss of appetite, and irritation or mild pain at the site of injection. On some rare occasions, it is also possible to get an allergic reaction after a vaccine. There are also some reports of neurological side effects such as seizures, but these are incredibly unlikely for most people.

Despite these side effects, the benefits of getting vaccinated far outweigh the potential risks of contracting the diseases they are designed to prevent.

How safe is vaccination?

Vaccinations are very safe for the vast majority of people. But, that being said, no vaccine is ever 100% side effect free or, for that matter, effective.

"First, no vaccine is 100 % effective. To make vaccines safer than the disease, the bacteria or virus is killed or weakened (attenuated). For reasons related to the individual, not all vaccinated persons develop immunity. Most routine childhood vaccines are effective for 85 % to 95 % of recipients." - World Health Organization.

Vocabulary

allergic reaction	antibody (n)
attenuated (adj)	disease (n)
fatigue (n)	headache (n)
immune system	injection (n)
irritation (n)	medical intervention
recipient (n)	routine (adj)
safe (adj)	seizure (n)
side effect	vaccinate (v)
weakened (adj)	World Health Organization

2. Answer the questions to the text:

1) Why should you get vaccinated?
2) Why are vaccinations one of the most effective medical interventions?
3) What do vaccines teach your immune system?
4) What are the disadvantages of vaccines?
5) What are the benefits of getting vaccinated?
6) How safe is vaccination?
7) What are the reasons why vaccination is so important?
8) What vaccines should be compulsory in your opinion?
9) Who are the most at risk from vaccine-preventable diseases?
10) Have you been vaccinated against COVID-19?

3. Read the additional text and translate it.

6 Reasons Why Vaccination Is So Important

Here are some of the many reasons why vaccinations are so important. Trust us when we say this list is far from exhaustive. It is also in no particular order.

1. Immunizations save lives

One of the most important reasons to get vaccinated is, it ultimately saves lives. Modern immunizations can help protect

children from a wide variety of diseases that could potentially be fatal. Some vaccinations have been so effective that they have actually completely eliminated some diseases. Polio, for example, was once America's most feared disease. It caused death and paralysis for many people. Today, thanks to vaccinations, Polio is practically extinct in places like the U.S.

2. Vaccination is very safe and effective but can have side effects

Vaccinations are only ever deemed safe to administer to people once they have been carefully reviewed by scientists, doctors, and other medical professionals. While they can cause discomfort, pain, redness or tenderness at the site of injection, this is nothing compared to the suffering from the actual diseases, if contracted. While there is also a risk of having an allergic reaction, this is rare.

3. Immunizations protect others around you too

One of the most important things about vaccinations is the fact that it helps protect you and others from dangerous diseases. While some have been eliminated, thanks to vaccinations, there are still many diseases doing the rounds in the population.

Some vaccine-preventable diseases, like measles, or whooping cough can, and will, have resurgences if not vaccinated against. For this reason, it is always advisable to get vaccinated to prevent the spread of potentially dangerous diseases to your friends and family - especially the infirm or very young.

4. Immunizations save time and money

Practically speaking, vaccinations can save you in lost time and money over the long run. For example, non-immunized children can be denied attendance at schools.

Some diseases that immunizations have been developed for can also lead to long term health problems and disabilities if contracted. This will not only affect your quality of life, but it can also seriously affect your ability to work, cost you in medical bills.

Diseases like influenza can incapacitate you for up to 15 days. This typically means losing five or six workdays. Adults who suffer from hepatitis A tend to lose around 1 month of work too.

5. Immunizations protect future generations too

As previously mentioned, vaccinations have helped rid the world of some very serious debilitating diseases. Smallpox, for example, has now been eradicated worldwide meaning current and future generations will never have to suffer from it.

Other diseases, like rubella, can also pass from a mother to their unborn child if the mother is not vaccinated. By vaccinating people today, we are able to prevent the spread of serious diseases to future generations.

6. Vaccine-preventable diseases haven't all gone away

While there have been some great successes with regards to eliminating some diseases through vaccines, there are many more than that still pose a risk to health. Many viruses and bacteria that cause illness and death are still present in many countries of the world. Without being vaccinated you are leaving yourself open to potentially getting infected and suffering the consequences. This is especially true where travel around the world has never been easier. We have seen just how devastating this can be with the current outbreak of COVID-19.

4. Give the definitions to the following words:

eliminate	polio
measles	whooping cough
resurgences	infirm
medical bills	influenza
incapacitate	hepatitis A
debilitating	smallpox
eradicate	rubella
consequences	vulnerable

5. Translate into English.

1) Вакцинация является одним из самых важных достижений медицины в истории.

2) Вакцинация является простым, эффективным и безопасным способом защиты от инфекционных болезней до контакта с их возбудителем.

3) При введении вакцины в организм происходит презентация антигена возбудителя инфекции в иммунной системе организма в безопасной форме, в которой он не способен вызвать инфекционное заболевание (в виде ослабленного или убитого патогена или его части).

4) Благодаря вакцине значительно снижается тяжесть течения заболевания и риск возникновения осложнений, а зачастую заболевание проходит бессимптомно.

5) Нежелание людей участвовать в программах вакцинации при доступности самих вакцин может обратить прогресс человечества, достигнутый в борьбе с болезнями.

6) Благодаря вакцинации число ежегодных смертей от кори снизилось во всём мире с 3-7 млн до менее чем 100 тыс., ликвидирована натуральная оспа (в 1979 г.) и чума крупного рогатого скота (в 2010 г.).

7) Вакцины, используемые в программах национальной иммунизации, являются безопасными, но, как и любые лекарственные средства, иногда могут вызывать побочные эффекты, например боль в руке или повышение температуры тела.

8) По подсчётам специалистов, ежегодно около 11 % российских родителей отказываются прививать своих детей.

9) В день проведения прививки пациента осматривает врач, непосредственно перед прививкой проводят термометрию.

10) Вакцинация, в зависимости от препарата, может быть проведена пероральным (капли, таблетки), скарификационным (накожным), инъекционным (внутрикожным, подкожным, внутримышечным),

трансдермальным или интраназальным (в виде капель, спрея или аэрозольное распыление в воздухе помещения для вакцинации) и др. образом.

6. Watch the video «Vaccination Debate: Parents, Doctors Discuss the Pros and Cons» and answer the questions:

1. How many cases of measles were diagnosed at the time this video was made?
   a) 88
   b) 8
   c) 80
2. What did claims in 2006 link vaccines to?
   a) Dengue fever
   b) Measles
   c) Autism
3. Lauren Fernandez (a mom of 2) is doing what to her children?
   a) Getting them some vaccinations
   b) Fully immunizing
   c) Not vaccinating them
4. Mother Kristen Russell suggests there may be a link between vaccinations and
   a) fever
   b) allergies
   c) colds
5. Celebrities came out with discrediting vaccinations
   a) talk-shows
   b) movies
   c) books
6. In New Jersey, vaccination rates are at
   a) 90 %
   b) 19 %
   c) 93 %

7. Dr. Levine thinks there are too many of these:
   a) People against vaccines
   b) Sources of information
   c) Children with measles

7. Discussion (according to the video). Practice your writing/speaking skills by discussing the questions below.

1. What is your opinion on the debate over vaccines? Do you think children should be vaccinated?
2. Would you feel comfortable having your children go to school with kids who aren't vaccinated?
3. Why do you think Doctor Levine suggests not to look for information on Google?

8. Read and translate the text into English.

Что такое вакцинация и для чего она нужна?

Вакцинация — практически единственный надёжный способ защиты от инфекции. Здоровый образ жизни, рациональное питание, безусловно, должны иметь место в жизни человека, поскольку обеспечивают нормальное функционирование всего организма. Но, к сожалению, эти факторы не могут гарантировать защиту от инфекций.

Вакцинация — это формирование адекватной реакции организма на инфекцию по естественному пути. Суть вакцинации сводится к введению ослабленных или убитых микробов, для того чтобы организм «запомнил» врага и при повторном попадании микроба был готов запустить защитные реакции с удвоенной силой. Благодаря прививкам можно подготовить организм к встрече с такими тяжёлыми заболеваниями, как гепатит, дифтерия, корь, коклюш, полиомиелит, свинка, столбняк, туберкулёз и так далее. На сегодняшний день прививка — это стандартная профилактическая процедура, являющаяся полностью

контролируемым процессом, реакция на которую известна врачам и вполне предсказуема.

Состав вакцины строго регламентирован. Тем не менее у некоторых людей введение вакцины вызывает ряд ответных реакций. Они делятся на допустимые и нежелательные. Допустимые реакции связаны с работой иммунитета. К ним относятся:

- повышение температуры тела;
- умеренное недомогание;
- вялость;
- капризность;
- чувство болезненности и припухлости на месте укола.

Эти симптомы проходят самостоятельно в течение непродолжительного времени. Медицинская помощь при этом не требуется.

Нежелательные реакции чаще всего возникают у людей с повышенной чувствительностью, индивидуальной непереносимостью или нарушениями иммунитета. В этом случае возможно появление самых разных аллергических реакций, в том числе и анафилактического шока.

Чтобы избежать проявление нежелательных реакций, перед вакцинацией человек должен пройти комплексное обследование. После введения препарата в течение получаса пациент так же должен находиться под наблюдением медицинского персонала.

К сожалению, нельзя сказать, что человек, который привит, на 100 % защищён от инфекции, но он на 100 % защищён от серьёзных осложнений и летального исхода. Если даже он заболеет, заболевание будет протекать легко.

9. Read and translate the text about COVID-19, and title it.

Coronaviruses are a type of virus. There are many different kinds, and some cause disease. A coronavirus identified in 2019, SARS-CoV-2, has caused a pandemic of respiratory illness, called COVID-19. As of now, researchers know that the coronavirus

is spread through droplets and virus particles released into the air when an infected person breathes, talks, laughs, sings coughs or sneezes. Larger droplets may fall to the ground in a few seconds, but tiny infectious particles can linger in the air and accumulate in indoor places, especially where many people are gathered and there is poor ventilation. This is why mask-wearing, hand hygiene and physical distancing are essential to preventing COVID-19.

The first case of COVID-19 was reported Dec. 1, 2019, and the cause was a then-new coronavirus later named SARS-CoV-2. SARS-CoV-2 may have originated in an animal and changed (mutated) so it could cause illness in humans. In the past, several infectious disease outbreaks have been traced to viruses originating in birds, pigs, bats and other animals that mutated to become dangerous to humans. Research continues, and more study may reveal how and why the coronavirus evolved to cause pandemic disease.

Symptoms show up in people within two to 14 days of exposure to the virus. A person infected with the coronavirus is contagious to others for up to two days before symptoms appear, and they remain contagious to others for 10 to 20 days, depending upon their immune system and the severity of their illness.

COVID-19 symptoms include: Cough, Fever or chills, Shortness of breath or difficulty breathing, Muscle or body aches, Sore throat, New loss of taste or smell, Diarrhea, Headache, New fatigue, Nausea or vomiting, Congestion or runny nose.

Treatment for COVID-19 depends on the severity of the infection. For milder illness, resting at home and taking medicine to reduce fever is often sufficient. More severe cases may require hospitalization, with treatment that might include intravenous medications, supplemental oxygen, assisted ventilation and other supportive measures.

Vaccination is recommended as highly effective in preventing serious disease, hospitalization and death from COVID-19.

10. Make questions of different types to the text.

11. Fill in the gaps with the proper word or word combination

at risk; bacteria; benefits; big deal; dangerous; breathing machine; forehead; jaw; medical personnel; muscle; pediatrician; safe; sick; symptoms; treatment; vaccine (3)

Kids' cuts and scrapes are rarely a_____. But one six-year-old boy in Oregon nearly died after getting a cut on his_____while playing outside. Six days after the accident, his_____began clenching. _____spasms wrenched his arms. His neck and back arched out of control. Then the boy had trouble breathing. Emergency_____airlifted the child from the family farm to a hospital. Doctors quickly figured out the problem: tetanus.

The_____that cause tetanus are everywhere. Luckily, there's a_____that can prevent tetanus. But the boy's parents wouldn't let him get it.

As a result, the child became so_____he had to spend 57 days in a hospital. For more than a month of that time, he needed a_____. After the hospital, he had to spend 17 more days in a health-recovery center. The_____was costly: $811,929. And that didn't cover the cost of airlifting him to the hospital when his_____turned deadly.

Eventually, the boy got better. Yet even after doctors explained the tiny risks and huge_____of vaccines, his parents refused follow-up doses of_____for their son.

"Vaccines are_____. Vaccines save lives," says Doctor Peter Hotez. "They are the most effective public health technology ever invented." He's a_____and vaccine scientist at Baylor College of Medicine and Texas Children's Hospital.

Most people gladly get_____for themselves and their children. Yet a small share of people says no. In fact, the percent that turns them down has been climbing. That is putting more

children_____. And it endangers the health of others, from babies to cancer patients and more.

"We've reached a point where so many children are not being vaccinated, that we're seeing a return of_____and even deadly infectious disease," Hotez says.

12. Find the appropriate definitions to the following words.

bacteria	Unintended problems or harm caused by a procedure or treatment
antibody	Any one-celled microorganism, such as a bacte rium or fungal species, or a virus particle
contagious	A type of bacterial infection; the source of germs is typically exposure to soil, dust or animal feces
diphtheria	A physical or mental indicator generally regarded to be characteristic of a disease
epidemiologist	that if most people within a population are immune to a disease, then they can't spread it
germ	The prevalence of illness
herd immunity	A biological mixture that resembles a disease-c ausing agent
immune	Single-celled organisms
infection	A disease that can spread from one organism to another
morbidity	Any of a large number of proteins that the body produces from B cells and releases int o the blood supply as part of its immune respon se
pediatrics	A highly contagious disease, typically striking children. Symptoms include a character istic rash across the body, headaches, runny nose, and coughing
measles	A researcher that figure out what causes a parti

	cular illness and how to limit its spread
outbreak	An adjective for some disease that can be sprea d by direct contact with an infected individual or the germs that they shed into the air, their clothes or their environment
side effects	The sudden emergence of disease in a populatio n of people or animals
vaccine	the ability to fight infections or deal with foreig n substances that may provoke allergies.
tetanus	A bacterial infection where the germs produce a poison that destroys healthy tissue in the respiratory system
symptom	A field of medicine that has to do with children and especially child health

13. Are you for or against vaccination? Give your arguments and express your opinion in the form of an opinion essay or have an oral discussion about this topic.

PART II
ADDITIONAL TEXTS

Texts for reading, translating and summarizing

Text 1

Reactivating aging stem cells in the brain
Science Daily (February 24, 2021)
Source: University of Zurich

The stem cells in our brain generate new neurons throughout life, for example in the hippocampus. This region of the brain plays a key role for a range of memory processes. With increasing age, and in patients suffering from Alzheimer's disease, the hippocampus' ability to create new neurons declines steadily - and with it, its memory functions.

Distribution of age-dependent cell damage

A study conducted by the research group of Sebastian Jessberger, a professor at the Brain Research Institute of the University of Zurich, shows how the formation of new neurons is impaired with advancing age. Protein structures in the nuclei of neural stem cells make sure that harmful proteins accumulating over time are unevenly distributed onto the two daughter cells during cell division. This seems to be an important part of the cells' ability to proliferate over a long time in order to maintain the supply of neurons. With advancing age, however, the amounts of nucleic proteins change, resulting in defective distribution of harmful proteins between the two daughter cells. This results in a decrease in the numbers of newly generated neurons in the brains of older mice.

The central element in this process is a nuclear protein called lamin B1, the levels of which decrease as people age. When the researchers increased lamin B1 levels in experiments in aging mice, stem cell division improved and the number of new neurons grew. "As we get older, stem cells throughout the body

gradually lose their ability to proliferate. Using genetic engineering and cutting-edge microscope technology, we were able to identify a mechanism that is associated with this process," says doctoral candidate and first author Khadeesh bin Imtiaz.

Halting the aging process of stem cells

The research is part of several ongoing projects aiming to reactivate aging stem cells. The ability to regenerate damaged tissue generally declines with age, thus affecting almost all types of stem cells in the body. "While our study was limited to brain stem cells, similar mechanisms are likely to play a key role when it comes to the aging process of other stem cells," says Sebastian Jessberger.

These latest findings are an important step towards exploring age-dependent changes in the behavior of stem cells. "We now know that we can reactivate aging stem cells in the brain. Our hope is that these findings will one day help increase levels of neurogenesis, for example in older people or those suffering from degenerative diseases such as Alzheimer's. Even if this may still be many years in the future," says Jessberger.

Text 2

Stem cells can use same method as plants and insects to protect against viruses

Science Daily (July 8, 2021)
Source: The Francis Crick Institute

Researchers at the Francis Crick Institute have found a vital mechanism, previously thought to have disappeared as mammals evolved, that helps protect mammalian stem cells from RNA viruses such as SARS-CoV-2 and Zika virus. The scientists suggest this could one day be exploited in the development of new antiviral treatments.

On infecting a host, a virus enters cells in order to replicate. For most cells in mammals the first line of protection are proteins, called interferons. Stem cells, however, lack the ability to trigger

an interferon response and there has been uncertainty about how they protect themselves.

In their study, published in *Science* today (8 July) the scientists analysed genetic material from mouse stem cells and found it contains instructions to build a protein, named antiviral Dicer (aviD), which cuts up viral RNA and so prevents RNA viruses from replicating. This form of protection is called RNA interference, which is the method also used by cells in plants and invertebrates.

Caetano Reis e Sousa, author and group leader of the Immunobiology Laboratory at the Crick says, "It's fascinating to learn how stem cells protect themselves against RNA viruses. The fact this protection is also what plants and invertebrates use suggests it might be something that goes far back in mammalian history, right up to when the evolutionary tree spilt. For some reason, while all mammalian cells possess the innate ability to trigger this process, it seems to only be relied upon by stem cells.

"By learning more about this process, and uncovering the secrets of our immune system we are hoping to open up new possibilities for drug development as we strive to harness our body's natural ability to fight infection."

In laboratory experiments which exposed engineered human cells to SARS-CoV-2, the virus infected three times fewer stem cells when aviD was present in the cells compared to when the researchers removed this protein.

The scientists also grew mini brain organoids from mouse embryonic stem cells and found that, when infected with Zika virus, the organoids with aviD grew more quickly and less viral material was produced than in organoids without this protein. Similarly, when organoids were infected with SARS-CoV-2, there were fewer infected stem cells in the organoids with aviD.

Enzo Poirier, author and postdoc in the Immunobiology Laboratory at the Crick says, "Why stem cells use this different mechanism of defence remains a mystery. It might be that the interferon process would cause too much harm to stem cells,

so mammals, including humans, have evolved to shield these precious cells from this damage. There is still a lot of uncertainty about how these cells are protected from viruses, which we're excited to explore further."

The researchers will continue this work, creating a mouse model which allows them to further study the effects and importance of aviD in mammalian stem cells.

Text 3

Effective way to replenish threatened plants: Cloning techniques to give the threatened Hill's thistle a fighting chance. From two seeds grew a thousand plants

Science Daily (April 22, 2020)
Source: University of Guelph

University of Guelph researchers used advanced cloning techniques to give the threatened Hill's thistle a fighting chance.

This cutting-edge propagation method could rejuvenate the population of other threatened and endangered plant species, said lead researcher Prof. Praveen Saxena, Department of Plant Agriculture.

Published recently in the journal *PLOS ONE*, the three-year study used the CPR (Conservation, Propagation, Redistribution) method to preserve the genetic material of germ cells, known as germplasm, and use that material to produce large quantities of plants in a controlled environment.

"A very small amount of plant material can produce large numbers of plants for conservation purposes," said Saxena, who heads the Gosling Research Institute for Plant Preservation (GRIPP) at U of G.

The conventional method of planting seeds to reintroduce Hill's thistle has shown limited success due to low flowering and low germination rates.

"The major goal of our research is to preserve threatened and endangered plant biodiversity through the application of in vitro culture technologies that can be used to prevent species loss in the field," said, Saxena, who worked on the study with fellow GRIPP researchers Bita Sheikholeslami, Christina Turi and Mukund Shukla. "We wanted to test our model for its practical utility in a real-life situation, when lab-generated plants are transferred to harsh natural sites."

Parks Canada provided the team with 29 seeds, of which only two germinated. Those two seeds sprouted enough plant material to grow 1,000 plants in the lab; 300 were transplanted back into the Bruce Peninsula National Park in southern Ontario.

The 300 plants were planted in 12 sites in the national park in summer 2017. The survival rate ranged from 67 to 99 per cent, with nearly all of these plants surviving the winter. Shoot regeneration and flowering occurred in most sites.

"Micropropagation is a good approach for Hill's thistle because germplasm can be stored for long-term in our GRIPP facility to conserve the limited genetic diversity, while the threats to the declining populations can be managed through reintroduction of micropropagated plants," said Shukla. "This extensive study provides solid evidence of the usefulness of in vitro-grown plants."

The Hill's thistle grows in scarce Great Lakes areas known as open alvar grasslands. In Ontario, the flowering plant, which supports the life cycles of rare bees and other pollinators, is found mostly on the Bruce Peninsula and Manitoulin Island.

It is listed as a threatened plant species in the province, and one likely to become endangered if steps are not taken to protect it. A lack of suitable habitat due to the encroachment of trees and shrubs, as well as cottage development and quarrying activity in its natural habitat, have contributed to the decline.

"In general, plant biodiversity is important for human lives, as well as animals and microbes, as it is critical to their survival because of the oxygen, food and medicine they provide," Saxena said. "A complete ecological system is not possible without plant

biodiversity. We are optimistic that the CPR model will prove to be an important tool in saving plant diversity, including important food and medicinal crops."

Text 4

Embryo stem cells created from skin cells
Science Daily (May 2, 2019)
Source: The Hebrew University of Jerusalem

Researchers at the Hebrew University of Jerusalem (HU) have found a way to transform skin cells into the three major stem cell types that comprise early-stage embryos. The work (in mouse cells) has significant implications for modelling embryonic disease and placental dysfunctions, as well as paving the way to create whole embryos from skin cells.

As published in *Cell Stem Cell*, Dr. Yossi Buganim of HU's Department of Developmental Biology and Cancer Research and his team discovered a set of genes capable of transforming murine skin cells into all three of the cell types that comprise the early embryo: the embryo itself, the placenta and the extra-embryonic tissues, such as the umbilical cord. In the future, it may be possible to create entire human embryos out of human skin cells, without the need for sperm or eggs. This discovery also has vast implications for modelling embryonic defects and shedding light on placental dysfunctions, as well as solving certain infertility problems by creating human embryos in a petri dish.

Back in 2006, Japanese researchers discovered the capacity of skin cells to be "reprogrammed" into early embryonic cells that can generate an entire fetus, by expressing four central embryonic genes. These reprogrammed skin cells, termed "Induced Plutipotent Stem Cells" (iPSCs), are similar to cells that develop in the early days after fertilization and are essentially identical to their natural counterparts. These cells can develop into all fetal cell types, but not into extra-embryonic tissues, such as the placenta.

Now, the Hebrew University research team, headed by Dr. Yossi Buganim, Dr. Oren Ram from the HU's Institute of Life Science and Professor Tommy Kaplan from HU's School of Computer Science and Engineering, as well as doctoral students Hani Benchetrit and Mohammad Jaber, found a new combination of five genes that, when inserted into skin cells, reprogram the cells into each of three early embryonic cell types - iPS cells which create fetuses, placental stem cells, and stem cells that develop into other extra-embryonic tissues, such as the umbilical cord. These transformations take about one month.

The HU team used new technology to scrutinize the molecular forces that govern cell fate decisions for skin cell reprogramming and the natural process of embryonic development. For example, the researchers discovered that the gene "Eomes" pushes the cell towards placental stem cell identity and placental development, while the "Esrrb" gene orchestrates fetus stem cells development through the temporary acquisition of an extrae-mbryonic stem cell identity.

To uncover the molecular mechanisms that are activated during the formation of these various cell types, the researchers analyzed changes to the genome structure and function inside the cells when the five genes are introduced into the cell. They discovered that during the first stage, skin cells lose their cellular identity and then slowly acquire a new identity of one of the three early embryonic cell types, and that this process is governed by the levels of two of the five genes.

Recently, attempts have been made to develop an entire mouse embryo without using sperm or egg cells. These attempts used the three early cell types isolated directly from a live, developing embryo. However, HU's study is the first attempt to create all three main cell lineages at once from skin cells. Further, these findings mean there may be no need to "sacrifice" a live embryo to create a test tube embryo.

Text 5

New study reveals why HIV remains in human tissue even after antiretroviral therapy

Science Daily (March 25, 2022)
Source: University of Alberta

Discovery could open the door to new treatments that improve our immune system's ability to eliminate the stubborn virus, lead to strides in MS research.

Thanks to antiretroviral therapy, HIV infection is no longer the life sentence it once was. But despite the effectiveness of drugs to manage and treat the virus, it can never be fully eliminated from the human body, lingering in some cells deep in different human tissues where it goes unnoticed by the immune system.

Now, new research by University of Alberta immunologist Shokrollah Elahi reveals a possible answer to the mystery of why infected people can't get rid of HIV altogether.

Elahi and his team found that in HIV patients, killer T cells - a type of white blood cells responsible for identifying and destroying cells infected with viruses - have very little to none of a protein called CD73.

Because CD73 is responsible for migration and cell movement into the tissue, the lack of the protein compromises the ability of killer T cells to find and eliminate HIV-infected cells, explained Elahi.

"This mechanism explains one potential reason for why HIV stays in human tissues forever," he said, adding that the research also shows the complexity of HIV infection.

"This provides us the opportunity to come up with potential new treatments that would help killer T cells migrate better to gain access to the infected cells in different tissues."

After identifying the role of CD73 - a three-year project - Elahi turned his focus to understanding potential causes for the drastic reduction. He found it is partly due to the chronic inflammation that is common among people living with HIV.

"Following extensive studies, we discovered that chronic inflammation results in increased levels of a type of RNA found in cells and in blood, called microRNAs," he explained. "These are very small types of RNA that can bind to messenger RNAs to block them from making CD73 protein. We found this was causing the CD73 gene to be suppressed."

The team's discovery also helps explain why people with HIV have a lower risk of developing multiple sclerosis, Elahi noted.

"Our findings suggest that reduced or eliminated CD73 can be beneficial in HIV-infected individuals to protect them against MS. Therefore, targeting CD73 could be a novel potential therapeutic marker for MS patients."

Elahi said the next steps in his research include identifying ways the CD73 gene can be manipulated to turn on in patients living with HIV and off in those with MS.

Text 6

Complications of measles can include hepatitis, appendicitis, and viral meningitis, doctors warn

Science Daily (February 17, 2020)
Source: BMJ

This entirely preventable viral infection can affect many different organs in the body. The complications of measles can be many and varied, and more serious than people might realise, doctors have warned in the journal *BMJ Case Reports* after treating a series of adults with the infection.

Measles is a highly contagious respiratory viral infection, the symptoms of which include fever, cough, conjunctivitis, and an extensive rash all over the body.

Measles is entirely preventable as the vaccine used to immunise against it is safe and very effective.

But in the past few decades, unfounded fears about the vaccine have prompted it to re-emerge as a health scourge around the world, with rising numbers of cases in teens and adults, say the authors.

In 2017 the global death toll from measles reached 110,000. Most of these deaths were in young children.

The authors treated three people with measles who had additional complications as a direct result of their infection.

The first case concerned a young man, who had only had the first of two doses of measles vaccine as a child. He was additionally diagnosed with hepatitis.

The second case involved a young woman who developed appendicitis associated with measles. In the third case, a middle aged man complained of blurred vision and severe headache. He was diagnosed with viral meningitis, caused by his measles infection.

All three people recovered fully after appropriate treatment and care, and none had any long lasting health problems as a result of their illness.

But because measles suppresses the immune system, it has been associated with complications in every organ of the body, note the authors. Almost a third of all reported cases are associated with one or more complications, they point out.

These can include pneumonia, febrile seizures, and encephalomyelitis (inflammation of the brain and spinal cord) which causes neurological problems.

Another possible complication of measles is SSPE (subacute sclerosing panencephalitis), a progressive neurological disorder that causes permanent nervous system damage and leads to a vegetative state.

"Large outbreaks with fatalities are currently ongoing in European countries which had previously eliminated or interrupted endemic transmission," write the authors, adding that in the first six months of 2019 alone, 10,000 measles cases were reported in Europe.

They attribute the rise in new cases to negative publicity in the early 2000s linking the measles, mumps and rubella (MMR) vaccine to autism, despite major studies proving otherwise. This prompted a fall in vaccine uptake and collective ('herd') immunity.

"Urgent efforts are needed to ensure global coverage with two-dose measles vaccines through education and strengthening of national immunisation systems," they conclude.

Text 7

Hemophilia three times more prevalent than thought
Science Daily (September 9, 2019)
Source: McMaster University

More than 1,125,000 men around the world have the inherited bleeding disorder of hemophilia, and 418,000 of those have a severe version of the mostly undiagnosed disease, says a new study led by McMaster University researchers.

This is three times what was previously known. Only 400,000 people globally were estimated to have the disorder which is caused by a defect in the F8 or F9 gene which encodes instructions for making the factor proteins that helps blood clot. For those with hemophilia, lack of treatment leads to chronic and disabling joint disease, while bleeding into organs and brain hemorrhages can lead to disability and death.

Hemophilia, which is found almost only in men, is currently treated with infusions of factor to prevent or stop debilitating bleeds, but treatment is expensive and scarce in many countries.

The international research team was also able to calculate, for the first time, the prevalence of hemophilia among babies at birth, which enabled them to estimate that the life expectancy of those with hemophilia is significantly less than other people,

particularly in lower-income countries where there is lack of treatment.

There are two main types of hemophilia: Hemophilia A has the factor 8 (F8) gene defect, and hemophilia B has a factor 9 (F9) gene defect.

They found that, per 100,000 males, 21 will have hemophilia A or B, seven of whom severely; among newborns, per 100,000 males, 29 will have hemophilia A or B, of whom 12 will have the severe form of disease.

Putting the numbers together, the 'life expectancy disadvantage' associated with hemophilia may be estimated and varies depending with the availability of care. For those born with hemophilia, the chances of living a life of normal duration and quality will be reduced by 64% in upper-middle income countries, 77% in middle income and up to 93% in low income countries.

The study will be published in the *Annals of Internal Medicine* on Sept. 10.

"This paper is a milestone in our journey to providing care for hemophilia patients worldwide," said Dr. Alfonso Iorio, lead author of the paper, professor health research methods, evidence, and impact at McMaster University and director of the Hamilton-Niagara hemophilia program at Hamilton Health Sciences.

"Knowing how many patients are expected in each country given its population is an important measure of the efficiency of the health care system. Knowing how many patients should be there, and how many less instead are reported to national and international registries is a measure of the work left to be done," he said.

"Knowing how many patients are out there will enable health care systems to estimate the resources needed to treat the disease, and enable drug manufacturers to increase the investment in research to match the demand of a patient population three times larger than we previously thought."

For the World Federation of Hemophilia, Iorio assembled an international team of researchers from France, U.S. and U.K.

to perform a meta-analysis of the registry data in countries with the most comprehensive registries of hemophilia, which were Australia, Canada, France, Italy, New Zealand and the U.K.

"This work is also a proof of the value of long-term studies in the field of rare diseases," said Iorio.

A related editorial published in the journal said the magnitude of the global gaps in care for people with hemophilia is daunting.

Text 8

Discovery of key protein in malaria parasite opens door to novel treatment

Science Daily (February 17, 2022)

Source: Université Laval

An international team has discovered a protein that plays a key biological role in a parasite that causes malaria. Deactivating this protein reduces in vitro growth of *Plasmodium falciparum*, the protozoa behind the most virulent form of the disease, by more than 75%. The team, led by Professor Dave Richard of Université Laval, recently published details of the discovery in the scientific journal *mBio*.

"This breakthrough could lead to the development of a treatment that targets a function of the parasite that no malaria drug has yet exploited," said Richard, professor in the Faculty of Medicine at Université Laval and researcher at CHU de Québec-Université Laval Research Centre.

Plasmodium falciparum is transmitted to humans through mosquito bites. After infecting the host's liver it circulates in the blood, hiding inside red blood cells and thereby avoiding attacks from the immune system. The parasite's main food source is hemoglobin, the protein that carries oxygen from the red blood cells to the rest of the body. The parasite digests the hemoglobin in structures called digestive vacuoles.

"The protein we discovered, PfPX1, is involved in transporting hemoglobin to these digestive vacuoles," said

Professor Richard. "When we deactivate PfPX1, we deprive the parasite of its main source of amino acids. This has an impact on its growth and survival."

In light of these findings, Richard sees a potential new way to fight malaria: "We could block the parasite's PfPX1 protein from performing its functions. Since the protein isn't present in humans, there would be decreased risk of disrupting any important functions in the human body."

Malaria continues to plague many parts of the world, including Sub-Saharan Africa. In 2020, 241 million people contracted malaria and 627,000 died from it. The disease mainly affects children under the age of five and pregnant women.

Although the World Health Organization recognized the first malaria vaccine last year, Richard thinks it is essential to continue exploring new therapeutic avenues: "As we have seen with COVID-19, new strains can continue to emerge and threaten the effectiveness of vaccines. What's more, strains resistant to artemisinin, the main anti-parasite drug used against malaria, have already emerged in Southeast Asia. To maintain treatment efficacy and reduce the risk of new drug-resistant strains, it is important to combine therapeutic approaches, as we do with AIDS. Our discovery may well have a role to play in the fight against malaria."

The authors of the *mBio* article are from Université Laval, Purdue University, the University of Alberta, the Biology Centre of the Czech Academy of Sciences, and the University of Notre Dame.

Text 9

Sweet pressure: Scientists discover link between high blood pressure and diabetes

Science Daily (February 1, 2022)
Source: University of Bristol

The long-standing enigma of why so many patients suffering with high blood pressure (known as hypertension) also have diabetes (high blood sugar) has finally been cracked by an international team led by the universities of Bristol, UK, and Auckland, New Zealand.

The important new discovery has shown that a small protein cell glucagon-like peptide-1 (GLP-1) couples the body's control of blood sugar *and* blood pressure.

Professor Julian Paton, a senior author, and Director of Manaaki Mãnawa - The Centre for Heart Research at the University of Auckland, said: "We've known for a long time that hypertension and diabetes are inextricably linked and have finally discovered the reason, which will now inform new treatment strategies."

The research, published online ahead of print in *Circulation Research* today [1 February], involved contributions from collaborating scientists in Brazil, Germany, Lithuania, and Serbia, as well as the UK and New Zealand.

GLP-1 is released from the wall of the gut after eating and acts to stimulate insulin from the pancreas to control blood sugar levels. This was known but what has now been unearthed is that GLP-1 also stimulates a small sensory organ called the carotid body located in the neck.

The University of Bristol group used an unbiased, high-throughput genomics technique called RNA sequencing to read all the messages of the expressed genes in the carotid body in rats with and without high blood pressure. This led to the finding that the receptor that senses GLP-1 is located in the carotid body, but less so in hypertensive rats.

David Murphy, Professor of Experimental Medicine from Bristol Medical School: Translational Health Sciences (THS) and senior author, explained: "Locating the link required genetic profiling and multiple steps of validation. We never expected to see GLP-1 come up on the radar, so this is very exciting and opens many new opportunities."

Professor Paton added: "The carotid body is the convergent point where GLP-1 acts to control both blood sugar and blood pressure simultaneously; this is coordinated by the nervous system which is instructed by the carotid body."

People with hypertension and/or diabetes are at high risk of life-threatening cardiovascular disease. Even when receiving medication, a large number of patients will remain at high risk. This is because most medications only treat symptoms and not causes of high blood pressure and high sugar.

Professor Rod Jackson, an epidemiologist from the University of Auckland, said "We've known that blood pressure is notoriously difficult to control in patients with high blood sugar, so these findings are really important because by giving GLP-1 we might be able to reduce both sugar and pressure together, and these two factors are major contributors to cardiovascular risk."

Mr Audrys Pauža, a British Heart Foundation-funded PhD student in Professor David Murphy's lab in the Bristol Medical School and lead author on the study, added: "The prevalence of diabetes and hypertension is increasing throughout the world, and there is an urgent need to address this.

"Drugs targeting the GLP-1 receptor are already approved for use in humans and widely used to treat diabetes. Besides helping to lower blood sugar these drugs also reduce blood pressure, however, the mechanism of this effect wasn't well understood.

"This research revealed that these drugs may actually work on the carotid bodies to enact their anti-hypertensive effect. Leading from this work, we are already planning translational

studies in humans to bring this discover into practice so that patients most at risk can receive the best treatment available."

But GLP-1 is just the start. The research has revealed many novel targets for ongoing functional studies that the team anticipate will lead to future translational projects in human hypertensive and diabetic patients.

The study was funded by the British Heart Foundation and the Health Research Council of New Zealand.

Text 10

Case of anthrax in wildlife in the Namib Desert: Infected zebra most likely causes death of three cheetahs

Science Daily (September 27, 2021)
Source: Leibniz Institute for Zoo and Wildlife Research (IZW)

Anthrax is an infectious bacterial disease endemic in some parts of Africa. It affects people, livestock as well as wildlife. Using GPS telemetry data, a team of scientists from the Cheetah Research Project of the Leibniz Institute for Zoo and Wildlife Research (Leibniz-IZW) reconstructed a special case of anthrax infection in Namibia: Three free-ranging cheetahs in the Namib Desert died within 24 hours after feeding on a mountain zebra that tested positive for the disease. The zebra is the first described case of a wild animal infected with anthrax in this arid region. The case also shows that there might be previously unknown risks to cheetah populations in the desert. It is described in detail in the scientific journal Frontiers in Veterinary Science.

Since 2015, scientists of the Leibniz-IZW Cheetah Research Project (CRP) conduct a National Cheetah Survey together with the Namibian Ministry of Environment, Forestry and Tourism (MEFT). The purpose is to obtain data on cheetah density and distribution across the country. Within this framework, a coalition of three cheetah males was captured in the Namib Desert and one animal equipped with a GPS collar. The recorded location and movement data were regularly downloaded during

aerial tracking flights. On one of these flights, on October 5th 2019, the carcass of a collared cheetah - one of the members of the coalition - was located from the aircraft. During the following ground inspection, the other two cheetahs were also found dead. "The GPS data of the collared cheetah revealed that they died within a time window of six hours a few days before we found them," says Ruben Portas, CRP scientist. "Evaluating their most recent movements, we identified a cluster of GPS locations approximately two kilometres away from the location where they were found dead." At this spot the cheetahs spent 20 hours on the day before their death. When visiting this cluster, Portas found the carcass of an adult mountain zebra. The GPS and activity data from the collar suggested that the cheetahs fed on it. *Bacillus anthracis*, the cause of Anthrax infections, was isolated from buccal and nasal swabs collected from the dead zebra, making it the first confirmed anthrax infection in a wildlife species in the Namib Desert.

Carnivores are typically less susceptible to anthrax than herbivores. Cheetahs in particular have a high constitutive innate immunity which provides them with a rapid first line of defence against pathogens such as *Bacillus anthracis*. "However, when a high load of bacteria is ingested, for example with meat from a contaminated carcass, their potent constitutive innate immunity might be overloaded," explains CRP project head Bettina Wachter. "Cheetahs scavenge only rarely, which reduces their exposure to anthrax infected prey. As a result, they do not produce high antibody titres, which would be another line of defence. Thus, cheetahs die quickly when infected, as studies in Etosha National Park in northern Namibia have shown."

The pathogen was not detected in any of the three cheetahs found in the Namib, but the scientists consider it very likely that anthrax was the direct cause of their death. Bacterial cultures from highly susceptible animals that quickly die are often anthrax negative, because the animals might die already at a low presence of bacteria in the blood or from a high load of toxin released by *Bacillus anthracis* when destroyed by the immune system.

Additionally, the vegetative form of the pathogen only develops when exposed to air quickly after the death of the host. The cheetahs were untouched for 11 days after their death and their bodies were not opened by scavengers, which might also explain the negative results of the lab tests for anthrax.

Anthrax is an unstudied disease in arid habitats. When wildlife dies in the Namib Desert, causes are often attributed to drought, hunger and the challenging desert conditions. "The few reported cases in which diseases such as anthrax were tested in the arid environments of Namibia are when livestock or people were directly affected," says Portas. "We do not know the prevalence of anthrax in the Namib desert and how wildlife populations are affected by the disease. For other habitats, such as the Etosha National Park, there is a large body of research showing that anthrax has a key ecological role in the environment."

This first confirmed case of anthrax in the Namib Desert in wildlife demonstrates that the disease might by endemic in the desert and other arid environments. Most of the Namib Desert is included in protected areas where cheetahs and other species find an important refuge from conflict with humans. Thus, this new knowledge may be important for assessing risks to the species. "Although few data are available, no other disease has shown such an impact on the cheetah population and certainly requires further research that may lead to appropriate conservation measures," Wachter concludes. "This study shows that data recorded by GPS collars have the potential to disclose additional important information in addition to spatial movement information."

Text 11

New treatment for people with asthma, food allergies?
Science Daily (February 22, 2022)
Source: Indiana University School of Medicine

Researchers at Indiana University School of Medicine Department of Microbiology and Immunology have made an important new discovery about how a particular molecule could improve lung function for people with asthma and food allergies.

"Millions of children and adults in the United States have asthma, which results from allergen-induced inflammation in the lungs," said Mark Kaplan, PhD, chair of the Department of Microbiology and Immunology and the senior author of the study. "The ability of cells to communicate with each other is critical in the development of inflammation and occurs through the release of molecules called cytokines.

One of these cytokines, interleukin-9 (IL-9), has been found in patients with asthma and food allergy, but how IL-9 promotes inflammation has been unclear. In the study published recently in *Science Immunology*, researchers define one of the cell types, called the lung macrophage, as a major target of IL-9.

They found allergic lung inflammation decreased when the receptor for IL-9 was missing and the macrophage is critical for IL-9 function in the allergic lung. They also defined downstream effectors of IL-9 in the macrophage, identifying enzymes and additional cytokines that are required for the development of allergic inflammation, and found a correlation between IL-9 and the downstream effectors with the diagnosis of asthma in patients.

"This work is a significant advancement in our study of allergic lung inflammation," Kaplan said. "We can use this information to further study the macrophage populations and determine how it could be a potential therapeutic approach for treatment of asthma and other types of lung inflammation."

The study was led by Yongyao Fu, PhD, MS, a former graduate student and now an adjunct assistant scientist in microbiology and immunology at IU School of Medicine and a scientist at Genentech in California. Read the full publication in Science Immunology.

Text 12

Tuberculosis induces premature cellular aging
Science Daily (March 24, 2022)
Source: Baylor College of Medicine

Tuberculosis (TB) is a potentially serious infectious disease caused by a type of bacterium called *Mycobacterium tuberculosis*. The bacteria usually affect the lungs, but also can invade other organs.

In 2018, tuberculosis bacteria infected 1.7 billion people - roughly 23 % of the world's population, according to the Centers for Disease Control and Prevention (CDC). In 2020, the CDC reported 7,174 TB cases and 13 million people living with a latent tuberculosis infection (the germs are in the body but do not cause sickness) in the United States.

Even after successful therapy for tuberculosis, survivors of the disease have an increased risk of recurrent infection and death. A new study published recently by researchers at Baylor College of Medicine found that the cells of humans and animals who have recovered from tuberculosis had prematurely aged up to 12 to 14 years.

"It's possible that this premature cellular aging is one reason why survivors of tuberculosis have a high risk of mortality," said Dr. Andrew DiNardo, assistant professor of infectious diseases at Baylor College of Medicine and senior author of the paper.

To measure the aging of the cells, researchers looked at the epigenetic clock of the cells. Epigenetics looks at how the DNA inside every cell is coiled. As we age, how the DNA is

coiled changes, and severe infection is changing it in such a way to increase premature aging.

In this study, the researchers studied multiple cohorts and multiple tissue types, and discovered that tuberculosis induced perturbations in epigenetic regulation, specifically in the regulation mediated by DNA methylation. These changes correlated with oxidative stress-induced senescence and was associated with premature cellular aging. These processes were conserved across both guinea pigs and humans.

DiNardo, who also is with Texas Children's Hospital, says that this is an important area to look into after any severe infection, including sepsis or even SARS-CoV-2. The severity of the infection also could play a role in the aging of the cells.

"A multi-omic epigenetic clock assay could become part of the standard of care for infectious diseases and further inform increased risk for comorbidities after chronic conditions or environmental exposure," said Dr. Cristian Coarfa, associate professor of molecular and cellular biology at Baylor and co-corresponding author of the paper. Coarfa also is with the Dan L Duncan Comprehensive Cancer Center at Baylor.

A multi-omic approach would integrate epigenomics and other 'omics,' such as proteomics (proteins produced), metabolomics (metabolites present) and microbiomics (microorganisms) data.

"Now that we know the mechanism, there are some ways that we can target it to slow down and decrease the premature epigenetic aging that is happening in these cells," Coarfa said.

Their report appears in the journal *Aging*.

Texts for analytical, reading and rendering

1. Enzyme Engineering for In Situ Immobilization

Enzymes are used as biocatalysts in a vast range of industrial applications. Natural enzymes catalyze reactions under mild conditions (e.g., low temperature, atmospheric pressure, and neutral pH). Immobilization of enzymes their applicability by strongly improving properties such as stability in changing environments, re-usability and applicability in continuous biocatalytic processes. There are different immobilization in vitro and in situ strategies.

In vitro enzyme immobilization strategies are chemical/enzymatic cross-linking, adsorbtion, and entrapment/entrapment. Chemical and enzymatic Cross-Linking is often needed for enzyme immobilization in order to avoid leaching of soluble enzyme under various process conditions. Active esters, epoxides, glutaraldehyde, and some enzymes that catalyze peptide bond formation such as transglutaminases are used as cross-linkers. Non-covalent binding of a given biocatalyst to a carrier can be achieved by physical adsorption. It is frequently reversible causing leaching of the respective biocatalyst. Hydrophobic enzymes, such as lipases, can be readily adsorbed onto hydrophobic carriers. Ionic interaction of enzyme and carrier follows the principle of ion exchange chromatography. A specific adsorption approach is realized by affinity binding which harnesses the specific interaction between complementary biomolecules. Another means of non-covalent immobilization is encapsulation/entrapment where polymers such as alginates self-assemble into spheres in the presence of soluble enzymes. This immobilization approach differs by not using prefabricated support materials, instead assembling the carrier in the presence of the soluble biocatalyst. Materials are required to assemble into supramolecular structures such as gels in the presence of the enzyme.

Recombinant production of biocatalysts allows to genetically engineer biocatalyst to improve their enzymatic properties and to enable their targeted site-specific and oriented immobilization to a range of carrier materials. A high proportion of enzyme functionality are retains by increasing conformational stability and ensuring optimized access of substrate to the immobilized enzyme.

In situ immobilization strategies provide a means for one-step production of already immobilized biocatalyst. This is realized by recombinant production of the enzyme of interest engineered to self-assemble into insoluble aggregates. These aggregates could be polyester/lipid inclusions or magnetosomes as well as protein inclusion bodies. There is also the possibility of producing engineered inclusions with binding affinity for biocatalyst co-expressed in the same cell. In contrast to in vitro immobilization strategies, the carrier-free in situ approach avoids the immobilization step after isolation of the biocatalyst.

In situ immobilization strategies are emerging as a cost-effective one-step production alternative of immobilized enzymes. This new approach offers the potential of cost-effective manufacture of biocatalysts, which are produced as already immobilized. The immobilized and insoluble nature of the produced biocatalyst also facilitates downstream processing, i.e., the efficient recovery of the biocatalysts by such as centrifugation and/or filtration. Further investigations will be needed to demonstrate the implementation and applicability of the various biocatalysts immobilized using in situ immobilization strategies.

2. Molecular engineering of industrial enzymes: recent advances and future prospects

Various enzymes are currently widely used in many industries. Microorganisms have become prominent sources of enzymes owing to advantages such as easy culture, wide sourcing, and diversity. The use of natural enzymes as biocatalysts has limitations such as low catalytic efficiency, low activity, and low stability, especially under industrial conditions. Molecular engineering can improve catalytic performance by changing the structure of certain proteins. Commonly used engineering strategies include directed evolution, site-directed mutagenesis, saturation mutagenesis, terminal fusion, and truncation.

Directed evolution is a powerful technique that is widely used as the most practical and efficient means of modifying enzymes to improve catalytic performance. This method combines random mutagenesis via error-prone polymerase chain reaction, DNA shuffling, staggered extension process, and appropriate high through put screening or selection methods to mimic natural evolution.

The strategy has yielded mutants exhibiting desirable properties such as enhanced enzymatic activity, improved environmental durability, and even novel catalytic activities distinct from those of the parent enzymes.

Site-directed mutagenesis is an invaluable tool to study the structural and functional properties of a protein. Site-directed mutagenesis is based on analyses of the structure, function, catalytic mechanism, and catalytic residues of enzymes. Structural analysis using bioinformatics methods is important for site-directed mutagenesis, which includes single and combinational mutation. To expedite and simplify methods for mutagenesis, single site-directed mutagenesis and multiple mutations are recommended.

Site-directed saturation mutagenesis is a unique method for rapid laboratory evolution of proteins whereby each amino acid of a protein is replaced with each of the other 19 naturally

occurring amino acids. Saturation mutagenesis is performed at "hotspots" of enzymes, and variants with single amino acid changes show improved thermostability or catalytic efficiency.

Random or directed truncation has been used to improve the expression or change the properties of enzymes, because some domains of enzyme proteins are unnecessary for enzyme activity. Truncation includes site-directed truncation, through which truncated enzymes can be directly obtained, and random truncation, through which a truncation library is obtained and the mutants with optimum properties are screened.

The construction of new "chimeric enzymes" with improved catalytic quality has become a novel and effective method for engineering enzymes. Most chimeric enzymes are constructed by fusing the catalytic domain and substrate binding domain from different enzymes. In addition, other genes or oligopeptides with effects on functional and structural characteristics can be used to construct new chimeric enzymes with multiple activities and high stability.

To select an engineering strategy for a given protein if the structure information is unknown, we can use directed evolution, terminal fusion, or truncation. If the structural information has been known from experimental data or can be obtained from homology modeling, site-directed mutagenesis can be applied directly to improve catalytic properties based on the analysis of three dimensional structure and catalytic mechanism.

3. A roadmap to directed enzyme evolution and screening systems for biotechnological applications

Directed enzyme evolution represents a highly versatile approach for tailoring enzyme properties to the needs in industrial applications through iterative cycles of gene diversity generation and high throughput screening, providing, in addition, valuable insights in structure-function relationships in recently isolated and less studied enzymes. A classic directed evolution experiment comprises three main iterative steps: Design and construction of a mutant library from a parent gene, screening to identify improved variants out of a large mutant pool, and isolating the genes encoding for improved variants.

Enzymes can be evolved towards improving an existing activity, conversion of novel substrates or performing novel reactions under non-natural conditions. A suitable combination of activity and stability of the selected parent is a main parameter to judge on an appropriate starting point for a directed evolution campaign.

Genetic diversity is generated by introducing random mutations in the parent gene in a single event over multiple rounds, yielding a population of mutant variants that can be screened for a desired trait. Methods to generate mutant libraries range from codon focused to random unbiased mutagenesis, and every approach has advantages and drawbacks. A straightforward brute-force random mutagenesis approach would consist in generating a mutant library covering the whole diversity available within the protein sequence space of the target protein, and subsequent screening for improved variants. In the case of localized enzyme properties, such as substrate binding, a focused mutant library approach can be performed; when a 3-dimensional model or a crystal structure of the enzyme is available.

There are, however, enzyme properties which are not understood, such as solvent related properties (solubility, co-

solvent resistance), salt and surfactant effects, allosteric inhibition and temperature activity and stability, where focused libraries cannot be applied. Random mutagenesis libraries offer the possibility to improve enzymes in virtually any property that can be reflected in a screening assay, offering in addition to improved variants, novel structure-function relationship data for the target enzyme. They are commonly generated using PCR - based methods differing mainly in how they tackle the mutational bias of DNA polymerases, the organization of the genetic code, and the limitation of single nucleotide exchanges.

All abovementioned challenges are conveniently integrated in the genetic code most likely as a protection mechanism of the biological system to hamper the accumulation of mutations and drastic protein modifications.

A reliable enzyme production system is a pre-requisite for a suitable high throughput screening system. Although enzymes are isolated from numerous organisms, directed evolution is performed only in a few different host organisms with *Escherichia coli, Bacillus subtilis* and *Saccharomyces cerevisiae* being the standard hosts, based on their high transformation efficiencies and well established genetic manipulation tools. Important is that enzyme production is sufficient for activity and is homogenous across the host population, which can be statistically assessed by measuring enzymatic activity from multiple initial cultures of the selected host.

High throughput assay development usually deals with a balance between substrate selection, assay complexity, and detection limits. Protein engineers are often presented with the challenge of not being able to use the “real” substrate due to availability, economic or complexity reasons.

The ultimate challenge in protein engineering is to understand and to predict protein behavior. A main conceptual challenge of directed enzyme evolution is to predict and relate enzyme evolutive behavior in the laboratory with that of natural evolution. Laboratory evolution allows to study and modify

enzymes as an isolated entity in the context of the selected pressure to which is subjected during the screening campaign. On the other hand, natural evolution the selection pressure is multifactorial, occurs over an extended period of time, and those selection pressures are variable across different evolutionary periods. Considering that starting points for directed evolution are natural enzymes, there is always an uncertainty on how the neutral mutations will translate when a unique evolutionary pressure is applied to the enzyme.

Reducing the timescale of a directed evolution campaign is the main challenge for studying the evolutionary behavior of enzymes. Reducing the time required for a directed evolution round requires overcoming two major bottlenecks: 1) the growth rate of the host organism, which affects transformation, pre-culture and protein production timescales, and 2) the library screening throughput.

Directed evolution is nowadays a general and often validated approach to generate tailored enzymes for specific applications providing additionally valuable information regarding how enzymes adapt and hints in how selection under simple evolutionary pressure can be extrapolated to natural evolution. The future of directed enzyme evolution as a research field seems quite promising; the increasing demand of engineered enzymes, especially for industrial applications, will continue to fuel research and development of faster, better, more efficient mutagenesis and screening methods for tailoring biocatalysts. Due to rapid advances in diversity generation and screening technologies, it is not difficult to envision a near future in which protein engineering – and especially directed protein evolution – shares a primary role in developing biocatalysts for industrial and end-user processes, leading the way in understanding of protein adaptation and evolutionary behavior.

4. The promises and challenges of fusion constructs in protein biochemistry and enzymology

Optimization of the biochemical characteristics of target enzymes and other functional proteins is imperative to achieve wide biotechnological application. The various technologies developed to improve protein activity and stability primarily involve fusion of large protein fragments and oligopeptides. If target proteins and protein partners have known structures from homology modeling or experiment data, fusion can be optimized by computer simulation and molecular dynamics. But for proteins with unknown structures, optimal fusion can be screened and obtained by high-throughput technology. Fusion proteins are expressed in the recombinant hosts, and then their properties are determined and analyzed.

The fusion of proteins has a wide range of applications in several areas, including biodetection, molecular biology, and in the paper, textile, food, and biopharmaceutical industries. Protein fusion has become an important strategy in the biopharmaceutical industry.

Most chimeric proteins are constructed by fusing proteins or protein domains to generate various domains. Fusion with different protein fragments allows the properties of a target protein to be modified when fusion proteins were expressed in recombinant hosts.

Well-established fusion tags in classical and modern protein biochemistry include protein fragments and peptides. The parameters of enzymes or functional proteins optimized by fusion constructs primarily include catalytic efficiency, stability, activity, expression and secretion, solubility, immobilization, and crystal quality.

Fusion can increase the catalytic efficiency by changing tertiary and/or quaternary structure or conformational of enzymes. Peptides or protein fragments fused to the N or C terminus can enhance thermostability and stable pH range of target enzymes. Further, fusion constructs can improve enzyme activity through

interactions between N or C termini of enzymes and peptides or protein fragments. Several fusion fragments (e.g., MBP) can improve expression and secretion levels of heterologous recombinant proteins. Fusion with proteins (e.g., fluorescent protein) or peptides may improve the solubility of target proteins insolubly expressed in the recombinant host. Moreover, fusion to N and C termini of target proteins has been used to immobilize proteins. The fusion of interacting proteins and heterologous fusion-protein approaches can also improve crystal quality and molecular structure determination. With an increasing number and availability of new fusion tag options, protein fusion is a promising approach to improve the functionality of enzymes and other proteins.

However, most current fusion designs are uncertain, intuitive, and empirical because the relationship between structure and function is not clear. In the future, a versatile and well-defined fusion protein should be constructed based on precise computational design and knowledge of high-throughput technology.

5. Topical and transdermal absorption enhancers

It is generally accepted that the bioavailability of most topically applied drugs remains low. Various methods to increase this bioavailability have been used. One of the approaches is the use of absorption enhancers, and over the years, there has been a great interest in new chemical absorption enhancers. An absorption enhancer should be pharmacologically inert, non-toxic, have a rapid and reversible onset of action, be chemically and physically compatible with other formulation compounds, and be cosmetically acceptable. Of course not all absorption enhancers possess all of these characteristics, and a benefit–to–risk evaluation will determine the choice of a molecule as an absorption enhancer. The range of absorption enhancers that has been researched is large. Thus, overview of the most researched compounds is presented.

Alcohols and Polyols

Some solvents are able to remove lipids from the stratum corneum, and several topical preparations (e.g., gels) and transdermal reservoir systems contain high concentrations of ethanol capable of modifying the lipid content of the skin. Solvents, such as ethanol, but also others such as propylene glycol, N-methylpyrrolidone, and Transcutol TM, might also increase the drug flux through the skin by increasing the solubility of the permeant in the skin. It has also been suggested that the activity of propylene glycol results from solvatation of a-keratin within the stratumcorneum, hereby promoting permeation by reducing drug-tissue binding.

Amines and Amides

Some excipients might intercalate into the structure of lipids of the skin and disrupt the ordered packing making so the structure more fluid and influencing positively the diffusion coefficient. Azone and its analogues have been widely studied in that respect, and it has been shown that the hydrogen bonding between the polar head group in Azone probably interacts with the skin ceramides. Godwin et al. compared the penetration-enhancing ability of a wide range of pyrrolidone compounds, including those with different chain lengths and functional groups. Using hydrocortisone as a model drug, these authors suggested that N-dodecyl-2-pyrrolidone and its acetate analogue were the two most effective penetration enhancers using in vitro hairless mouse skin model. Several studies dealed also with the mechanism of action of Azone and its analogues. Compounds with short alkyl chains, such as N-methylpyrrolidone, seemed to have no effect on the phase transition temperature and probably work through its action of solvency rather than through a structural change of the skin barrier function. Using multilamilar DDPE liposomes, Hadgraft et al. showed that their phase transition temperature was lowered by the Azone and its analogues in the same rank order

as their enhancing abilities. This indicates that the modifier activity might be related to the fluidising effect on the lipid lamellae.

Studies involving the structure activity relationship of several groups of enhancers showed that the presence of a cyclic structure in the molecule plays an important role in the activity determination of the enhancers. In addition, the greatest barrier disruption activity was recorded for compounds with long alkyl chains between C8–C16. Unfortunately, these molecules show also irritating potentials. Recently, Hadgraft described some new molecules with similar structures but with low irritance potential.

Urea promotes transdermal permeation by facilitating hydration of the stratum corneum and the formation of hydrophilic channels.

Fatty Acids

The perturbation of the intercellular lipid bilayers in the stratum corneum seems to be the most important reason for the enhancing activity of fatty acids such as oleic acid. Oleic acid has been described to decrease the phase transition temperatures of the skin lipids with a resultant increase in motational freedom—or fluidity—of these lipids.

Terpenes

Mono- and sesquiterpenes are known to increase percutaneous resorption by increasing the diffusion in the stratum corneum and/or disruption of the intercellular lipid barrier. It has been shown that there is a major difference between different types of terpenes: e.g., it was shown that d-limonene did not disrupt the intercellular bilayers, whereas 1-8-cineole seemed lipid disruptive at physiological temperatures.

Menthol also has been described as a potential penetration enhancer due to its preferential distribution into the intercellular spaces of the stratum corneum and its possible reversible disruption of the intercellular lipid domain.

Esters

A typical example of an ester acting as a penetration enhancer is isopropyl myristate. Isopropyl myristate might show a double action: influence on the partition between vehicles and skin by solubilization and disruption of lipid packing, thus increasing the lipid fluidity.[14, 15]

Sulfoxides

Dimethylsulfoxide (DMSO) has been found to be a potent enhancer, but unfortunately high concentrations which produce irreversible skin damage, erythema, and wheals, are required to obtain a desired effect. Recently, novel molecules were produced by modifying DMSO, by replacing the oxygen atom with a nitrogen atom that was substituted with an arylsulfonyl, aroyl, or aryl group. The S, S,-dimethyl-N- (4-bromobenzoyl)iminosulfurane produced the highest activity. But these compounds require more activity and toxicity studies, especially in less permeable models such as the human skin.

Cyclodextrins

Cyclodextrins can form inclusion compounds with an increase in solubility of lipophilic compounds, but they seemed less effective alone than in combination with fatty acids and propyleneglycol.

Surface Active Agents

The effect of surface active agents on the skin barrier function depends on the agent's chemical structure.

In general, anionic surfactants tend to be more effective than cationic ones, whereas non-ionic surfactants are considerably less effective. Most anionic surfactants can induce swelling of the stratum corneum, as well as uncoiling and stretching of a-keratin helices, thereby opening up the protein controlled polar pathways.

The impact of anionic surfactants is a function of the alkyl chain length of the molecule. A maximum was observed for surfactants having a linear alkyl chain of 12 carbon atoms (e.g., sodiumlauryl sulphate). Unfortunately, anionic surfactants are reported to be irritative.

Non-ionic surfactants might increase the membrane fluidity of the intercellular regions of the stratum corneum (e.g., Brij) and may extract lipid components and additionally, though of minor importance, they might interfere with keratin filaments and create a disorder within the corneocytes.[19] It should be emphasized that surfactant form micelles which, if used above their CMC, might negatively influence the drug bioavailability.

Other Enhancers

Other potential penetration enhancers have also been described, such as N-acetylprolineesters[20] and glyceryl monocaprylate/caprate.

It should be emphasized that the activity of any enhancer should be evaluated in terms of function of the vehicle used and that the selection of the combination enhancer-vehicle is a function of the final therapeutic objectives.

6. Basic Concepts and Definitions of Chromatographic Methods of Analysis (High Performance Liquid Chromatography)

In HPLC for separation of individual components, the sample is introduced into a flowing stream of a liquid (mobile phase) and the analytes are allowed to pass through a layer column of packing materials of very small diameters (large surface area), called the stationary phase. As the analyte molecules pass through the column, carried by the moving mobile phase, there is constant interaction of the analyte molecules (or solutes) with the stationary phases as well as with the moving mobile phase. This results in a dynamic equilibrium. The differences in the equilibrium processes of the different solute molecules result in the separation of components of the mixture. When such separation is achieved by maintaining a constant composition of all the constituents of the mobile phase, the process is known as isocratic elution.

If the mobile phase composition is changed continuously with respect to one or more of the solvents in the mobile phase, as a function of time, it is called gradient elution. When the effluent with mobile phase zones containing the analyte molecules emerges out of the column, it is passed through a detector, or a series of detectors. The detector signals respond as function of the solute concentration in the mobile phase zones.

These signals are fed into data processors, which plot signal responses as a function of time. The graphic display of signals is called a chromatogram and the individual component zones are identified as chromatographic peaks. These peaks are characterized by the following parameters: their peak widths, peak areas or peak heights, and the extent of tailing and the retention time of the peaks. The instrumental set up is called a chromatograph.

In HPLC solute molecules are introduced into a moving mobile phase stream. The stream passes through an inlet and emerges through the outlet of the column. Since the particles are extremely small in size (10 mm or less) and the column is fully

packed, the moving mobile phase has to be pumped through using high pressure pumps. The solute molecules are only carried by the moving mobile phase. Molecules that interact with the surface of the column will be impeded and the emerging band will elute later than a band of weakly interacting molecules.

The relative migration of the solute is dependent on the thermodynamic and kinetic properties of the solute. The extent and quality of separation of two closely eluting peaks are expressed by retention (or capacity) factor (k0), selectivity factor (a), and the number of theoretical plats (N). Capacity factor is a measure of time that the solute molecules are attached to the column particles, in comparison to that of the mobile phase. Thus greater the value of k0, the greater is the interaction with the column particles. The capacity factor is dependent on the nature of the column, the organic or aqueous strength of the mobile phase, and the temperature at which the column is maintained.

Experimentally measurable parameter of relative retention time with respect to the retention time of an active drug is computed. Under isocratic elution conditions, a value of 2–6 for capacity factor is optimal and normally values between 1 and 10 are acceptable.

Greater the value of k0, greater is the resolution between adjoining bands. However, as k0 increases, there is increase in analysis time, which also results in lower detection limit, because of peak broadening. By using gradient elution these two disadvantages of isocratic elution can be overcome.

The chromatographic separation process is considered efficient if all the components are completely separated and the peak width is relatively narrow. Theoretically, when identical molecules enter the column head in a narrow band, the band width should be the same at the outlet.

However, since solute molecules can elute at slightly different times because not all molecules will take the same path. These differences are caused by differences in the local surface area, relative physical activity of the interacting surface,

the presence of stagnant mobile phase pools in crevices and pores, and minor variations of flow rate of mobile phases through these surfaces. Not all solute molecules traverse the same path and hence they might contribute to peak broadening.

Additionally, the quality of separation is evaluated by measurement of resolution, ‘‘R,’’ between two closely eluting peaks.

$$R = 2\,(t_2 - t_1) / (w_1 + w_2)$$

where w1 and w2 are peak widths expressed in the same units as retention times, t1 and t2.

The greater the value of R, greater is the separation.

For an R value of 1.00, solute purity is about 97.7 % if each peak is Gaussian. In practice to attain a peak purity of 99.8 % or greater a resolution of 1.50 is required.

The efficiency of separation, expressed as theoretical plate number, N, is calculated as follows:

$$N = 16\,(t_r / w_B)^2 = 5.54\,(t_r / w_{t/2})$$

where ‘‘tr’’ is the retention time, wB, is the peak width at the base, and ‘‘w’’ is the band width at the peak height. A column independent parameter, H [heightequivalent to Theoretical Plate, (HETP) ¼ L/N, where L is the length of the column], is more often used.

Column efficiency is inversely proportional to the particle size of the column packing. Thus the efficiency of separation will follow the following order.

$$E_{3\mu} > E_{5\mu} > E_{10\mu}$$

where E is efficiency and the subscripts denote particle size.

HPLC techniques can be used for preparative chemical separations. However, this discussion will be restricted to quantitative analytical separations. For quantitative analysis a known volume of a standard solution of known concentration is injected multiple times (most compendial methods require typically five to six injections). The average peak area of the peak of interest is computed. From a comparison of the peak area of similarly injected and separated analyte with that of the standard, the concentration of the unknown in the analyte is calculated. This procedure is known as external calibration. However, sometimes a known compound is added to both the standard and the analyte sample. Then the ratio of the relative peak area (or some times peak height) responses of the peak of interest, and that of the added compound are evaluated.

From a comparison of the relative responses of the standard and that of the analyte injections, the concentration of the unknown is computed. This is known as internal calibration. Sometimes, peak height is used instead of peak area. The theoretical plates, resolution of two closely eluting peaks, percent relative standard deviation values of multiple injections, and tailing factor (extent of deviation of the chromatographic peak shape from symmetrical Guassian peak) are used as system suitability parameters. USP 24 (see Bibliography), and other monographs provide examples of system suitability requirements and methods of measurement to meet the corresponding requirements.

7. Mechanical products for plaque control

Good control of plaque is accomplished by mechanical procedures, which include brushing, flossing, and professional prophylaxis. A professional cleaning is recommended at least twice a year to remove plaque and tartar (calculus), both supragingivally and subgingivally.

This article is devoted to toothpastes. The majority of toothpastes advertised as specially formulated to control plaque contain (in addition to fluoride) a foaming agent and a mild abrasive, both of which facilitate plaque removal. However, the only toothpaste accepted by the ADA as possessing an active ingredient with proven ability to prevent or control plaque formation and reduce gingivitis is Colgate Total, with Triclosan as the active ingredient. Toothpastes claiming to be effective against plaque are simply more effective than brushing without any toothpaste because the use of toothpaste motivates people to brush longer and more thoroughly. In fact, it is mainly the mechanical action of brushing that removes plaque.

Toothpastes are effective as vehicles to deliver fluoride and Triclosan to the tooth surface, and although fluoride may have some effect against plaque bacteria and their enzymes, its major effect is to make the tooth surface more resistant to destruction by plaque bacteria.

With the exception of Colgate Total, other toothpastes are accepted by the ADA for their fluoride content and effectiveness against tooth decay but not for their plaque–and gingivitis-reducing properties.

8. Intrinsic Dissolution Rate

The intrinsic dissolution rate (IDR) of a pure substance is the rate at which it dissolves from a constant surface area whilst the temperature, agitation, pH, and ionic strength of the dissolution medium are kept constant.

Thus, for a drug substance, the IDR is independent of formulation factors and measures the inherent solubility of the drug in the dissolution medium. Thus, IDR determinations can be used to characterize bulk drug substances and excipients and to test the chemical equivalence of active pharmaceutical ingredients synthesized by different processes. They can also provide an important insight into the dissolution behavior of a drug in physiological conditions or distinguish whether changes in the dissolution profile of a drug product in various biorelevant media are due to interactions between the medium and formulation excipients or medium and drug substance or both. Subsequently, this test has a place in the screening process of drug candidates for further development. Yu et al. have discussed the feasibility of using IDR as opposed to saturation solubility data to place drugs in a Biopharmaceutics Classification System.
(BCS) class as in vivo drug dissolution is a dynamic rate controlled process rather than an equilibrium process.

The IDR is a key indicator of the potential bioavailability of a candidate drug where an IDR 1.0 mg/ min/cm2 suggests that drug dissolution will not be the rate-limiting step to absorption whilst an IDR - 0.1mg/ min/cm2 suggests that drug dissolution will be the rate limiting step to absorption. An intermediate value suggests that drug dissolution may be the rate-limiting step to absorption.

9. The polymerase chain reaction (PCR) and the detection of microbes

If a dozen copies of a pathogenic DNA virus are present per milliliter or gram in body fluid or beef tissue intended for sale, inoculation of the suspect source material into cell culture or in a test animal for analytical testing is a very lengthy, expensive process. It is unrealistic for use in the food industry or in a hospital, as are many other tests. If we seek particular viruses (e.g., rabies), the most rapid, practical, and effective means of detecting the virions is the PCR.

The general sequence of events in performing PCR is shown in Fig. 4. The primer used is an oligo specific to the organism to be detected. Commencing with the DNA recovered from one or several organisms, the multiplication of genomic material can be 107- to 108- fold in 35–90 min. By comparison, growing the virions in cell culture to equivalent numbers (to allow monoclonal antibody type analyses) usually requires 48 h or more. In cases where life hangs in the balance of an accurate analysis, those hours may be critical. Even with bacterial or fungal pathogens, the time required to generate sufficient genomic material for analysis by PCR is 35–45 min but 24–48 h in conventional culture an appropriate nutrient medium on.

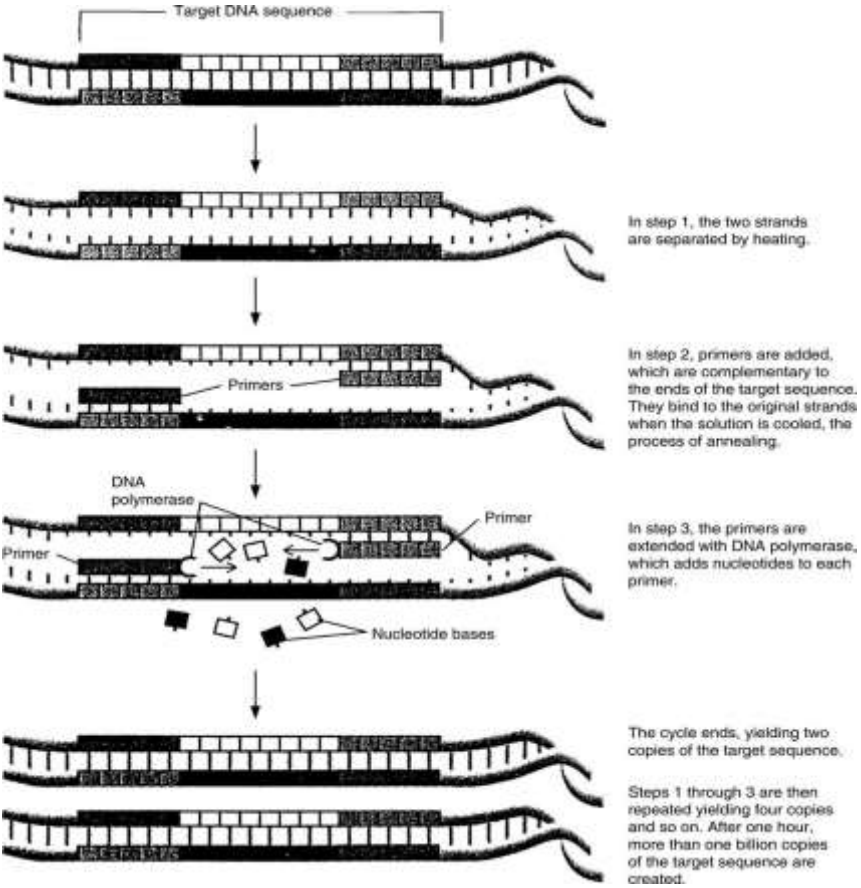


Fig. 4 Sequence of events in the PCR

10. Dosage Form Design: A Physicochemical Approach

Over the past several years, the fraction of new drug products that are new chemical entities has steadily decreased, reflecting the tremendous cost required to bring new chemical entities to the marketplace. Increased understanding of drug metabolic and toxicologic factors, such as the effect of the patient age on drug distribution, the genetic factors that may result in dramatic intersubject variability in metabolism, short-term versus long-term exposure toxicities, and the potential for teratogenic, mutagenic, and embryotoxic effects, has increased the scrutiny under which governmental agencies view the new chemical entity.

This careful inspection is intended to minimize the possibility of toxic reaction(s) and to demonstrate the safety and efficacy of new drug products. The regulatory process has also resulted in significantly more costly and time-consuming testing prior to commercialization.

This increased emphasis on safety has placed an additional burden on those who are involved in the development of new drugs, while increasing financial pressures have led to the need for decreased development time. The investigation of approved drugs has resulted in enhanced patient safety and therapeutic efficacy by directing research efforts toward the more efficacious delivery of known pharmacologically active agents to the appropriate physiologic site. This trend has caused pharmaceutical researchers to seek the most suitable methods to deliver both new and existing compounds in the most pharmacologically appropriate manner. The methods may be designed to optimize bioavailability, minimize toxicity and side effects, and improve stability. The objective of this article is to present approaches that have been employed to improve bioavailability and/or minimize the toxicity and side effects of various drugs.

A rational approach to dosage form design requires a complete understanding of the physicochemical and biopharmaceutical properties of the drug substance.

For example, the successful design of an efficacious oral dosage form requires an understanding of the pathways of physiologic disposition of the drug.

On oral administration of an immediate release dosage form (the most common delivery system), the dosage form must disintegrate, the drug must dissolve in the gastrointestinal (GI) fluids, cross the GI mucosa, enter the mesenteric blood system, and pass through the liver prior to reaching the systemic circulation and the site of action.

The drug may be metabolized by GI fluids, by enzymes in the gut wall, or by hepatic metabolism prior to reaching the systemic circulation. The net result is incomplete bioavailability due to first-pass metabolism (inactivation), and/or metabolic formation of a pharmacologically active species.

The physicochemical and biopharmaceutical properties of the drug can have a tremendous impact on its bioavailability and, hence, on its efficacy and toxicity profile. Thus, understanding these parameters is often tantamount to the selection and development of the optimum dosage form. These properties of the drug are its:

- pH solubility profile and dissolution rate;
- Partition coefficient between lipoidal barriers and aqueous physiologic media;
- Stability and/or degradation rate in the physiologic;
- Fluids;
- Susceptibility to metabolic inactivation;
- Mechanism of transport through biologic membranes.

The aqueous solubility of a drug in the 2–8pH range has a direct influence on its oral and parenteral formulations. A drug with poor solubility (i.e., less than 0.1 mg/ml) in acidic media may show poor and erratic oral bioavailability due to the dependency of absorption processes in GI fluids.

Intravenous dosing requires that the drug be administered in a soluble form. The adjustment of pH, the addition of a cosolvent or a ligand for complexation, or the formation of an emulsion may permit solubilization, but each of these techniques has limitations. Rapid intravenous administration of a solubilized drug can result in rapid dilution in an environment in which the drug is insoluble, resulting in incomplete availability and a delayed response due to the formation of particulate matter within the vascular system.

Poor aqueous solubility is not always a limitation; in fact, it may be a desirable feature for a sustained effect after oral or parenteral administration. Oral sustained release may be achieved if the drug combines poor aqueous solubility with the ability to be adsorbed throughout the GI tract. Parenteral sustained release can be achieved after intramuscular administration of a suspension of a drug with low solubility under physiologic conditions or from a drug that precipitates from an aqueous vehicle or that forms a reservoir or depot from an oil-containing dosage form.

The lipid-aqueous partition coefficient of a drug molecule affects its absorption by passive diffusion.

In general, octanol/pH 7.4 buffer partition coefficients in the 1–2 pH range are sufficient for absorption across lipoidal membranes. However, the absence of a strict relationship between the partition coefficient of a molecule and its ability to be absorbed is due to the complex nature of the absorption process. Absorption across membranes can be affected by several diverse factors that may include the ionic and/or polar characteristics of the drug and/or membrane as well as the site and capacity of carrier-mediated absorption or efflux systems.

Compounds that are intended for oral administration and can undergo rapid degradation at low pH may require protection from the acidic environment of the stomach. Protection can often be afforded by administering the drug in the form of an acid-insoluble chemical species or in a dosage form with an acid resistant coating. The insoluble chemical species must remain

insoluble and unavailable for solution degradation as it passes through the stomach and must dissolve upon reaching the chemically more stable environment of the intestine at a higher pH. To be effective, an acid-resistant coating must remain intact and protect its contents until it reaches the required pH to dissolve the coating and release the contents in the intestine where the drug may be more stable. Metabolic inactivation of a compound following oral administration can occur in the GI lumen, the GI mucosa, or the liver. The site of metabolism and the susceptibility of the metabolic processes to saturation are factors that may influence oral bioavailability.

Occasionally, some of these factors may be altered to optimize oral bioavailability. For example, segment specific metabolic sites within the GI tract may be avoided through the use of pH-dependent coating materials that rely on the local pH environment of the GI tract to release the drug. Absorption from the lower colon and rectum can reduce exposure to the portal circulation and the first-pass inactivation that can occur in the liver and, thus, provide the opportunity to improve systemic availability following oral administration. Enzyme systems may be saturated by the rapid release of the contents of the dosage form at a local site or by co-administration within the dosage form of a competitive inhibitor.

Once the physicochemical and biopharmaceutical properties of the drug are determined and the desired plasma concentration profile is defined, the pharmaceutical scientist can select and develop an efficacious dosage form by utilizing a formulation approach, a prodrug approach, a device approach, or an alternative administration route approach.

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