А.В. Вдовичев
И.В. Баценко

ПЕРЕВОД ЕСТЕСТВЕННОНАУЧНЫХ ТЕКСТОВ

TRANSLATING NATURAL SCIENCE TEXTS

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Рецензенты:
канд. филол. наук, доцент *Н.И. Мосунова* (БГУ);
канд. пед. наук, доцент *Н.П. Грицкевич* (МГЛУ)

Вдовичев А.В.

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Целью настоящего пособия является развитие навыков письменного перевода естественнонаучных текстов. Оно содержит тренировочные упражнения и тексты для устного и письменного перевода.

Для студентов филологических и переводческих факультетов, а также для студентов неязыковых вузов.

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Посвящается памяти
великолепного педагога,
профессионального переводчика,
отзывчивого коллеги
Сталины Адамовны Игнатовой

ПРЕДИСЛОВИЕ

Подготовка специалистов в области перевода предполагает практику по переводу научной литературы. Настоящее пособие предназначено для студентов филологических и переводческих факультетов и имеет своей целью формирование знаний, умений и навыков, необходимых для выполнения письменного перевода естественнонаучных текстов.

Пособие состоит из шести разделов, каждый из которых посвящен отдельной области естественной науки (биологии, генетике, геологии, физике, химии и астрономии) и предназначен для отработки и закрепления практических навыков перевода специальных текстов. Данные разделы имеют одинаковую структуру и включают тексты для перевода, глоссарий терминов, относящихся к определенной области знаний, а также упражнения на закрепление специальной лексики и усвоение грамматических особенностей естественнонаучных текстов.

Поскольку понимание предмета текста является важным предварительным этапом перевода, после каждого текста следуют упражнения, направленные на проверку понимания естественнонаучных терминов, терминологических сочетаний, аббревиатур. Обязательным этапом работы над темой каждого раздела является задание по письменному переводу текста с русского языка на английский.

Пособие подготовлено с учетом требований учебных программ по письменному переводу естественнонаучных и общественно-политических текстов для студентов филологических и переводческих факультетов, но может использоваться в качестве дополнительного пособия или материала для самостоятельной работы в неязыковых учреждениях высшего образования.

UNIT 1. BIOLOGY

Text 1

BIOLOGICAL SCIENCES

The life sciences, as the name implies, study living organisms. They also are known as the biological sciences or biology. Alongside physics and chemistry, biology is one of the largest and most important branches of science. At the highest level, biology is broken down based on the type of organism being studied: zoology, the study of animals; botany, of plants; and microbiology, of microorganisms. Each field of biology has contributed to mankind or the Earth's well-being in numerous ways. Most prominently: botany, to agriculture; zoology, to livestock and protection of ecologies; and microbiology, to the study of disease and ecosystems in general.

Besides classifications based on the category of organism being studied, biology contains many other specialized sub-disciplines, which may focus on just one category of organism or address organisms from different categories. This includes biochemistry, the interface between biology and chemistry; molecular biology, which looks at life on the molecular level; cellular biology, which studies different types of cells and how they work; anatomy, which examines the structure of living things; physiology, which looks at organisms at the level of tissue and organs; ecology, which studies the interactions between organisms themselves; ethology, which studies the behavior of animals, especially complex animals; and genetics, overlapping with molecular biology, which studies the code of life, DNA.

The foundations of modern biology include four components: cell theory, that life is made of fundamental units called cells;

evolution, that life is not deliberately designed but rather evolves incrementally through random mutations and natural selection; gene theory, that tiny molecular sequences of DNA dictate the entire structure of an organism and are passed from parents to offspring; and homeostasis, that each organism's body includes a complex suite of processes designed to preserve its biochemistry from the entropic effects of the external environment.

The basic picture in biology has stayed roughly the same since DNA was first imaged using x-ray crystallography in the 1950s, although there are constant refinements to the details, and life is so complex that it could be centuries or even millennia before we begin to understand it in its entirety. But it should be made clear that we are moving towards complete understanding: life, while complex, consists of a finite amount of complexity that only appreciably increases on relatively long timescales of hundreds of thousands or millions of years. Evolution, while creative, operates slowly.

(from https://en.wikipedia.org)

Text 2

WHAT IS LIFE?

The question seems simple enough. But biologists, although they have a vast knowledge of living things, find that the definition of life isn't always so obvious — sometimes the dividing line between living and nonliving things is quite obscure. For example, a virus is lifeless by itself, because it does not grow, metabolize, or respond to its environment, but it can reproduce once it enters a living cell.

Instead of trying to reach a precise definition of life, scientists focus on the characteristics that seem to distinguish living things. No single characteristic tells us what life is, but together they form a composite that generally sets living things apart from nonliving things. Nearly all living things share the following characteristics:

- Growth. Growth in living things is more than simply an increase in size. Living things are able to produce organic molecules that become part of their structure.
- Metabolism. Living things undergo chemical processes to produce the materials and energy necessary for life.
- Reproduction. Living things are able to produce more of their kind sexually or asexually.
- Movement. Almost every living thing moves, either by moving from place to place or undergoing internal movements such as circulation or the movement of organs.
- Responsiveness. Living things react to their changing environments.
- Adaptation. Most living things are able to adjust to changes in their living conditions. Adaptation helps an organism survive and reproduce in its particular environment.

The two most widely accepted theories of the origin of life are the theory of panspermia and the theory of chemical evolution. *The theory of panspermia* claims that spores — specialized reproductive cells — from some other part of the universe landed on the Earth and began to develop.

The theory of chemical evolution proposes that life developed through a series of chemical reactions in the atmosphere and oceans early in the Earth's history. This theory is more widely accepted today than the theory of panspermia.

In order to understand the theory of chemical evolution, we need some knowledge of the elements of life. The most common elements in living things are carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur. Other elements are present in smaller amounts.

Water, the simplest chemical compound of importance to living things, makes up 50 to 95 percent of most organisms and is an essential part of many life processes. Most chemical reactions within organisms can occur only in a water solution, and water is also a part of many such chemical reactions. In addition, water moves nutrients within organisms.

Most of the principal compounds in living things — except water — contain carbon. Almost all living material consists of about 50 kinds of carbon molecules, plus the macromolecules — large, complex molecules — formed from them. The four main types of macromolecules are carbohydrates, lipids, proteins, and nucleic acids.

Carbohydrates consist of carbon, hydrogen, and oxygen and serve as the principal energy source for most living things. Carbohydrates also provide the basic material from which many other kinds of molecules are made.

Lipids consist primarily of carbon and hydrogen. The best-known lipids are animal fats and vegetable oils, both rich sources of energy. Many kinds of organisms store food in the form of lipids. Other lipids form the basic structure of cell membranes.

Proteins are the most common — and most complex — macromolecules in living things. They are important structural parts of the tissues of cells and of the substances between cells. They are also the most varied — human beings have thousands of different proteins. Proteins in the form of enzymes also play an essential role in the control of chemical reactions in the body. Proteins are made up of one or more long chains called polypeptides, which consist of many small molecules called amino acids. All amino acids contain carbon, hydrogen, nitrogen, and oxygen.

Nucleic acids store and transmit the information necessary for producing proteins. They consist of long chains of smaller molecules called nucleotides, which consist of a nucleic base (adenine, guanine, cytosine, or thymine), a sugar, and a phosphate group. There are two types of nucleic acids: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid). DNA carries the hereditary information that an organism passes on to its offspring — it determines that a cat will produce a cat, not a dog. DNA has a nucleotide consisting of one of the four bases plus deoxyribose, a form of sugar. RNA, serving as a pattern for building proteins, transmits DNA's instructions. RNA consists of a nucleotide that has adenine, guanine, cytosine, or uracyl plus ribose, a more complex form of the sugar contained in DNA.

(from www.faculty.washington.edu)

VOCABULARY

adenine (A) — аденин
autotroph — автотроф, автотрофный организм (организм, рост и размножение которого не зависят от внешних источников органических соединений)
bladder (urinary bladder) — мочевой пузырь
carbohydrates — углеводы
carbon dioxide — углекислота, углекислый газ
cartilage — хрящ
cavity — полость
cell — клетка
cephalic — головной, расположенный около головы, верхний
cervix — шея; шейка (какого-л. органа)
cytosine (C) — цитозин
deoxyribonucleic acid (DNA) — дезоксирибонуклеиновая кислота (ДНК)
ecosystem — экосистема
enzyme — фермент, энзим
fertilization — оплодотворение, опыление, удобрение
gall bladder — желчный пузырь
guanine (G) — гуанин
heterotroph — гетеротроф, гетеротрофный организм (организм, для роста и размножения которого необходимы экзогенные органические вещества)
homeostasis — гомеостаз(ис) (постоянство внутренней среды организма, ее устойчивого равновесия с внешним миром)
lipid(e) — липид
livestock — домашний скот
lymph node — лимфатический узел, лимфоузел
metabolism — метаболизм, обмен веществ
nucleic acid — нуклеиновая кислота
nucleotide — нуклеотид
nutrient — питательное вещество, нутриент
organogenesis — органогенез (формирование органов во время роста)
ovary — *анат.* яичник, *бот.* завязь

pancreas — поджелудочная железа
polypeptide — полипептид
predator — хищник, пожиратель
protein — белок, протеин
puberty — половая зрелость, период полового созревания
reproduction — репродукция, воспроизведение, размножение, воспроизводство, возобновление (растений)
ribonucleic acid (RNA) — рибонуклеиновая кислота (РНК)
spleen — селезенка
thoracic — торакальный, грудной
thymine (T) — тимин
thymus — тимус, вилочковая железа, зобная железа
uterus — (*pl.* -ri) матка
vertebrate body — позвоночное животное
zygote — зигота, оплодотворенная яйцеклетка

Exercise 1. ***Give Russian equivalents for the following terms.***

1) metabolism; 2) nutrient; 3) cell; 4) fertilization; 5) zygote; 6) autotroph; 7) heterotroph; 8) organogenesis; 9) puberty; 10) reproduction; 11) homeostasis; 12) predator; 13) enzyme; 14) protein; 15) carbohydrate.

Exercise 2. ***Give English equivalents for the following terms.***

1) гетеротрофный организм; 2) питательное вещество; 3) клетка; 4) оплодотворение; 5) оплодотворенная яйцеклетка; 6) автотроф; 7) обмен веществ; 8) органогенез; 9) половая зрелость; 10) размножение; 11) гомеостаз(ис); 12) хищник.

Exercise 3. ***Substitute the corresponding terms for the following definitions.***

1) deals with plants; 2) deals with animals; 3) examines the structure of living things; 4) deals with the normal functions of

living things and their parts; 5) studies bacteria; 6) investigates how organisms pass on characteristics to their offspring; 7) focuses on the structure and function of molecules essential to life; 8) studies the origin and development of human cultures and physical characteristics; 9) an organism that is able to form nutritional organic substances from simple inorganic substances such as carbon dioxide; 10) an organism deriving its nutritional requirements from complex organic substances; 11) production and development of the organs of an animal or plant; 12) the period during which adolescents reach sexual maturity and become capable of reproduction; 13) the tendency towards a relatively stable equilibrium between interdependent elements; esp. as maintained by physiological processes; 14) an animal that naturally preys on others.

Exercise 4. ***Translate the terms into Russian and say which of the sciences (biology, physiology, bacteriology, genetics, anatomy, zoology, botany, molecular biology) they belong to.***

Thyroid, cartilage, thymus, adrenal, pituitary, pancreas, pineal gland, ovary, vertebra, thorax, bladder, gall bladder, uterus, allostery, cephalic region, vertebrate body, cavity, thoracic, thymus, lymph nodes, spleen, cervix, small intestine, large intestine, amino acid, enzyme, adrenal, homeostasis, integument, excretory, heterotroph, livestock, DNA, mutation, rodent, anaerobic, genus, meiosis.

Exercise 5. ***Match the organ system with the function it performs. Translate the terms into Russian.***

1) excretory; 2) digestive; 3) cardiovascular; 4) skeletal; 5) muscular; 6) endocrine; 7) respiratory; 8) integumentary; 9) nervous; 10) reproductive (male); 11) reproductive (female); 12) lymphatic.

a) ingests and breaks down food so that it can be absorbed by the body; b) elimination of liquid wastes; regulation of water balance; c) enables gas exchange, supplying blood with oxygen and removing carbon dioxide; d) provides mechanical support for the body; mineral storage; red blood cell production; e) contraction and extension of muscles enables movements, posture, and balance; f) protects body from environment, injury, and infection; fat storage; g) transport of nutrients, gases, hormones, and wastes to and from all the cells of the body; h) secretes hormones into bloodstream for regulation of body activities; i) senses environment, communicates with and activates other parts of the body; j) protects against infection; k) produces eggs, receives sperm from males, and supports the development of offspring; l) produces and delivers sperm.

Exercise 6. ***Translate the terms into English and say to what organ systems they belong.***

mouth, esophagus, stomach, liver, pancreas, gall bladder, small and large intestine; 2) kidney, ureter, bladder, urethra; 3) trachea, bronchi, lung: 4) cartilage, bone; 5) skeletal muscles; 6) hair, nails, skin; 7) blood vessels, heart; 8) pituitary gland, thyroid, thymus; 9) brain, spinal cord, nerves; 10) thymus, lymph nodes, lymphatic vessels, spleen; 11) ovary, uterus, cervix, vagina; 12) prostate, testicle, penis.

Exercise 7. ***Say what the following sciences study.***

1) biology; 2) zoology; 3) microbiology; 4) biochemistry; 5) molecular biology; 6) cellular biology; 7) physiology; 8) ecology; 9) ethology; 10) genetics; 11) botany; 12) anthropology; 13) ornithology;14) ichthyology;15) mycology; 16) protozoology; 17) herpetology; 18) entomology; 19 physical anthropology.

Exercise 8. ***Insert the missing terms.***

Biology is the study of life. At the highest level ... is broken down based on the type of organism being studied: ... , the study of animals; ... , of plants; and ... , of microorganisms. Each field has contributed to mankind or the Earth's well-being in numerous ways. Most prominently: botany, to agriculture; zoology, to livestock and protection of ecologies; and microbiology, to the study of disease and ecosystems in general.

Besides classifications based on the category of organism being studied, biology contains many other specialized sub-disciplines, which may focus on just one category of organism or address organisms from different categories. This includes ... , the interface between biology and chemistry; ... , which looks at life on the molecular level; ... , which studies different types of cells and how they work; ... , which looks at organisms at the level of tissue and organs; ... , which studies the interactions between organisms themselves; ... , which studies the behavior of animals, especially complex animals; and ... , overlapping with molecular biology, which studies the code of life, DNA.

Exercise 9. ***Answer the questions.***

1) Into what sciences is biology subdivided on the basis of the type of organism being studied? 2) What contribution has biology made to mankind and the Earth's well-being? 3) What sub-disciplines does biology contain apart from zoology, botany, and microbiology? 4) What does physiology (ethology) study? 5) What is the subject matter of ecology? 6) What theories lay the foundation of modern biology? 7) What characteristics do nearly all living things share? 8) What are the two most accepted theories of the origin of life? 9) What is the essence of the theories of the origin of life? 10) What are the most common elements in living things? 11) What is the simplest chemical compound of importance to living things? 12) What element do most of the principal compounds in living things contain? 13) What are the four main types of macromolecules? 14) What macromolecules serve as the principal energy source for most living things? 15) What are the best-known lipids? 16) What are the most complex and varied macromolecules in living things? 17) What functions do nucleic acids perform?

Exercise 10. ***Translate into Russian.***

1) Biology literally means "the study of life." Biology is such a broad field, covering the minute workings of chemical machines inside our cells, to broad scale concepts of ecosystems and global climate change.

2) The foundations of modern biology include four components: cell theory; that life is made of fundamental units called cells; evolution, that life is not deliberately designed but rather evolves incrementally through random mutations and natural selection; gene theory, that tiny molecular sequences of DNA dictate the entire structure of an organism and are passed from parents to offspring; and homeostasis, that each organism's body includes a complex suite of processes designed to preserve its biochemistry from the entropic effects of the external environment.

3) Each field of biology has contributed to mankind or the Earth's well-being in numerous ways. Most prominently: botany, to agriculture; zoology, to livestock and protection of ecologies; and microbiology, to the study of disease and ecosystems in general.

4) I do not believe any concept in science has ever given rise to as many controversies and controversial debates as evolution has. But even with so many controversies, nothing in biology makes sense except in the light of evolution. When we think of evolution, the first name to strike even someone who is not from a biological sciences background would be Charles Darwin. Not a word can be written on evolution without mentioning the name of this pioneering evolutionary biologist. His work *On the Origin of Species* has been the topic of much discussion ever since it was first published.

5) Systems biology is a term used to describe a number of trends in bioscience research, and a movement which draws on those trends. Proponents describe systems biology as a biology-based interdisciplinary study field that focuses on complex interactions in biological systems, claiming that it uses a new perspective (holism instead of reduction). Particularly from year 2000 onwards, the term is used widely in the biosciences, and in a variety of contexts.

An often stated ambition of systems biology is the modeling and discovery of emergent properties, properties of a system whose theoretical description is only possible using techniques which fall under the remit of systems biology. These typically involve cell signaling networks, via long range allostery.

6) Animal organs are usually composed of more than one cell type. Recall that the stomach contains all four animal tissue types: epithelium to line the stomach and secrete gastric juices; connective tissues to give the stomach flexibility to expand after a large meal; smooth muscle tissues to churn and digest that meal without the need for conscious thought (indeed, we are aware of that action only when we burp or suffer some sort of gastric distress!); and nervous tissues to monitor the progress of food as it is worked on by the stomach, and to direct secretion and muscle activity. Each organ typically performs a given function set. The stomach is an organ composed of tissues that aid in the mechanical and chemical breakdown of food. Most organs have functions in only one organ system. The stomach is involved only in the digestion of food as part of the digestive system. Organ systems, such as the digestive system, are collections of organs that perform a major function for the organism.

7) Homeostasis is the maintenance of a dynamic range of conditions within which the organism can function. Temperature, pH, and energy are major components of this concept. Thermodynamics is a field of study that covers the laws governing energy transfers, and thus the basis for life on Earth. Two major laws are known: the conservation of matter, and entropy. The universe is composed of two things: matter (atoms, etc.) and energy.

8) Homeostasis is the maintenance of a stable internal environment. Homeostasis is a term coined in 1959 to describe the physical and chemical parameters that an organism must maintain to allow proper functioning of its component cells, tissues, organs, and organ systems. Enzymes function best when within a certain range of temperature and pH, and cells must strive to maintain a balance between having too much or too little water in relation to

their external environment. Both situations demonstrate homeostasis. Just as we have a certain temperature range (or comfort zone), so our body has a range of environmental (internal as well as external) parameters within which it works best. Multicellular organisms accomplish this by having organs and organ systems that coordinate their homeostasis. In addition to the other functions that life must perform, unicellular creatures must accomplish their homeostasis within but a single cell!

9) Eleven major organ systems are present within animals, although some animals lack one or more of them. The vertebrate body has two cavities: the thoracic, which contains the heart and lungs; and the abdominal, which contains digestive organs. The head, or cephalic region, contains four of the five senses as well as a brain encased in the bony skull.

10) Eleven major organ systems are: the integumentary, skeletal, muscular, digestive, respiratory, circulatory or cardiovascular, lymphatic, nervous, endocrine, excretory, and reproductive systems.

Exercise 11. ***Translate into English.***

1) Биология — наука о жизни (живой природе), одна из естественных наук, предметом которой являются живые существа и их взаимодействие с окружающей средой.

2) Биология — это комплекс знаний о жизни и совокупность научных дисциплин, изучающих живое.

3) Биология исследует многообразие существующих и вымерших живых существ, их строение, функции, происхождение, эволюцию, распространение и индивидуальное развитие, связи друг с другом, между сообществами и с неживой природой.

4) Биология рассматривает общие и частные закономерности, присущие жизни во всех ее проявлениях и свойствах: обмен веществ, размножение, наследственность, изменчивость, приспособляемость, рост, развитие, раздражимость, подвижность и некоторые другие.

5) Биология изучает все аспекты жизни, в частности, структуру, функционирование, рост, происхождение, эволюцию и распределение живых организмов на Земле.

6) Биология классифицирует и описывает живые существа, происхождение их видов, взаимодействие между собой и с окружающей средой.

7) Биология включает в себя зоологию, ботанику, микробиологию, экологию и другие дисциплины.

__Exercise 12.__ ***Translate the text using PROMT (Déjà Vu, TRADOS). Analyze the translation and make corrections.***

CHARACTERISTICS OF LIVING THINGS

All individuals which have life in them are known as living things. Broadly, these living things can be classified as plants and animals. They both have common characteristics as they depend on oxygen for life. These living things follow a universal circle of life with birth, reproduction and death. They need all the basic nutrients for growth and development and are prone to disturbances in their metabolism. They share a mutual bonding through the ecosystem they survive in i.e. plants depend on animals for carbon dioxide and animals depend on plants for oxygen.

The basic component present in every living thing is the cell. Both plants and animals are made up of one to countless number of cells which carry out different sets of functions. Life before evolution began from a single cell. Similarly even today, life is generated from a single cell which then divides or multiplies to give rise to a complex living form. After fertilization, once the zygote is formed, the cells start differentiating into their types and over a certain period of time give rise to a fully developed, mature living thing.

One of the most important characteristics of living things is the energy that they need to survive. Plants and animals use various forms of energy for the development of their bodies. The chemical processes that occur within a living organism in order to maintain life are called metabolism. Plants use the energy from the sun or solar energy to carry out photosynthesis which is the process for making their food (glucose). They are hence known as autotrophs. Animals and humans however cannot produce their own food and are dependent on plants and other animals for their food and hence they are called the heterotrophs. Therefore, energy is a common characteristic needed by all living things.

One of the rules of nature followed by all living things is growth. As development is an involuntary process, every cell in living things has to age. Growth and change is a part of all living organisms as cells divide to give rise to new and identical ones. Sometimes due to some genetic defects, during differentiation, some cells mutate to form other types of cells and result in complex organisms. This process of constant development and growth is also called organogenesis.

All organisms reproduce to continue their species' life. This is also one of the main characteristics of living things. Plants and animals have a reproductive system which is completely developed at puberty. There are two types of reproduction prevalent in nature, viz sexual and asexual. The sexual reproduction involves the combination of genetic material to give rise to a single zygote that further develops into a bigger organism. The asexual reproduction involves the splitting of one organism or cell to form two separate individuals of the same species. Every living thing is highly organized when it comes to the pattern or built of the body. Plants as well as animals have very complicated cell structures arranged very uniquely in the different organs. The cells form organelles, and organelles form organs. The organs make up the various parts of the organism. This is a network which every cell follows and thus living things are called highly organized beings. Death is also considered to be one of the most important characteristics of living things as whatever is created has to come to an end. Both plants and animals have limited life spans during which they go through their life processes like development and reproduction. As the cells age over a particular time period, these overgrown cells start becoming weak and lose their functions. They can't survive the atmospheric pressures and give in to them eventually. This is called death of the living things. They all have a particular age they live up to and then surrender to nature.

Some of the other living thing characteristics include homeostasis, which is the process to maintain stable internal conditions for survival. These conditions have to be maintained for body temperature, heartbeat, water content, etc. When the homeostasis is regulated the metabolism of the body is regulated and the living things stay healthy and fit.

Movement is also one such characteristic which is common to all living things. These movements depend on each species of plants and animals. Adaptation and defense are considered as common traits too. Every living thing has to adapt to certain conditions for survival and if it can't then it won't survive. Defense is also a gift that is given to every living thing and it is their right to protect themselves from predators.

Evolution is a type of miracle that has accompanied us for billions of years and is still in process. Eventually all living things complement each other through their characteristics and that is what Darwin's theory of evolution is all about.

(from www.sciencelearn.org.nz)

<u>**Exercise 13.**</u> ***Write a précis and an annotation of the text given below.***

CLASSIFICATION OF LIVING THINGS AND NAMING

With so many flora and fauna on planet Earth, there must be a method to classify each organism to distinguish it from others so it can be correctly identified. In science, the practice of classifying organisms is called taxonomy. To distinguish different levels of similarity, each classifying group, called taxon (pl. taxa) is subdivided into other groups: Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species. The domain is the broadest category, while species is the most specific category available.

Binomial nomenclature is used to name an organism, where the first word beginning with a capital letter is the genus of the organism and the second word beginning with a lowercase letter is the species of the organism. The name must be in italics and in Latin, which was the major language of arts and sciences in the 18th century. The scientific name can be also abbreviated, where the genus is shortened to only its first letter followed by a period. For example: *Lepus europaeus* would become *L. europaeus*.

There are two basic types of cells: eukaryotes and prokaryotes.

Eukaryotes are more complex in structure, with nucleand membrane-bound organelles. Some characteristics of eukaryotes are:

- Large (100—1000 μm).
- DNA in nucleus, bounded by membrane.
- Genome consists of several chromosomes.
- Sexual reproduction common, by mitosis and meiosis.
- Mitochondria and other organelles present.
- Most forms are multicellular.
- Aerobic.

Prokaryotes refer to the smallest and simplest type of cells, without a true nucleus and no membrane-bound organelles. Bacteria fall under this category. Some characteristics:

- Small (1—10 μm).
- DNA circular, unbounded.
- Genome consists of single chromosome.
- Asexual reproduction common, not by mitosis or meiosis.
- No general organelles.
- Most forms are singular.
- Anaerobic.

The three domains (Archaea, Bacteria (Eubacteria), and Eukaryota) are organised based on the difference between eukaryotes and prokaryotes.

There are six kingdoms in taxonomy: plants, animals, protista (microorganisms which are neither animals nor plants), fungi (mushrooms and moulds), eubacteria (monera), archaebacteria (bacteria which live in extreme environments, have unique properties and features, their cell walls lack peptidoglycan).

One goal of taxonomy is to determine the evolutionary history of organisms. This can be achieved by comparing species living today with species in the past. The comparison in anatomy and structure is based on data from development, physical anatomy, biochemistry, DNA, behaviour, and ecological preferences.

Biochemical analysis of animals similar in appearance have yielded surprising results. For example, although guinea pigs were once considered to be rodents, like mice, biochemistry led them to be in the taxon of their own.

Modern taxonomy is based on many hypotheses' of the evolutionary history of organisms, known as phylogeny. Scientists develop a hypothesis on the history of an animal and utilise modern science and technology to prove the phylogeny.

Cladistics is a classification system which is based on phylogeny. Expanding on phylogeny, cladistics is based on the assumption that each group of related species has one common ancestor and would therefore retain some ancestral characteristics. Moreover, as these related species evolve and diverge from their common ancestor, they would develop unique characteristics. Such characteristics are known as derived characteristics.

The principles of phylogeny and cladistics can be expressed visually as a cladogram, a branching diagram which acts as a family (phylogenetic) tree for similar species. A cladogram can also be used to test alternative hypotheses for an animal's phylogeny. In order to determine the most likely cladogram, the derived characteristics of similar species are matched and analysed.

The diversity in our planet is attributed to diversity within a species. As the world changed in climate and in geography as time passed, the characteristics of species diverged so much that new species were formed. This process, by which new species evolve, was first described by British naturalist Charles Darwin as natural selection.

For an organism to change, genetic mutations must occur. At times, genetic mutations are accidental, as in the case of prokaryotes when they undergo asexual reproduction. For most eukaryotes, genetic mutations occur through sexual reproduction, where meiosis produces haploid gametes from the original parent cells. The fusion of these haploid gametes into a diploid zygote results in genetic variation in each generation. Over time, with enough arrangement of genes and traits, new species are produced. Sexual reproduction creates an immense potential of genetic variety.

Exercise 14. ***Write an annotation of the text given below.***

HUMAN BODY

The muscular system produces body movements, body heat, maintains posture, and supports the body. Muscle fibers are the main cell type. Action of this system is closely tied to that of the skeletal system, which provides support and protection, and attachment points for muscles. The skeletal system provides rigid framework for movement. It supports and protects the body and body parts, produces blood cells, and stores minerals.

The skin or integument is the outermost protective layer. It prevents water loss from and invasion of foreign microorganisms and viruses into the body. There are three layers of the skin. The epidermis is the outer, thinner layer of skin. Basal cells continually undergo mitosis. Skin is waterproof because keratin, a protein is produced. The next layer is the dermis a layer of fibrous connective tissue. Within the dermis many structures are located, such as sweat glands, hair follicles and oil glands. The subcutaneous layer is composed of loose connective tissue. Adipose tissue occurs here, serving primarily for insulation. Nerve cells run through this region, as do arteries and veins.

The respiratory system moves oxygen from the external environment into the internal environment; also removes carbon dioxide. The respiratory system exchanges gas between lungs (gills in fish) and the outside environment. It also maintains pH of the blood and facilitates exchange of carbon dioxide and oxygen.

The digestive system digests and absorbs food into nutrient molecules by chemical and mechanical breakdown; eliminates solid wastes into the environment. Digestion is accomplished by mechanical and chemical means, breaking food into particles small enough to pass into bloodstream. Absorption of food molecules occurs in the small intestine from where they are sent into circulatory system. The digestive system also recycles water and reclaims vitamins from food in the large intestine.

The circulatory or cardiovascular system transports oxygen, carbon dioxide, nutrients, waste products, immune components, and hormones. Major organs include the heart, capillaries, arteries, and veins. The lymphatic system also transports excess fluids to and from circulatory system and transports fat to the heart.

The immune (lymphatic) system defends the internal environment from invading microorganisms and viruses, as well as cancerous cell growth. The immune system provides cells that aid in protection of the body from disease via the antigen / antibody response. A variety of general responses are also part of this system.

The excretory system regulates volume of internal body fluids as well as eliminates metabolic wastes from the internal environment. The excretory system removes organic wastes from the blood, accumulating wastes as urea in the kidneys. These wastes are then removed as urine. This system is also responsible for maintaining fluid levels.

The nervous system coordinates and controls actions of internal organs and body systems. Memory, learning, and conscious thought are a few aspects of the functions of the nervous system. Maintaining autonomic functions such as heartbeat, breathing, control of involuntary muscle actions are performed by some of the parts of this system.

The endocrine system works with the nervous system to control the activity of the internal organs as well as coordinate long range response to external stimuli. The endocrine system secretes hormones that regulate body metabolism, growth, and reproduction. These organs are not in contact with each other, although they communicate by chemical messages dumped into the circulatory system.

The reproductive system is mostly controlled by the endocrine system, and is responsible for survival and perpetuation of the species. Elements of the reproductive system produce hormones (from endocrine control) that control and aid in sexual development. Organs of this system produce gametes that combine in the female system to produce the next generation (embryo).

(from www.encyclopedia.com)

Exercise 15. ***Write a précis of the following text.***

PATHWAYS THAT ALTER HOMEOSTASIS

A variety of homeostatic mechanisms maintain the internal environment within tolerable limits. Either homeostasis is maintained through a series of control mechanisms, or the body suffers various illnesses or disease. When the cells in the body begin to malfunction, the homeostatic balance becomes disrupted. Eventually this leads to disease or cell malfunction. Disease and cellular malfunction can be caused in two basic ways: either, deficiency (cells not getting all they need) or toxicity (cells being poisoned by things they do not need). When homeostasis is interrupted in your cells, there are pathways to correct or worsen the problem. In addition to the internal control mechanisms, there are external influences based primarily on lifestyle choices and environmental exposures that influence our body's ability to maintain cellular health.

Nutrition: If your diet is lacking in a specific vitamin or mineral your cells will function poorly, possibly resulting in a disease condition. For example, a menstruating woman with inadequate dietary intake of iron will become anemic. Lack of hemoglobin, a molecule that requires iron, will result in reduced oxygen-carrying capacity. In mild cases symptoms may be vague (e.g. fatigue), but if the anaemia is severe the body will try to compensate by increasing cardiac output, leading to palpitations and sweatiness, and possibly to heart failure.

Toxins: Any substance that interferes with cellular function, causing cellular malfunction. This is done through a variety of ways; chemical, plant, insecticides, and/or bites. A commonly seen example of this is drug overdoses. When a person takes too much of a drug their vital signs begin to waver; either increasing or decreasing, these vital signs can cause problems including coma, brain damage and even death.

Psychological: Your physical health and mental health are inseparable. Our thoughts and emotions cause chemical changes to take place either for better as with meditation, or worse as with stress.

Physical: Physical maintenance is essential for our cells and bodies. Adequate rest, sunlight, and exercise are examples of physical mechanisms for influencing homeostasis. Lack of sleep is related to a number of ailments such as irregular cardiac rhythms, fatigue, anxiety and headaches.

Genetic / Reproductive: Inheriting strengths and weaknesses can be part of our genetic makeup. Genes are sometimes turned off or on due to external factors which we can have some control over, but at other times little can be done to correct or improve genetic diseases. Beginning at the cellular level a variety of diseases come from mutated genes. For example, cancer can be genetically inherited or can be caused due to a mutation from an external source such as radiation or genes altered in a fetus when the mother uses drugs.

Medical: Because of genetic differences some bodies need help in gaining or maintaining homeostasis. Through modern medicine our bodies can be given different aids, from antibodies to help fight infections, or chemotherapy to kill harmful cancer cells. Traditional and alternative medical practices have many benefits, but like any medical practice the potential for harmful effects is present. Whether by nosocomial infections, or wrong dosage of medication, homeostasis can be altered by that which is trying to fix it. Trial and error with medications can cause potential harmful reactions and possibly death if not caught soon enough.

The factors listed above all have their effects at the cellular level, whether harmful or beneficial. Inadequate beneficial pathways (deficiency) will almost always result in a harmful waver in homeostasis. Too much toxicity also causes homeostatic imbalance, resulting in cellular malfunction. By removing negative health influences, and providing adequate positive health influences, your body is better able to self-regulate and self-repair, thus maintaining homeostasis.

(https://en.wikipedia.org)

UNIT 2. GENETICS

Text 1

BASIC PRINCIPLES OF GENETICS

Chromosomes. The entire genetic information of an individual is contained in the chromosomes. The nucleus of every cell in the human body contains 46 chromosomes, which can be said to represent the library of hereditary information. These 46 chromosomes consist of 23 pairs, with each set of chromosomes deriving from one parent (mother / father). Chromosomes 1—22 are called autosomes and the 23rd chromosome pair is called the sex chromosome (gonosome), since it determines the human sexual characteristics. In women this chromosome pair consists of two X chromosomes whereas men have one X chromosome and one Y chromosome. Apart from the cell nucleus, the mitochondria in the cytoplasm of the cell also possess an albeit negligibly small amount of hereditary information.

Genes, DNA. A single human chromosome is composed of 50 to 250 million building blocks, made of deoxyribonucleic acid (DNA). The DNA consists of two long strands, which are twisted together in a double helix like a spiral staircase. The hand rail or the banister of the staircase is formed by a framework of sugar and phosphate molecules, while the individual steps are each formed by one base pair. Only four different building blocks (nucleotide bases or nucleotides) are involved in the formation of these steps: adenine (A), guanine (G), cytosine (C) and thymine (T). Only the nucleotide bases A and T on the one hand and G and C on the other hand fit together. The bases are complementary — they fit together like a key in a lock (i.e. as base "pairs"). This allows the DNA to reproduce itself with the help of certain enzymes: it splits into two single strands with each strand acting as the template for the reassembly of the missing strand.

The sequence of the bases within the DNA molecule (DNA sequence) contains the entire genetic information or “code” used by a cell in order to perform its functions. So nature utilizes a code with only four different “letters” — A, G, C and T — in order to determine such different traits as hair colour, blood type, etc.

The sequence of nucleotides (of which the base is the key coding component) used by a cell to manufacture an individual protein is called a gene. In the entire human genome it is thought that there are 70,000—1000,000 different genes, which thus have the instructions for building every cell, organ and tissue of an individual. This information is contained in about 5% of the total DNA. This leaves 95% of DNA whose function is still unclear. It is believed, however, that these “extra” sections of DNA may govern how genes interact and are controlled.

Messenger ribonucleic acid. For a certain cell (e.g. heart muscle cell, pancreas cell, stem cell in the bone marrow) to perform its predetermined action (pumping action of the heart muscle, insulin secretion of the pancreas, formation of blood cells in the marrow), it must communicate its encoded information outside of the cell nucleus. This means that the information which is coded and stored in genes must be transported in a biologically active form. This process is called gene expression and takes place in several steps. In order to transmit its information out of the cell nucleus to the periphery, the gene first makes use of a messenger. This messenger reads the information from the gene in the cell nucleus, as defined by the sequence of bases. In this way, a complementary nucleic acid chain may be produced using the DNA segment as a template. This newly made chain is called a messenger ribonucleic acid (m-RNA) and this process is called transcription. By using m-RNA as an intermediary, it is ensured that DNA as the source of information is not used up or destroyed.

Transcription is followed by so called translation. This involves the messenger RNA being transported from the cell nucleus and then serving in the cytoplasm (part of the cell that contains cytosol, but excluding the cell nucleus) as a pattern for a specific amino acid to be incorporated in the protein chain. The genetic information of the m-RNA is transformed into an amino acid in the cell periphery on so called ribosomes. Here three m-RNA nucleotides are "translated" to produce one amino acid, the primary component of all proteins.

It is known from electron microscope images and biochemical investigations that DNA of a gene and the corresponding m-RNA do not have the same length. What happens is that the m-RNA is further processed before it leaves the cell nucleus, with the DNA sequences which are not needed for protein synthesis stripped away. The DNA sequences responsible for protein synthesis are called coding exons and the RNA sections stripped away before translation are called non-coding introns. So a gene consists not only of information which lays down the composition of proteins but also of controlling and regulating sections.

Proteins and their importance. Of all the organic compounds occurring in living forms, the carbohydrates (sugars) lipids (fats) and proteins are the most important substances. While the fats and carbohydrates mainly perform the function of energy carriers, proteins have a vast array of functions to fulfill. Proteins also form the majority of organic compounds, accounting for about 50% of these. Proteins are often called the building blocks of life since they represent the messengers and tools which are necessary for the processes of life in the organism. As enzymes, they catalyze the metabolic process; as hormones, they control and regulate these processes; as receptors and messenger substances, they transmit the important information to the inside of the cells; as antibodies, they form an essential part of the immune system; as plasma proteins, they transport important nutrients to the blood and as structural proteins, they form building blocks and mechanical supports for all cells, organs, bones and connective tissue.

Proteins consist of amino acids. Their function depends on which amino acids they are formed from and how many. In total, tens of thousands of different proteins are known in humans, with major differences in their function and size. This wide variety of proteins is produced from only 20 different amino acids, which in turn are coded by only four different nucleotides: adenine (A), guanine (G), cytosine (C) and thymine (T). Each of these 20 amino acids needs a combination of only three of the four nucleotides (codon) to determine its identity. This genetic language (genetic code) applies in an identical manner to (almost) all living forms. In this way, a specific sequence of letters in the genes is always translated into the same protein.

(by M. Adem from Molecular Biology and Applied Genetics)

VOCABULARY

adenine (A) — аденин
amino acid — аминокислота
autosome — аутосома, неполовая хромосома
base — основание
cell — клетка
chromosome — хромосома
cytobiology — цитобиология, биология клетки
cytocinesis — цитокинез, клеточное деление
cytology — цитология (учение о клетке)
cytoplasm — цитоплазма
cytosine (C) — цитозин
cytosol — цитозоль
cytosome — цитосома, клеточное тело
deoxyribonucleic acid (DNA) — дезоксирибонуклеиновая кислота (ДНК)
enzyme — фермент, энзим
exon — экзон
expression — экспрессия

gene — ген

genome — геном

gonosome — гоносома, половая хромосома

helix (pl. helices, helixes) — спираль

hereditary — наследственный, передающийся по наследству

intron — интрон

karyon — клеточное ядро

messenger — посредник; информационная РНК, матричная РНК

mitochondrion (*pl.* mitochondria) — митохондрия

nucleotide — нуклеотид

nucleus (*pl.* nuclei) — ядро (клетки)

phosphate — фосфат

protein — белок, протеин

ribonucleic acid (RNA) — рибонуклеиновая кислота (РНК)

ribosome — рибосома

sequence — последовательность, порядок следования (нуклеотидов в нуклеиновых кислотах или аминокислот в белках)

strand — нить, цепь (ДНК)

template — матрица

thymine (T) — тимин

tissue — ткань

transcription — считывание биологической информации

translation — трансляция (синтез полипептидной цепи белковой молекулы)

Exercise 1. ***Give the Russian equivalents for the following terms.***

1) cell; 2) chromosome; 3) autosome; 4) carbohydrate; 5) lipid; 6) codon; 7) gonosome; 8) cytoplasm; 9) cytosol; 10) nucleus; 11) mitochondrion; 12) deoxyribonucleic acid (DNA);13) ribonucleic acid (RNA); 14) transcription; 15) expression; 16) translation; 17) amino acid;18) sequence; 19) adenine; 20) guanine; 21) cytosine; 22) thymine; 23) strand; 24) nucleotide; 25) enzyme; 26) template; 27) base; 28) protein; 29) tissue; 30) messenger.

Exercise 2. ***Give the English equivalents for the following terms.***

1) клетка; 2) хромосома; 3) аутосома; 4) углевод; 5) липид; 6) кодон; 7) половая хромосома; 8) цитоплазма; 9) цитозоль; 10) ядро (клетки); 11) митохондрия; 12) дезоксирибонуклеиновая кислота; 13) рибонуклеиновая кислота; 14) считывание биологической информации; 15) аминокислота; 16) последовательность, порядок следования; 17) аденин; 18) гуанин; 19) цитозин; 20) тимин; 21) нить (цепь) ДНК; 22) нуклеотид; 23) фермент; 24) матрица; 25) основание; 26) белок; 27) ткань; 28) посредник.

Exercise 3. ***Give the full forms and Russian equivalents of the following abbreviations.***

1) A; 2) G; 3) C; 4) T; 5) DNA; 6) RNA; 7) m-RNA.

Exercise 4. ***Substitute the corresponding terms for the following definitions.***

1) The "control centre" of a cell surrounded by a membrane and containing the chromosomes; 2) chromosomes present in the same number in men and women; 3) constituents of the nucleotides; 4) a substance produced by a living organism that acts as a catalyst to bring about a specific biochemical reaction; 5) the structures of the cell nucleus containing the hereditary material; 6) sequence of three nucleotides (triplet) of DNA or RNA, which is responsible for translation into a specific amino acid; 7) a double-stranded giant molecule which stores the genetic information in its nucleotide sequence; 8) linear sequence of nucleotide units; 9) a basis for inheritance; 10) procedures for changing the genetic information; 11) utilization of DNA polymorphisms for producing a genotype specific to the individual; 12) the entire genetic information of a cell or a living organism; 13) cell sequence from the fertilized egg cell to the germ cells (egg or sperm cells) of the new life form; 14) sex chromosomes; 15) non-coded section of a gene (or m-RNA).

Exercise 5. ***Insert the missing terms. Translate the sentences into Russian.***

1) Of all the organic compounds occurring in living forms, the carbohydrates (sugars), ... (fats) and proteins are the most important substances. 2) While the lipids (fats) and ... mainly perform the function of energy carriers, proteins have a vast array of functions to fulfill. 3) ... are often called the building blocks of life since they represent the messengers and tools which are necessary for the processes of life in the organism. 4) As ... , proteins catalyze the metabolic processes; as ... , they control and regulate these processes; as receptors and messenger substances, they transmit important information to the inside of the ... ; as antibodies, they form an essential part of the ... . 5) Proteins consist of ... . Their function depends on which amino acids they are formed and how many. 6) This wide variety of proteins is produced from only 20 different amino acids, which in turn are coded by only four different ...: adenine (A), guanine (G), ... (C) and thymine (T). 7) Each of these 20 amino acids needs a combination of only three of the four nucleotides (...) to determine its identity.

Exercise 6. ***Translate the nominative attributive constructions into Russian.***

1) tissue structure; 2) genome research; 3) muscle cell; 4) cell differentiation; 5) genome analysis; 6) sperm cell; 7) pancreas cell; 8) bone marrow; 9) base pair; 10) point mutation; 11) DNA strand substitution; 12) essenger ribonucleic acid; 13) heart muscle cell; 14) bone marrow cell; 15) germ line cell; 16) stem cell; 17) germ cell.

Exercise 7. ***Translate the following sentences from English into Russian.***

1) These 46 chromosomes consist of 23 pairs, with each set of chromosomes deriving from one parent (mother /

father). 2) Chromosomes 1—22 are called autosomes and the 23rd hromosome pair is called the sex chromosome (gonosome), since it determines the human sexual characteristics. 3) In women this chromosome pair consists of two X chromosomes whereas men have one X chromosome and one Y chromosome. 4) Apart from the cell nucleus, the mitochondria in the cytoplasm of the cell also possess an albeit negligibly small amount of hereditary information. 5) This allows the DNA to reproduce itself with the help of certain enzymes: it splits into two single strands with each strand acting as the template for the reassembly of the missing strand. 6) By using m-RNA as an intermediary, it is ensured that DNA as the source of information is not used up or destroyed. 7) This involves the messenger RNA being transported from the cell nucleus and then serving in the cytoplasm (part of the cell that contains cytosol, but excluding the cell nucleus) as a pattern for a specific amino acid to be incorporated in the protein chain. 8) What happens is that the m-RNA is further processed before it leaves the cell nucleus, with the DNA sequences which are not needed for protein synthesis stripped away. 9) In total, tens of thousands of different proteins are known in humans, with major differences in their function and size. 10) The sequence of nucleotides (of which the base is the key coding component) used by a cell to manufacture an individual protein is called a gene.

Exercise 8. ***Translate into English.***

1) Сотрудники научно-исследовательского центра по изучению белков при университете Копенгагена (Novo Nordisk Foundation Center for Protein Research) совместно со своими коллегами из других стран смогли собрать данные, описывающие десятки тысяч процессов, протекающих в рамках репарации повреждений ДНК. Работа систем репарации обеспечивает нормализацию протекания внутриклеточных процессов и защищает организм от возникновения раковых опухолей. Результаты проведенного исследования ценны тем, что они помогают разо-

браться в том, как именно протекают репаративные процессы и как химиотерапия влияет на жизнедеятельность клеток. Можно предположить, что полученные результаты будут способствовать поиску новых более безопасных и эффективных лекарственных средств.

2) «Репарация ДНК имеет жизненно важное значение для поддержания клеток в нормальном состоянии. И уточнение деталей того, как клетки взаимодействуют в тех случаях, когда их ДНК повреждена, поможет нам понять, как клетки защищают собственный геном», — говорит Кунарам Кхоудари (Chunaram Choudhary), сотрудник научно-исследовательского центра по изучению белков, университет Копенгагена.

3) «Мы, например, знаем, что химиотерапия убивает раковые клетки через повреждение их ДНК. Это происходит по той причине, что быстро растущие опухолевые клетки более восприимчивы к повреждениям ДНК по сравнению со здоровыми клетками. Однако как именно химиотерапия работает на клеточном уровне, все еще далеко не ясно. Как только мы поймем последствия влияния химиотерапии, возникающие на клеточном уровне, то сможем начать работу над способами защиты здоровых клеток пациентов, лечащихся от рака», — говорит постдок Пстра Бели (Petra Beli).

Exercise 9. ***Translate the text using PROMT (Déjà Vu, TRADOS). Analyze the translation and make corrections.***

The bases for hereditary diseases are changes in the hereditary substances which are passed on from one generation to the next via the germ line cells. The change in the hereditary substance may take place at chromosome level or in the DNA itself. A distinction is made between monogenic and polygenic diseases. However, it is becoming increasingly apparent that the distinction between monogenic and polygenic diseases is an artificial one. Many of the so called monogenic diseases are not determined by a single gene but depend in their manifestation on the controlling and regulating influences of other genes. The term multifactorial illnesses refers to disorders which arise as a result of an interaction between heredity and environment that is not fully understood in the majority of cases.

<u>**Exercise 10.**</u> ***Write a précis and an annotation of Text 1.***

<u>**Exercise 11.**</u> ***Write an annotation of the following article from the Herald Sun.***

GENDER BENDING IN THE GENES

MELBOURNE scientists have broken new ground in supporting the case that genetics more than individual choice play a key role in determining our sense of gender.

A transsexual gene, believed to be responsible for people feeling they were born the wrong sex, has been discovered by the Melbourne team.

The breakthrough supports the view that there is a biological basis to the gender confusion faced by transsexuals, rather than the social stigma attached with theories that gender reassignment is a lifestyle choice.

In the largest genetic study of its kind, 112 male-to-female transsexuals took part in a study involving several Melbourne research bodies and the University of California, Los Angeles.

After studying the DNA of the male-to-female transsexuals, genetic experts from Prince Henry's Institute at the Monash Medical Centre found they were more likely to have a longer version of a gene known to modify the action of sex hormone testosterone.

The genetic abnormality on the androgen receptor gene is believed to lower testosterone action during fetal development, and "under-masculinise" the person's brain, leading them to feel like a female trapped in a male body.

Lead researcher Associate Prof Vincent Harley, head of molecular genetics at Prince Henry's, said the findings dismissed decades of debate that physiological factors such as childhood trauma were responsible for people's belief they should be the opposite sex.

"There is a social stigma that transsexualism is simply a lifestyle choice. However, our findings support a biological basis of how gender identity develops," he said.

Other recent studies have indicated family history and genetics are involved in gender identity, a view supported by Monash Gender Dysphoria Clinic director Dr Trudy Kennedy.

"People who come to our clinic describe how they knew they were different at a very early age; just three or four years old when they were at kindergarten," Dr Kennedy said.

"This is something that people are born with, and it's certainly not a lifestyle choice, as some have suggested."

Publishing their results today in the Biological Psychiatry journal, the researchers call for expanded genetic studies to investigate a wider range of genes, which may also play a part in gender identity.

"It is possible that a decrease in testosterone levels in the brain during development might result in incomplete masculinisation of the brain in male-to-female transsexuals, resulting in a more feminised brain and a female gender identity," they wrote.

Julie Peters, a transgender person, said she knew from as young as three that she did not fit into being a boy.

"I have always had the personality of a girl. I suppose is the way I perceive it, and even from a very young age, three or four, I was really mad at people for making me a boy," she said.

"I personally think it (gender) is a combination of both (nature and nurture). You are born with a predisposition to have a certain personality, and then depending on the culture you are brought up in your personal situation."

The study research was jointly funded by the National Health and Medical Research Council and the US National Institutes of Health.

(by Grant McArthur)

Text 2

DNA, MUTATIONS AND GENES

Reproduction of DNA (replication). Most cells have to divide all the time. They have a limited lifespan. In order to maintain their function, they must pass on the hereditary information stored in their nuclei to daughter cells. The DNA strands therefore have to be copied. For this, the DNA double strands have to divide into single strands and a complementary strand is then produced (DNA replication). In this way the genome duplicates itself. Then the sets of chromosomes move to opposite cell poles and the cell divides. In this way, the sell has propagated itself. This process happens a million times every second in the human organism and ensures that the human body renews (regenerates) itself. In old age, the production rate of new cells no longer keeps up with the dying rate of old cells. This leads to atrophy and dying processes.

Importance of mutations. For perfect functioning of the human organism, stability and constancy of the genetic information is essential. On the other hand, such a complex process as the transfer of genetic information is very susceptible to error. If the hereditary information is altered in any way, this can have far reaching consequences. Such alterations are called mutations. A mutation can occur spontaneously during the coping of the DNA (faulty replication) or through the external influence damaging the cell. Examples of external influences (mutagens) which can damage the hereditary information are chemicals, radiation and viruses. Sometimes mutations lead to an exchange of only a single DNA base (nucleotide). Such a mutation is called a point mutation. Other kinds of mutation are the deletion and the addition of several nucleotide sequences. These lead to a change in the original nucleotide sequence with the likelihood that proteins will be improperly produced either quantitatively or qualitatively. This in its turn may have consequences with regard to the functions of the cell and the organism. Of course, mutations can affect the chromosomes as a whole, so that, for example, the number of chromosomes is increased or chromosome sections are deleted.

Mutations can occur in all types of cell; in a muscle cell, an intestinal cell or in a bone cell. Such mutations (somatic mutations; mutations of body cells) remain restricted to the corresponding body tissue of the individual and are not passed on to future progeny. On the other hand, if mutations occur in the germ line cells, these changes may be passed on to the next generation.

This distinction shows that genetic changes do not always have to be inherited. It is much more likely that during the innumerable cell divisions which take place in the organism during the course of human life, somatic mutations will occur time and time again which may cause or contribute to an illness. This is the case, for example, in the majority of cancers. A genetic disease is, therefore, not necessarily an inherited disease. On the other hand, mutations in the germ line cells can cause inherited genetic illnesses to develop. Such a mutation may have happened several thousands of years ago and has since then been passed down from one generation to the next within certain families according to certain rules of inheritance.

Not every nucleotide sequence departing from the norm within a gene (mutation) leads to illness. Our genes with their innumerable mutations, exhibit a broad span of variation which gives every individual life form its own unique identity. In medicine this fact is used not only to provide evidence of current or future diseases. Genome analysis can also be used to identify persons (e.g. as part of a paternity test) by means of a process called genetic fingerprinting (DNA fingerprinting). DNA can also be recovered from the remains of the deceased even after long periods of time. For example, after a plane crash, DNA analysis enables casualties to be identified. Historical research also makes use of genome analysis.

Active and inactive genes. Human life starts when an egg cell is fertilized by a sperm cell. Each cell contributes half a set of its hereditary material. So 23 maternal chromosomes and 23 paternal chromosomes meet in a fertilized cell. This fertilized cell (zygote) doubles its set of chromosomes before its division and so then passes on the genetic information (the genome) to two daughter cells, which in their turn divide into four cells and so on until after 9 months a child is born with all its organs fully developed. Continuous cell division associated with DNA replication guarantees that the original genetic information in the starting cell is passed on to all other cells. And yet during the embryo phase, cells emerge which have to perform very different tasks and also "know" that they have to carry out different functions (cell differentiations). But why does a muscle cell look quite different and have a function different from say an intestinal cell although they both have the same hereditary material in their nucleus? In every cell only a fraction of the entire genome is active. A large number of regulatory and control sections determine what part of the cell genome is inactivated at what time and what part actively synthesizes proteins and so also forms certain tissue structures. This is a highly complex process which is only beginning to be understood in the still relatively young branch of genome research.

(by M. Adem from Molecular Biology and Applied Genetics)

VOCABULARY

allele — аллель
atrophy — атрофия, ослабление (органа, ткани), истощение
chromatin — хроматин
diploid — диплоид (с двойным числом хромосом)
DNA fingerprinting — анализ ДНК
dying rate — скорость отмирания
egg cell — яйцеклетка
gamete — гамета, половая клетка
genome analysis — исследование генома
haploid — гаплоид
histone — гистон (низкомолекулярный белок, связанный с ДНК)
inherited disease — наследственная болезнь
life form — форма жизни, живой организм
mutagen, mutagene — мутаген
mutation — мутация
onset — вспышка, проявление (болезни), начало, наступление

ovum (*pl.* ova) — яйцо, женская зародышевая клетка
paternity test — тест на установление отцовства
point mutation — точечная мутация
progeny — потомство
propagate — размножаться, репродуцировать
replication — репликация, ауторепродукция
somatic mutation — соматическая мутация
sperm cell — сперматозоид
zygote — зигота, оплодотворенная яйцеклетка

Exercise 12. ***Give the Russian equivalents for the following terms.***

1) progeny; 2) replication; 3) propagate; 4) dying rate; 5) atrophy; 6) mutagene; 7) reproduction; 8) inherited disease; 9) life form; 10) paternity test; 11) genome analysis; 12) egg cell.

Exercise 13. ***Give the English equivalents for the following terms.***

1) воспроизведение, репродукция; 2) матрица; 3) размножаться, репродуцировать; 4) скорость отмирания; 5) атрофия, ослабление (органа, ткани), истощение; 6) мутаген; 7) потомство; 8) посредник; 9) форма жизни, живой организм; 10) тест на установление отцовства; 11) исследование генома; 12) яйцеклетка; 13) нить (цепь) ДНК; 14) нуклеотид; 15) фермент; 16) репликация, ауторепродукция; 17) основание; 18) белок; 19) ткань; 20) наследственная болезнь.

Exercise 14. ***Substitute the corresponding terms for the following definitions.***

1) chromosomes present in the same number in men and women; 2) constituents of the nucleotides; 3) material from which the chromosomes are made: DNA, proteins (histones and non-histone proteins); 4) different alternative forms of the same gene; 5) procedures for changing the genetic information; 6) utilization of DNA polymorphisms for producing a genotype specific to the

individual; 7) the changing of the structure or a gene, resulting in a variant form that may be transmitted to subsequent generations, caused by the alteration of single base units in DNA, or the deletion, insertion, or rearrangement of larger sections of genes or chromosomes; 8) the process by which genetic material gives rise to a copy of itself; 9) a fertilized ovum; 10) a mature haploid male or female germ cell that is able to unite with another of the opposite sex in sexual reproduction to form a zygote.

Exercise 15. ***Insert the missing terms. Translate the sentences into Russian.***

1) In order to maintain their function, cells must pass on the ... stored in their nuclei to daughter cells. 2) In old age the production rate of new cells no longer keeps up with the ... of old cells. 3) For perfect functioning of the human organism, stability and constancy of the ... is essential. 4) Sometimes mutations lead to an exchange of only a single ... (nucleotide). 5) ... or mutations of body cells remain restricted to the corresponding body tissue of the individual and are not passed on to the future progeny. 6) On the other hand, if mutations occur in the ... line cells, these changes may be passed on to the next generation. 7) Genome analysis can also be used to identify persons (e.g. as part of a paternity test) by means of a process called genetic ... . 8) Historical research also makes use of ... analysis. 9) So 23 maternal chromosomes and 23 paternal chromosomes meet in a fertilized ... . 10) Continuous cell division associated with DNA ... guarantees that the original genetic information in the starting cell is passed on to all other cells. 11) But why does a muscle cell look quite different and have a function different from say intestinal cell although they both have the same hereditary material in their ... ?

Exercise 16. ***Translate the nominative attributive constructions into Russian.***

1) production rate; 2) point mutation; 3) DNA double strand; 4) DNA replication; 5) opposite cell poles; 6) nucleotide sequence;

7) body tissue; 8) germ cell; 9) cell division; 10) genome analysis (research); 11) cell differentiation; 12) tissue structure; 13) sickle cell; 14) sickle cell disease; 15) sperm cell; 16) nucleotide base; 17) germ line cell; 18) template strand.

Exercise 17. ***Find in the text the description of the following processes.***

1) DNA replication; 2) faulty replication; 3) mutation; 4) point mutation; 5) somatic mutation; 6) cell differentiation.

Exercise 18. ***Answer the questions.***

1) What is the genome? 2) In what way does the genome duplicate itself? 3) What guarantees that the original genetic information in the starting cell is passed on to all other cells? 3) What ensures that the human body regenerates itself? 4) What is the cause leading to atrophy and dying processes? 5) What is essential for perfect functioning of the human organism? 6) How can a mutation occur? 7) What is a point mutation? 8) What is the difference between somatic mutations and mutations in the germ line cell? 9) What mutations are not passed on to future progeny? 10) What external factors can damage the hereditary information? 11) What mutations can cause inherited genetic illnesses to develop? 12) What are the spheres of genome analysis application?

Exercise 19. ***Translate from Russian into English***

ПОВРЕЖДЕНИЯ ДНК ОПАСНЫ ДЛЯ ЗДОРОВЬЯ

Многие факторы (от солнечного излучения до экологической обстановки и нормальных метаболических процессов, протекающих в клетке) могут повреждать ДНК изо дня в день. В результате возникновения данных повреждений могут образовываться атипичные белковые молекулы, которые способны резко повышать вероятность возникновения новообразований.

Для того чтобы защититься от развития новообразований, поврежденная ДНК запускает в клетке сложную последовательность цепных реакций. В результате протекания данных реакций происходит замедление различных процессов или их остановка. Таким образом, клетка как бы начинает ждать, когда великое множество молекул начнет работать над поврежденной ДНК.

Идентификация белков, имеющих ключевое значение для восстановления поврежденной ДНК, может помочь в поиске новых лекарственных мишеней. И путем использования препаратов, работающих через такие мишени, возможно, получится минимизировать побочные эффекты, которые имеют место в тех случаях, когда лекарственное соединение обладает слишком широким спектром действия в организме.

Exercise 20. ***Translate the text using PROMT (Déjà Vu, TRADOS). Analyze the translation and make corrections.***

It is thought that about 5% of all newborn babies come into the world with an inherited disorder. About 0.5% have a clinically relevant chromosome anomaly and about 1% have a monogenic inherited disorder. The remainder of disorders are multifactorial or due to external factors. Among those who die before their 65th year, inherited disorders are still the fifth most frequent cause of death. Most death result from inherited heart disorders followed by anomalies of the central nervous system (brain, spinal cord) as well as urogenital anomalies (urinary and reproductive organs) and gastrointestinal anomalies (digestive organs).

(www.medweb.ru)

Exercise 21. ***Write a précis and an annotation of Text 2.***

UNIT 3. GEOLOGY

Text 1

DEEP EARTH

The surface of the Earth is covered by a relatively thin, cold, hard crust. Beneath the oceans it is about 7 or 8 kilometres thick; in the continents, 30 to 60 kilometres thick. At its base lies the Mohorovicic discontinuity or Moho, a layer which reflects seismic waves, probably as a result of a change in composition to the dense rocks of the mantle beneath. The lithosphere, the complete slab of cold, hard material on the Earth's surface, includes not only the crust but the top of the mantle as well. In total, the continental lithosphere may be 250 or even 300 kilometres thick. It thins under the oceans, as you approach the mid-ocean ridge system, down to little more than the 7-kilometre crust. The lithosphere is not a single rigid layer, however. It is split into a series of slabs called tectonic plates. They are our principal clue as to how the deep Earth works. To understand what's going on, we must probe beneath the crust.

Only 30 kilometres away from us lies a place we can never visit. If the distance was horizontal it would just be an easy bus ride away, but the same distance beneath our feet is a place of almost unimaginable heat and pressure. No mine can tunnel that deep. A proposal in the 1960s to use ocean drilling techniques from the oil exploration industry to drill right through the ocean crust into the mantle, the so called Moho project, was ruled out on grounds of cost and difficulty. Attempts at deep drilling on land on Russia's Kola Peninsula and in Germany had to be abandoned after about 11,000 metres. Not only was the rock difficult to drill, but the heat and pressure tended to soften the drill components and squeeze the hole shut again as soon as it was drilled.

There is one way in which we can sample the mantle directly: in the outpourings of deep rooted volcanoes. Most of the magma that erupts from volcanoes comes from only partial melting of the source material, so basalt, for example, is not a complete sample of mantle rock. It does, however, carry isotopic clues to what lies beneath.

Violent volcanic eruptions do sometimes carry in their magma more direct samples of mantle rocks. These so called xenoliths are samples of mantle rock that have not been melted, just carried along in the flow. They are typically dark, dense, greenish rocks such as peridotite, rich in the mineral olivine, a magnesium / iron silicate. Similar rock is sometimes found in the deep cores of mountain ranges which have been thrust up from great depths.

Recent analysis of seismic data from around the world has revealed a thin layer at the base of the mantle, the D-layer, up to 200 kilometres thick. It is not a continuous layer but seems more like a series of slabs, a bit like continents on the underside of the mantle. This could be regions where silicate rocks in the mantle are partly mixed with iron-rich material from the core. But another explanation is that this is where ancient ocean lithosphere comes to rest. After its descent through the mantle, the slab is still cold and dense so it spreads out at the base of the mantle and is slowly heated by the core until, perhaps a billion years later, it rises again in a mantle plume to form new ocean crust.

Clues to the deep interior of the Earth also come from measuring tiny variations in day length. Our spinning planet is gradually slowing down due to the pull of the moon on the tides and to the rising of land compressed by ice in the last Ice Age. But there are other even smaller variations of a few billionths of a second. Some may be due to atmospheric circulation blowing on mountain ranges like wind on a sail. But there is another component which seems to be caused by circulation in the outer core pushing on ridges in the base of the mantle like ocean currents pushing on the keel of a ship. So there may be ridges and valleys like upside down mountain ranges on the base of the mantle. There seems to be a great depression in the core beneath the Philippines that is 10 kilometres deep, twice the depth of the Grand Canyon. Bulging up beneath the Gulf of Alaska is a high spot on the core; a liquid mountain taller than Everest. Maybe sinking cold material indents the core, while hotspots bulge up.

We have no direct experience or samples of the Earth's core. But we do know from seismic waves that the outer part of it is liquid and only the inner core is solid. We also know that the core has a much higher density than the mantle. The only material that is dense enough and sufficiently abundant in the solar system to make up the bulk of the core is iron. Although we do not have samples of the Earth's core, we do have pieces of something that's likely to be similar, in iron meteorites. Though not as common as stony meteorites, they are easier to spot. They are believed to come from large asteroids in which an iron core separated out before they were smashed by bombardment early in the history of the solar system. They are mostly made of iron metal but contain between 7% and 15% of nickel. Often, they have a structure of intergrown crystals of two alloys, one containing 5% nickel, the other about 40% nickel, in proportions that give the bulk composition.

An iron core must have formed in the Earth by gravitational separation from the silicate mantle when the new Earth was at least partially molten. As the layers separated, so called siderophile elements such as nickel, sulphur, tungsten, platinum, and gold that are soluble in molten iron would have separated with them. Lithophile elements would have been held back by the silicate mantle. Radioactive elements such as uranium and hafnium are lithophile, whereas their decay products, or daughters, are isotopes of lead and tungsten so would have been separated out into the core at its formation. That consequently reset the radioactive clock in the mantle at the time the core formed.

The centre of the Earth is frozen. Frozen at least from the viewpoint of molten iron at the incredible pressures down there. As the planet cools, solid iron crystallizes out from the molten core.

Today, the inner core is about 2,440 kilometres across, 1,000 kilometres smaller than the Moon. But it is still growing. The iron is crystallizing at a rate of about 800 tonnes a second. That releases a considerable amount of latent heat, which passes through the liquid outer core, contributing to the churning of the fluid within it. As the iron or iron-nickel alloy crystallizes out, impurities within the melt, mostly dissolved silicates, separate out. This material is less dense than the molten outer core, so it rises through it in a steady rain of perhaps sand-like particles. It probably accumulates on the base of the mantle like a sort of upside down sedimentation, collecting in upside down valleys and depressions. There are seismic hints of a very low velocity layer at the base of the mantle that this upward sedimentation could explain. The sandy sediment would trap molten iron just as ocean sediment traps water. By holding iron within it, the layer provides material that can magnetically couple the magnetic field generated in the core with the solid mantle. If some of this material rises in superplumes to contribute to flood basalts on the surface, it could explain the high concentrations of precious metals such as gold and platinum in such rocks.

Like the Earth as a whole, the inner core is rotating, but not exactly in the same way as the rest of the Earth. It is in fact rotating slightly faster than the remainder of the planet, gaining nearly one-tenth of a turn in the past 30 years. Understanding why the inner core is spinning so fast may give insight into what is going on in that strongly magnetic environment. It could be that currents in the outer core, analogous to the jet streams in the atmosphere, are putting a magnetic tug on the inner core.

So far, only about 4% of the total core has frozen. But, in 3 or 4 billion years' time, the entire core will have solidified and we may lose our magnetic protection.

(by Dr. F.Borrero et al. from Earth Science: Geology, the Environment and the Universe)

VOCABULARY

asthenosphere — *геол.* астеносфера (земли)

bulge — выпучиваться, выпячиваться, выдаваться

bulk — масса, основная масса

convergent boundaries — сходящиеся границы

core — ядро (небесного тела)

crust — *геол.* земная кора, поверхностные отложения

D-layer — слой D

depression — *геофиз.* впадина, депрессия, углубление

divergent boundaries — расходящиеся границы

eruption — извержение (вулкана); выброс, прорыв (пламени, вод)

igneous — *геол.* изверженный, магматический, вулканический

impurity — примесь, загрязнение

indent — вдавливать, делать зазубрины

lead — свинец

lithosphere — *геофиз.* литосфера

magnesium silicate — силикат магния (белый пигмент)

mantle — мантия (часть внутренней структуры земного шара)

melt — расплав

Mohorovicic discontinuity (Moho) — слой Мохоровичича (Мохо) (назван так в честь сербского сейсмолога Мохоровичича)

oceanic trench — океаническая впадина

outpouring — выливание

olivine — минерал оливин, хризолит, перидот

peridotite — минерал перидотит

plume — тепломассопоток, плюм, струя, шлейф

rift — трещина, расселина, разлом

sediment — отстоявшийся слой, осадок

sedimentation — осаждение, оседание

seismic wave — сейсмическая волна

sideriphil — сидерофил (что-л., имеющее тенденцию к поглощению железа)

slab — плита

squeeze — *нефт.* закупоривающий материал

subduction — *геол.* субдукция, подвиг, пододвигание (одной тектонической плиты под другую)
sulphur — сера
tungsten — вольфрам
tug — рывок, тянущее усилие
xenolith — минерал ксенолит

Exercise 1. ***Give Russian equivalents for the following terms.***

1) crust; 2) mantle; 3) core; 4) slab; 5) eruption; 6) tungsten; 7) lead; 8) iron-nickel alloy; 9) impurity; 10) sedimentation.

Exercise 2. ***Give English equivalents for the following terms.***

1) сходящиеся границы; 2) ядро (небесного тела); 3) *геол.* земная кора; 4) пододвигание (одной тектонической плиты под другую); 5) трещина, расселина, разлом; 6) мантия (часть внутренней структуры земного шара); 7) *геофиз.* впадина, депрессия, углубление; 8) плита; 9) сера; 10) вольфрам.

Exercise 3. ***Substitute the corresponding terms for the following definitions.***

1) a thin semifluid layer of the Earth (100—200 km thick), below the outer rigid lithosphere, forming part of the mantle and thought to be able to flow vertically and horizontally, enabling sections of lithosphere to subside, rise, and undergo lateral movement; 2) the rigid outer layer of the Earth, having an average thickness of about 75 km and comprising the Earth's crust and the solid part of the mantle above the asthenosphere; 3) the solid outer shell of the Earth, with an average thickness of 30—35 km in continental regions and 5 km beneath the oceans, forming the upper part of the lithosphere and lying immediately above the mantle, from which it is separated by the Mohorovicic discontinuity; 4) the central part of the Earth, beneath the mantle, consisting mainly of iron and nickel, which

has an inner solid part surrounded by an outer liquid part; 5) the boundary between the Earth's crust and mantle, across which there is a sudden change in the velocity of seismic waves; 6) the part of the Earth between the crust and the core, accounting for more than 82% of the Earth's volume (but only 68% of its mass) and thought to be composed largely of peridotite; 7) *geol.* the process of one tectonic plate sliding under another, resulting in tensions and faulting in the Earth's crust, with earthquakes and volcanic eruptions; 8) seismic wave — an earth vibration generated by an earthquake or explosion; 9) a dark coarse-grained ultrabasic plutonic igneous rock consisting principally of olivine; 10) an olive-green mineral of the olivine group, found in igneous and metamorphic rocks.

Exercise 4. ***Insert the missing terms.***

There is strong evidence that Earth has a layered structure with (1) a (2), and (3). This description of the structure is important for historical reasons and for understanding how (4) evolved over time. There is also another, more detailed structure that can be described. This structure is far more important in understanding the history and present appearance of (5) surface, including the phenomena of earthquakes and volcanoes.

The important part of this different structural description of Earth's (6) was first identified from seismic data. There is a thin zone in the (7) where (8) undergo a sharp *decrease* in velocity. This low-velocity zone is evidently a hot, elastic semiliquid (9) that extends around the entire Earth. It is called the (10) after the Greek for "weak shell." The asthenosphere is weak because it is plastic and mobile and yields to stresses. In some regions, the (11) is completely liquid, containing pockets of magma.

The rocks above and below the asthenosphere are rigid, lacking a partial melt. The solid layer above the asthenosphere is called the (12) after the Greek for "stone shell." The lithosphere is also known as the "strong layer" in contrast to the "weak layer" of the asthenosphere. The lithosphere includes the entire (13), the (14), and the upper part of the (15). The asthenosphere is one important source of magma that reaches Earth's surface. It is also a necessary part of the mechanism involved in the movement of the (16). The lithosphere is made up of comparatively rigid plates that are moving, floating in the upper (17) like giant ice sheets floating in the ocean.

Exercise 5. ***Translate the nominative attributive constructions used in text 1 into Russian.***

1) mid-ocean ridge system; 2) the 7-kilometre crust; 3) easy bus ride away; 4) ocean drilling techniques; 5) oil exploration industry; 6) ocean crust; 7) ocean sediment;8) mantle rock; 9) magnesium / iron silicate; 10) silicate rocks; 11) iron-rich material; 12) ocean lithosphere; 13) mantle plume; 14) day length; 15) mountain range; 16) bulk composition.

Exercise 6. ***Read text 1 and answer the questions.***

1) What are the three main areas of Earth's interior?

2) Why did attempts at deep drilling on land on Russia's Kola Peninsula and in Germany have to be abandoned after about 11,000 metres?

3) What is the middle part of Earth's interior?

4) In which way can we sample the mantle directly?

5) What elements is the core of the Earth composed of?

6) Seismological studies suggest that the core has a liquid outer core and solid inner core, don't they?

7) What is the separation of materials that gave Earth its layered interior called?

8) What is a vibration that moves through any part of Earth called?

9) What is the boundary between the crust and the mantle called?

10) What is the mantle composed of?

11) What does the evidence from meteorite studies propose about the chemical composition of the core?

12) What is the layer that is broken up into plates that move in the upper mantle?

Exercise 7. ***Translate into Russian.***

1) The surface of the Earth is covered by a relatively thin, cold, hard crust. Beneath the oceans it is about 7 or 8 kilometres thick; in the continents, 30 to 60 kilometres thick. At its base lies the Mohorovicic discontinuity or Moho, a layer which reflects seismic waves, probably as a result of a change in composition to the dense rocks of the mantle beneath.

2) The lithosphere, the complete slab of cold, hard material on the Earth's surface, includes not only the crust but the top of the mantle as well. In total, the continental lithosphere may be 250 or even 300 kilometres thick. It thins under the oceans, as you approach the mid-ocean ridge system, down to little more than the 7-kilometre crust.

3) The lithosphere is not a single rigid layer, however. It is split into a series of slabs called tectonic plates. They are our principal clue as to how the deep Earth works. To understand what's going on, we must probe beneath the crust.

4) No mine can tunnel that deep. Attempts at deep drilling on land on Russia's Kola Peninsula and in Germany had to be abandoned after about 11,000 metres. Not only was the rock difficult to drill, but the heat and pressure tended to soften the drill components and squeeze the hole shut again as soon as it was drilled.

5) There is one way in which we can sample the mantle directly: in the outpourings of deep rooted volcanoes.

6) Violent volcanic eruptions do sometimes carry in their magma more direct samples of mantle rocks. These so called xenoliths are samples of mantle rock that have not been melted, just carried along in the flow. They are typically dark, dense, greenish rocks such as peridotite, rich in the mineral olivine, a magnesium / iron silicate.

7) Recent analysis of seismic data from around the world has revealed a thin layer at the base of the mantle, the D-layer, up to 200 kilometres thick. It is not a continuous layer but seems more like a series of slabs, a bit like continents on the underside of the mantle. This could be regions where silicate rocks in the mantle are partly mixed with iron-rich material from the core.

8) So there may be ridges and valleys like upside down mountain ranges on the base of the mantle. There seems to be a great depression in the core beneath the Philippines that is 10 kilometres deep, twice the depth of the Grand Canyon. Bulging up beneath the Gulf of Alaska is a high spot on the core; a liquid mountain taller than Everest. Maybe sinking cold material indents the core, while hotspots bulge up.

9) We have no direct experience or samples of the Earth's core. But we do know from seismic waves that the outer part of it is liquid and only the inner core is solid. We also know that the core has a much higher density than the mantle. The only material that is dense enough and sufficiently abundant in the solar system to make up the bulk of the core is iron. Although we do not have samples of the Earth's core, we do have pieces of something that's likely to be similar, in iron meteorites.

10) An iron core must have formed in the Earth by gravitational separation from the silicate mantle when the new Earth was at least partially molten. As the layers separated, so called siderophile elements such as nickel, sulphur, tungsten, platinum, and gold that are soluble in molten iron would have separated with them. Lithophile elements would have been held back by the silicate mantle. Radioactive elements such as uranium and hafnium are lithophile, whereas their decay products, or daughters, are isotopes of lead and tungsten so would have been separated out into the core at its formation. That consequently reset the radioactive clock in the mantle at the time the core formed.

11) Continental crust is less dense, granite-type rock, while the oceanic crust is denser basaltic rock. Both types of crust behave as if

they were floating on the mantle, which is denser than either type of crust.

Exercise 8. ***Translate into English.***

1) Астрономы изучают космос, получают информацию о планетах и звездах, несмотря на их огромную удаленность. При этом на самой Земле не меньше тайн, чем во Вселенной. И сегодня ученые не знают, что внутри нашей планеты. Наблюдая, как выливается лава при извержении вулкана, можно подумать, что внутри Земля тоже расплавленная. Но это не так.

2) Центральная часть земного шара называется ядром. Его радиус составляет около 3500 км. Ученые полагают, что внешняя часть ядра находится в расплавленно-жидком состоянии, а внутренняя — в твердом. Температура в нем достигает +5000°С. От ядра к поверхности Земли температура и давление постепенно снижаются.

3) Ядро Земли покрыто мантией. Ее толщина составляет приблизительно 2900 км. Мантию, как и ядро, никто никогда не видел. Но предполагают, что чем ближе к центру Земли, тем давление в ней выше, а температура — от нескольких сотен до +2500°С. Считают, что мантия твердая, но одновременно и раскаленная.

4) Поверх мантии наша планета покрыта корой. Это верхний твердый слой Земли. По сравнению с ядром и мантией земная кора очень тонкая. Ее толща составляет лишь 10—70 км. Но это та земная твердь, по которой мы ходим, текут реки, на ней построены города.

5) Земная кора образована различными веществами. Она состоит из минералов и горных пород (гранит, песок, глина, торф и др.). Минералы и горные породы различаются по цвету, твердости, строению, температуре плавления, растворимости в воде и другим свойствам. Многие из них человек широко использует, например, как топливо, в строительстве, для получения металлов.

6) Толщина земной коры (внешней оболочки) изменяется от нескольких километров (в океанических областях) до нескольких десятков километров (в горных районах материков). Сфера земной коры очень небольшая, на ее долю приходится всего около 0,5% общей массы планеты.

7) На долю мантии приходится около 67% общей массы планеты. Твердый слой верхней мантии, распространяющийся до различных глубин под океанами и континентами, совместно с земной корой называют литосферой — самой жесткой оболочкой Земли. Под ней отмечен слой, где наблюдается некоторое уменьшение скорости распространения сейсмических волн, что говорит о своеобразном состоянии вещества. Этот слой, менее вязкий и более пластичный по отношению к выше- и нижележащим слоям, называют астеносферой. Считается, что вещество мантии находится в непрерывном движении.

8) Земное ядро разделяется на 2 отдельные области: жидкую (внешнее ядро) и твердую (внутреннее), переход между ними лежит на глубине 5156 км. По современным данным внешнее ядро представляет собой вращающиеся потоки расплавленного железа и никеля, хорошо проводящие электричество. Именно с ним связывают происхождение земного магнитного поля. Считается, что электрические токи, текущие в жидком ядре, создают глобальное магнитное поле.

9) Слой мантии, находящийся в соприкосновении с внешним ядром, испытывает его влияние, поскольку температуры в ядре выше, чем в мантии. Местами этот слой порождает огромные, направленные к поверхности Земли тепломассопотоки — плюмы.

10) Земная кора — внешняя твердая оболочка (кора) Земли, верхняя часть литосферы. Ниже коры находится мантия, которая отличается составом и физическими свойствами — она более плотная, содержит в основном тугоплавкие элементы. Разделяет кору и мантию граница Мохоровичича, или сокращенно Мохо, на которой происходит резкое увеличение скоростей сейсмических волн. С внешней стороны большая часть коры покрыта

гидросферой, а меньшая находится под воздействием атмосферы. Земная кора схожа по структуре с корой большинства планет земной группы, за исключением Меркурия. Кроме того кора схожего типа есть на Луне и многих спутниках планет-гигантов. При этом Земля уникальна тем, что обладает корой двух типов: континентальной и океанической. Масса земной коры оценивается в $2,8 \times 10^{19}$ тонн (из них 21% — океаническая кора и 79% — континентальная). Кора составляет лишь 0,473% общей массы Земли. В большинстве случаев кора состоит из базальтов. Для земной коры характерны постоянные движения: горизонтальные и колебательные.

11) Характерная черта эволюции Земли — дифференциация вещества, выражением которой служит оболочечное строение нашей планеты. Литосфера, гидросфера, атмосфера, биосфера образуют основные оболочки Земли, отличающиеся химическим составом, мощностью и состоянием вещества.

Exercise 9. ***Translate the text using PROMT (Déjà Vu, TRADOS). Analyze the translation and make corrections.***

HISTORY OF EARTH'S INTERIOR

Many of the properties and characteristics of Earth, including the structure of its interior, can be explained from current theories of how it formed and evolved. Here is the theoretical summary of how Earth's interior was formed, discussed as if it were a fact. Keep in mind, however, that the following is all conjecture, even if it is conjecture based on facts.

In brief, Earth is considered to have formed about 4.6 billion years ago in a rotating disk of particles and grains that had condensed around a central protosun. The condensed rock, iron, and mineral grains were pulled together by gravity, growing eventually to a planet-sized mass. Not all the bits and pieces of matter in the original solar nebula were incorporated into the newly formed planets. They were soon being pulled by gravity to the newly born planets and their satellites. All sizes of these leftover bits and pieces of matter thus began bombarding the planets and their moons. Evidently, the bombardment was so intense that the heat generated by impact after impact increased the surface temperature to the melting point. Evidence visible on the Moon and other planets today indicates that the bombardment was substantial as well as lengthy, continuing for several hundred million years. Calculations of the heating resulting from this tremendous bombardment indicate that sufficient heat was liberated to melt the entire surface of Earth to a layer of glowing, molten lava. Thus, the early Earth had a surface of molten lava that eventually cooled and crystallized to solid igneous rocks as the bombardment gradually subsided, then stopped.

Then Earth began to undergo a second melting, this time from the inside. The interior slowly accumulated heat from the radioactive decay of uranium, thorium, and other radioactive isotopes. Heat conducts slowly through great thicknesses of rock and rock materials. After about 100 million years or so of accumulating heat, parts of the interior became hot enough to melt into pockets of magma. Iron and other metals were pulled from the magma toward the center of Earth, leaving less dense rocks toward the surface. The melting probably did not occur all at one time throughout the interior but rather in local pockets of magma. Each magma pocket became molten, cooled to a solid, and perhaps repeated the cycle numerous times. With each cyclic melting, the heavier abundant elements were pulled by gravity toward the center of Earth, and additional heat was generated by the release of gravitational energy. Today, Earth's interior still contains an outer core of molten material that is predominantly iron. The environment of the center of Earth today is extreme, with estimates of pressures up to 3,5 million atmospheres (3,5 million times the pressure of the atmosphere at the surface). Recent estimates of the temperatures at Earth's core are about the same as the temperature of the surface of the Sun, about 6,000°C (11,000°F).

The melting and flowing of iron to Earth's center were the beginnings of differentiation, the separation of materials that gave Earth its present-day stratified or layered interior. The different crystallization temperatures of the basic minerals further differentiated the materials in Earth's interior.

(by Dr. F.Borrero et al. from Earth Science: Geology, the Environment and the Universe)

<u>Exercise 10.</u> ***Write a précis and an annotation of the texts given below in Russian.***

EARTH'S INTERNAL STRUCTURE

The theoretical formation of Earth and the layered structure of its interior are supported by indirect evidence from measurements of vibrations in Earth, Earth's magnetic field, gravity, and heat flow. First, we will consider how vibrations tell us about Earth's interior.

If you have ever felt vibrations in Earth from a passing train, an explosion, or an earthquake, you know that Earth can vibrate. In fact, a large disturbance such as a nuclear explosion or really big earthquake can generate waves that pass through the entire Earth. A vibration that moves through any part of Earth is called a seismic wave. Geologists use seismic waves to learn about Earth's interior.

Seismic waves radiate outward from an earthquake, spreading in all directions through the solid Earth's interior as do sound waves from an explosion. There are basically three kinds of waves:

A longitudinal (compressional) wave called a P-wave. P-waves are the fastest and move through surface rocks and solid and liquid materials below the surface. The *P* stands for primary.

A transverse (shear) wave called an S-wave. The *S* stands for secondary. S-waves are second fastest after the P-waves. S-waves do not travel through liquids

Using data from seismic waves, scientists were able to determine that the interior of Earth can be broken down into three zones. The *crust* is the outer layer of rock that forms a thin shell around Earth. Below the crust is the *mantle,* a much thicker shell than the crust. The mantle separates the crust from the center part, which is called the *core.*

THE CRUST

Seismic studies have found that Earth's crust is a thin skin that covers the entire Earth, existing below the oceans as well as making up the continents. According to seismic waves, there are differences between the crust making up the continents and the crust beneath the oceans. These differences are that (1) the oceanic crust is much thinner than the continental crust and (2) seismic waves move through the oceanic crust faster than they do through continental crust. The two types of crust vary because they are made up of different kinds of rock.

The boundary between the crust and the mantle is marked by a sharp increase in the velocity of seismic waves as they pass from the crust to the mantle. Today, this boundary is called the Mohorovicic discontinuity, or the "Moho" for short. The boundary is a zone where seismic P-waves increase in velocity because of changes in the composition of the materials. The increase occurs because the composition on both sides of the boundary is different. The mantle is richer in ferromagnesian minerals and poorer in silicon than the crust.

Studies of the Moho show that the crust varies in thickness around Earth's surface. It is thicker under the continents and thinner under the oceans.

The age of rock samples from Earth's continents has been compared with the age samples of rocks taken from the seafloor by oceanographic ships. This sampling has found the continental crust to be much older, with parts up to 3,8 billion years old. By comparison, the oldest oceanic crust is less than 200 million years old.

Comparative sampling also found that continental crust is a less dense, granite-type rock with a density of about 2,7 g/cm^3. Oceanic crust, on the other hand, is made up of basaltic rock with a density of about 3,0 g/cm^3. The less dense crust behaves as if it were floating on the mantle, much as less dense ice floats on water. There are exceptions, but in general, the thicker, less dense continental crust "floats" in the mantle above sea level, and the thin, dense oceanic crust "floats" in the mantle far below sea level.

THE MANTLE

The middle part of Earth's interior is called the mantle. The mantle is a thick shell between the core and the crust. This shell takes up about 80 percent of the total volume of Earth and accounts for about two thirds of Earth's total mass. Information about the composition and nature of the mantle comes from (1) studies of seismological data, (2) studies of the nature of meteorites, and (3) studies of materials from the mantle that have been ejected to Earth's surface by volcanoes. The evidence from these separate sources all indicates that the mantle is composed of silicates, predominantly the ferromagnesian silicate *olivine.* Meteorites, as discussed in chapter 15, are basically either iron meteorites or stony meteorites. Most of the stony meteorites are silicates with a composition that would produce the chemical composition of olivine if they were melted and the heavier elements separated by gravity. This chemical composition also agrees closely with the composition of basalt, the most common volcanic rock found on the surface of Earth.

THE CORE

Information about the nature of the core, the center part of Earth, comes from studies of three sources of information: (1) seismological data, (2) the nature of meteorites, and (3) geological data at the surface of Earth. Seismological data provide the primary evidence for the structure of the core of Earth. Seismic P-waves spread through Earth from a large earthquake. However, there are places between 103^0 and 142^0 of arc from the earthquake that do not receive P-waves. This region is called the P-wave shadow zone, since no P-waves are received here. The P-wave shadow zone is explained by P-waves being refracted by the core, leaving a shadow. The paths of P-waves can be accurately calculated, so the size and shape of Earth's core can also be accurately calculated.

Seismic S-waves leave a different pattern at seismic receiving stations around Earth. Recall that S-waves (sideways or transverse) can travel only through solid materials. An S-wave shadow zone also exists and is larger than the P-wave shadow zone. S-waves are not recorded in the entire region more than 103° away from the epicenter. The S-wave shadow zone seems to indicate that S-waves do not travel through the core at all. If this is true, it implies that the core of Earth is a liquid or at least acts as a liquid.

Analysis of P-wave data suggests that the core has two parts: a liquid outer core and a solid inner core. Both the P-wave and S-wave data support this conclusion. Overall, the core makes up about 15 percent of Earth's total volume and about one third of its mass.

(by Dr. F.Borrero et al. from Earth Science: Geology, the Environment and the Universe)

Exercise 11. ***Write an annotation of the text given below in Russian.***

EARTH'S INTERIOR

What is deep inside Earth? What you can see — the rocks, minerals, and soil on the surface — is a thin veneer. Nothing has ever been directly observed below this veneer, however. The deepest mine has penetrated to depths of about 3 km (about 2 mi), and the deepest oil wells may penetrate down to about 8 km (about 5 mi). But Earth has a radius of about 6,370 km (about 3,960 mi). How far have the mines and wells penetrated into Earth? By way of analogy, consider the radius of Earth to be the length of a football field, from one goal line to the other. The deep mine represents progress of 4,3 cm (1,7 in) from one goal line. The deep oil well represents progress of about 11,5 cm (about 4,5 in). It should be obvious that human efforts have only sampled materials directly beneath the surface. What is known about Earth's interior was learned indirectly, from measurements of earthquake waves, how heat moves through rocks, and Earth's magnetic field.

Indirect evidence suggests that Earth is divided into three main parts — the crust on the surface, a rocky mantle beneath the crust, and a metallic core. The crust and the uppermost mantle can be classified on a different basis, as a rigid layer made up of the crust and part of the upper mantle, and as a plastic, movable layer below in the upper mantle.

Understanding that Earth has a rigid upper layer on top of a plastic, movable layer is important in understanding the concepts of plate tectonics. Plate tectonics describes how the continents and the seafloor are moving on giant, rigid plates over the plastic layer below. This movement can be measured directly. In some places, the movement of a continent is about as fast as your fingernail grows, but movement does occur.

Understanding that Earth's surface is made up of moving plates is important in understanding a number of Earth phenomena. These include earthquakes, volcanoes, why deep-sea trenches exist where they do, and why mountains exist where they do. This chapter is the "whole Earth" chapter, describing all of Earth's interior and the theory of plate tectonics. A bit of indirect information about Earth's interior, a theory of plate tectonics, and the observation of a number of related Earth phenomena all fit together. You can use this concept to explain many things that happen on the surface of Earth.

(by Dr. F. Borrero et al. from Earth Science: Geology, the Environment and the Universe)

Exercise 12. ***Write a précis and an annotation of the text below in English.***

ВНУТРЕННЕЕ СТРОЕНИЕ ЗЕМЛИ

Земля так же, как и многие другие планеты, имеет слоистое внутреннее строение. Наша планета состоит из трех основных слоев. Внутренний слой — это ядро, наружный — земная кора, а между ними размещена мантия.

Ядро представляет собой центральную часть Земли и расположено на глубине 3000—6000 км. Радиус ядра составляет 3500 км. По мнению ученых, ядро состоит из двух частей: внешней — вероятно, жидкой, и внутренней — твердой. Температура ядра составляет около 5000 градусов. Современные представления о ядре нашей планеты получены в ходе длительных исследований и анализа полученных данных. Так, доказано, что в ядре планеты содержание железа достигает 35%, что обусловливает его характерные сейсмические свойства. Внешняя часть ядра представлена вращающимися потоками никеля и железа, которые хорошо проводят электрический ток.

Происхождение магнитного поля Земли связано именно с этой частью ядра, так как глобальное магнитное поле создается электрическими токами, протекающими в жидком веществе внешнего ядра. Из-за очень высокой температуры внешнее ядро оказывает значительное влияние на соприкасающиеся с ним участки мантии. В некоторых местах возникают громадные тепломассопотоки (плюмы), направленные к поверхности Земли. Внутреннее ядро Земли твердое и также имеет высокую температуру. Ученые полагают, что такое состояние внутренней части ядра обеспечивается очень высоким давлением в центре Земли, достигающим 3 млн атмосфер. При увеличении расстояния от поверхности Земли повышается сжатие веществ, при этом многие из них переходят в металлическое состояние.

Промежуточный слой — мантия — покрывает ядро. Мантия занимает около 80% объема нашей планеты, это самая большая часть Земли. Мантия расположена кверху от ядра, но не достигает поверхности Земли, снаружи она соприкасается с земной корой. В основном вещество мантии находится в твердом состоянии, кроме верхнего вязкого слоя толщиной примерно 80 км. Это астеносфера, что в переводе с греческого языка означает *слабый шар*. По мнению ученых, вещество мантии непрерывно движется. При увеличении расстояния от земной коры в сторону ядра происходит переход вещества мантии в более плотное состояние.

Снаружи мантию покрывает земная кора — внешняя прочная оболочка. Ее толщина варьирует от нескольких километров под океанами до нескольких десятков километров в горных массивах. На долю земной коры приходится всего 0,5% общей массы нашей планеты. Часть земной коры, простирающаяся до глубин, доступных для геологического изучения, образует недра Земли, которые требуют особой охраны и разумного использования. В состав коры входят оксиды кремния, железа, алюминия, щелочных металлов. Континентальная земная кора делится на три слоя: осадочный, гранитный и базальтовый. Океаническая земная кора состоит из осадочного и базальтового слоев.

Литосферу Земли формирует земная кора вместе с верхним слоем мантии. Литосфера слагается из тектонических литосферных плит, которые как будто «скользят» по астеносфере со скоростью от 20 до 75 мм в год. Двигающиеся друг относительно друга литосферные плиты различны по величине, а кинематику передвижения определяет тектоника плит.

Согласно современной теории литосферных плит вся литосфера узкими и активными зонами — глубинными разломами — разделена на отдельные блоки, перемещающиеся в пластичном слое верхней мантии относительно друг друга со скоростью 2—3 см в год. Эти блоки называются литосферными плитами.

Особенность литосферных плит — их жесткость и способность при отсутствии внешних воздействий длительное время сохранять неизменными форму и строение.

Литосферные плиты подвижны. Их перемещение по поверхности астеносферы происходит под влиянием конвективных течений в мантии. Отдельные литосферные плиты могут расходиться, сближаться или скользить друг относительно друга. В первом случае между плитами возникают зоны растяжения с трещинами вдоль их границ, во втором — зоны сжатия, сопровождаемые надвиганием одной плиты на другую (надвигание — обдукция; поддвигание — субдукция), в третьем — сдвиговые зоны — разломы, вдоль которых происходит скольжение соседних плит.

В местах схождения континентальных плит происходит их столкновение, образуются горные пояса. Так возникла, например, на границе Евразийской и Индо-Австралийской плиты горная система Гималаи.

В результате столкновения континентальной и океанической литосферных плит образуются глубоководные желоба и островные дуги.

Для осевых зон срединно-океанических хребтов характерны рифты (от англ. *rift* — расщелина, трещина, разлом) — крупная линейная тектоническая структура земной коры протяженностью в сотни, тысячи, шириной в десятки, а иногда и сотни километров, образовавшаяся главным образом при горизонтальном растяжении коры. Очень крупные рифты называются рифтовыми поясами, зонами или системами.

Так как литосферная плита представляет собой единую пластину, то каждый ее разлом — это источник сейсмической активности и вулканизма. Эти источники сосредоточены в пределах сравнительно узких зон, вдоль которых происходят взаимные перемещения и трения смежных плит. Эти зоны получили название сейсмических поясов. Рифты, срединно-океанические хребты и глубоководные желоба являются подвижными областями Земли и располагаются на границах литосферных плит. Это свидетельствует о том, что процесс формирования земной коры в этих зонах в настоящее время происходит очень интенсивно.

Химический состав Земли схож с составом других планет земной группы, например Венеры или Марса. В целом преобладают такие элементы, как железо, кислород, кремний, магний, никель. Содержание легких элементов невелико. Средняя плотность вещества Земли 5,5 г/см^3.

(www.geographya.ru)

UNIT 4. PHYSICS

Text 1

WHAT IS ENERGY?

Living things need energy to survive. In order to eat, move, play, think, attend school, catch a football, chat on the computer, and even to sleep, you need energy. In the wild, animals have to have energy to find food, escape predators, and capture prey.

What about non-living things? They need energy, too. Your car isn't going to get you to the beach without the energy to power it. You can't send an email without your computer being powered by energy. And your house won't be warm in the winter and cool in the summer without energy.

While you hear about energy every day, needing energy isn't something that's new to humans. Ancient cave dwellers may not have been able to "tune in" and catch the nightly news on wide-screen televisions or call the local dinomart to order a pizza. But they still needed energy in the form of heat, to stay warm and to cook their food. So they burned wood.

All that makes sense, right? But what is energy? How does it work in so many different ways?

Simply put, energy is the ability to do work. Without energy, nothing would move, change, or grow. In this case, "work" doesn't specifically mean doing your homework or sweeping out the garage (although you do need energy to do those things!).

Scientists define work as when a force is applied to an object. A force is something that pushes or pulls on something else. That force transfers energy to the object, making the object move. Think about sweeping the garage again. You apply pressure to the broom, pushing and pulling on it. You're transferring your energy to the broom — and it's doing work for you. All over the world, from rabbits munching on grass to power plants generating electricity, work is being done. You may think energy is electricity. That's partly right. But electricity isn't a source of energy. It's an energy carrier.

Energy sources are the things that have stored energy. A great example of stored energy is a wire spring. Imagine you have that small spring between your thumb and forefinger. When you squeeze down, you're applying a force on the spring. You know what will happen if you release your fingers — that spring will go flying. It has stored energy. When you do finally release it, the spring pushes back against your fingers, releasing that energy again and launching itself. Same thing with a rubber band. You stretch it out nice and tight and it's loaded with stored energy.

When you release it — zing! Off it goes toward your target, changing that energy into motion.

Go ahead and turn the pages to get started. You'll be using some stored energy inside your body to apply a force to each page to make it work for you — and you'll be glad you did!

Energy is the ability to make things happen — to do work. It doesn't matter if it's a living creature or a school bus, everything needs energy to move and do things. Whether you're running a marathon or taking a nap, you're using energy to move, breathe, and make your body go. When a tree grows, it's using energy. And non-living things, like the hands on a clock, use energy to move, too.

There's a saying, "Energy cannot be created or destroyed." That's because everything in the universe is made up of matter. Anything that takes up space and has mass is matter. An electric guitar is made of matter. An imaginary guitar is not. You're made of matter, and so is your cat, your best friend, your family minivan, and everything else you can physically touch in the entire world.

Even air is made out of matter. Think of it this way: if you fill up a balloon with air, you can see the shape of the air filling it up. Air fills it because it's made of oxygen, nitrogen, and carbon dioxide molecules.

Imagine you have a very strong microscope and put a piece of matter, like a bit of an apple, under it. If you zoomed in, you'd see the cells that make up the apple. Keep zooming in and you'd eventually see what matter is made up of — atoms. These are the microscopic parts that, when they come together in a particular way, make up everything.

Atoms are matter. They can't be created or destroyed. If you're thinking, "Whoa, if I eat an apple, I'm destroying it," you're partly right.

The apple was grown from a chemical reaction the sun's energy started, called photosynthesis. Then, you gobbled up the apple (using energy to eat it). The apple itself, a round, red piece of fruit, no longer exists in that form. You chewed it up and your stomach digested it. But the atoms that made up that apple are still around — they just got rearranged (teeth can do that) and used for other things. In this case, your body took what it needed from the apple to absorb into your body, using it as fuel to make you move and grow.

Think of it like this. An apple tree takes the sun's energy and converts it into sugars using photosynthesis. The sugars, called carbohydrates, give the tree the energy to grow apples. You eat the apple, and convert it into energy for your body to use. Your body might use it to run, or in "behind the scenes" ways, like building cells or maintaining your body heat. Energy changes forms, but it's still in the universe in some way. It never — poof! — disappears.

Without energy, living things couldn't move or grow. We wouldn't be able to use things like videogames or bicycles. Think about all the different things that move or do work. Now think about what would happen if we had no energy at all.

Sometimes we use the words "energy" and "power" to mean the same thing. They are similar, but there is a difference between them. You just saw that energy is the ability to do work. If something has an energy source, say, if your car has gasoline or if your MP3 player has charged batteries, it can do work. Your car can drive and your MP3 player can play music.

Power is the measurement of energy being used up over time. The more power something has, the more energy it uses.

There's another difference: Energy can't be created or destroyed. It changes forms, but it's always present in the universe. Power is created. You create power when you use energy. If you flip on a light switch to light a room for an hour, you're using power over a period of time. That usage can be measured — and that's power. When the light is off, there's no power.

But now that the words have been defined, here's the catch: Sometimes the words are used to mean the same thing! That's why "nuclear power" and "nuclear energy" mean the same thing — energy that's created from atoms. The words "energy" and "power" are partners.

(by Kathleen M. Reilly from Energy: Investigate Why we Need Power and How We Get It)

VOCABULARY

energy — энергия, сила, мощность
energy carrier — рабочее тело или вещество, энергоноситель
matter — материя, вещество
power — сила, энергия, потенциал
predator — хищник
prey — ловить, охотиться
to flip — щелкнуть, включить / выключить
to power — приводить в действие, питать / снабжать энергией
to rearrange — перегруппировать
to store — сохранять, хранить
to tune in — настраивать, фиксировать

Exercise 1. ***Answer the following questions:***

1) Why do living things need energy?
2) What does the expression "to do work" mean in this text?
3) What do energy sources do?

4) What is everything in the universe made up of?

5) What is the difference between the notions "power" and "energy"?

6) How can we measure power? Is it possible to measure energy?

7) What is the difference between "nuclear power" and "nuclear energy"?

8) Is there any difference in translation of these expressions into Russian?

Exercise 2. ***Translate the following word combinations containing words "energy" and "power" into Russian, paying attention to the use of words "атомный" and "ядерный".***

1) to apply one's energy; 2) to expend one's energy; 3) to redirect one's energies; 4) to dissipate energy; 5) to provide energy for; 6) to harness energy (*to harness solar energy*); 7) atomic energy; 8) nuclear energy; 9) kinetic energy; 10) solar energy; 11) sources of energy; 12) an energy crisis; 13) to sap somebody's energy; 14) boundless energy; 15) limitless energy; 16) unflagging energy; 17) latent energy; 18) misguided energy; 19) unharnessed energy; 20) a burst of energy; 21) to assume power; 22) to take power; 23) to exercise power; 24) to wield power; 25) to seize power; 26) to transfer power; 27) emergency power; 28) executive power; 29) political power; 30) discretionary powers; 31) power over (they seized power over several provinces); 32) in power (*the government in power*); 33) into power (*to come into power*); 34) the balance of power nation; 35) the great powers; 36) world powers; 37) a superpower; 38) warring powers; 39) a foreign power; 40) an occupying power; 41) to develop one's powers (of observation); 42) bargaining power; 43) earning power; 44) healing power; 45) purchasing power; 46) recuperative power; 47) staying power; 48) supernatural powers; 49) air power; 50) military power; 51) naval power; 52) sea power; 53) police power; 54) fire power; 55) to turn on the power; 56) to cut off the power; 57) turn off the power; 58) electric power; 59) hydroelectric power; 60) nuclear

power; 61) water power; 62) under one's own power; 63) to raise to a power (*to raise five to the third power*).

Exercise 3. ***Translate the following Russian synonyms into English.***

1) смелость; 2) отвага; 3) решимость; 4) мужество; 5) предприимчивость; 6) самонадеянность; 7) самоуверенность; 8) энергия; 9) присутствие духа; 10) подъем духа; 11) храбрость; 12) крепость; 13) мощь; 14) держава; 15) власть; 16) вес; 17) владычество; 18) господство; 19) держава; 20) сила; 21) могущество; 22) полномочие; 23) право (полное); 24) престол; 25) царство.

Exercise 4. ***Give Russian equivalents to the following words.***

1) energy; 2) power; 3) forcefulness; 4) intensity; 5) determination; 6) vivacity; 7) force; 8) drive; 9) strength; 10) dynamism.

Exercise 5. ***Translate the following quotes into Russian.***

a) Imagine a world in which there is no disease... where hunger is unknown... where food never rots and crops never spoil... Where "dirt" is an old-fashioned word, and routine household tasks are just a matter of pressing a few buttons... a world where no one ever stokes a furnace or curses the smog, where the air everywhere is as fresh as on a mountaintop and the breeze from a factory as sweet as from a rose... Imagine the world of the future... the world that nuclear energy can create for all of us *(from "Atoms for Peace," Ladies Home Journal)*.

b) Since I do not foresee that atomic energy is to be a great boon for a long time, I have to say that for the present it is a menace. Perhaps it is well that it should be. It may intimidate the human race into bringing order into its international affairs, which, without the presence of fear, it would not do (*Albert Einstein* from *Atlantic Monthly*).

c) Energy is central to achieving sustainable development goals. With more than 1,6 billion people still lacking access to electricity worldwide and 2,4 billion using traditional biomass, improving access to reliable, affordable and environmentally friendly energy services is a major challenge to poverty eradication and the achievement of the MDGs. There is also an urgent need to transform global energy systems, as current approaches are causing serious harm to human health, the Earth's climate and ecological systems on which all life depends, and because access to clean, reliable energy services is a vital prerequisite for alleviating poverty *(Archbishop Celestino Migliore from Statement to the United Nations).*

Exercise 6. ***What do these branches of physics study? Use reference books, guidebooks and Internet sources.***

1) astrophysics; 2) biophysics; 3) chemical physics; 4) econophysics; 5) geophysics; 6) medical physics; 7) physical chemistry.

Exercise 7. ***Learn the main physics theories, subtopics and the concepts they employ. Translate this table into Russian.***

Theory	Major subtopics	Concepts
Classical mechanics	Newton's laws of motion, Lagrangian mechanics, Hamiltonian mechanics, kinematics, statics, dynamics, chaos theory, acoustics, fluid dynamics, continuum mechanics	Density, dimension, gravity, space, time, motion, length, position, velocity, acceleration, Galilean invariance, mass, momentum, impulse, force, energy, angular velocity, angular momentum, moment of inertia, torque, conservation law, harmonic oscillator, wave, work, power, Lagrangian, Hamiltonian, Tait—Bryan angles, Euler angles, pneumatic, hydraulic

Theory	Major subtopics	Concepts
Electromagnetism	Electrostatics, electrodynamics, electricity, magnetism, magnetostatics, Maxwell's equations, optics	Capacitance, electric charge, current, electrical conductivity, electric field, electric permittivity, electric potential, electrical resistance, electromagnetic field, electromagnetic induction, electromagnetic radiation, Gaussian surface, magnetic field, magnetic flux, magnetic monopole, magnetic permeability
Thermodynamics and statistical mechanics	Heat engine, kinetic theory	Boltzmann's constant, conjugate variables, enthalpy, entropy, equation of state, equipartition theorem, thermodynamic free energy, heat, ideal gas law, internal energy, laws of thermodynamics, Maxwell relations, irreversible process, Ising model, mechanical action, partition function, pressure, reversible process, spontaneous process, state function, statistical ensemble, temperature, thermodynamic equilibrium, thermodynamic potential, thermodynamic processes, thermodynamic state, thermodynamic system, viscosity, volume, work, granular material

Theory	Major subtopics	Concepts
Quantum mechanics	Path integral formulation, scattering theory, Schrödinger equation, quantum field theory, quantum statistical mechanics	Adiabatic approximation, black-body radiation, correspondence principle, free particle, Hamiltonian, Hilbert space, identical particles, matrix mechanics, Planck's constant, observer effect, operators, quanta, quantization, quantum entanglement, quantum harmonic oscillator, quantum number, quantum tunneling, Schrödinger's cat, Dirac equation, spin, wave function, wave mechanics, wave-particle duality, zero-point energy, Pauli exclusion principle, Heisenberg uncertainty principle
Relativity	Special relativity, general relativity, Einstein field equations	Covariance, Einstein manifold, equivalence principle, four-momentum, four-vector, general principle of relativity, geodesic motion, gravity, gravitoelectromagnetism, inertial frame of reference, invariance, length contraction, Lorentzian manifold, Lorentz transformation, mass-energy equivalence, metric, Minkowski diagram, Minkowski space, principle of relativity, proper length, proper time, reference frame, rest energy, rest mass, relativity of simultaneity, spacetime, special principle of relativity, speed of light, stress-energy tensor, time dilation, twin paradox, world line

Exercise 8. ***Translate the following text into Russian. Write an abstract consisting of 4—6 sentences.***

Энергетическая безопасность — одна из важнейших составляющих национальной безопасности страны. Она трактуется как защищенность граждан и государства в целом от угроз дефицита всех видов энергии и энергоресурсов, возникающих из-за воздействия негативных природных, техногенных, управленческих, социально-экономических, внутри- и внешнеполитических факторов.

В наши дни актуальность проблемы энергетической безопасности вполне очевидна. Это обусловлено рядом крупных аварий, произошедших за последние годы в США и в ряде стран Европы, Африки, Азии и Южной Америки. Всего за последние 40 лет в энергосистемах мира произошло более четырех десятков крупных системных аварий, при этом половина из них — в США. Основные причины таких аварий лежат в стремлении решать в полном объеме коммерческие задачи без учета технологических возможностей электрических сетей, что приводит к многочисленным их перегрузкам и отключениям. Этому способствуют, в частности, либерализация и дерегулирование в электроэнергетике.

Расширение масштабов аварий по территории и времени наблюдалось также в связи с проблемами в информационном обеспечении, включая нарушения в работе телекоммуникационных и компьютерных сетей, в средствах системной автоматики и управления. Кроме того, отмечались отсутствие четкости в распределении ответственности между диспетчерскими центрами и недостаточный уровень подготовки персонала диспетчерских центров.

Одна из крупнейших аварий последних лет, в результате которой было потеряно более 61 тыс. МВт электроэнергии, произошла 14 августа 2003 года на территории США и Канады. Эта авария затронула более 50 млн человек и по предварительным оценкам нанесла ущерб в размере почти 10 млрд долл. в США и около 2,3 млрд канадских долл. в Канаде. В целом, продолжительность аварии составила 48 часов. Однако в некоторых районах США полное энергоснабжение было восстановлено лишь через четверо суток, а в Канаде — через семь суток.

Проведенный анализ нарушений энергоснабжения потребителей в ряде стран показал, что среднегодовая продолжительность отсутствия электроснабжения в пересчете на одного человека составляет 200 мин в США, 80 мин в Великобритании, 60 мин во Франции и 25 мин в Германии. В России этот показатель соответствует среднеевропейскому. Совершенно очевидно, что аварии энергосистем исключить полностью невозможно. Однако их частоту и масштабы можно существенно снизить, что вполне реально. Так, например, в нашей стране крупных системных аварий не было в течение 56 лет — с 18 декабря 1948 года по 25 мая 2005 года. Столь длительный безаварийный период был обеспечен эффективно работающими системами противоаварийного управления и рациональной структурой диспетчерского управления энергосистемами, энергообъединениями и Единой энергосистемой страны в целом.

(by Vyacheslav Ishkin from «Энергетическая безопасность — одна из основ безопасности страны»)

Exercise 9. ***Translate the italicised words and word combinations without using a dictionary. Render the text in English.***

Последняя ***крупная авария*** произошла в Московском регионе 25 мая 2005 года. Ее основными причинами стали следующие факторы:

— ***изношенность*** оборудования;

— ***опережающий*** рост потребления электроэнергии по сравнению с ростом генерирующих ***мощностей***, чему в первую очередь способствовал быстрый рост потребления электроэнергии ***непромышленными пользователями***. В результате баланс мощности сводился с резервом 10%, а иногда и ниже (в развитых странах обеспечиваемый резерв мощности составляет 25—30%);

— ***перегруженность*** электрических сетей;

— непрофессиональные действия ***эксплуатационного (в первую очередь, оперативно-диспетчерского) персонала***.

Московская авария выявила ***неподготовленность*** многих предприятий и организаций к подобным ***нештатным*** ситуациям. Значительное количество больниц, супермаркетов, центров управления, ***метрополитен*** и другие учреждения и предприятия не имеют резервных источников электропитания, или же резервирование обеспечивается в течение ограниченного времени.

Очевидно, что не следует экономить на создании резервных источников электропитания, так как эти затраты многократно ***окупаются*** при первой же аварии. Еще 40 лет назад президент крупнейшей в мире электроэнергетической организации — ***Международного Комитета по большим электроэнергетическим системам СИГРЭ*** (CIGRE) г-н Купер по этому поводу образно сказал, что «лучше до аварии потерять один палец, чем во время аварии потерять всю руку, а может быть и голову». В качестве примера хотелось бы поделиться опытом создания системы гарантированного электропитания в Центральном ***диспетчерском управлении Единой*** энергосистемой (ЦДУ ЕЭС) страны.

(by Vyacheslav Ishkin from «Энергетическая безопасность — одна из основ безопасности страны»)

Exercise 10. ***Translate the following information into Russian (in writing).***

The International Atomic Energy Agency:

- is an independent intergovernmental, science and technology-based organization, in the United Nations family, that serves as the global focal point for nuclear cooperation;
- assists its Member States, in the context of social and economic goals, in planning for and using nuclear science and technology for various peaceful purposes, including the generation

of electricity, and facilitates the transfer of such technology and knowledge in a sustainable manner to developing Member States;

- develops nuclear safety standards and, based on these standards, promotes the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation;
- verifies through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes.

Exercise 11. ***Using the translator's note-taking skills, write down the key events in nuclear non-proliferation. Translate the text into Russian based on your notes.***

2—27 May 2005: The *Seventh Review Conference of the States Parties to the NPT* convened in New York.

29 November 2004: The IAEA Board of Governors adopts a resolution, noting with interest the agreement between Iran, France, Germany and the United Kingdom, and welcoming the fact that Iran had decided to continue and extend its suspension of all enrichment related and reprocessing activities.

15 November 2004: Iran signs an agreement with France, Germany and the United Kingdom, in which Iran states its decision to continue and extend its suspension of all enrichment related and reprocessing activities.

10 March 2004: Libya signs the Additional Protocol with the IAEA.

6 January 2004: Libya ratifies the CTBT and accedes to the Chemical Weapons Convention (CWC).

19 December 2003: Libya announces that it would dismantle its WMD programmes, disclose all relevant information about those programmes, and allow IAEA inspectors to verify its compliance.

18 December 2003: Iran signs the Additional Protocol to its IAEA safeguards agreement.

23 September 2003: The Foreign Ministers of the NAC issue a joint statement in which they renew their commitment to achieve a world free from nuclear weapons.

11 September 2003: Following the initiative of the United States of 31 May 2003, 10 other states join the Proliferation Security Initiative (PSI) and issue a statement on Interdiction Principles. To enhance efforts to prevent the proliferation of WMD, their delivery systems, and related materials on the ground, in the air and at sea to and from countries of proliferation concern, PSI envisions partnerships of states employing their national capabilities to develop a broad range of legal, diplomatic, economic, military and other tools to interdict shipments of such items.

16 June 2003: The IAEA Board of Governors discusses the nuclear programme of Iran, disclosing that Iran had failed to report certain nuclear material and activities.

5 May 2003: Timor Leste accedes to the NPT.

10 January 2003: The Democratic People´s Republic of Korea announces its withdrawal from the NPT.

25 November 2002: The Hague Code of Conduct Against Ballistic Missile Proliferation (HCOC) is launched.

4 November 2002: Cuba accedes to the NPT as a non-nuclear-weapon State.

26—27 June 2002: The leaders of the Group of Eight Nations (G8) announce the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction at their summit in Kananaskis, Canada. Participants pledge to raise up to USD 20 billion over the next 10 years to combat the threat of WMD. Additionally, the G8 leaders agree on a comprehensive set of non-proliferation principles and a specific set of guidelines for new or expanded cooperation projects to address non-proliferation, disarmament, counter-terrorism and nuclear safety issues.

13 June 2002: Following the announcement on 13 December 2001, the United States withdraws from the 1972 Anti-Ballistic Missile Treaty (ABM).

24 May 2002: The Russian Federation and the United States sign the "Treaty on Strategic Offensive Reductions" (SORT) at the Moscow Summit ("Moscow Treaty"), agreeing upon reducing and limiting their respective strategic nuclear warheads to an aggregate number of 1700—2200 for each Party by 31 December 2012.

5 December 2001: The Russian Federation and the United States have completed reductions of their respective nuclear arsenals to the levels required under START I.

11—13 November 2001: The second Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty is held in New York and adopts a Final Declaration.

2 November 2001: The IAEA holds a Special Session on Combating Nuclear Terrorism, addressing among others the issue of assistance to States in that matter, and to reinforce international programmes for nuclear security and safety.

18 June 2001: The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management enters into force.

31 May 2001: The Russian Federation and the United States conduct the final inspection pursuant to the provisions of the INF Treaty.

10—11 May 2001: The Nuclear Suppliers Group meeting in Aspen, Colorado, establishes a standing intersessional body, the Consultative Group, tasked to hold consultations on issues associated with its Guidelines on nuclear supply and the technical annexes. The NSG also agrees to amend the Guidelines on nuclear supply and the technical annexes to increase clarity on current policies and conditions of supply.

13 September 2000: The Foreign Ministers of Brazil, Egypt, Ireland, Mexico, New Zealand, South Africa and Sweden (New Agenda Coalition) issue a communiqué on their meeting to review progress in their joint initiative "Towards a Nuclear-Weapon-Free World: The Need for a New Agenda."

4 May 2000: The Russian Federation ratifies START II.

Exercise 12. ***Practice a bilateral translation of the following text.***

"Code of Conduct on the Safety and Security of Radioactive Sources" — «Кодекс поведения по обеспечению безопасности и сохранности радиоактивных источников»

Every State should, в целях защиты individuals, society and the окружающей среды, take the соответствующие measures necessary to обеспечения:

(a) that the радиоактивные источники, находящиеся в пределах его territory, or under its jurisdiction or control, are safely managed and securely protected during своего полезного срока службы and at the end of their useful lives; and

(b) the promotion of safety culture and of security culture в отношении radioactive sources.

Every State should ensure that appropriate facilities and услуг for radiation защиты, safety and security are available to, and used by, the persons who are authorized to manage с радиоактивными источниками. Such технические средства and services should include, but не ограничиваясь только ими, those needed for:

(a) searching for пропавших sources and securing найденных sources;

(b) intervention in the event of an accident or malicious актов involving с радиоактивным источником;

(c) personal dosimetry and окружающей среды monitoring; and

(d) the calibration of радиационного контроля equipment.

Каждому государству следует принимать соответствующие меры, consistent with its национальным законодательством, для охраны the confidentiality of any information, которую они получают от другого государства конфиденциально согласно this Code of Conduct или в результате участия в деятельности, проводимой в целях осуществления настоящего Кодекса поведения. Если государство предоставляет информацию international organizations in confidence, то следует steps should be taken для обеспечения охраны секретности такой информации.

<u>Exercise 13.</u> ***Put the verbs in brackets in the appropriate tense-form. Translate the following text into Russian.***

DISCOVERY OF THE NUCLEUS

In 1907 Ernest Rutherford ***(to publish)*** "Radiation of a Particle from Radium in Passing through Matter." Geiger expanded on this work in a communication to the Royal Society with experiments he and Rutherford ***(to do)*** passing a particles through air, aluminum foil and gold leaf. More work ***(to publish)*** in 1909 by Geiger and Marsden and further greatly expanded work was published in 1910 by Geiger. In 1911-12 Rutherford ***(to go)*** before the Royal Society to explain the experiments and propound the new theory of the atomic nucleus as we now ***(to understand)*** it.

The key experiment behind this announcement ***(to happen)*** in 1909 as Ernest Rutherford's team performed a remarkable experiment in which Hans Geiger and Ernest Marsden under his supervision fired alpha particles (helium nuclei) at a thin film of gold foil. The plum pudding model ***(to predict)*** that the alpha particles should ***(to come)*** out of the foil with their trajectories being at most slightly bent. Rutherford had the idea to instruct his team to look for something that ***(to shock)*** him to actually observe: a few particles ***(to scatter)*** through large angles, even completely backwards, in some cases. The discovery, beginning with Rutherford's analysis of the data in 1911, eventually ***(to lead)*** to the Rutherford model of the atom, in which the atom has a very small, very dense nucleus containing most of its mass, and consisting of heavy positively charged particles with embedded electrons in order to balance out the charge (since the neutron was unknown). As an example, in this model (which is not the modern one) nitrogen-14 consisted of a nucleus with 14 protons and 7 electrons (21 total particles), and the nucleus ***(to surround)*** by 7 more orbiting electrons.

The Rutherford model ***(to work)*** quite well until studies of nuclear spin ***(to carry)*** out by Franco Rasetti at the California Institute of Technology in 1929. By 1925 it ***(to know)*** that protons and electrons had a spin of 1/2, and in the Rutherford model of nitrogen-14, 20 of the total 21 nuclear particles should have paired up to cancel each other's spin, and the final odd particle should have left the nucleus with a net spin of 1/2. Rasetti ***(to discover)***, however, that nitrogen-14 has a spin of 1.

(by Graham Richards)

<u>Exercise 14.</u> ***Insert appropriate prepositions where necessary. Translate the text in writing.***

for (5) ***of*** (4) ***with*** (2) ***on*** (6) ***in*** (9) ***to*** (5) ***at*** (3)
throughout over by (4)

LIFE OF MARIE CURIE

From childhood Marie Curie was remarkable ... her prodigious memory, and ... the age of 16 she won a gold medal ... completion of her secondary education at the Russian lycée. Because her father, a teacher ... mathematics and physics, lost his savings through bad investment, she had to take work as a teacher and, at the same time, took part clandestinely in the nationalist "free university," reading in Polish ... women workers. At the age of 18 she took a post as governess, where she suffered an unhappy love affair. From her earnings she was able to finance her sister Bronislawa's medical studies ... Paris, with the understanding that Bronislawa would ... turn later help her to get an education.

In 1891 Sklodowska went to Paris and, now using the name Marie, began to follow the lectures of Paul Appel, Gabriel Lippmann, and Edmond Bouty at the Sorbonne. There she met physicists who were already well known — Jean Perrin, Charles Maurain, and Aimé Cotton. Sklodowska worked far into the night in her student-quarters garret and virtually lived ... bread and butter and tea. She came first in the licence of physical sciences in 1893. She began to work in Lippmann's research laboratory and in 1894 was placed second in the licence of mathematical sciences. It was ... the spring of that year that she met Pierre Curie.

Their marriage (July 25, 1895) marked the start of a partnership that was soon to achieve results ... world significance, in particular the discovery of polonium (so called by Marie ... honour of her native land) in the summer of 1898 and that of radium a few months later. Following Henri Becquerel's discovery (1896) of a new phenomenon (which she later called "radioactivity"), Marie Curie, looking ... a subject for a thesis, decided to find out if the property discovered in uranium was to be found in other matter. She discovered that this was true ... thorium ... the same time as G.C. Schmidt did.

Turning her attention ... minerals, she found her interest drawn to pitchblende, a mineral whose activity, superior to that of pure uranium, could be explained only ... the presence in the ore of small quantities of an unknown substance of very high activity. Pierre Curie then joined her in the work that she had undertaken to resolve this problem and that led ... the discovery of the new elements, polonium and radium. While Pierre Curie devoted himself chiefly to the physical study of the new radiations, Marie Curie struggled to obtain pure radium in the metallic state — achieved ... the help of the chemist André-Louis Debierne, one of Pierre Curie's pupils. ... the results of this research, Marie Curie received her doctorate of science ... June 1903 and, with Pierre, was awarded the Davy Medal of the Royal Society. Also in 1903 they shared with Becquerel the Nobel Prize for Physics ... the discovery of radioactivity.

The birth of her two daughters, Irène and Ève, in 1897 and 1904 did not interrupt Marie's intensive scientific work. She was appointed lecturer in physics at the École Normale Supérieure for girls in Sèvres (1900) and introduced there a method of teaching based ... experimental demonstrations. In December 1904 she was appointed chief assistant in the laboratory directed by Pierre Curie.

The sudden death of Pierre Curie (April 19, 1906) was a bitter blow to Marie Curie, but it was also a decisive turning point in her career: henceforth she was to devote all her energy to completing alone the scientific work that they had undertaken. ... May 13, 1906, she was appointed to the professorship that had been left vacant on her husband's death; she was the first woman to teach in the Sorbonne. In 1908 she became titular professor, and in 1910 her fundamental treatise on radioactivity was published. In 1911 she was awarded the Nobel Prize for Chemistry, for the isolation of pure radium. In 1914 she saw the completion of the building of the laboratories of the Radium Institute (Institut du Radium) at the University of Paris.

... World War I, Marie Curie, with the help of her daughter Irène, devoted herself ... the development of the use of X-radiography. In 1918 the Radium Institute, the staff of which Irène had joined, began to operate in earnest, and it was to become a universal centre for nuclear physics and chemistry. Marie Curie, now ... the highest point ... her fame and, from 1922, a member of the Academy of Medicine, devoted her researches to the study of the chemistry of radioactive substances and the medical applications of these substances.

In 1921, accompanied ... her two daughters, Marie Curie made a triumphant journey to the United States, where President Warren G. Harding presented her ... a gram of radium bought as the result of a collection among American women. She gave lectures, especially in Belgium, Brazil, Spain, and Czechoslovakia. She was made a member of the International Commission on Intellectual Cooperation by the Council ... the League of Nations. ... addition, she had the satisfaction of seeing the development of the Curie Foundation in Paris and the inauguration in 1932 in Warsaw of the Radium Institute, of which her sister Bronislawa became director.

One of Marie Curie's outstanding achievements was to have understood the need to accumulate intense radioactive sources, not only to treat illness but also to maintain an abundant supply for research... nuclear physics; the resultant stockpile was an unrivaled instrument until the appearance after 1930 of particle accelerators. The existence in Paris at the Radium Institute of a stock of 1,5 grams of radium in which, ... a period of several years, radium D and polonium had accumulated made a decisive contribution ... the success of the experiments undertaken in the years around 1930 and ... particular of those performed by Irène Curie in conjunction with Frédéric Joliot, whom she had married in 1926 (Joliot-Curie, Frédéric and Irène). This work prepared the way for the discovery of the neutron by Sir James Chadwick and, above all, for the discovery in 1934 ... Irène and Frédéric Joliot-Curie of artificial radioactivity. A few months after this discovery, Marie Curie died as a result of leukemia caused by the action of radiation. Her contribution to physics had been immense, not only in her own work, the importance of which had been demonstrated ... the award to her of two Nobel Prizes, but because of her influence ... subsequent generations of nuclear physicists and chemists. Marie Curie, together with Irène Joliot-Curie, wrote the entry on radium for the 13th edition (1926) of the Encyclopædia Britannica.

In 1995 Marie Curie's ashes were enshrined ... the Panthéon in Paris; she was the first woman to receive this honour ... her own achievements. Her office and laboratory in the Curie Pavilion of the Radium Institute are preserved as the Curie Museum.

(from Britannica)

Exercise 15. ***Translate the text using PROMT (Déjà Vu, TRADOS). Analyze the translation and make corrections.***

ENERGY EFFICIENCY

Energy efficiency is increasing by about 2% a year, and absorbs most of the requirements for energy development. New technology makes better use of already available energy through improved efficiency, such as more efficient fluorescent lamps, engines, and insulation. Using heat exchangers, it is possible to recover some of the energy in waste warm water and air, for example to preheat incoming fresh water. Hydrocarbon fuel production from pyrolysis could also be in this category, allowing recovery of some of the energy in hydrocarbon waste. Already existing power plants often can and usually are made more efficient with minor modifications due to new technology. New power plants may become more efficient with technology like cogeneration. New designs for buildings may incorporate techniques like passive solar. Light-emitting diodes are gradually replacing the remaining uses of light bulbs. Note that none of these methods allows perpetual motion, as some energy is always lost to heat.

Mass transportation increases energy efficiency compared to widespread conventional automobile use while air travel is regarded as inefficient. Conventional combustion engine automobiles have continually improved their efficiency and may continue to do so in the future, for example by reducing weight with new materials. Hybrid vehicles can save energy by allowing the engine to run more efficiently, regaining energy from braking, turning off the motor when idling in traffic, etc. More efficient ceramic or diesel engines can improve mileage. Electric vehicles such as Maglev, trolleybuses, and PHEVs are more efficient during use (but maybe not if doing a life cycle analysis) than similar current combustion based vehicles, reducing their energy consumption during use by 1/2 to 1/4. Microcars or motorcycles may replace automobiles carrying only one or two people. Transportation efficiency may also be improved by in other ways, see automated highway system.

Electricity distribution may change in the future. New small scale energy sources may be placed closer to the consumers so that less energy is lost during electricity distribution. New technology like superconductivity or improved power factor correction may also decrease the energy lost. Distributed generation permits electricity "consumers," who are generating electricity for their own needs, to send their surplus electrical power back into the power grid.

(https://en.wikipedia.org)

<u>Exercise 16.</u> ***Translate the following sentences from Russian into English, paying special attention to translation of the terms.***

1) Расщепление ядра — это ядерная реакция, при которой ядра радиоактивных атомов распадаются, выпуская нейтроны, которые, в свою очередь, попадают в другие атомы и вызывают их распад.

2) Если радиоактивного вещества достаточно, то реакция может стать цепной. Реакция на атомной станции находится под жестким контролем.

3) В ядерной бомбе она проходит бесконтрольно.

4) При ядерной реакции выделяется огромное количество энергии, в миллионы раз больше чем, скажем, при сжигании той же массы горючего, и в процессе образуются крайне радиоактивные отходы.

5) В природе распад ядра — редкость.

6) Последние реакции такого рода на Земле закончились два миллиарда лет назад.

7) С тех пор радиоактивное вещество полностью распалось, и в естественных условиях на Земле такая реакция невозможна.

8) В 1917 году новозеландец Эрнест Резерфорд стал первым, кому удалось расщепить ядро атома.

9) В 1934 году итальянский физик Энрико Ферми провел эксперимент с бомбардировкой ядер урана нейтронами.

10) В том же году Ида Ноддак ввела понятия деления ядра, постоянной ядерной реакции.

11) В 1938 году немецкие химики Отто Ган и Фриц Штрассман успешно осуществили первую в истории цепную ядерную реакцию.

12) С началом Второй мировой войны началась борьба за обладание ядерным оружием.

13) Получив письмо от физиков-беженцев — Альберта Эйнштейна и Лео Силарда — о том, насколько смертоносным может быть ядерное оружие, президент США Рузвельт сформировал команду ученых и военных, поручив им создание атомной бомбы.

14) Их задачей было создать бомбу раньше немцев: считалось, что те также стремятся получить ядерное оружие.

15) Ученые из США, Канады и Великобритании вместе работали над проектом атомного оружия под кодовым названием «Манхэттен».

16) Через пять лет упорной работы ученым удалось собрать и испытать атомную бомбу.

17) 6 и 9 августа 1945 года войска США сбросили ядерные бомбы на японские города Хиросима и Нагасаки.

18) Взрыв унес жизни 120 000 японцев в первый день, еще столько же погибли в течение трех месяцев от ожогов, радиации и травм.

19) Япония подписала безоговорочную капитуляцию 15 августа 1945 года.

20) После окончания Второй мировой войны ядерное оружие больше не применялось на поле боя (хотя было проведено множество испытаний).

21) США, Россия, Великобритания и Франция обладают крупными запасами ядерного оружия (больше всего у России и США).

22) Позднее к клубу ядерных держав присоединились Китай, Израиль, Пакистан, Индия и КНДР.

23) США изо всех сил пытаются предотвратить получение ядерного оружия Ираном, но удастся им это или нет, остается под вопросом.

__Exercise 17.__ ***Translate the following sentences from English into Russian, paying special attention to translation of the terms.***

1) Fission may take place in any of the heavy nuclei after capture of a neutron.

2) However, low-energy (slow, or thermal) neutrons are able to cause fission only in those isotopes of uranium and plutonium whose nuclei contain odd numbers of neutrons (e.g. U-233, U-235, and Pu-239).

3) Thermal fission may also occur in some other transuranic elements whose nuclei contain odd numbers of neutrons.

4) For nuclei containing an even number of neutrons, fission can only occur if the incident neutrons have energy above about one million electron volts (MeV).

5) Newly created fission neutrons are moving at about 7% of the speed of light, and moderated neutrons are moving at about 8 times the speed of sound.

6) The probability that fission or any another neutron-induced reaction will occur is described by the **neutron cross-section** for that reaction.

7) The cross-section may be imagined as an area surrounding the target nucleus and within which the incoming neutron must pass if the reaction is to take place.

8) The fission and other cross sections increase greatly as the neutron velocity reduces from around 20,000 km/s to 2 km/s, making the likelihood of some interaction greater.

9) In nuclei with an odd number of neutrons, such as U-235, the fission cross-section becomes very large at the thermal energies of slow neutrons.

10) While not strictly from uranium, a great deal of research is being undertaken to harness nuclear fusion power.

11) A number of reactions are possible, but the one which is within reach technologically is the deuterium-tritium reaction.

12) This has proven possible in a small reactor — the Joint European Torus (JET) — where 16 MW was achieved briefly, and 5 MW was sustained in 1997.

13) This work is now being scaled up internationally with ITER, being built in France.

14) The reaction is: H-2 + H-3 => He-4 + neutron + 17,6 MeV.

15) Tritium can be bred from lithium-6 (from seawater) in a blanket around the torus, using neutrons from the reaction.

16) Deuterium is relatively abundant in seawater.

Exercise 18. ***Do sight translation from English into Russian of the following without using a dictionary.***

The accident at the Chernobyl nuclear power plant in 1986 was the most severe in the history of the nuclear power industry, causing a huge release of radionuclides over large areas of Belarus, Ukraine and the Russian Federation. Now, 20 years later, UN Agencies and representatives of the three countries have reviewed the health, environmental and socio-economic consequences.

The highest radiation doses were received by emergency workers and on-site personnel, in total about 1000 people, during the first days of the accident, and doses were fatal for some of the workers. In time more than 600,000 people were registered as emergency and recovery workers ('liquidators'). Although some received high doses of radiation during their work, many of them and the majority of the residents of areas designated as 'contaminated' in Belarus, Russia and Ukraine (over 5 million people) received relatively low whole-body doses of radiation, not much higher than doses due to natural background radiation. The mitigation measures taken by the authorities, including evacuation of people from the most contaminated areas, substantially reduced radiation exposures and the radiation-related health impacts of the accident. Nevertheless, the accident was a human tragedy and had significant environmental, public health and socio-economic impacts.

Childhood thyroid cancer caused by radioactive iodine fallout is one of the main health impacts of the accident. Doses to the thyroid received in the first few months after the accident were particularly high in those who were children at the time and drank milk with high levels of radioactive iodine. By 2002, more than 4000 thyroid cancer cases had been diagnosed in this group, and it is most likely that a large fraction of these thyroid cancers is attributable to radioiodine intake.

Apart from the dramatic increase in thyroid cancer incidence among those exposed at a young age, there is no clearly demonstrated increase in the incidence of solid cancers or leukaemia due to radiation in the most affected populations. There was, however, an increase in psychological problems among the affected population, compounded by insufficient communication about radiation effects and by the social disruption and economic depression that followed the break-up of the Soviet Union.

It is impossible to assess reliably, with any precision, numbers of fatal cancers caused by radiation exposure due to the Chernobyl accident — or indeed the impact of the stress and anxiety induced by the accident and the response to it. Small differences in the assumptions concerning radiation risks can lead to large differences in the predicted health consequences, which are therefore highly uncertain. An international expert group has made projections to provide a rough estimate of the possible health impacts of the accident and to help plan the future allocation of public health resources. The projections indicate that, among the most exposed populations (liquidators, evacuees and residents of the so called 'strict control zones'), total cancer mortality might increase by up to a few per cent owing to Chernobyl related radiation exposure. Such an increase could mean eventually up to several thousand fatal cancers in addition to perhaps one hundred thousand cancer deaths expected in these populations from all other causes. An increase of this magnitude would be very difficult to detect, even with very careful long term epidemiological studies.

Since 1986, radiation levels in the affected environments have declined several hundred fold because of natural processes and countermeasures. Therefore, the majority of the 'contaminated' territories are now safe for settlement and economic activity. However, in the Chernobyl Exclusion Zone and in certain limited areas some restrictions on land-use will need to be retained for decades to come.

The Governments took many successful countermeasures to address the accident's consequences. However, recent research shows that the direction of current efforts should be changed. Social and economic restoration of the affected Belarusian, Russian and Ukrainian regions, as well as the elimination of the psychological burden on the general public and emergency workers, must be a priority.

(www.worldnuclear.org)

<u>**Exercise 19.**</u> ***Translate the following newspaper article into English.***

ЯДЕРНОЙ ЭНЕРГЕТИКЕ БЫТЬ

Предварительные работы на стройплощадке под Островцом идут к финалу. Подготовка инфраструктуры для возведения белорусской АЭС завершается. Специалисты, занятые на стройке, заверяют, что действуют строго по графику. Тем временем продолжаются и международные консультации по проекту. Причем не только с соседями, но и в более широком формате. Что нисколько неудивительно. Да, решение о строительстве АЭС — безусловное внутреннее дело любого государства. Однако, с другой стороны, речь идет о вхождении Беларуси в клуб стран, развивающих атомную энергетику. И это само по себе придает проекту глобальный характер, обеспечивает к нему внимание всего мира.

Естественным образом к планам Беларуси по возведению АЭС проявляет внимание и Международное агентство по атомной энергии (МАГАТЭ). Тем более что наша страна — одна из основательниц этой организации, которая сегодня объединяет 153 государства. У нас есть уже определенный опыт взаимодействия с МАГАТЭ. Правда, в прошлом оно строилось преимущественно вокруг чернобыльской проблематики. Теперь же открывается новый контекст. О чем свидетельствует содержание визита в Беларусь генерального директора организации Юкия Амано. Череду его переговоров в Минске завершила встреча с Президентом. Тепло поприветствовав гостя, Александр Лукашенко сказал:

— Я твердо убежден, что ядерной энергетике быть и что это наиболее безопасная сфера и наиболее безопасный путь получения дешевой энергии, в которой мир все больше будет нуждаться.

События недавнего прошлого на родине гостя, увы, пошатнули доверие к мирному атому. Президент говорил об этом откровенно, вспомнив реакцию некоторых стран на аварию японской станции «Фукусима». Некоторые из них свернули или приостановили свои ядерные программы. Но осталось немало и тех, кто полон решимости развивать эту сферу. Беларусь, по словам Президента, в их числе:

— В этот особый период мы твердо и однозначно заявляем о том, что мы не просто намерены построить атомную электростанцию, но и начали ее строительство.

Особую значимость проект приобретает от того, что реализуется он в стране, наиболее пострадавшей от Чернобыля. Однако прогресс не остановить. И сегодня замыслы по возведению белорусской станции поддерживаются большинством населения. Это очень важный знак. Вот что сказал Президент:

— Я полагаю, что МАГАТЭ — организация, крайне заинтересованная в том, чтобы подобные, конечно же, безопасные проекты в мире реализовывались. Поэтому мы очень надеемся, что господин Амано, как и предыдущие руководители этого агентства, окажет нам серьезную моральную поддержку в строительстве атомной электростанции... Если будет ваше содействие, поддержка и соответствующие условия, мы готовы и вторую атомную станцию построить в Беларуси...

Чуть позже, общаясь с журналистами, г-н Амано прокомментировал эти слова Президента так:

— МАГАТЭ не говорит, сколько атомных электростанций должно быть в той или иной стране. Вопрос, строить АЭС или нет и сколько их должно быть в стране, каждое государство решает самостоятельно. Но если страна строит АЭС, то это должно осуществляться наиболее безопасным путем, и в этом контексте МАГАТЭ может предоставить свои услуги.

А в беседе с Президентом генеральный секретарь МАГАТЭ назвал нашу страну очень важным партнером. Все же опыт Чернобыля, пусть и однозначно печальный, но все же чрезвычайно ценный для мировой атомной энергетики. Он пригодился и при решении нынешних проблем с «Фукусимой». Однако вектор оценок все же должен через уроки прошлого восходить к будущему. Гость рассуждал: «Каждая страна нуждается в развитии энергетики, улучшении жизни своего населения, и в связи с этим является важным решение об использовании атомной энергии».

Юкия Амано считает очень важным то, что Беларусь настроена и берет на себя ответственность в обеспечении более высокого уровня безопасности и прозрачности при реализации своего проекта. Он обратил внимание на то, что ответственность за обеспечение ядерной безопасности лежит на каждой стране, и

МАГАТЭ имеет возможность оказывать содействие в обеспечении безопасности. Предполагается направление в Беларусь интегрированной миссии МАГАТЭ для обзора создаваемой инфраструктуры для АЭС. Гость уточнил механизм:

— Путем направления миссии, проведения встреч мы можем достичь понимания того, что ядерная энергетика используется страной безопасно, с соблюдением защиты ядерных объектов и используется на долгосрочной основе.

И такой уровень взаимодействия вполне соотносится с ожиданиями белорусской стороны.

(Дмитрий Крят, «Беларусь сегодня», 4 апреля 2012 г.)

Exercise 20. ***Make up a brief English-language press-release based on the information below. Find out more using the Internet sources.***

«Специалистов для белорусской атомной электростанции будут готовить в трех базовых университетах Беларуси», — сообщил заместитель председателя Государственного комитета по науке и технологиям (ГКНТ) Беларуси Игорь Войтов на пресс-конференции 24 января в Минске.

Он пояснил, что в перспективе специальности в области ядерной энергетики будут открыты в Белорусском национальном техническом университете (БНТУ) на факультете энергетического строительства, на факультете физики Белгосуниверситета, а также в Белорусском государственном университете информатики и радиоэлектроники (БГУИР).

По словам зампреда ГКНТ, сейчас прорабатывается вопрос о внесении в план набора аспирантов ряда специальностей в области атомной физики.

В свою очередь, первый заместитель председателя президиума Национальной академии наук Петр Витязь отметил, что для работы на белорусской АЭС планируется приглашать специалистов из других стран. «К нам уже обращаются специалисты из России, стран Балтии, которые готовы приехать к нам и работать на нашей АЭС», — сказал он.

П. Витязь так же проинформировал, что подписано соглашение с Россией, которое предусматривает возможность подготовки белорусских специалистов на российской базе. Возможно, будут приглашаться и специалисты из других стран.

(www.naviny.by)

Exercise 21. ***Render the following article in English. Make up an abstract consisting of 5—10 sentences.***

Группа белорусских ученых приняла решение создать движение «За безъядерную Беларусь». Об этом было заявлено на круглом столе 9 марта.

Как отметил в своем докладе кандидат технических наук, директор Института гуманитарных и экологических технологий Международной академии информационных технологий Егор Федюшин, «необходимость создания такого движения возникла после того, как руководство страны объявило о политическом решении строительства в Беларуси атомной электростанции».

«Затея со строительством на территории Беларуси атомной станции чревата множеством бед и тяжелейших испытаний, которые готовы возложить на плечи народа власти страны. Мы ни при каких условиях не согласимся, что строить АЭС в Беларуси целесообразно», — сказал ученый.

По мнению Е. Федюшина, атомная энергетика не является «неизбежной необходимостью», поскольку для ее развития отсутствуют экономические, социальные и технические условия. Он отметил, что за все время существования спора о том, строить АЭС или нет, однозначно никто никаких данных в защиту атомной энергетики ни разу не привел.

«В тот момент, когда народы все большего числа стран мира выступают за принятие их странами безъядерного статуса, мы — представители науки и интеллигенции — не можем оставаться в стороне», — отметил ученый.

Целью создаваемого движения «За безъядерную Беларусь», по словам Е. Федюшина, является защита народа Беларуси от «Чернобыльского ада» и «ядерного рая».

В своем выступлении физик-ядерщик предложил составить обращение к руководству страны с требованием отменить решение о строительстве АЭС. Ученый считает, что необходимо организовать международную конференцию с рабочим названием «Проблемы и перспективы развития энергетического комплекса Беларуси», где будут обсуждаться вопросы целесообразности строительства АЭС в стране и развития ядерной энергетики в Беларуси.

По словам Е. Федюшина, в стране необходимо также создать институт альтернативной энергетики, который бы занимался перспективами развития микроэнергетики, возможностями использования в стране возобновляемых источников энергии. «Если же необходимость строительства АЭС возникнет, в стране должен быть проведен референдум по этому вопросу», — подчеркнул Е. Федюшин.

Кроме того, белорусские ученые предлагают создать комиссию по оценке целесообразности развития в стране атомной энергетики. Профессор Георгий Лепин проинформировал, что подобная комиссия была создана распоряжением премьер-министра в 1998 году. По его словам, она должна была «проанализировать и оценить применительно к Беларуси данные о развитии мировой атомной энергетики, альтернативные варианты обеспечения республики топливно-энергетическими ресурсами, базирующимися на рациональном их использовании, применении современных парогазовых технологий и нетрадиционных источников энергии».

Одно из важных решений, по мнению ученого, которое удалось в то время принять, — это приостановка на 10 лет работ в области атомной энергетики в Беларуси. Однако срок моратория истекает 1 января 2009 года, поэтому «было бы разумно», по мнению Г. Лепина, создать комиссию, которая «подведет итоги всей работы в этом направлении за 10 лет».

Так, например, в заключении действовавшей комиссии было сказано, что необходимо изучать мировой опыт в атомной энергетике. «В своих заявлениях сторонники строительства АЭС пишут, что во всем мире активно строят АЭС. Однако мировой опыт развития атомной энергетики показывает обратное: за последние годы строительство атомных станций фактически было свернуто во всех странах, кроме развивающихся стран, которые активно рвутся к атомному оружию», — считает ученый.

По его словам, в Германии сокращено количество уже работающих АЭС с 20 до 17. «В США с 1978 года ни одна АЭС не построена, там лишь пытаются продлить срок эксплуатации с 30 лет до 50 лет. Во Франции, где наибольшая плотность АЭС, решено строить только в том случае, если какая-то станция выводится из эксплуатации», — сказал Г. Лепин.

Не изучен вопрос по захоронению радиоактивных отходов и выводу АЭС из эксплуатации. «Здесь вообще мирового опыта нет, поскольку отсутствуют технологии», — подчеркнул ученый. По его словам, если 10 лет назад выведение из эксплуатации АЭС стоило 10% от стоимости станции, то сейчас это соизмеримо с затратами на само ее строительство.

По мнению Г. Лепина, никто также не просчитывал, во сколько обойдутся с вводом атомных энергоблоков структурные изменения в белорусской энергосистеме.

Также ученые обеспокоены вероятностью того, что с началом строительства АЭС в Беларуси другие направления энергетики не будут развиваться. Такую точку зрения выразил кандидат технических наук, главный технолог производственно-технического отдела РУП «БелНИПИэнергопром» Виктор Юшко.

По мнению ученого, строительство АЭС в Беларуси — это «политика на загнивание». «К 2020 году мы запустим атомную станцию. Нормально функционировать она не сможет, потому что к тому времени ядерное топливо в мире будет на исходе. Другие же направления энергетики мы не развивали, потому что все средства были пущены на АЭС. Развалится вся экономика республики, вся энергетика», — отметил В. Юшко.

Он считает, что «дешевизна атомной энергии — это миф». «Эти утверждения были обоснованы в конце 1990-х — начале

2000-х годов. Однако за последние семь лет ядерное топливо подорожало в 21 раз. Сравним, газ — всего в три раза», — подчеркнул ученый. Поэтому электроэнергия, вырабатываемая на АЭС, с каждым годом становится все дороже и дороже. Реальная стоимость атомной электроэнергии, по его словам, в пять раз выше стоимости электроэнергии тепловых станций.

Ученый привел данные Сибирского отделения Российской академии наук о том, что развитие ядерной энергетики на реакторе с тепловыми нейтронами бесперспективно. Согласно их исследованиям, к 2020—2025 годам на 50% АЭС не будет хватать ядерного топлива, а к 2050 году его вообще не будет, так как запасы природного урана ограничены и к тому времени исчерпаются.

В. Юшко подчеркнул, что с научной и практической точки зрения сегодня целесообразней вкладывать средства «в более перспективные направления в энергетике», например в ветроэнергетику. По его словам, разработанная им программа по развитию альтернативных источников энергии предполагает до 2020 года полностью заместить атомную электроэнергию альтернативными источниками энергии.

(www.gazetaby.com)

UNIT 5. CHEMISTRY

Text 1

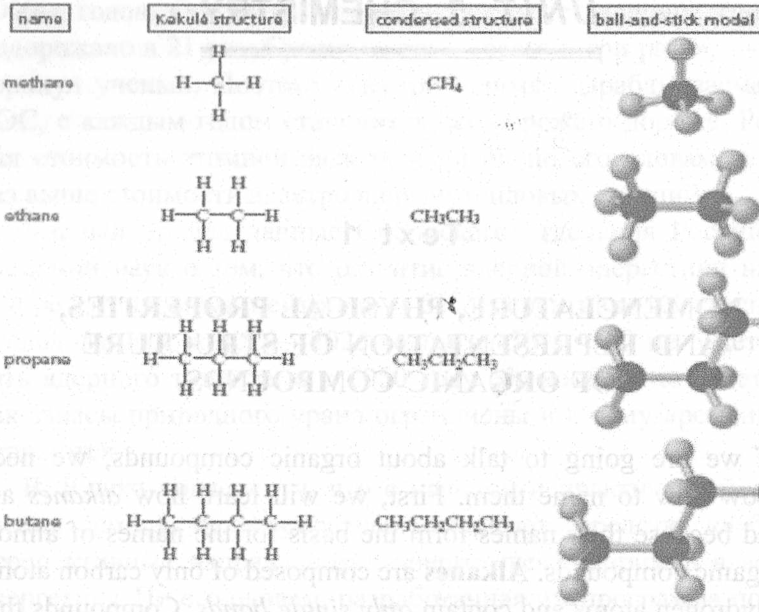
NOMENCLATURE, PHYSICAL PROPERTIES, AND REPRESENTATION OF STRUCTURE OF ORGANIC COMPOUNDS

If we are going to talk about organic compounds, we need to know how to name them. First, we will learn how *alkanes* are named because their names form the basis for the names of almost all organic compounds. **Alkanes** are composed of only carbon atoms and hydrogen atoms and contain *only single bonds.* Compounds that contain only carbon and hydrogen are called **hydrocarbons.** Thus, alkanes are hydrocarbons.

Alkanes in which the carbons form a continuous chain with no branches are called **straight-chain alkanes.** The names of several straight-chain alkanes are given in the table after the text.

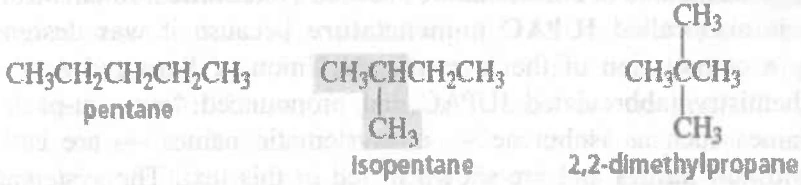
If you look at the relative numbers of carbon and hydrogen atoms in the alkanes listed in the table below, you will see that the general molecular formula for an alkane is C_nH_{2n+2}, where *n* is any integer. So, if an alkane has one carbon atom, it must have four hydrogen atoms; if it has two carbon atoms, it must have six hydrogen atoms.

Carbon forms four covalent bonds and hydrogen forms only one covalent bond. This means that there is only one possible structure for an alkane with molecular formula CH_4 (methane) and only one structure for an alkane with molecular formula C_2H_6 (ethane). There is also only one possible structure for an alkane with molecular formula C_3H_8 (propane).



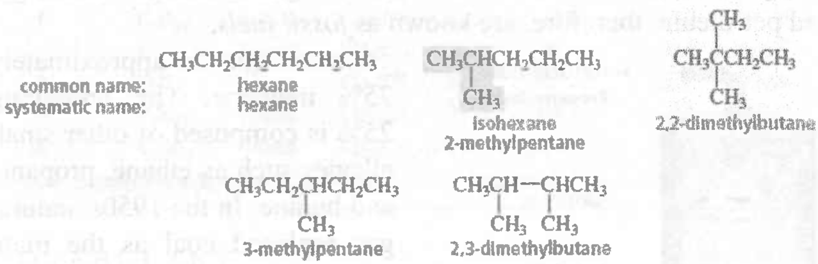
As the number of carbons in an alkane increases beyond three, the number of possible structures increases. There are two possible structures for an alkane with molecular formula C_4H_{10}. In addition to butane — a straight-chain alkane — there is a branched butane called isobutane. Both of these structures fulfill the requirement that each carbon forms four bonds and each hydrogen forms only one bond.

Compounds such as butane and isobutane that have the same molecular formula but differ in the order in which the atoms are connected are called **constitutional isomers** — their molecules have different constitutions. In fact, isobutane got its name because it is an "iso" mer of butane. The structural unit consisting of a carbon bonded to a hydrogen and two CH_3 groups — that occurs in isobutene — has come to be called "iso." Thus, the name isobutane tells you that the compound is a four-carbon alkane with an iso structural unit.



There are three alkanes with molecular formula C_5H_{12}. You have already learned to name two of them. Pentane is the straight-chain alkane. Isopentane, as its name indicates, has an iso structural unit and five carbon atoms. We cannot name the other branched-chain alkane without defining a name for a new structural unit.

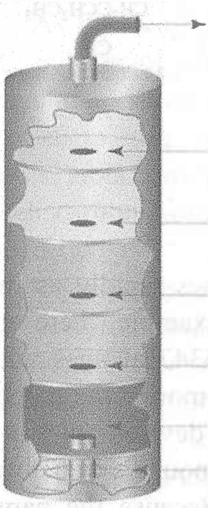
There are five constitutional isomers with molecular formula C_6H_{14}. Again, we are able to name only two of them, unless we define new structural units.



The number of constitutional isomers increases rapidly as the number of carbons in an alkane increases. For example, there are 75 alkanes with molecular formula $C_{10}H_{22}$ and 4347 alkanes with molecular formula $C_{15}H_{32}$. To avoid having to memorize the names of thousands of structural units, chemists have devised rules for creating systematic names that describe the compound's structure. That way, only the rules have to be learned. Because the name describes the structure, these rules also make it possible to deduce the structure of a compound from its name.

This method of nomenclature is called **systematic nomenclature.** It is also called **IUPAC nomenclature** because it was designed by a commission of the International Union of Pure and Applied Chemistry (abbreviated IUPAC and pronounced "eye-you-pack"). Names such as isobutene — nonsystematic names — are called **common names** and are shown in red in this text. The systematic (IUPAC) names are shown in blue. Before we can understand how a systematic name for an alkane is constructed, we must learn how to name alkyl substituents.

Alkanes are widespread both on Earth and on other planets. The atmospheres of Jupiter, Saturn, Uranus, and Neptune contain large quantities of methane (CH4), the smallest alkane, an odorless and flammable gas. In fact, the blue colors of Uranus and Neptune are the result of methane in their atmospheres. Alkanes on Earth are found in natural gas and petroleum, which are formed by the decomposition of plant and animal material that has been buried for long periods in the Earth's crust, where oxygen is scarce. Natural gas and petroleum, therefore, are known as *fossil fuels.*



Natural gas is approximately 75% methane. The remaining 25% is composed of other small alkanes such as ethane, propane, and butane. In the 1950s, natural gas replaced coal as the main energy source for domestic and industrial heating in the United States.

Petroleum is a complex mixture of alkanes that can be separated into fractions by distillation. The fraction that boils off at the lowest temperature (hydrocarbons containing three and four carbons) is a gas that can be liquefied under pressure. This gas is used as a fuel for cigarette lighters, camp stoves, and barbecues. The fraction that boils at somewhat higher temperatures (hydrocarbons containing 5 to 11 carbons) is gasoline; the next fraction (9 to 16 carbons) includes kerosene and jet fuel. The fraction with 15 to 25 carbons is used for heating oil and diesel oil, and the highest boiling fraction is used for lubricants and greases. After distillation, a nonvolatile residue called asphalt or tar is left behind.

(by P.Y. Bruice from Essential Organic Chemistry)

Table 1 Nomenclature and Physical Properties of Some Straight-Chain Alkanes

Number of carbons	Molecular formula	Name	Condensed structure	Boiling point (°C)	Melting point (°C)	Density[a] (g/mL)
1	CH_4	methane	CH_4	−167.7	−182.5	
2	C_2H_6	ethane	CH_3CH_3	−88.6	−183.3	
3	C_3H_8	propane	$CH_3CH_2CH_3$	−42.1	−187.7	0.5005
4	C_4H_{10}	butane	$CH_3CH_2CH_2CH_3$	−0.5	−138.3	0.5787
5	C_5H_{12}	pentane	$CH_3(CH_2)_3CH_3$	36.1	−129.8	0.5572
6	C_6H_{14}	hexane	$CH_3(CH_2)_4CH_3$	68.7	−95.3	0.6603
7	C_7H_{16}	heptane	$CH_3(CH_2)_5CH_3$	98.4	−90.6	0.6837
8	C_8H_{18}	octane	$CH_3(CH_2)_6CH_3$	125.7	−56.8	0.7026
9	C_9H_{20}	nonane	$CH_3(CH_2)_7CH_3$	150.8	−53.5	0.7177
10	$C_{10}H_{22}$	decane	$CH_3(CH_2)_8CH_3$	174.0	−29.7	0.7299

[a]Density is temperature dependent. The densities given are those determined at 20 °C.

VOCABULARY

alkane — алифатический углеводород, алкан
carbon — углерод
chain — цепь, цепочка
compound — соединение
constitutional isomer — структурный изомер
covalent bond — атомная связь, ковалентная связь
ethane — этан
fraction — фракция, доля
hydrocarbon — углеводород
hydrogen — водород

integer — целое, единое целое
isobutene — изобутен
isopentane — изопентан
IUPAC — Международный союз теоретической и прикладной химии (ИЮПАК)
methane — метан
nonvolatile residue — нелетучий остаток / осадок
propane — пропан
single bond — одинарная связь

Exercise 1. ***Answer the following questions.***

1) What do we call alkanes?
2) What is called a hydrocarbon?
3) What kind of alkanes do we call straight-chain ones?
4) What is an integer?
5) Name the general molecular formula of an alkane.
6) What do we call constitutional isomers?
7) What does the abbreviation IUPAC stand for?
8) Where can we find alkanes?

Exercise 2. ***Deabbreviate the following chemical elements in English (see Annex at the end of the textbook).***

1) H; 2) F; 3) N; 4) Al; 5) Cr; 6) Mo; 7) Fe; 8) Sn; 9) Ag; 10) Au; 11) Hg; 12) Pb; 13) U; 14) Pu; 15) Zn.

Exercise 3. ***Translate the chemical elements mentioned in exercise 2 into Russian.***

Exercise 4. ***Translate the following sentences from English into Russian.***

1) Modern society faces three major problems as a consequence of our dependence on fossil fuels for energy.

2) First, these fuels are a nonrenewable resource and the world's supply is continually decreasing.

3) Second, a group of Middle Eastern and South American countries controls a large portion of the world's supply of petroleum.

4) These countries have formed a cartel known as the *Organization of Petroleum Exporting Countries (OPEC),* which controls both the supply and the price of crude oil.

5) Political instability in any OPEC country can seriously affect the world oil supply.

6) Third, burning fossil fuels increases the concentrations of CO_2 in the atmosphere; burning coal increases the concentration of both CO_2 and SO_2.

7) Scientists have established experimentally that atmospheric SO_2 causes "acid rain," which represents a threat to the Earth's plants and, therefore, to our food and oxygen supplies.

8) Since 1958, the concentration of atmospheric CO_2 at Mauna Loa, Hawaii has been measured periodically.

9) The concentration has increased 20% since the first measurements were taken, causing scientists to predict an increase in the Earth's temperature as a result of the absorption of infrared radiation by CO_2 (the *greenhouse effect).*

10) A steady increase in the temperature of the Earth would have devastating consequences, including the formation of new deserts, massive crop failure, decreasing polar ice sheets, and the melting of glaciers with a concomitant rise in sea level.

11) Clearly, what we need is a renewable, nonpolitical, nonpolluting, and economically affordable source of energy.

Exercise 5. ***Translate the following text from Russian into English using the vocabulary and data you have learnt from text 1 in this Unit.***

АЛКАНЫ

Алканы (предельные углеводороды, парафины) — насыщенные углеводороды общей формулы C_nH_{2n+2}. Простейшим представителем ряда является метан CH_4.

Номенклатура. Названия первых четырех алканов — это исторически сложившиеся названия. Наименования остальных алканов с неразветвленной цепью складываются из греческого или латинского названия числительных, соответствующих количеству атомов углерода, и добавления суффикса *-ан*.

По рациональной номенклатуре все алканы рассматриваются как производные метана, в котором один или несколько атомов водорода замещены на радикал, названия радикалов (в алфавитном порядке) выносятся перед словом метан.

Этапы построения названия алкана по номенклатуре ИЮПАК:

1. Найти самую длинную, наиболее разветвленную углерод-углеродную цепь.

2. Пронумеровать атомы углерода этой цепи так, чтобы заместители и характеристические группы получили наименьший номер.

3. Указать цифрой местоположение заместителя в цепи, назвать заместитель.

4. Назвать главную цепь.

Изомерия. В алканах, начиная с бутана, мы сталкиваемся с явлением структурной изомерии. Изомеры — это индивидуальные соединения, имеющие один и тот же состав, но различное строение, т.е. иное расположение тех же атомов в пространстве, а следовательно, и различные физико-химические свойства.

С увеличением числа атомов углерода в молекулах алканов возрастает и число структурных изомеров: для гексана оно равно 5, для гептана — 9, для октана — 18, для нонана — уже 35.

В молекулах углеводородов не все атомы углерода равнозначны. Атом углерода, связанный с одним углеродным атомом, называют первичным, с двумя — вторичным, с тремя — третичным, с четырьмя — четвертичным. Все эти атомы различаются по реакционной способности.

СПОСОБЫ ПОЛУЧЕНИЯ

Алканы широко распространены в природе: нефть, попутные нефтяные газы и природный газ, поэтому в промышленных масштабах их выделяют из природного сырья.

Нефть — природное ископаемое, представляющее собой сложную смесь органических веществ, главным образом углеводородов. Состав нефти неодинаков в различных месторождениях, например, некоторые нефти содержат значительные количества ароматических углеводородов.

Нефть содержит как жидкие, так и растворенные в ней твердые и в некотором количестве газообразные углеводороды. При большом содержании последних нефть иногда под давлением газов фонтанирует из буровых скважин.

Нефть — эффективное и дешевое топливо. Кроме того, она является ценным химическим сырьем, на основе которого получают синтетический каучук, пластмассы и т.д.

Крекинг углеводородов. При нагревании углеводородов до высоких температур (450—550°С) без доступа воздуха они распадаются с разрывом углеродных цепей и образованием более простых, непредельных углеводородов. Такой процесс называют крекингом (расщеплением). Разложение углеводородов при еще более высоких температурах (550—650°С и выше) приводит к образованию простейших (главным образом газообразных) углеводородов; кроме того, при этом происходит замыкание углеродных цепей в циклы и получаются значительные количества ароматических углеводородов. Этот процесс называют пиролизом. Применением в процессах крекинга и пиролиза специальных катализаторов и давления удается регулировать эти процессы и получать необходимые продукты.

Физические свойства. В обычных условиях (при 25°С и атмосферном давлении) первые четыре члена гомологического ряда алканов (C_1—$C_{4)}$ — газы, C_5—C_{15} — жидкости, начиная с C_{16} — твердые вещества. С ростом числа атомов углерода в соединении возрастают температуры кипения и плавления. Алканы практически не растворимы в воде, хорошо растворимы в неполярных органических растворителях, таких как толуол, бензол, тетрахлорметан и других.

Химические свойства. В обычных условиях алканы химически инертны (русский химик М.И. Коновалов называл предельные углеводороды химическими мертвецами), они не взаимодействуют с концентрированными кислотами и щелочами, не окисляются перманганатом калия и хромовой смесью.

Алканам характерны реакции замещения, протекающие по цепному радикальному механизму, в результате которых атомы водорода в молекуле замещаются на приходящий атом или группу атомов с образованием производных углеводородов.

ОТДЕЛЬНЫЕ ПРЕДСТАВИТЕЛИ

Метан CH_4 (болотный, рудничный газ) — газ без запаха, растворим в этаноле, эфире, углеводородах и мало растворим в воде (45 мл в 1 л воды при 20°С), является главным компонентом нефтяного и природного газа. Применяется метан как высококалорийное топливо в составе природного газа и как сырье для промышленных синтезов многих продуктов: водорода, ацетилена, хлороформа и других хлорметанов, фреонов, нитрометана, синильной кислоты, синтез-газа. С воздухом образует взрывоопасные смеси, что является причиной взрывов в угольных шахтах. Метан составляет основу атмосферы некоторых планет, например, Сатурна, Юпитера.

Пропан C_3H_8, бутан C_4H_{10} — легкосжижаемые газы, используемые в быту в виде баллонного газа. Пропан применяют и как автомобильное топливо, экологически более чистое, чем бензин. Бутан используется для получения бутадиена-1,3, являющегося сырьем для производства синтетических каучуков.

Петролейный эфир — смесь жидких насыщенных алифатических углеводородов (главным образом C_5—C_6 разветвленного строения), получаемая отгонкой легких фракций бензина. Применяется как растворитель смол, жиров, эфирных масел и других неполярных веществ.

Парафин — смесь твердых алканов C_{18}—C_{35} (температура плавления 45—65°С) преимущественно нормального строения, получаемая из нефти. Представляет собой бесцветный продукт, без запаха и вкуса, жирный на ощупь, нерастворимый в воде и спирте, хорошо растворим в большинстве органических растворителей. Применяется в пищевой промышленности при изготовлении упаковочных материалов, как компонент жевательных резинок, в производстве резинотехнических изделий и товаров бытовой химии. В медицине используют при парафинолечении. Служит сырьем для получения жирных кислот и спиртов, поверхностно-активных веществ.

Вазелин — однородная мазеобразная масса без вкуса и запаха, получаемая расплавлением парафина в минеральном масле. Легко растворяется в углеводородах, в спирте и эфире — при нагревании. Используется в основном для защиты металлических изделий от коррозии.

Вазелин медицинский отличается от технического более высокой степенью очистки и применяется для медицинских, фармацевтических и косметических целей.

(Макарова Н.А. «Органическая химия»)

Exercise 6. ***What do the following branches of chemistry study? Use reference-books, guidebooks and Internet sources.***

1) physical chemistry; 2) organic chemistry; 3) inorganic chemistry; 4) analytical chemistry; 5) environmental chemistry; 6) green chemistry; 7) biochemistry; 8) chemical engineering; 9) nanotechnology; 10) petrochemistry.

Exercise 7. ***Translate the following text from Russian into English and make up an abstract consisting of 3—5 sentences.***

ФОТОСИНТЕЗ

Фотосинтез, образование зелеными растениями и некоторыми бактериями орг. веществ с использованием энергии солнечного света. Происходит при участии пигментов (у растений хлорофиллов). В основе фотосинтеза лежат окислительно-восстановительные реакции, в которых электроны переносятся от донора (например, H_2O, H_2S) к акцептору (CO_2) с образованием восстановленных соединений (углеводов) и выделением O_2

(если донор электронов H_2O), S (если донор электронов, напр., H_2S) и др.

Фотосинтез — один из самых распространенных процессов на Земле, обусловливает круговорот в природе углерода, O_2 и др. элементов. Он составляет материальную и энергетическую основу всего живого на планете. Ежегодно в результате фотосинтеза в виде органического вещества связывается ок. 8×10^{10} т углерода, образуется до 10^{11} т целлюлозы. Благодаря фотосинтезу растения суши образуют ок. $1{,}8\times10^{11}$ т сухой биомассы в год; примерно такое же количествово биомассы растений образуется ежегодно в Мировом океане. Тропический лес вносит до 29% в общую продукцию фотосинтеза суши, а вклад лесов всех типов составляет 68%. Фотосинтез высших растений и водорослей — единственный источник атм. O_2.

Возникновение на Земле ок. 2,8 млрд лет назад механизма окисления воды с образованием O_2 представляет собой важнейшее событие в биол. эволюции, сделавшее свет Солнца главным источником свободной энергии биосферы, а воду — практически неограниченным источником водорода для синтеза веществ в живых организмах. В результате образовалась атмосфера современного состава, O_2 стал доступным для окисления пищи, а это обусловило возникновение высокоорганизованных гетеротрофных организмов (применяют в качестве источника углерода экзогенные органические вещества).

Около 7% органических продуктов фотосинтеза человек использует в пищу, в качестве корма для животных, а также в виде топлива и строительного материала. Ископаемое топливо — тоже продукт фотосинтеза. Его потребление в конце XX века примерно равно приросту биомассы.

Общее запасание энергии солнечного излучения в виде продуктов фотосинтеза составляет ок. $1{,}6\times10^{21}$ кДж в год, что примерно в 10 раз превышает современное энергетическое потребление человечества. Примерно половина энергии солнечного излучения приходится на видимую область спектра (длина волны l от 400 до 700 нм), которая используется для фотосинтеза (физиологически активная радиация, или ФАР). ИК-излучение не пригодно для фотосинтеза кислородовыделяющих организмов (высших растений и водорослей), но используется некоторыми фотосинтезирующими бактериями.

(from «Химическая энциклопедия»)

<u>**Exercise 8.**</u> ***Translate the following abstracts into Russian.***

1) Chemoselective Reduction of the Carbonyl Functionality through Hydrosilylation: Integrating Click Catalysis with Hydrosilylation in One Pot

S.R. Roy, S.C. Sau, S.K. Mandal, *J. Org. Chem.*, 2014, *79*, 9150—9160.

Abstract

A chemoselective reduction of the carbonyl functionality via hydrosilylation using low loadings of a copper (I) catalyst bearing an abnormal NHC takes place at ambient temperature in excellent yield within a very short reaction time. The hydrosilylation reaction of α,β-unsaturated carbonyl compounds gives allyl alcohols in good yields. The catalyst can also be used for azide-alkyne cycloadditions.

Key Words

reduction of carbonyl compounds, phenylsilane

2) A New Iron (III)-Salen Catalyst for Enantioselective Coniaene Carbocyclization

S. Shaw, J. D. White, *J. Am. Chem. Soc.*, 2014, *136*, 13174—13177.

Abstract

A chiral iron(III)-salen complex catalyzes an asymmetric Conia-ene-type cyclization of α-functionalized ketones containing an unactivated terminal alkyne and produces an *exo*-methylenecyclopentane scaffold possessing a stereodefined quaternary center.

Key Words

Conia-ene reaction, Cyclopentanes

3) Cobalt-Catalyzed Vinylation of Aromatic Halides Using β-Halostyrene: Experimental and DFT Studies

A. Moncomble, P. Le Floch, A. Lledos, C. Gosmini, *J. Org. Chem.*, 2012, *77*, 5056—5062.

Abstract

A direct cobalt-catalyzed vinylation of various aromatic halides using β-halostyrene proceeded smoothly with a total retention of the double bond configuration in the presence of triphenylphosphine as ligand. This procedure offers a new route to the stereoselective synthesis of functionalized stilbenes.

Key Words

Stilbenes, Manganese

<u>Exercise 9.</u> *Translate the following abstracts of scientific articles into English.*

ЕЖЕГОДНИК
УСПЕХИ БИОЛОГИЧЕСКОЙ ХИМИИ

Аннотации статей (т. 42)

1) *И.Н. Сердюк.* Физические методы в структурной молекулярной биологии в начале XXI века.

За годы, прошедшие после открытия двойной спирали ДНК, физики разработали ряд новых методов, позволивших изучать структуру биологических макромолекул с разным пространственным разрешением: от низкого, соответствующего размерам целой молекулы, до высокого, соответствующего расстояниям между отдельными атомами в молекуле. Это позволило окончательно сформировать науку, получившую название структурной биологии. В 1980-х годах ее плавное развитие было прервано двумя революционными событиями. Первое из них произошло в физике и связано, в первую очередь, с появлением синхротронных источников и быстродействующих рентгеновских детекторов. Их применение в рентгеноструктурном анализе привело к тому, что число расшифрованных белковых трехмерных структур стало быстро расти. Другое событие произошло в биологии, когда было показано, что последовательность аминокислотных остатков белка гораздо быстрее можно определить по последовательности его ДНК. Эти два события создали условия для появления новой ветви структурной биологии, структурной геномики — науки, главной задачей которой является определение в атомарном разрешении набора трехмерных структур белков, кодируемых данным геномом. Ее дальнейшим развитием является функциональная протеомика, одной из задач которой является изучение на молекулярном уровне фенотипа организма, т.е. свойств организма, вытекающих из комбинации его генотипа и факторов окружающей среды.

В данном обзоре в сжатой форме описано прошлое и современное состояние физических методов, обсуждаются тенденции их развития. Говоря о будущем этих методов, надо всегда помнить, что перспективы их развития не отделимы от перспектив развития компьютеров, электроники, лазеров, оптики, нейтронных и синхротронных источников.

2) *М.В. Хоретоненко, Е.А. Рудакова, М.Г. Ивановская.* Современные методы изучения РНК-полимеразы *E. coli.*

РНК-полимераза *E.coli* отвечает за транскрипцию в бактериальных клетках. В настоящее время накоплено большое количество данных, касающихся механизма действия и структурно-функциональной характеристики этого фермента, которые свидетельствуют о том, что процесс транскрипции в *E.coli* во многом сходен с процессом транскрипции в других, в том числе и эукариотических клетках. Поэтому РНКП *E.coli* остается объектом пристального изучения. Наряду с традиционными биохимическими методами изучения транскрипции в настоящее время широко используются новые физические и физико-химические подходы. В обзоре рассматриваются основные физико-химические и новые физические методы исследования белково-нуклеиновых взаимодействий на примере комплекса РНКП *E.coli* с промотором. Наряду с широко распространенными методами, такими, как рентгено-структурный анализ, флуоресценция, футпринтинг, обсуждаются и новые: метод резонансного переноса энергии возбуждения флуоресценции, кросслинк, новейшие варианты электронной микроскопии и т.д. Приведена оценка возможностей и ограничений указанных методов, а также некоторые данные по структуре и функции промоторного комплекса РНКП *E.coli*.

3) *А.Д. Никулин.* Изучение взаимодействий рибосомных белков с рибосомными РНК.

В обзоре рассмотрены имеющиеся на середину 2001 года модели рибосомы и рибосомных субчастиц, полученные как электронно-микроскопическими методами, так и рентгено-структурными методами. Дан краткий анализ моделей рибосомных субчастиц. Показано, что полученные модели рибосомы и рибосомных субчастиц содержат довольно большую ошибку в координатах атомов, что не позволяет с достаточной точностью проанализировать взаимодействия рибосомных белков и рРНК между собой. Кроме того, структуру не всех участков рибосомы удается определить даже при наличии карт электронной плотности высокого разрешения. Поэтому в настоящее время большое внимание уделяется структурным исследованиям сравнительно небольших комплексов рибосомных белков со специфично связывающимися фрагментами рРНК. Для таких комплексов можно получить кристаллы, дающие дифракционные картины высокого разрешения, определить структуры комплексов с высокой точностью и детально проанализировать РНК-белковые взаимодействия, что также позволяет восполнить пробелы в структуре рибосомы. Проведен анализ полученных к настоящему времени моделей структур комплексов рибосомных белков с рРНК и сделан ряд предварительных выводов относительно принципов РНК-белковых взаимодействий.

4) *Б.И. Курганов.* Оценка активности молекулярных шаперонов в тест-системах, основанных на подавлении агрегации белков.

Функция молекулярных шаперонов состоит в том, что, взаимодействуя с развернутыми состояниями белковой молекулы, они препятствуют их агрегации и обеспечивают, таким образом, возможность сворачивания полипептидной цепи в нативную структуру. Оценка эффективности действия шаперонов в тест-системах, основанных на подавлении агрегации белковых субстратов, требует понимания механизма агрегации белков. В обзоре обсуждаются кинетические режимы агрегации белков. Проведенный автором обзора анализ кинетики агрегации белков показывает, что в большинстве случаев протекающая во времени агрегация после прохождения лаг-фазы следует кинетике реакции первого порядка. Разработаны подходы, позволяющие количественно оценить эффективность подавления агрегации белкового субстрата шапероном.

5) *А.С. Воронина.* Трансляционная регуляция в раннем развитии.

Вниманию читателей представляется обзор совокупности данных по регуляции трансляции на запасенных мРНК в оогенезе, эмбриогенезе и в дифференцированных тканях. Рассмотрена роль нетранслируемых областей мРНК, с которыми связываются определенные белки, регулирующие функционирование индивидуальных мРНК. Описаны примеры пространственной и временной регуляции трансляции индивидуальных мРНК в эмбриогенезе.

6) *Н.М. Груздева, А.П. Куллыев.* Инсуляторы *Drosophila melanogaster:* структура, функции.

Несмотря на множество имеющихся данных о регуляции транскрипции, механизм взаимодействия между регуляторными элементами остается неясным. Недавние исследования взаимодействий между энхансером и промотором на больших дистанциях позволили объединить регуляторные элементы в единую систему, в результате работы которой осуществляется контроль над экспрессией генов. В обзоре излагаются современные представления об инсуляторах как элементах, регулирующих взаимодействия между энхансерами и промоторами. На основе предложенной ранее модели, основывающейся на взаимодействии между инсуляторами, излагается возможный механизм регуляции транскрипции в локусе Abd-B.

7) *В.А. Костюченко, В.В. Месянжинов.* Архитектура сферических вирусов

Простейшие капсиды сферических вирусов, состоящие из идентичных копий продукта одного гена, построены на основе икосаэдрической симметрии с идентичными (эквивалентными) взаимодействиями субъединиц и представляют генетически экономичный способ формирования оболочки для упаковки и хранения вирусного генома. Капсиды вирусов, построенные более чем из 60 копий одного или нескольких продуктов генов, благодаря конформационной гибкости молекул белка, способных формировать в поверхностной решетке капсида различные олигомеры, как, например, гексамеры и пентамеры, обладают квазиэквивалентными взаимодействиями субъединиц в поверхностной решетке. Для сборки сложных капсидов с нарушениями квазиэквивалентности необходимы вспомогательные белки, как, например, внутреннее ядро у ДНК-содержащих фагов, таких как фаг Т4 и вирус герпеса. Вокруг ядра собирается прокапсид, ядро удаляется с помощью протеолиза, а затем в капсид упаковывается геномная ДНК вируса. Принципы ассоциации субъединиц белка и регуляции сборки вирусов реализуются во многих биологических структурах и процессах клетки.

8) *Т.А. Валуева, В.В. Мосолов.* Роль ингибиторов протеолитических ферментов в защите растений.

В процессе эволюции растения выработали механизмы, позволяющие им успешно противостоять неблагоприятным воздействиям, в том числе, различного рода вредителям и патогенным микроорганизмам. Важнейшими компонентами подавляющего большинства таких механизмов являются вещества белковой природы. Среди них важную группу составляют ингибиторы ферментов и, в первую очередь, ингибиторы протеаз. В обзоре анализируются имеющиеся в литературе и собственные данные о различных формах участия ингибиторов протеолитических ферментов в защите растений. Рассмотрено действие ингибиторов протеиназ из растений и некоторых других источников на ферменты насекомых, нематод, фитопатогенных микроорганизмов и вирусов. Значительное внимание уделено процессам индукции ингибиторов протеиназ у растений в ответ на поражение насекомыми и микроорганизмами. Рассмотрены также выработанные насекомыми в процессе эволюции способы нейтрализации действия ингибиторов протеиназ, содержащихся в растениях. В обзоре затрагиваются некоторые аспекты применения ингибиторов протеиназ в биотехнологии для получения трансгенных растений, характеризующихся повышенной устойчивостью к вредителям и болезням.

9) *А.С. Костюкова* Структура и функции тропомодулина, белка, регулирующего длину актиновых филаментов.

Тропомодулин (40 кДа) — это уникальный белок, кэпирующий актиновые филаменты на медленно растущем (остром) конце и тем самым определяющий их длину. Структура и функции N- и C-концевых половин тропомодулина различны. C-концевая половина определяет кэпирующие свойства тропомодулина и, по-видимому, взаимно. Описаны примеры пространственной и временной регуляции трансляции индивидуальных мРНК в эмбриогенезе.

10) *Е.В. Кудряшова, А.К. Гладилин, А.В. Левашов.* Белки (ферменты) в надмолекулярных ансамблях: исследование структуры методом разрешенно-временной флуоресцентной анизотропии.

Надмолекулярные структуры играют важную роль в таких ключевых биохимических процессах, как фолдинг белков, транспорт разнообразных соединений, биосинтез и многих других. Регуляция каталитической активности и стабильности ферментов in vivo часто осуществляется посредством образования надмолекулярных ансамблей с веществами различной природы. В обзоре рассмотрены белок-содержащие нековалентные комплексы с основными классами природных и синтетических соединений и физико-химические методы исследования структуры таких комплексов. Подробно обсуждаются флуоресцентные методы анализа. Одним из наиболее информативных при исследовании структуры надмолекулярных ансамблей является метод разрешенно-временной флуоресцентной анизотропии, позволяющий следить за вращательной динамикой как всего комплекса, так и его отдельных фрагментов. Благодаря высокой чувствительности метод позволяет получить детальную информацию о структурной организации надмолекулярных ансамблей.

UNIT 6. ASTRONOMY

Text 1

THE SUN

The vast nuclear furnace that we know as the Sun is responsible for dictating the seasons, climate and characteristics of every planet in the Solar System.

At about 150 million kilometres (93 million miles) from Earth lies a giant incandescent ball of gas weighing in at almost 2,000 trillion trillion kilograms and emitting power equivalent to1 million times the annual power consumption of the United States in a single second. Since the dawn of Earth 4,6 billion years ago it has been the one ever-present object in the sky, basking our world and those around us in energy and light and providing the means through which environments, and ultimately life, can flourish. We see it every day and rely on its energy to keep our planet ticking, but what exactly is this giant nuclear reactor at the centre of the Solar System that we call the Sun?

Over 5 billion years ago a vast cloud of dust and gas was located where our Solar System is now. Inside this nebula something huge was happening; gravity was pulling together the debris, likely the remnants of another star going supernova, into one central mass. As the various metals and elements were brought together they began to fuse into an object at the heart of this nebula. This dense clump of matter, called a protostar, grew and grew in size until it reached a critical temperature due to friction, about 1 million degrees Celsius (1,8 million degrees Fahrenheit). At this point nuclear fusion kicked in and our Sun was born.

At the heart of the Sun, hydrogen atoms fused together to produce helium, releasing photons of light in the process that extended throughout the Solar System. Eventually the hydrogen and helium atoms began to fuse and form heavier elements such as carbon and oxygen, which in turn formed key components of the Solar System, including humans. To us, it's the most important object in the sky. An observer watching from afar, however, would see no discerning qualities of our star that would make it stand out from any of the other hundreds of billions of stars in the Milky Way. In the grand scheme of things it's a fairly typical star that pales in comparison to the size of others.

For instance Sirius, the brightest star in the night sky, is twice as massive as the Sun and 25 times more luminous while Arcturus, the fourth brightest object in the night sky is almost 26 times the size of our closest star.

The Sun is located at a mean distance of 150 million kilometres (93 million miles) from Earth, a distance known as one astronomical unit (1 AU). This giant nuclear furnace is composed mostly of ionized gas and drives the seasons, ocean currents, weather and climate on Earth. Over a million Earths could fit inside the Sun, which is itself held together by gravitational attraction, resulting in immense pressure and temperature at its core. In fact, the core reaches a temperature of about 15 million degrees Celsius (27 million degrees Fahrenheit), hot enough for thermonuclear fusion to take place. The intense physical process taking place in the Sun produces heat and light that radiates throughout the Solar System. It's not a quick process, though; it takes more than 170,000 years for energy from the core to radiate outwards towards the outer layers of the Sun.

Our Sun is classified as a yellow dwarf star and these stars range in mass from about 80 per cent to 100 per cent the mass of the Sun, meaning our star is at the upper end of this group. There are also three further groups into which stars are classified: Population I, II and III. Our Sun is a Population I star, which denotes that it contains more heavy elements compared to other stars (although still accounting for no more than approximately 0,1 per cent of its total mass). Population III stars are those that formed at the start of the universe, possibly just a few hundred million years after the Big Bang, and they are made from pure hydrogen and helium. Although hypothesised, no such star has ever been found, as the majority of them exploded as supernovae in the early universe and led to the formation of Population I and II stars, the latter of which are older, less luminous and colder than the former.

By now you're probably thinking our Sun is insignificant, but that's anything but the case. Being our closest star, and the only one we can study with orbiting telescopes, it acts as one of the greatest laboratories available to mankind. Understanding the Sun allows us to apply our findings to research here on Earth, such as nuclear reactors, and our observations of distant stars.

(www.nationalgeographic.org)

VOCABULARY

Andromeda nebula — туманность Андромеды
Arcturus — Арктур (звезда)
coronal mass ejection (CME) — выброс корональной массы
debris — осколки, обломки
dense clump of matter— плотный сгусток вещества
facula — факел
furnace — очаг; печь
gravitational attraction — гравитационное притяжение
helium — гелий
hydrogen — водород
incandescent — раскаленный, накаленный добела
nebula (мн. *nebulae, nebulas*) — туманность
prominence — (солнечный) протуберанец
protostar — протозвезда
remnant — след, остаток
spicule — спикула (на Солнце)
sunspot — солнечное пятно

supernova (мн. *supernovae, supernovas*) — сверхновая звезда
supernova explosion — взрыв сверхновой (звезды)
thermonuclear fusion — термоядерный синтез

Exercise 1. ***Answer the following questions.***

1) What characteristics of the Sun are mentioned in paragraph 1?
2) How did the Sun come into being?
3) Which processes formed key components of the solar system?
4) Are there any discerning qualities of the Sun that would make it stand out from any of the other hundreds of billions of stars in the Milky Way?
5) What is the distance between the Sun and the Earth?
6) What is the Sun composed of?
7) What is the temperature of the core of the Sun?
8) What groups are stars classified into?
9) What category of stars does our Sun belong to?
10) What spheres can findings about the Sun be applied on Earth?

Text 2

SPACE-X WINS AND LOSSES

On June 28, SpaceX attempted what was to be the company's seventh resupply mission to the International Space Station (ISS), only to have the unmanned vehicle break up just over two minutes after launch, resulting in total mission failure, the company's first. In a statement July 20, Elon Musk, SpaceX's CEO, attributed the Falcon 9 rocket's breakup to a strut that failed to meet force requirements, resulting in an overpressure event in the second-stage oxygen tank, though he declined to name the outside manufacturer and labeled this "an initial assessment."

Six previous resupply missions had gone smoothly for the private space firm. On May 6, SpaceX also successfully tested its launch abort system — a sort of ejector seat for future crew. Additionally, the June 28 launch was meant to be the third attempt to land Falcon 9 on a drone barge — a bonus but so far unsuccessful objective — after launching the Dragon supply ship into orbit. While the rocket hit its target accurately on two previous landing attempts, it has been unable to land gently or upright enough to avoid destruction. SpaceX is striving for reusable rockets in order to drastically cut costs on future space launch missions. Unfortunately, the SpaceX ISS resupply failure was the third such in eight months, starting with Orbital Sciences Corporation's Antares rocket malfunction last October and the Russian loss of its Progress capsule in April. The ISS still had supplies for several months, and further resupply missions occurred in July and August. Furthermore, several successful missions docked with the ISS in between the recent failures, including several SpaceX flights.

(by K. Haynes from Astronomy, October 2015)

Exercise 2. ***Translate the following terms into Russian:***

Астероид, черная дыра, созвездие, полумесяц, полнолуние, солнечное затмение, лунное затмение, комета, световой год, Млечный Путь, северное сияние, красный гигант, желтый карлик, сила притяжения, ось Земли.

Exercise 3. ***Match the terms with their definitions:*** **faculae, sunspot, spicules, prominences, coronal mass ejection (CME).**

1. ______ These supersonic jets of hot plasma form in the Sun's interior and rise to a height of around 5,000 km (3,000 miles) above the Sun's photosphere.

2. A ______ is a burst of plasma and magnetic fields, known as stellar wind, being thrown into space from the Sun's corona.

3. ______ Produced by concentrations of magnetic field lines, these bright spots appear on the Sun's chromosphere in

regions where a sunspot will form Granulation. The Sun often appears granulated in images because of convection currents in its photosphere and chromosphere.

4. ______ These large loops of energy extend outwards from the Sun's corona. They can range over 700,000 km (430,000 miles), approximately the radius of the Sun.

5. ______ These dark spots on the surface of the Sun are caused by intense magnetic fields and are usually accompanied by a solar flare or CME.

Exercise 4. ***Fill in the gaps with these words:*** **the photosphere, corona, fusion power, the Sun's radius, radiative zone chromosphere, solar flares and sunspots.**

The visible surface of the Sun, 1) ______, has a temperature of 5,530°C (9,980°F) and is made mostly of convection cells, giving it a granulated appearance. Most of the Sun's 2) ______ is generated in the inner core, which extends outwards from the centre to about a quarter of 3) ______.

4) ______ is a thin layer about 2,000km (1,240 miles) thick, that sits just above the photosphere and is the area where 5) ______ are visible. 6) ______ is the outer 'atmosphere' of the Sun. It is made of plasma, extends millions of kilometres outwards and has a higher temperature than the inner photosphere. 7) ______ is the area full of electromagnetic radiation from the core that bounces around as photon waves. It makes up about 45 per cent of the Sun.

Exercise 5. ***Name all the planets in order they appear in the Solar System.***

Exercise 6. ***Translate into English.***

СОЛНЕЧНАЯ СИСТЕМА

Солнечная система — планетная система, включающая в себя центральную звезду — Солнце — и все естественные космические объекты, обращающиеся вокруг Солнца. Она сформировалась путем гравитационного сжатия газопылевого облака примерно 4,57 млрд лет назад.

Большая часть массы объектов Солнечной системы приходится на Солнце; остальная часть содержится в восьми относительно уединенных планетах, имеющих почти круговые орбиты и располагающихся в пределах почти плоского диска — плоскости эклиптики.

Четыре меньшие внутренние планеты — Меркурий, Венера, Земля и Марс (также называемые планетами земной группы) — состоят в основном из силикатов и металлов. Четыре внешние планеты — Юпитер, Сатурн, Уран и Нептун (также называемые газовыми гигантами) — намного более массивны, чем планеты земной группы. Крупнейшие планеты Солнечной системы, Юпитер и Сатурн, состоят главным образом из водорода и гелия; внешние, меньшие Уран и Нептун, помимо водорода и гелия, содержат в составе своих атмосфер метан и угарный газ. Такие планеты выделяются в отдельный класс «ледяных гигантов». Шесть планет из восьми и три карликовые планеты имеют естественные спутники. Каждая из внешних планет окружена кольцами пыли и других частиц.

В Солнечной системе существуют две области, заполненные малыми телами. Пояс астероидов, находящийся между Марсом и Юпитером, схож по составу с планетами земной группы, поскольку состоит из силикатов и металлов.

(https://ru.wikipedia.org/wiki/Солнечная_система)

<u>Exercise 7.</u> ***Write a précis and an annotation of the text given below.***

SOLAR MAXIMUM

Our local star might seem to be an unchanging ball of blazing light, but in reality its upper layers are seething with extreme activity that varies in a period of around 11 years, and whose influence reaches as far as Earth.

The Sun is a very special star, not only because the life on Earth depends on it, but because the Sun is the only star that we can observe in detail. What makes the Sun (and other active stars) very interesting is the presence of a magnetic field. One of the great challenges in solar physics is to understand, and ultimately predict, solar magnetic activity.

The Sun is the dominant force shaping conditions on Earth and throughout our Solar System — a brilliant ball of gas powered by nuclear fusion in its core, whose influence reaches out across billions of kilometres. Radiation at both visible and invisible wavelengths provides heat and light to the planets, and from the point of view of a casual observer, seems more or less constant — certainly seasonal changes as a planet moves around its orbit and changes its orientation and distance from the Sun have a far greater influence over its climate than any slight fluctuations in the Sun's behaviour.

But nevertheless, these changes are real — and while they do little to change the Sun's heating effect on Earth, they can be spectacularly violent in other ways, threatening orbiting satellites, distant space probes and even reaching down to the surface of the Earth itself. The Sun is unpredictable and can produce extreme outbursts at any time, but in general, the frequency and intensity of these events varies in a 'solar cycle' of around 11 years. The cycle, as we shall see, is fundamentally driven by the Sun's changing magnetic field and, through improving their understanding of it, astronomers hope to learn more about the deep structure of all stars.

While it may appear superficially solid, the Sun's visible surface, or photosphere, is in fact a layer a few hundred kilometers deep marking the region where the Sun's gases finally become transparent and allow light and other radiations to escape into space — temperatures in this region average approximately 5,500 degrees Celsius (9,930 degrees Fahrenheit), but sunspot regions are up to 2,000 degrees Celsius (3,630 degrees Fahrenheit) cooler, and so appear dark in comparison.

Sunspots are regions of strong magnetic fields that appear dark when the Sun is observed in visible light. At solar maximum sunspots are more numerous than at solar minimum. Larger and more complex sunspots are more commonly seen near solar maximum. But while you might think that dark spots on the Sun's surface would cause its overall energy output to fall, the opposite is actually the case: The Sun's radiative output peaks at solar maximum. This seems counter-intuitive, but sunspots are surrounded by bright features called faculae and plages that make the Sun brighter at solar maximum.

While sunspot activity is by far the most obvious indication of the solar cycle at work, it is far from being the only one. Since the beginning of the space age, new technologies for studying the Sun at invisible, high-energy wavelengths such as the ultraviolet and X-rays have revealed far more spectacular outbursts that are also linked to the cycle. The magnitude of the solar radiative variation over a solar cycle is a function of wavelength. In visible light, the change is very small, but it is much larger in the shorter wavelengths of ultraviolet and X-ray radiation. Much of this higher-energy radiation is associated with solar flares — sudden brightenings of the Sun's surface that typically last for just a few minutes but can release enormous amounts of energy — equivalent to a billion megatons of TNT. They occur in the solar corona — the Sun's thin outer atmosphere where gas is far more tenuous than at the photosphere, but temperatures can soar up to 2 million degrees Celsius (3,6 million degrees Fahrenheit), and are often seen above active sunspot regions. Flares, too, are thought to be connected to changes in the Sun's magnetic field, specifically 'reconnection events' in which a loop of magnetic field arcing high into the corona 'short-circuits' at a lower level to release an enormous amount of energy and a burst of high-energy radiation. Flares are also often associated with huge releases of high-speed subatomic particles known as coronal mass ejections (CMEs). Travelling at millions of kilometres per hour, the particles from a CME can reach Earth within a couple of days.

A direct hit by a powerful CME can cause significant disruption to our planet's magnetic field. This kind of event, known as a geomagnetic storm, can send particles pouring into Earth's upper atmosphere where they cause stunning displays of aurorae (northern and southern lights). However, the combination of high-energy radiation and energetic particles can also have more serious effects for modern civilisation, affecting orbiting spacecraft and even ground-based power networks.

Perhaps the most famous geomagnetic storm is the 'Carrington Event' of 1859, associated with a brilliant flare first spotted by English astronomer Richard Carrington on 1 September 1859. The ensuing coronal mass ejection, travelling at tremendous speed, reached the Earth barely a day later, triggering northern lights that were visible as far south as the Caribbean, and bright enough for people at higher latitudes to read newspapers in the middle of the night. As the Earth's magnetic field warped under the onslaught, telegraph systems around the world went haywire as they were overloaded with unexpected electric currents.

While both flares and CMEs can occur throughout the solar cycle, frequency and average strength rises significantly around the solar maximum (the Carrington Event, for instance, is acknowledged as the peak of 'Solar Cycle 10'). Despite the energies involved, the total solar irradiance (TSI) — the amount of solar radiative energy that reaches the Earth's upper atmosphere — varies by just 0,1 per cent over a solar cycle, but recent research has shown that within this overall pattern, solar output at different wavelengths can vary by much greater amounts.

One thing is for certain, however — the Sun and its various cycles will continue to influence everything from technology to climate. We can do nothing to influence our local star, so we must learn to at least understand it more accurately, and be prepared for its occasional outbursts of violence.

(www.nationalgeographic.org)

Exercise 8. ***Write in English a précis and an annotation of the text given below.***

СОЛНЦЕ VS ЗЕМЛЯ: ВОПРОС ЖИЗНИ И СМЕРТИ

Через несколько миллиардов лет Солнце станет «красным гигантом», настолько большим, что оно поглотит нашу планету. Однако непригодной для жизни Земля окажется гораздо раньше, чем это произойдет. Примерно через миллиард лет тепло, исходящее от Солнца, вскипятит океаны.

На сегодняшний день ученые классифицируют Солнце как звезду главной последовательности. Это означает, что оно находится на самом стабильном этапе своей жизни. В этот период водород, который находится в его ядре, преобразовывается в гелий. У звезды такого размера данная фаза длится чуть более 8 миллиардов лет. Возраст нашей Солнечной системы составляет немногим больше 4,5 миллиардов лет. Это значит, что Солнце лишь на половине своей стабильной фазы.

По истечению 8 миллиардов лет размеренная жизнь Солнца станет активнее. Причиной таких изменений послужит тот факт, что в ядре закончится водород — весь он превратится в гелий. Проблема заключается в том, что ядро Солнца недостаточно горячее для того, чтобы сжигать гелий.

Гравитационная сила звезды толкает все газы в сторону центра. Пока в ядре имеется водород, он сжигается в гелий. В результате этого создается внешнее давление, достаточное для того, чтобы уравновесить гравитационное притяжение. Но когда в ядре звезды не останется водорода, гравитационная сила одержит верх. В конце концов она сожмет центр звезды до такой степени, что начнется горение водорода в оболочке вокруг мертвого ядра, наполненного гелием. Как только Солнце начнет сжигать больше водорода, оно будет считаться «красным гигантом».

Но почему же «красный гигант»? Процесс сжатия в центре позволит расшириться внешней области звезды. Горение водорода в оболочке вокруг ядра значительно увеличит яркость Солнца. Из-за увеличения размера звезды поверхность остынет и изменит цвет из белого в красный. Из-за того, что такие звезды увеличиваются в размере, становятся ярче и краснее, их принято называть «красными гигантами».

Понятно, что Земля как планета не выживет в условиях таких изменений солнечной активности. Увеличенная поверхность Солнца, вероятно, достигнет орбиты Марса. Несмотря на то, что земная орбита также предположительно расширится, этого будет недостаточно для того, чтобы Земля могла устоять перед воздействием «красного гиганта». Наша планета начнет быстро разрушаться.

Прежде чем Земля будет окончательно разрушена, жизнь столкнется с рядом непреодолимых препятствий. Это произойдет еще до того, как закончится горение водорода. Каждый миллиард лет яркость Солнца увеличивается на 10%. Это означает, что с течением времени на нашей планете становится теплее. По мере того как Земля будет нагреваться, вода на ее поверхности начнет испаряться.

Увеличение яркости Солнца на 10% в сравнении с текущим показателем кажется не таким уж существенным изменением. В действительности же последствия этого будут катастрофическими для нашей планеты. Такое увеличение яркости Солнца будет достаточным для того, чтобы изменить расположение зоны обитаемости вокруг звезды. Под обитаемой зоной понимается условная область в космическом пространстве, где вода может стабильно существовать в жидкой фазе.

(http://www.astronews.ru/cgi-bin/mng.cgi?page=articles&id=37)

Exercise 9. ***Read quickly the briefcases and express the same ideas in Russian.***

GALACTIC SMOG

ALMA peered into the early universe, only a billion years after the Big Bang, to find the elusive signature of ionized carbon in early galaxies. Carbon likes to bond with other elements, so seeing carbon on its own in an ionized (highly energized) state is a strong sign that astronomers are looking at unevolved young galaxies that have not had time to form complex molecules. The new information, published June 25 in *Nature*, sheds light on how the early universe evolved.

MARTIAN GLASS

Scientists using data from the Mars Reconnaissance Orbiter identified glass deposits around ancient craters on the Red Planet. The researchers, writing in *Geology*'s June issue, point out that on Earth impact glass can preserve valuable biosignatures from earlier eras, and the same could be true on Mars. That makes these glassy deposits prime targets for future sample exploration missions.

X-RAY ECHOES

Astronomers using the Chandra X-ray Observatory pinpointed the location of a neutron star system called Circinus X-1. The star is embedded in a thick shroud of gas and dust, obscuring the source. But, as reported in the June 20 issue of *The Astrophysical Journal*, scientists combined the different arrival times of X-rays echoing off these clouds with detailed radio images to home in on a distance of 30,700 light years to the star.

<u>**Exercise 10.**</u> ***Translate into Russian.***

WHY DID VENUS TURN INSIDE OUT?

Three quarters of a billion years ago, our "sister planet" globally resurfaced. Venus is unmistakable in our sky. Never straying terribly far from the Sun, it blazes brilliantly either in the evening or morning. But along with its brilliance, Venus hides a secret.

Many inner planets and moons preserve a great record of ancient impacts from objects that struck them in the early history of the solar system, right on down to the present. But planetary scientists have found that Venus underwent a colossal resurfacing event, a volcanic cataclysm, some three quarters of a billion years ago. This means that most of the craters and other surface features we find on Venus are relatively young. But what could have caused such a huge, relatively recent global resurfacing? As one planetary scientist put it, "We are in the unenviable place of having to explain a planet that inexplicably threw up all over itself!"

For as yet unknown reasons, Venus seems to have stored enormous amounts of energy deep inside for a long time after the planet's formation. Scientists know that the better part of a billion years ago, a huge amount of this banked energy was released. But no one yet knows what triggered this event or why it happened exactly when it did.

Instabilities deep within Venus conspired — through physical evolution, the laws of physics, and interplay between countless atoms — to let loose and recover our "sister planet" in a large way.

(by David J. Eicher from Astronomy, October 2015)

<u>**Exercise 11.**</u> ***Translate the text using PROMT (Déjà Vu, TRADOS). Analyze the translation and make corrections.***

INTENTIONAL IGNORANCE

Climate change deniers are trying to make NASA conveniently blind

In the 1990s, NASA undertook an initiative called Mission to Planet Earth. The program would take the remote sensing techniques used to explore other planets and turn them on our home world. The plan virtually screamed "practical benefits."

By any measure, NASA's Earth science program has been an extraordinary success. It has revolutionized weather forecasts, agricultural predictions, resource management, and climate science. Return on investment is off the charts. But such a program has to be maintained. Quoting a 2007 report from the National Academy of Sciences, "The current capability to observe Earth from space is in jeopardy." Without resources, that capability will be lost.

So why is it that as of this writing, Congress is poised to slash as much as three quarters of a billion dollars from the program and cripple a vital global perspective that we have come to depend on? The answer is disturbingly simple. Many in Congress, along with their well-heeled backers, would prefer that we not see what NASA's data are showing us.

The crux of the issue is, of course, global warming. But one thing that you *won't* often hear amid the hype on cable news is a calm, rational explanation of what global warming is and how it works.

Imagine a rock adrift in space. Energy arrives as visible sunlight, trying to heat things up. Energy leaves as thermal infrared radiation, trying to cool things down. At some temperature, the two will balance. Voilà! Now imagine the rock is wrapped in a blanket that lets sunlight in but makes it harder for infrared to get out. More energy is coming in than is leaving, so things heat up. Eventually, balance is restored, but at a new higher temperature.

The atmospheres of Venus, Earth, and Mars are just such blankets. Gases like carbon dioxide, water vapor, and methane are transparent to visible sunlight but block escaping infrared. The thin atmosphere of Mars only raises the temperature by about 9°F (5°C). The massive atmosphere of Venus heats the surface to a whopping 860°F (460°C), well above the melting point of lead!

Earth is the Goldilocks world. The so-called greenhouse effect raises Earth's average temperature from 33°F (18°C) *below* the freezing point of water to 27°F (15°C) *above* the freezing point of water.

Since 1750, humans have released over 300 billion metric tons of carbon into the atmosphere. There is 44 percent more carbon dioxide in our atmosphere today than there was before the Industrial Revolution. Half of that increase has come since 1980. There is over 30 percent more atmospheric carbon dioxide than at any time in the last 800,000 years. And just as our student realized, when you crank up the thermostat, things will start to heat up.

There are about a half dozen ways to measure Earth's thermal imbalance, and they all show that the planet is warming. Imagine

Earth's surface covered by 1-kilowatt heaters, one every 100 feet (30 meters) or so. The heaters run 24/7, year after year, decade after decade: That is global warming.

While the details are subtle, the basics of global warming are incontrovertible and easily understood. It is disingenuous and irresponsible to pretend otherwise. Politicizing climate change is like politicizing gravity. If you step off of a building, you fall and hurt yourself, regardless of your politics. Crippling NASA's ability to observe Earth will not stop global warming; it will only leave us blind.

(by Jeff Hester)

KEYS TO EXERCISES

UNIT 1. BIOLOGY

Exercise 1. 1) обмен веществ; 2) питательное вещество; 3) клетка; 4) оплодотворение; 5) оплодотворенная яйцеклетка; 6) автотроф; 7) гетеротрофный организм; 8) органогенез; 9) половая зрелость; 10) размножение; 11) гомеостаз(ис); 12) хищник; 13) фермент; 14) белок; 15) углевод.

Exercise 2. 1) heterotroph; 2) nutrient; 3) cell; 4) fertilization; 5) zygote; 6) autotroph ; 7) metabolism; 8) organogenesis; 9) puberty; 10) reproduction; 11) homeostasis; 12) predator.

Exercise 3. 1) botany; 2) zoology; 3) anatomy; 4) physiology; 5) bacteriology; 6) genetics; 7) molecular biology; 8) anthropology; 9) autotroph; 10) heterotroph; 11) organogenesis; 12) puberty; 13) homeostasis; 14) predator.

Exercise 5. 1-b; 2-a; 3-g; 4-d; 5-e; 6-h; 7-c; 8-f; 9-i; 10-l; 11-k; 12-j.

Exercise 6. 1) digestive; 2) excretory; 3) respiratory; 4) skeletal; 5) muscular; 6) integumentary; 7) cardiovascular; 8) endocrine; 9) nervous; 10) lymphatic; 11) reproductive (female); 12) reproductive (male).

Exercise 7. 1) life; 2) animals; 3) microorganisms; 4) the interface between biology and chemistry; 5) life on the molecular level; 6) different types of cells and how they work; 7) organisms at the level of tissue and organs; 8) the interactions between organisms themselves; 9) the behavior of animals, especially complex animals; 10) (overlapping with molecular biology) the code of life; 11) plants; 12) the origin and development of human cultures and physical characteristics; 13) the study of birds; 14) the study of fishes; 15) the study of fungi; 16) the study of one-celled animals; 17) the study of amphibians and reptiles; 18) the study of insects; 19) the study of man.

Exercise 8. 1) biology; 2) zoology; 3) botany; 4) microbiology; 5) livestock; 6) biochemistry; 7) molecular biology; 8) cellular biology; 9) physiology; 10) ecology; 11) ethology; 12) genetics.

UNIT 2. GENETICS

Exercise 1. 1) клетка; 2) хромосома; 3) аутосома; 4) углевод; 5) липид; 6) кодон; 7) гоносома, половая хромосома; 8) цитоплазма; 9) цитозоль; 10) ядро (клетки); 11) митохондрия; 12) дезоксирибонуклеиновая кислота (ДНК); 13) рибонуклеиновая кислота (РНК); 14) считывание биологической информации; 15) экспрессия; 16) трансляция (синтез полипептидной цепи белковой молекулы); 17) аминокислота; 18) последовательность; порядок следования; 19) аденин; 20) гуанин; 21) цитозин; 22) тимин; 23) нить, цепь ДНК; 24) нуклеотид; 25) фермент, энзим; 26) матрица; 27) основание; 28) белок, протеин; 29) ткань; 30) посредник, мессенджер; информационная РНК, матричная РНК, м-РНК, РНК-посредник.

Exercise 2. 1) cell; 2) chromosome; 3) autosome; 4) carbohydrate; 5) lipid; 6) codon; 7) gonosome; 8) cytoplasm; 9) cytosol; 10) nucleus; 11) mitochondrion; 12) deoxyribonucleic acid (DNA); 13) ribonucleic acid (RNA); 14) transcription; 15) amino acid;16) sequence; 17) adenine; 18) guanine; 19) cytosine; 20) thymine; 21) strand; 22) nucleotide; 23) enzyme; 24) template; 25) base; 26) protein; 27) tissue; 28) messenger.

Exercise 3. 1) adenine (аденин); 2) guanine (гуанин); 3) cytosine (цитозин); 4) thymine (тимин); 5) deoxyribonucleic acid (дезоксирибонуклеиновая кислота); 6) ribonucleic acid (рибонуклеиновая кислота); 7) messenger ribonucleic acid (информационная рибонуклеиновая кислота).

Exercise 4. 1) cell nucleus; 2) autosomes; 3) bases; 4) enzyme; 5) chromosomes; 6) codon; 7) DNA; 8) DNA sequence; 9) gene; 10) gene technology; 11) genetic fingerprinting; 12) genome; 13) germ line; 14) gonosomes; 15) intron.

Exercise 5. 1) lipids; 2) carbohydrates; 3) proteins; 4) enzymes, hormones, cells, immune system; 5) amino acids; 6) nucleotides, cytosine; 7) codon.

Exercise 6. 1) структура ткани; 2) исследование генома; 3) мышечная клетка; 4) клеточная дифференцировка; 5) исследование генома; 6) сперматозоид; 7) клетка поджелудочной железы; 8) костный мозг; 9) пара оснований; п.о. (в ДНК или РНК); 10) точковая (точечная) мутация; 11) замещение цепи ДНК; 12) информационная РНК (иРНК, мРНК); 13) клетка сердечной мышцы; 14) клетка костного мозга; 15) клетка зародышевой линии; 16) стволовая клетка; исходная клетка; 17) зародышевая клетка.

Exercise 12. 1) потомство; 2) репликация, ауторепродукция; 3) размножаться, репродуцировать; 4) уровень смертности; 5) атрофия, ослабление (органа, ткани), истощение; 6) мутаген; 7) воспроизведение, репродукция; 8) наследственная болезнь; 9) форма жизни, живой организм; 10) тест на установление отцовства; 11) исследование генома; 12) яйцеклетка.

Exercise 13. 1) reproduction; 2) template; 3) propagate; 4) dying rate; 5) atrophy; 6) mutagene; 7) progeny; 8) messenger; 9) life form; 10) paternity test; 11) genome analysis; 12) egg cell; 13) DNA strand; 14) nucleotide; 15) enzyme; 16) replication; 17) base; 18) protein; 19) tissue; 20) inherited disease.

Exercise 14. 1) autosomes; 2) bases; 3) chromatin; 4) allele; 5) genetic technology; 6) genetic fingerprinting; 7) mutation; 8) replication; 9) zygote; 10) gamete.

Exercise 15. 1) hereditary information; 2) dying rate; 3) genetic information; 4) DNA base; 5) somatic mutations; 6) germ; 7) fingerprinting; 8) genome 9) cell; 10) replication; 11) nucleus.

Exercise 16. 1) темп производства; 2) точечная мутация; 3) двойная нить ДНК; 4) репликация ДНК; 5) противоположные полюса клетки; 6) нуклеотидная последовательность; 7) ткань тела; 8) зародышевая клетка; 9) деление клетки; 10) анализ, исследование генома; 11) клеточная дифференцировка; 12) структура ткани; 13) серповидная клетка, дрепаноцит, серповидный эритроцит; 14) серповидно-клеточная болезнь; 15) сперматозоид; 16) нуклеотидное основание; 17) клетка зародышевой линии; 19) матричная нить.

UNIT 3. GEOLOGY

Exercise 1. 1) земная кора; 2) мантия; 3) ядро; 4) плита; 5) извержение; 6) вольфрам; 7) свинец; 8) сплав железа и никеля; 9) примесь; 10) осаждение, отложение осадка.

Exercise 2. 1) convergent boundaries; 2) core; 3) crust; 4) subduction ; 5) rift; 6) mantle; 7) depression; 8) slab; 9) sulphur; 10) tungsten .

Exercise 3. 1) asthenosphere; 2) lithosphere; 3) crust; 4) core; 5) Mohorovicic discontinuity (Moho); 6) mantle; 7) subduction; 8) seismic wave; 9) peridotite; 10) olivine.

Exercise 4. 1) core; 2) mantle; 3) crust ; 4) Earth; 5) Earth's; 6) interior; 7) mantle; 8) seismic waves; 9) layer; 10) asthenosphere; 11) asthenosphere; 12) lithosphere; 13) crust; 14) Moho; 15) mantle; 16) crust; 17) mantle.

Exercise 5. 1) срединно-океанические хребты; 2) 7-километровая кора; 3) легкая поездка на автобусе; 4) технология (техника, режим) бурения морского дна; 5) разведка нефтяных месторождений;

6) (суб)океаническая кора; 7) океанический осадок; 8) твердые породы мантии; 9) силикат магния / железа; 10) силикатная порода; 11) вещество, богатое железом; 12) (суб)океаническая литосфера; 13) термомассопоток в мантии; 14) продолжительность дня; 15) горный хребет; 16) состав массы.

Exercise 6. 1) Crust, mantle and core; 2) the heat and pressure tended to soften the drill components and squeeze; 3) mantle; 4) in the outpourings of deep rooted volcanoes; 5) iron and nickel; 6) yes, they do; 7) stratification; 8) seismic wave; 9) Moho discontinuity; 10) silicates; 11) nickel and iron; 12) lithosphere.

UNIT 4. PHYSICS

Exercise 6. 1) the physics in the universe, including the properties and interactions of celestial bodies in astronomy; 2) studying the physical interactions of biological processes; 3) the science of physical relations in chemistry; 4) dealing with physical processes and their relations in the science of economy; 5) the sciences of physical relations on our planet; 6) the application of physics to prevention, diagnosis, and treatment; 7) dealing with physical processes and their relations in the science of physical chemistry.

UNIT 5. CHEMISTRY

Exercise 2. 1) hydrogen; 2) fluorine; 3) nitrogen; 4) aluminum; 5) chromium; 6) molybdenum; 7) iron; 8) tin; 9) silver; 10) gold; 11) mercury; 12) lead; 13) uranium; 14) plutonium; 15) zinc.

Exercise 3. 1) водород; 2) фтор; 3) азот; 4) алюминий; 5) хром; 6) молибден; 7) железо; 8) олово; 9) серебро; 10) золото; 11) ртуть; 12) свинец; 13) уран; 14) плутоний; 15) цинк.

Exercise 6. 1) study of the physical and fundamental basis of chemical systems and processes. In particular, the energetics and dynamics of such systems and processes are of interest to physical chemists. Important areas of study include chemical thermodynamics, chemical kinetics, electrochemistry, statistical mechanics, spectroscopy, and more recently, astrochemistry. Physical chemistry has large overlap with molecular physics. Physical chemistry involves the use of infinitesimal calculus in deriving equations. It is usually associated with quantum chemistry and theoretical chemistry. Physical chemistry is a distinct discipline from chemical physics, but again, there is very strong overlap; 2) study of the structure, properties, composition, mechanisms, and reactions of organic compounds; 3) study of the properties and reactions of inorganic compounds. The distinction between organic and inorganic disciplines is not absolute and there is much overlap, most importantly in the sub-discipline of organometallic chemistry; 4) analysis of material samples to gain an understanding of their chemical composition and structure. Analytical chemistry incorporates standardized experimental methods in chemistry. These methods may be used in all subdisciplines of chemistry, excluding purely theoretical chemistry; 5) study of chemical and biochemical phenomena that occur diverse aspects of the environment such the air, soil, and water. It also studies the effects of human activity on the environment; 6) a philosophy of chemical research and engineering that encourages the design of products and processes that minimize the use and generation of hazardous substances; 7) includes the study of Immunology, Molecular Biology, and Neurochemistry. Biochemistry has emerged from Organic Chemistry because it is less about synthesis and organic reactions, and more about using chemistry to understand what is happening in biology at the molecular level; 8) branch of engineering that applies the physical sciences (e.g., chemistry and physics) and/or life sciences (e.g., biology, microbiology and biochemistry) together with mathematics and economics to processes that convert raw materials or chemicals into more useful or valuable forms; 9) study and application of matter that is at an atomic and molecular scale. This broad field interacts with chemistry at such scales; 10) study of the transformation of petroleum and natural gas into useful products or raw materials.

UNIT 6. ASTRONOMY

Exercise 3. 1) Spicules; 2) coronal mass ejections; 3) faculae; 4) prominences; 5) sunspots.

Exercise 4. 1) the photosphere; 2) fusion power; 3) the Sun's radius; 4) chromosphere; 5) solar flares and sunspots; 6) corona; 7) radiative zone.

Exercise 5. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

RECOMMENDED INTERNET GLOSSARIES

http://www.paralink.com/context/_dCnOL_8944/
http://www.paralink.com/context/_dCnOL_2538/
http://www.medialingua.ru/russian/multilexonline/molframes.htm
http://isabase.philol.msu.ru/mu-online/
http://www.lingvo.ru/lingvo/index.asp
http://www.ling98.com/
http://www.langtolang.com/
http://www.multitran.ru/
http://www.electropedia.org
http://www.en.wikipedia.org
http://www.lingvoda.ru
http://www.abbreviations.com

TABLE OF CHEMICAL ELEMENTS
(Latin, Russian, English)

No.	Символ	Латинское название	Русское название	Английское название
1	H	Hydrogenium	Водород	Hydrogen
2	He	Helium	Гелий	Helium
3	Li	Lithium	Литий	Lithium
4	Be	Beryllium	Бериллий	Beryllium
5	B	Borum	Бор	Boron
6	C	Carboneum	Углерод	Carbon
7	N	Nitrogenium	Азот	Nitrogen
8	O	Oxygenium	Кислород	Oxygen
9	F	Fluorum	Фтор	Fluorine
10	Ne	Neon	Неон	Neon
11	Na	Natrium	Натрий	Sodium
12	Mg	Magnesium	Магний	Magnesium
13	Al	Aluminium	Алюминий	Aluminum
14	Si	Silicium	Кремний	Silicon
15	P	Phosphorus	Фосфор	Phosphorus
16	S	Sulfur	Сера	Sulfur
17	Cl	Chlorum	Хлор	Chlorine
18	Ar	Argon	Аргон	Argon
19	K	Kalium	Калий	Potassium

No.	Символ	Латинское название	Русское название	Английское название
20	**Ca**	Calcium	Кальций	Calcium
21	**Sc**	Scandium	Скандий	Scandium
22	**Ti**	Titanium	Титан	Titanium
23	**V**	Vanadium	Ванадий	Vanadium
24	**Cr**	Chromium	Хром	Chromium
25	**Mn**	Manganum	Марганец	Manganese
26	**Fe**	Ferrum	Железо	Iron
27	**Co**	Cobaltum	Кобальт	Cobalt
28	**Ni**	Niccolum	Никель	Nickel
29	**Cu**	Cuprum	Медь	Copper
30	**Zn**	Zincum	Цинк	Zinc
31	**Ga**	Gallium	Галлий	Gallium
32	**Ge**	Germanium	Германий	Germanium
33	**As**	Arsenicum	Мышьяк	Arsenic
34	**Se**	Selenium	Селен	Selenium
35	**Br**	Bromum	Бром	Bromine
36	**Kr**	Krypton	Криптон	Krypton
37	**Rb**	Rubidium	Рубидий	Rubidium
38	**Sr**	Strontium	Стронций	Strontium
39	**Y**	Yttrium	Иттрий	Yttrium
40	**Zr**	Zirconium	Цирконий	Zirconium
41	**Nb**	Niobium	Ниобий	Niobium
42	**Mo**	Molybdaenum	Молибден	Molybdenum
43	**Tc**	Technetium	Технеций	Technetium

No.	Символ	Латинское название	Русское название	Английское название
44	**Ru**	Ruthenium	Рутений	Ruthenium
45	**Rh**	Rhodium	Родий	Rhodium
46	**Pd**	Palladium	Палладий	Palladium
47	**Ag**	Argentum	Серебро	Silver
48	**Cd**	Cadmium	Кадмий	Cadmium
49	**In**	Indium	Индий	Indium
50	**Sn**	Stannum	Олово	Tin
51	**Sb**	Stibium	Сурьма	Antimony
52	**Te**	Tellurium	Теллур	Tellurium
53	**I**	Jodum	Иод	Iodine
54	**Xe**	Xenon	Ксенон	Xenon
55	**Cs**	Caesium	Цезий	Cesium
56	**Ba**	Barium	Барий	Barium
57	**La**	Lanthanum	Лантан	Lanthanum
58	**Ce**	Cerium	Церий	Cerium
59	**Pr**	Praseodymium	Празеодим	Praseodymium
60	**Nd**	Neodymium	Неодим	Neodymium
61	**Pm**	Promethium	Прометий	Promethium
62	**Sm**	Samarium	Самарий	Samarium
63	**Eu**	Europium	Европий	Europium
64	**Gd**	Gadolinium	Гадолиний	Gadolinium
65	**Tb**	Terbium	Тербий	Terbium
66	**Dy**	Dysprosium	Диспрозий	Dysprosium
67	**Ho**	Holmium	Гольмий	Holmium

No.	Символ	Латинское название	Русское название	Английское название
68	**Er**	Erbium	Эрбий	Erbium
69	**Tm**	Thulium	Тулий	Thulium
70	**Yb**	Ytterbium	Иттербий	Ytterbium
71	**Lu**	Lutetium	Лютеций	Lutetium
72	**Hf**	Hafnium	Гафний	Hafnium
73	**Ta**	Tantalum	Тантал	Tantalum
74	**W**	Wolfram	Вольфрам	Tungsten
75	**Re**	Rhenium	Рений	Rhenium
76	**Os**	Osmium	Осмий	Osmium
77	**Ir**	Iridium	Иридий	Iridium
78	**Pt**	Platinum	Платина	Platinum
79	**Au**	Aurum	Золото	Gold
80	**Hg**	Hydrargyrum	Ртуть	Mercury
81	**Tl**	Thallium	Таллий	Thallium
82	**Pb**	Plumbum	Свинец	Lead
83	**Bi**	Bismuthum	Висмут	Bismuth
84	**Po**	Polonium	Полоний	Polonium
85	**At**	Astatium	Астат	Astatine
86	**Rn**	Radon	Радон	Radon
87	**Fr**	Francium	Франций	Francium
88	**Ra**	Radium	Радий	Radium
89	**Ac**	Actinium	Актиний	Actinium
90	**Th**	Thorium	Торий	Thorium
91	**Pa**	Protactinium	Протактиний	Protactinium

No.	Символ	Латинское название	Русское название	Английское название
92	**U**	Uranium	Уран	Uranium
93	**Np**	Neptunium	Нептуний	Neptunium
94	**Pu**	Plutonium	Плутоний	Plutonium
95	**Am**	Americium	Америций	Americium
96	**Cm**	Curium	Кюрий	Curium
97	**Bk**	Berkelium	Берклий	Berkelium
98	**Cf**	Californium	Калифорний	Californium
99	**Es**	Einsteinium	Эйнштейний	Einsteinium
100	**Fm**	Fermium	Фермий	Fermium
101	**Md**	Mendelevium	Менделевий	Mendelevium
102	**No**	Nobelium	Нобелий	Nobelium
103	**Lr**	Lawrencium	Лоуренсий	Lawrencium
104	**Rf**	Rutherfordium	Резерфордий	Rutherfordium
105	**Db**	Dubnium	Дубний	Dubnium
106	**Sg**	Seaborgium	Сиборгий	Seaborgium
107	**Bh**	Bohrium	Борий	Bohrium
108	**Hs**	Hassium	Хассий	Hassium
109	**Mt**	Meitnerium	Мейтнерий	Meitnerium

LIST OF GREEK AND LATIN PREFIXES AND SUFFIXES

Latin Prefixes	Greek Prefixes
a-, ab-, abs- — from, away from	a-, an- — not, without
am-, amb-, ambi- — about, around	anti- — opposite, against
bi-, bis- — twice	ap- — from, away from
com- — with, together	auto- — self
contra- — against	di-, dis- — twice
de- — down	hemi- — half
dis- — apart	hyper- — over, above
ex- — out of, from, off	par-, para- — beside
extra- — beyond	
inter- — between, within	
non- — not	
post- — after	
pre- — before	
re- — back, again	
se- — aside, apart	
sub- — under	
super- — above, over	
trans- — beyond, through, across	

Latin Suffixes	Greek Suffixes
-age — формирует абстрактные существительные -al — формирует отглагольные существительные -ant — обозначает деятеля -ary — обозначает принадлежность -ate — обозначает должность или функцию -ess — обозначает женский род -ice — обозначает качество, условие -ine — обозначает женский род и абстрактное понятие -ion, -tion, -sion — формирует абстрактные существительные -ment — инструмент, действие -ory — обозначает место -ty — качество, состояние -ure — действие, результат	-ic — принадлежность -isk — уменьшительный -ism — действие, состояние, формирует абстрактные существительные -ist — деятель -sis, -sy — действие, состояние -y — формирует абстрактные существительные

LIST OF PHYSICAL UNITS (English)

Base quantity	Symbol	Description	SI unit	Symbol for dimension	Comments
Length	l	The one-dimensional extent of an object	metre (m)	**L**	
Mass	m	The amount of matter in an object	kilogram (kg)	**M**	extensive, scalar
Time	t	The duration of an event	second (s)	**T**	scalar
Electric current	I	Rate of flow of electrical charge	ampere (A)	**I**	
Temperature	T	Average energy per degree of freedom of a system	kelvin (K)	**Θ**	intensive, scalar
Amount of substance	n	Number of particles compared to the number of atoms in 0,012 kg of ^{12}C	mole (mol)	**N**	extensive, scalar
Luminous intensity	L	Amount of energy emitted by a light source in a particular direction	candela (cd)	**J**	scalar

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Plane angle	θ	Measure of a change in direction or orientation	radian (rad)	1	
Solid angle	Ω	Measure of the size of an object as projected on a sphere	steradian (sr)	1	
Absorbed dose rate		Absorbed dose received per unit of time	Gy s^{-1}	$L^2 T^{-3}$	
Acceleration	$\vec{a}$	Rate of change of the speed or velocity of an object	m s^{-2}	$L T^{-2}$	vector
Angular acceleration	α	Rate of change in angular speed or velocity	rad s^{-2}	T^{-2}	
Angular speed (or angular velocity)	ω	The angle incremented in a plane by a segment connecting an object and a reference point	rad s^{-1}	T^{-1}	scalar or pseudovector
Angular momentum	L	Measure of the extent and direction an object rotates about a reference point	kg m^2 s^{-1}	$M L^2 T^{-1}$	conserved quantity, pseudovector

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Area	A	The two-dimensional extent of an object	m^2	L^2	scalar
Area density	ρ_A	The amount of mass per unit area of a two-dimensional object	$kg\ m^{-2}$	$M\ L^{-2}$	
Capacitance	C	Measure for the amount of stored charge for a given potential	farad ($F = A^2\ s^4\ kg^{-1}\ m^{-2}$)	$I^2\ T^4\ M^{-1}\ L^{-2}$	scalar
Catalytic activity		Change in reaction rate due to presence of a catalyst	katal ($kat = mol\ s^{-1}$)	$N\ T^{-1}$	
Catalytic activity concentration		Change in reaction rate due to presence of a catalyst per unit volume of the system	$kat\ m^{-3}$	$N\ L^{-3}\ T^{-1}$	
Chemical potential	μ	The amount of energy needed to add a particle to a system	$J\ mol^{-1}$	$M\ L^2\ T^{-2}\ N^{-1}$	intensive

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Molar concentration	C	Amount of substance per unit volume	$mol\ m^{-3}$	$N\ L^{-3}$	intensive
Crackle	$\vec{c}$	Rate of change of Jounce. The fifth derivative of position	$m\ s^{-5}$	$L\ T^{-5}$	vector
Current density	$\vec{J}$	Amount of electric current flowing through a surface	$A\ m^{-2}$	$I\ L^{-2}$	vector
Dose equivalent	H	Measure for the received amount of radiation adjusted for the effect of different types of radiant on biological tissue	sievert ($Sv = m^2\ s^{-2}$)	$L^2\ T^{-2}$	
Dynamic Viscosity	η	Measure for the resistance of an incompressible fluid to stress	Pa s	$M\ L^{-1}\ T^{-1}$	
Electric Charge	Q	Amount of electric charge	coulomb ($C = A\ s$)	$I\ T$	extensive, conserved quantity

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Electric charge density	ρ_Q	Amount of electric charge per unit volume	$C\ m^{-3}$	$\mathbf{I\ T\ L^{-3}}$	intensive
Electric displacement	*D*	Strength of the electric displacement	$C\ m^{-2}$	$\mathbf{I\ T\ L^{-2}}$	vector field
Electric field strength	$E\rightarrow$	Strength of the electric field	$V\ m^{-1}$	$\mathbf{M\ L\ T^{-3}\ I^{-1}}$	vector field
Electrical conductance	*G*	Measure for how easily current flows through a material	siemens ($S = A^2\ s^3\ kg^{-1}\ m^{-2}$)	$\mathbf{L^{-2}\ M^{-1}\ T^3\ I^2}$	scalar
Electric potential	*V*	The amount of work required to bring a unit charge into an electric field from infinity	volt ($V = kg\ m^2\ A^{-1}\ s^{-3}$)	$\mathbf{L^2\ M\ T^{-3}\ I^{-1}}$	scalar
Electrical resistance	*R*	The degree to which an object opposes the passage of an electric current	ohm ($\Omega = kg\ m^2\ A^{-2}\ s^{-3}$)	$\mathbf{L^2\ M\ T^{-3}\ I^{-2}}$	scalar
Energy	*E*	The capacity of a body or system to do work	joule ($J = kg\ m^2\ s^{-2}$)	$\mathbf{M\ L^2\ T^{-2}}$	extensive, scalar, conserved quantity

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Energy density	ρ_E	Amount of energy per unit volume	$J\ m^{-3}$	$\mathbf{M\ L^{-1}\ T^{-2}}$	intensive
Entropy	*S*	Measure for the amount of available states for a system	$J\ K^{-1}$	$\mathbf{M\ L^2\ T^{-2}}$ И$^{-1}$	extensive, scalar
Force	$F\rightarrow$	The cause of acceleration, acting on an object	newton ($N = kg\ m\ s^{-2}$)	$\mathbf{M\ L\ T^{-2}}$	vector
Fuel efficiency	*mpg*	Distance traveled per meter cubed	fuel efficiency ($mpg = m\ m^{-3}$)	$\mathbf{M\ M^{-3}}$	scalar
Impulse	$p\rightarrow$	The cause of a change in momentum, acting on an object	$kg\ m\ s^{-1}$	$\mathbf{M\ L\ T^{-1}}$	vector
Frequency	*f*	The number of times something happens in a period of time	hertz ($Hz = s^{-1}$)	$\mathbf{T^{-1}}$	
Half-life	$t_{1/2}$	The time needed for a quantity to decay to half its original value	s	$\mathbf{T}$	

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Heat	Q	Amount of energy transferred between systems due to temperature difference	J	$M L^2 T^{-2}$	
Heat capacity	C_p	Amount of energy needed to raise the temperature of a system by one degree	$J K^{-1}$	$M L^2 T^{-2} \Theta^{-1}$	extensive
Heat flux density	φ_Q	Amount of heat flowing through a surface per unit area	$W m^{-2}$	$M T^{-3}$	
Illuminance	E_v	Total luminous flux incident to a surface per unit area	lux (lx = cd sr m^{-2})	$J L^{-2}$	
Impedance	Z	Measure for the resistance of an electrical circuit against an alternating current	ohm (Ω = kg $m^2 A^{-2} s^{-3}$)	$L^2 M T^{-3} I^{-2}$	complex scalar
Index of refraction	n	The factor by which the speed of light is reduce in a medium		1	intensive, scalar

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Inductance	L	Measure for the amount of magnetic flux generated for a certain current run through a circuit	henry (H = kg $m^2 A^{-2} s^{-2}$)	$M L^2 T^{-2} I^{-2}$	scalar
Irradiance	E	Power of electromagnetic radiation flowing through a surface per unit area	$W m^{-2}$	$M T^{-2}$	
Intensity	I	Power per unit cross sectional area	$W m^{-2}$	$M T^{-2}$#	
Jerk	$j\rightarrow$	Rate of change of acceleration. The third derivative of position	$m s^{-3}$	$L T^{-3}$	vector
Jounce	$s\rightarrow$	Rate of change of Jerk. The fourth derivative of position	$m s^{-4}$	$L T^{-4}$	vector
Linear density	ρ_l	Amount of mass per unit length of a one-dimensional object		$M L^{-1}$	

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Luminous flux (or *luminous power*)	*F*	Perceived power of a light source.	lumen (lm = cd sr)	J	
Mach Number (or *mach*)	*M*	Ratio of flow velocity to the local speed of sound	Unitless (M = u/c)	1	
Magnetic field strength	*H*	Strength of a magnetic field in a material	A m^{-1}	**$I\,L^{-1}$**	vector field
Magnetic flux	*Φ*	Measure of quantity of magnetism, taking account of the strength and the extent of a magnetic field	weber (Wb = kg m^2 A^{-1} s^{-2})	**$M\,L^2\,T^{-2}\,I^{-1}$**	scalar
Magnetic flux density	*B*	Measure for the strength of the magnetic field	tesla (T = kg A^{-1} s^{-2})	**$M\,T^{-2}\,I^{-1}$**	pseudovector field
Magnetization	*M*	Amount of magnetic moment per unit volume	A m^{-1}	**$I\,L^{-1}$**	vector field
Mass fraction	*x*	Mass of a substance as a fraction of the total mass	kg/kg	1	intensive
(Mass) Density (volume density)	*ρ*	The amount of mass per unit volume of a three-dimensional object	kg m^{-3}	**$M\,L^{-3}$**	intensive

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Mean lifetime	*τ*	Average time needed for a particle to decay	s	T	intensive
Molar energy		Amount of energy present is a system per unit amount of substance	J mol^{-1}	**$M\,L^2\,T^{-2}\,N^{-1}$**	intensive
Molar entropy		Amount of entropy present in a system per unit amount of substance	J K^{-1} mol^{-1}	**$M\,L^2\,T^{-2}\,\Theta^{-1}\,N^{-1}$**	intensive
Molar heat capacity	*c*	Heat capacity of a material per unit amount of substance	J K^{-1} mol^{-1}	**$M\,L^2\,T^{-2}\,N^{-1}$**	intensive
Moment of inertia	*I*	Inertia of an object with respect to angular acceleration	kg m^2	**$M\,L^2$**	tensor, scalar
Momentum	*p*→	Product of an object's mass and velocity	N s	**$M\,L\,T^{-1}$**	vector, extensive
Permeability	*μ*	Measure for how the magnetization of material is affected by the application of an external magnetic field	H m^{-1}	**$M\,L\,T^{-2}\,I^{-2}$**	intensive

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Permittivity	ε	Measure for how the polarization of a material is affected by the application of an external electric field	$F\ m^{-1}$	$I^2\ M^{-1}\ L^{-3}\ T^4$	intensive
Power	P	The rate of change in energy over time	watt (W)	$M\ L^2\ T^{-3}$	extensive, scalar
Pressure	p	Amount of force per unit area	pascal ($Pa = kg\ m^{-1}\ s^{-2}$)	$M\ L^{-1}\ T^{-2}$	intensive, scalar
Pop	$p\rightarrow$	Rate of change of crackle. The sixth derivative of position	$m\ s^{-6}$	$L\ T^{-6}$	vector
(Radioactive) Activity	A	Number of particles decaying per unit time	becquerel ($Bq = s^{-1}$)	T^{-1}	extensive, scalar
(Radioactive) Dose	D	Amount of energy absorbed by biological tissue from ionizing radiation per unit mass	gray (unit) ($Gy = m^2\ s^{-2}$)	$L^2\ T^{-2}$	

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Radiance	L	Power of emitted electromagnetic radiation per solid angle and per projected source area	$W\ m^{-2}\ sr^{-1}$	$M\ T^{-3}$	
Radiant intensity	I	Power of emitted electromagnetic radiation per solid angle	$W\ sr^{-1}$	$M\ L^2\ T^{-3}$	scalar
Reaction rate	r	Measure for speed of a chemical reaction	$mol\ m^{-3}\ s^{-1}$	$N\ L^{-3}\ T^{-1}$	intensive, scalar
Speed	v	Rate of change of the position of an object	$m\ s^{-1}$	$L\ T^{-1}$	scalar
Specific energy		Amount of energy present per unit mass.	$J\ kg^{-1}$	$L^2\ T^{-2}$	intensive
Specific heat capacity	c	Heat capacity per unit mass	$J\ kg^{-1}\ K^{-1}$	$L^2\ T^{-2}\ \Theta^{-1}$	intensive
Specific volume	v	The volume occupied by a unit mass of material (reciprocal of density)	$m^3\ kg^{-1}$	$L^3\ M^{-1}$	intensive

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Spin	S	Intrinsic property of particles, roughly to be interpreted as the intrinsic angular momentum of the particle	kg m^2 s^{-1}	M L^2 T^{-1}	
Strain		Extension per unit length	Unitless	Dimensionless	
Stress	σ	Amount of force exerted per surface area	Pa	M L^{-1} T^{-2}	2-tensor. (or scalar)
Surface tension	γ	Amount of work needed to change the surface of a liquid by a unit surface area	N m^{-1} or J m^{-2}	M T^{-2}	
Thermal conductivity	k	Measure for the ease with which a material conducts heat	W m^{-1} K^{-1}	M L T^{-3} Θ^{-1}	intensive
Torque	τ	Product of a force and the perpendicular distance of the force from the point about which it is exerted	N m	M L^2 T^{-2}	pseudovector

The Table (cont.)

Derived quantity	Symbol	Description	SI units	Dimension	Comments
Velocity	$\vec{v}$	Speed of an object in a chosen direction	m s^{-1}	L T^{-1}	vector
Volume	V	The three dimensional extent of an object	m^3	L^3	extensive, scalar
Wavelength	λ	Distance between repeating units of a propagating wave	m	L	
Wavenumber	k	Reciprocal of the wavelength	m^{-1}	L^{-1}	
Weight	w	Amount of gravitation force exerted on an object	newton (N = kg m s^{-2})	M L T^{-2}	vector
Work	W	Energy dissipated by a force moving over a distance, scalar product of the force and the movement vector	joule (J = kg m^2 s^{-2})	M L^2 T^{-2}	scalar
Young's modulus		Ratio of Stress over Strain	pascal (Pa = kg m^{-1} s^{-2})	M L^{-1} T^{-2}	scalar

LIST OF PHYSICAL UNITS
(Russian)

Основные величины	Размер-ность	Символ	Описание	Единица СИ	Примечания
Длина	**L**	*l*	Протяженность объекта в одном измерении	метр (м)	
Масса	**M**	*m*	Величина, определяющая инерционные и гравитационные свойства тел	килограмм (кг)	Экстенсивная величина
Время	**T**	*t*	Продолжительность события	секунда (с)	
Сила тока	**I**	*I*	Протекающий в единицу времени заряд	ампер (А)	
Температура	Θ	*T*	Средняя кинетическая энергия частиц объекта	кельвин (К)	Интенсивная величина
Количество вещества	**N**	*n*	Количество однотипных структурных единиц, из которых состоит вещество	моль (моль)	Экстенсивная величина
Сила света	**J**	I_v	Количество световой энергии, излучаемой в заданном направлении в единицу времени	кандела (кд)	Световая, экстенсивная величина

Производные величины	Символ	Описание	Единица СИ	Примечания
Площадь	*S*	Протяженность объекта в двух измерениях	$м^2$	
Объём	*V*	Протяженность объекта в трех измерениях	$м^3$	экстенсивная величина
Скорость	*v*	Быстрота изменения координат тела	м/с	вектор
Ускорение	*a*	Быстрота изменения скорости объекта	м/сI	вектор
Импульс	*p*	Произведение массы и скорости тела	кг·м/с	экстенсивная, сохраняющаяся величина
Сила	*F*	Действующая на объект внешняя причина ускорения	$кг·м/с^2$ (ньютон, Н)	вектор
Механическая работа	*A*	Скалярное произведение силы и перемещения	$кг·м^2/с^2$ (джоуль, Дж)	скаляр
Энергия	*E*	Способность тела или системы совершать работу	$кг·м^2/с^2$ (джоуль, Дж)	экстенсивная, сохраняющаяся величина, скаляр

The Table (cont.)

Производные величины	Символ	Описание	Единица СИ	Примечания
Мощность	*P*	Скорость изменения энергии	кг·м^2/с^3 (ватт, Вт)	
Давление	*p*	Сила, приходящаяся на единицу площади	кг/(м·с^2) (паскаль, Па)	интенсивная величина
Плотность	*с*	Масса на единицу объема	кг/м^3	интенсивная величина
Поверхностная плотность	$с_A$	Масса на единицу площади	кг/м^2	
Линейная плотность	$с_l$	Масса на единицу длины	кг/м	
Количество теплоты	*Q*	Энергия, передаваемая от одного тела к другому немеханическим путем	кг·м^2/с^2 (джоуль, Дж)	скаляр
Электрический заряд	*q*	Способность тел быть источником электромагнитного поля и принимать участие в электромагнитном взаимодействии	А·с (кулон, Кл)	экстенсивная, сохраняющаяся величина

The Table (cont.)

Производные величины	Символ	Описание	Единица СИ	Примечания
Напряжение	U	Изменение потенциальной энергии, приходящееся на единицу заряда	м^2·кг/(с^3·А) (вольт, В)	скаляр
Электрическое сопротивление	R	Сопротивление объекта прохождению электрического тока	м^2·кг/(с^3·А^2) (ом, Ом)	скаляр
Магнитный поток	Ц	Величина, учитывающая интенсивность магнитного поля и занимаемую им область	кг/(с^2·А) (вебер, Вб)	
Частота	н	Число повторений события за единицу времени	с$^{-1}$ (герц, Гц)	
Угол	б	Величина изменения направления	радиан (рад)	
Угловая скорость	щ	Скорость изменения угла	с$^{-1}$ (радиан в секунду)	
Угловое ускорение	е	Быстрота изменения угловой скорости	с$^{-2}$ (радиан на секунду в квадрате)	
Момент инерции	I	Мера инертности объекта при вращении	кг·м^2	тензорная величина

The Table (cont.)

Производные величины	Символ	Описание	Единица СИ	Примечания
Момент импульса	L	Мера вращения объекта	кг·м^2/с	сохраняющаяся величина
Момент силы	M	Произведение силы на длину перпендикуляра, опущенного из точки на линию действия силы	кг·м^2/с^2	вектор

ANNEX 5

LIST OF MINERALS, PRECIOUS AND SEMIPRECIOUS STONES (Russian, English)

Агат — Agate
Аквамарин — Aquamarine
Александрит — Alexandrite
Алмаз — Diamond
Аметист — Amethyst
Берилл — Beryl
Бирюза — Turquoise
Борнит — Peacock's stone
Гагат — Jet
Гиацинт — Hyacinth
Говлит — Howlite
Горный хрусталь — Rock crystal
Гранат — Garnet
Жемчуг — Pearl
Изумруд — Emerald
Коралл — Coral
Кошачий глаз — Chrysoberyl
Лазурит — Lazurite
Лунный камень — Adularia
Малахит — Malachite
Нефрит — Nephrite
Оливин — Olivine
Оникс — Onyx
Опал — Opal
Рубин — Ruby
Сапфир — Sapphire
Сардоникс — Sardonyx
Тигровый глаз — Tiger's eye
Топаз — Topaz
Халцедон — Chalcedony
Хризолит — Chrysolite
Хризопраз — Chrysoprase
Циркон — Zircon
Цитрин — Citrine
Шпинель — Spinel
Янтарь — Amber
Яшма — Jasper

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Вдовичев Алексей Владимирович
Баценко Ирина Владимировна

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