КАЗАНСКИЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ

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ENGLISH FOR BIOLOGY STUDENTS

Учебное пособие

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Данное пособие предназначено для студентов 1-2 курса, обучающихся по направлению 06.03.01 Биология Института фундаментальной медицины и биологии Казанского (Приволжского) федерального университета. Пособие включает в себя тексты энциклопедического и научно-популярного характера; практические задания, направленные на развитие навыков устной и письменной речи: чтения и перевода научной и научно-популярной литературы биологической направленности, реферирования текста, ведения дискуссии, изложения презентации.

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ПРЕДИСЛОВИЕ

Настоящее пособие предназначено для студентов 1-2 курса Института фундаментальной медицины и биологии Казанского (Приволжского) федерального университета, которые обучаются по направлению 06.03.01 Биология и изучают английский язык для специальных целей (ESP). Пособие охватывает темы, предусмотренные рабочей программой дисциплины: «Иностранный язык».

Основная цель пособия – развитие навыков коммуникации в устной и письменной формах на иностранном языке, что предполагает умение:

(1) читать и переводить адаптированные тексты по специальности на иностранном языке;

(2) делать реферирование текстов биологической направленности;

(3) использовать иностранный язык в ситуациях профессионального общения.

Пособие включает в себя тексты энциклопедического и научно-популярного характера, задания для аудиторной и внеаудиторной самостоятельной работы студентов, четыре приложения, список литературы. Система упражнений пособия направлена на усвоение лексического материала и отработку всех видов речевой деятельности.

Рекомендации для преподавателя

Курс включает в себя 15 разделов и рассчитан на 3 учебных семестра.

Каждый раздел данного пособия содержит упражнения на изучение и закрепление новой лексики, понимание прочитанного, развитие навыков говорения, письма и аудирования.

Тексты для дополнительного изучения (SUPPLEMENTARY READING) следует рассматривать как в качестве аудиторной, так и внеаудиторной, самостоятельной работы студентов.

Словарь основных терминов в Приложении А (APPENDIX A) предоставляет возможность повторить основную лексику уроков.

При изучении словообразования следует обратиться к упражнениям Приложения В (APPENDIX B), которое содержит информацию о греко-латинских словообразовательных элементах.

В Приложении С (APPENDIX C) представлены полезные выражения для реферирования текста и изложения презентации на английском языке.

В Приложении D (APPENDIX D) дана расшифровка текстов для аудирования, которая может быть использована для дополнительных заданий на совершенствование всех видов речевой деятельности.

При выполнении заданий в ходе внеаудиторной и самостоятельной работы следует обратить внимание студентов на ссылки, представленные в списке литературы (REFERENCES).

Рекомендации для студента

Данное пособие состоит из 15 разделов: 1. Биология как наука. Методы научного познания (The Science of Biology and the Scientific Method). 2. Открытия в биологии в 20-21 веке (Biology In the 20th and 21st centuries). 3. Биотехнология и генетическая инженерия (Biotechnology and Genetic Engineering). 4. Наследование (Inheritance). 5. Клетка (Cell). 6. Деление клетки (Cell Divisions). 7. Бесклеточные (Acellular Entities). 8. Бактерии и археи (Bacteria and Archaea). 9. Протисты (Protists). 10. Рыбы (Fish). 11. Амфибии (Amphibians). 12. Рептилии (Reptiles) 13. Птицы (Birds) 14. Млекопитающие (Mammals). 15. Теории эволюции (Evolution Theories). Также включены тексты для дополнительного изучения (SUPPLEMENTARY READING).

Каждый урок первой части имеет идентичную структуру: секции PRE-READING, AFTER-READING, LISTENING AND SPEAKING.

Секция PRE-READING вводит новые слова по изучаемой теме (“Study the vocabulary before reading the text”), знакомство с которой начинается с вопросов, отвечая на которые, студент может определить уровень собственных знаний по данной теме (“Before you read discuss the questions with your partner”).

Упражнения секции AFTER-READING на понимание прочитанного помогут повторить информацию, изложенную в тексте (“Answer the following questions”, «Decide if these statements are true, false or not stated”). Упражнения данной секции направлены на запоминание новых слов (“Give Russian equivalents for the following words and word combinations. Write down the sentences of your own”, “Match the words with the definitions”, “Find the equivalents for the following words in the text”).

Упражнения секции LISTENING (“Check your understanding: match the definition with the correct word”, “Listen to the recording Try to understand the general idea and fill in the gaps”) позволяют изучить дополнительную лексику по теме урока, послушав аудиозапись с голосом носителя английского языка, представляющего интересный научный факт.

Разговорные упражнения секции SPEAKING дают возможность высказать свое мнение по поводу озвученного факта (“Discuss the scientific fact and summarize it”) и изложенного научного факта (“Share your view with the rest of the class on the following scientific fact”).

Углубленно изучить отдельные аспекты изучаемой темы поможет задание сделать доклад в виде презентации по отдельным темам (“Choose one of the topics to make a report and present it in front of the class”).

Основные термины уроков, представленные в Приложении А (APPENDIX A), могут быть использованы при подготовке к диктанту.

Приложение В (APPENDIX B) содержит полезную информацию о греко-латинских словообразовательных элементах.

При выполнении письменных и устных заданий будут полезны фразы для реферирования текста и подготовки презентации на английском языке, представленные в Приложении С (APPENDIX C).

В списке литературы (REFERENCES) указаны ссылки на электронные ресурсы и учебники, которыми можно воспользоваться как дополнительными источниками для поиска информации во время обсуждения тем и при подготовке докладов.

CONTENTS

Unit 1. THE SCIENCE OF BIOLOGY AND THE SCIENTIFIC METHOD

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- compare all basic characteristics of living organisms;
- describe the main steps of the scientific method.

PRE-READING

1. Study the essential vocabulary before reading the text.

alive (*adj)*	[əˈlaɪv]	живой
cell (*n)*	[cell]	клетка
dilate (*v)*	[daɪˈleɪt]	расширять, распространяться
evidence (*n)*	[ˈevɪdəns]	доказательство, свидетельство
galloping (*adj)*	[ˈgæləpɪŋ]	несущийся, скачущий
hierarchical (*adj)*	[ˌhaɪəˈrɑːkɪkəl]	иерархический
homeostasis (*n)*	[ˌhəʊ.mi.əʊˈsteɪ.sɪs]	гомеостаз, саморегуляция
living thing (*n)*	[ˌlɪvɪŋ θɪŋ]	живое существо, живой организм
membrane (*n)*	[ˈmembreɪn]	мембрана, оболочка
multicellular (*adj)*	[ˌmʌltiˈseljələ(r)]	многоклеточный
muscle (*n)*	[ˈmʌsl]	мышца
observation (*n)*	[ˌɒbzəˈveɪʃn]	исследование
offspring (*n)*	[ˈɒfsprɪŋ]	потомство
reproduction (*n)*	[ˌriːprəˈdʌkʃn]	воспроизводство, размножение, репродукция, продолжение рода
science (*n)*	[ˈsaɪ.əns]	наука
sensitivity (*n)*	[ˌsen.sɪˈtɪv.ə.ti]	чувствительность, восприимчивость, раздражимость
stimulus (stimuli) (*n)*	[ˈstɪm.jə.ləs] [ˈstɪm.jʊ.laɪ]	стимулирующее воздействие, стимул
survival (*n)*	[səˈvaɪvəl]	жизнеспособность, выживаемость

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What do you know about biology?

2. What is the difference between living and non-living thing?
3. Who studied biology as a science?

3. Read the text and do your essential assignments.

Biology is the study of life. Living things come in an astounding variety of shapes and forms, and biologists study life in many different ways. What makes something "alive"? Anyone could deduce that a galloping horse is alive and a car is not, but why? All living organisms share certain basic characteristics:

1. Cellular organization. All organisms consist of one or more cells. Often too tiny to see, cells carry out the basic activities of living. Each cell is bounded by a membrane that separates it from its surroundings.

2. Order. All organisms consist of one or more cells with highly ordered structures: atoms make up molecules, which construct cellular organelles, which are contained within cells. This hierarchical organization continues at higher levels in multicellular organisms and among organisms.

3. Sensitivity. All organisms respond to stimuli. Plants grow toward a source of light, and your pupils dilate when you walk into a dark room.

4. Growth, development, and reproduction. All organisms are capable of growing and reproducing, and they all possess hereditary molecules that are passed to their offspring, ensuring that the offspring are of the same species. Although crystals also "grow," their growth does not involve hereditary molecules.

5. Energy utilization. All organisms take in energy and use it to perform many kinds of work. Every muscle in your body is powered with energy you obtain from your diet.

6. Homeostasis. All organisms maintain relatively constant internal conditions, different from their environment, a process called homeostasis.

7. Evolutionary adaptation. All organisms interact with other organisms and the nonliving environment in ways that influence their survival, and as a consequence, organisms evolve adaptations to their environments.

Biology is one of the most successful of the "natural sciences," explaining what our world is like. To understand biology, you must first understand the nature of science. The basic tool a scientist uses is thought. To understand the nature of science, it is useful to focus for a moment on how scientists think. They reason in two ways: deductively and inductively. **Inductive reasoning** is a form of logical thinking that uses related observations to arrive at a general conclusion. This type of reasoning is common in descriptive science. A biologist makes observations and records them. These data can be qualitative or quantitative, and the raw data can be supplemented with drawings, pictures, photos, or videos. From many observations, the scientist can

infer conclusions (inductions) based on evidence. Inductive reasoning involves formulating generalizations inferred from careful observation and the analysis of a large amount of data. **Deductive reasoning** or **deduction** is the type of logic used in hypothesis-based science. In deductive reasoning, the pattern of thinking moves in the opposite direction as compared to inductive reasoning. Deductive reasoning is a form of logical thinking that uses a general principle or law to forecast specific results. From those general principles, a scientist can extrapolate and predict the specific results that would be valid as long as the general principles are valid. Studies in climate change can illustrate this type of reasoning. For example, scientists may predict that if the climate becomes warmer in a particular region, then the distribution of plants and animals should change. These predictions have been made and tested, and many such changes have been found, such as the modification of arable areas for agriculture, with change based on temperature averages.

Even though biologists and other scientists study many different types of things, they all use the same basic steps. The common steps they use to do research and answer questions are called scientific methods. Forming a hypothesis is a research method scientists use often. A **hypothesis** is an explanation for a question or problem that can be tested. For example, imagine that the number of birds in an area decreased after snakes came into the area. A scientist might make the hypothesis that the snakes were the reason the number of birds decreased. A scientist who forms a hypothesis must be certain that it can be tested. Before testing a hypothesis, scientists make observations and do research. The results of the experiment will help the scientist answer whether or not the hypothesis is supported. To a scientist, an experiment is a test of a hypothesis by collecting information under controlled conditions. Controlled experiments involve two groups: the control group and the experimental or test group. The control is the part of an experiment that represents the standard conditions. The experimental group is the test group that receives experimental treatment. For instance, imagine an experiment to learn how fertilizer affects plant growth. Fertilizer would be used in the experimental group but not in the control group. All other conditions soil, light, and water would be the same for both groups. In this experiment, using fertilizer is the independent variable. The **independent variable** is the one condition in an experiment that is tested. How much the plants grow is the dependent variable. The **dependent variable** is the condition that changes because of a change in the independent variable. The information gathered from experiments is called **data.** A scientist carefully reviews or analyzes experimental results to decide if the data supports the hypothesis. Scientists repeat their experiments in order to gather more data. Data are considered reliable only when repeating the experiment several times

produces similar results. Scientists also compare the results of their experiments with the results of other studies. They research published information in scientific journals and computer databases. It is important to have details of an experiment presented in scientific journals and databases so scientists can compare their results with those of similar studies. It lets other scientists test the results by repeating the experiment. If many scientists get the same results, it helps support the hypothesis. A hypothesis that is supported by many different investigations and observations becomes a theory.

(Based on: Raven Johnson et al. Biology. – 6th Edition. – McGraw-Hill Science, 2001, p.3-15; Connie Rye et al. Biology. – Rice University, 2017, p.7-17; Biology - The Dynamics of Life. – Glencoe Science, 2005, p.1-8)

AFTER READING

4. Answer the following questions.

1. What are characteristics of living things?
2. What can be considered as the main difference between plant and stone?
3. What are ways in which human depend on other living things?
4. What is the difference between inductive and deductive reasoning?
5. What does the scientific method mean?
6. What are the steps of the scientific method?
7. What is the scientific definition of hypothesis?
8. What is the difference between a research question and the hypothesis?
9. Who is known as the founder of biology?
10. What scientific methods can you name?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. The information gathered from experiments is called database.
2. Biologists and other scientists study many different types of things.
3. Scientists repeat their experiments in order to check collected data.
4. A variable is one condition in an experiment.
5. Majority of living things respond to stimuli.
6. Living things have “life,” though some might not show its evident signs. For instance, a tree would probably not react the same way a human would.
7. The basic tool a scientist uses is thought.
8. The type of logic used in hypothesis-based science is called inductive reasoning.
9. All organisms are capable of growing and reproducing, and they all possess hereditary molecules that are passed to their offspring.

10. The control group is the test group that receives experimental treatment.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.
deduction, dependent variable, fertilizer, hypothesis, investigation, scientific journal, energy utilization.

7. Match the words with their definitions.

1	sensitivity	A	the young of an animal
2	reproduction	B	the process in which someone or something grows or changes and becomes more advanced
3	offspring	C	the scientific study of the natural processes of living things
4	organization	D	the ability or tendency of a living organism, cell, or group to keep the conditions inside it the same despite any changes in the conditions around it, or this state of internal balance
5	development	E	the process of discovering a general principle from a set of facts
6	homeostasis	F	information, especially facts or numbers, collected to be examined and considered and used to help decision-making, or information
7	biology	G	a formal statement of the rules on which a subject of study is based or of ideas that are suggested to explain a fact or event or, more generally, an opinion or explanation
8	induction	H	the process of having babies, producing young
9	data	I	the way in which something is done or arranged
10	theory	J	a strong physical reaction to something

8. Find the equivalents for the following words in the text.
review, change, test, state, information, researcher, creature.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	experiment	A	a long-term experiment which measures the flow of a piece of pitch over many years
2	laboratory experiment	B	things that are needed in order to do a particular activity
3	pitch drop experiment	C	made completely of the material mentioned (that is, the material is not only on the surface)
4	professor	D	a quality or characteristic that something has
5	material	E	thick and sticky; not flowing freely
6	property	F	a device that is wide at the top and narrow at the bottom,

			used for pouring liquids or powders into a small opening
7	solid	G	the process or act of writing down and storing information for official purposes
8	viscous	H	is an experiment conducted under highly controlled conditions, where accurate measurements are possible
9	glass funnel	I	a university teacher of the highest rank
10	recording	J	a scientific test that is done in order to study what happens and to gain new knowledge

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Materials, recording, solid, experiment, viscous, pitch drop, professor, glass funnel, laboratory experiment, properties.

In today's lecture we're going to be talking about 1. _____, and I thought it might be interesting for you all to learn about the world's oldest continuously running 2. _____ that is still going today. In fact, it holds the Guinness World Record for being the longest-running experiment. This experiment began in and has been going ever since. It's called the 3._____ and it was created by 4. _____ Thomas Parnell at the University of Queensland, Australia. Parnell was the university's first physics professor, and he wanted to show in this experiment that everyday 5. _____, such as pitch, can have quite surprising 6._____. You see, when pitch is at room temperature, it feels 7._____. You can easily break it with a hammer. However, it isn't in fact solid. At room temperature, pitch is many billions of times more 8. _____ than water, but it's actually fluid. In 1927, Professor Parnell took a sample of pitch. He heated it and poured it into a 9. _____. He allowed the pitch to cool and settle – for three years. He then turned the funnel upside down and cut the top off it. Since then, the pitch has slowly dropped out of the funnel. How slowly? Well, the first drop took eight years to fall. It took another forty years for another five drops to fall. Today it's been almost 90 years since the experiment started. Only nine drops have fallen from the funnel. The last drop fell in April 2014 and the next one is expected to fall in the 2020s. The experiment has a tragic story associated with it. Professor Parnell died without seeing a pitch drop. His replacement, Professor John Mainstone, became responsible for the pitch drop experiment from 1961. He held the job for 52 years, and missed seeing the drop fall three times – by a day in 1977, by just five minutes in 1988 and finally in 2000, when the webcam that was 10. _____ the experiment suffered a power outage for 20 minutes, during which time the pitch

dropped. The pitch drop experiment is something we can all participate in now. There's a live web stream that allows anyone to watch the glass funnel and wait for the fateful moment. A similar experiment to the Queensland pitch drop was set up in Dublin, and the video of the moment the pitch actually dropped went viral on the internet. It's interesting to see how a very slow event can spread news so quickly.
(Based on: https://learnenglish.britishcouncil.org/skills/listening/b2-listening/a lecture-about-an-experiment)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

Despite the basic biological, chemical, and physical similarities found in all living things, a diversity of life exists not only among and between species but also within every natural population. The phenomenon of diversity has had a long history of study because so many of the variations that exist in nature are visible to the eye. The fact that organisms changed during prehistoric times and that new variations are constantly evolving can be verified by paleontological records as well as by breeding experiments in the laboratory. (Based on Biology - The Dynamics of Life. – Glencoe Science, 2005, p.1-10)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. Modern biology.
2. Nanotechnologies in biology.
3. The history of biological science.
4. Biology and its branches.

Unit 2 BIOLOGY IN THE 20TH AND 21ST CENTURIES

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- discuss the new tendencies of modern biology;
- know about technology allowed the scientists to study the genetic blueprints.

PRE-READING

1. Study the essential vocabulary before reading the text.

alter (v)	['ɔ:ltə]	видоизменять; переделывать
biotic (*adj*)	[baɪ'ɔtɪk]	биотический (относящийся к живым существам или их деятельности)
blueprint (*n*)	['blu:'prɪnt]	план; чертеж
call (for) (*v*)	[kɔ:l]	предписывать; требовать
cellular (*adj*)	['seljulə]	клеточный; клеточного строения
conservation (*n*)	['kɔnsə'veɪʃ(ə)n]	сохранение; охрана природы
contaminant (*n*)	[kən'tæmɪnənt]	загрязнитель
convergence (*n*)	[kən'vɜ:ʤ(ə)ns]	взаимодействие; взаимопроникновение
customize (*v*)	['kʌstəmaɪz]	дорабатывать; настраивать; выдоизменять
DNA (deoxyribonucleic acid) (*n*)	[di:.enˈeɪ] [di˧pk.si˧raɪ.bəʊ.nju: ˧kleɪ.ɪk ˈæs.ɪd]	ДНК (дезоксирибонуклеиновая кислота)
de-extinction (*n*)	['di ɪk'stɪŋkʃ(ə)n]	возрождение
editing (*n*)	['edɪtɪŋ]	редактирование (генома)
eliminate (*v*)	[ɪ'lɪmɪneɪt]	исключать; устранять
emerge (*v*)	[ɪ'mɜ:ʤ]	вырасти; возникать
emission (*n*)	[ɪ'mɪʃ(ə)n]	выпуск (дыма); выхлоп (автомобиля)
enable (*v*)	[ɪ'neɪb(ə)l]	давать возможность
endanger (*v*)	[ɪn'deɪnʤə]	подвергать опасности; угрожать
facilitate (*v*)	[fə'sɪlɪteɪt]	способствовать; содействовать; упрощать
fuel (*v*)	[fjuəl]	давать импульс; обусловить
gigabase (*n*)	[ˈgɪg.ə.beis]	миллиард пар нуклеотидов
impact (*n*)	['ɪmpækt]	влияние; воздействие

modify (*v*)	['mədɪfaɪ]	модифицировать; изменять
moratorium (*n*)	['mərə'tɔ:rɪəm]	отсрочка или приостановление каких-л. Действий
peer (into) *(v)*	[pɪə]	всматриваться
polymerase (*n*)	['pɔlɪməreɪs]	полимераза
recombine *(v)*	['ri:kəm'bain]	рекомбинировать; воссоединять
recombinant (*adj*)	['ri:'kɔmbɪnənt]	рекомбинантный; искусственно-созданный
redefine *(v)*	['ri:dɪ'faɪn]	уточнять; найти новое определение
remain (*n*)	[rɪ'meɪn]	Останки
resurrect *(v)*	['rezə'rekt]	воскрешать; возрождать
sequencing (*n*)	['si:kwənsɪŋ]	секвенирование; расшифровка генетической последовательности
trait (*n*)	[treɪ(t)]	характерная черта; особенность

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What are unsolved problems in biology?
2. What do biotic and abiotic environments mean?
3. What are three different types of artificial cloning?

3. Read the text and do your essential assignments.

Biology in the 20th and 21st centuries

By utilizing modern methods of investigation, such as X-ray diffraction and electron microscopy, to explore levels of cellular organization beyond that visible with a light microscope – the ultrastructure of the cell – new concepts of cellular function were produced. As a result, the study of the molecular organization of the cell had tremendous impact on biology during the 20th and 21st centuries. It also led directly to the convergence of many different scientific disciplines in order to acquire a better understanding of life processes. Technologies such as DNA sequencing and the polymerase chain reaction also were developed, allowing biologists to peer into the genetic blueprints that give rise to organisms.

First-generation sequencing technologies emerged in the 1970s and were followed several decades later by so-called next generation sequencing technologies, which were superior in speed and cost-efficiency. Next-generation sequencing

provided researchers with massive amounts of genetic data, typically gigabases in size (1 gigabase = 1,000,000,000 base pairs of DNA).

In the 1970s the development of recombinant DNA technology opened the way to genetic engineering, which enabled researchers to recombine nucleic acids and thereby modify organisms' genetic codes, giving the organisms new abilities or eliminating undesirable traits. Together, recombinant DNA technology and reproductive cloning (the method used to produce a living animal clone) facilitated great progress in the development of genetically modified organisms (GMOs). Genetically modified (GM) mice and other animals were developed to model certain human diseases, thereby facilitating the investigation of new therapies and the factors that cause disease. Recombinant DNA technology played a crucial role in the generation of GM crops, including pest-resistant forms of cotton and herbicide resistant forms of maize (corn) and soybeans.

In the 20th century, chemical contaminants introduced into the environment by manufacturing processes, pesticides, automobile emissions, and other means seriously endangered all forms of life. Hence, biologists began to pay much greater attention to the relationships of living things to each other as well as to their biotic and abiotic environments.

The growing significance of climate change and its impact on ecosystems fueled advances in ecology, as well as the development of fields such as conservation biology and conservation genetics. As in almost every other area of biology, molecular biology came to fulfill an important role in those fields, with techniques such as whole genome sequencing being used to gather information on the genetic diversity of populations of endangered species and techniques such as cloning and genome editing raising the possibility of someday resurrecting extinct species (a process known as de-extinction).

In the 20th century, the emerging social and political role of scientists made it necessary for biologists to redefine their social obligations and functions, particularly in the realm of making judgments about ethical problems, such as human control of the environment or the manipulation of genes to direct further evolutionary development. The possibilities for misuse of genetic engineering were vast. There was a significant concern, for example, about genetically modified organisms, particularly modified crops, and their impacts on human and environmental health. The emergence of cloning technologies, including somatic cell nuclear transfer, also raised concerns. The Declaration on Human Cloning passed in 2005 by the United Nations called upon member states to prohibit the cloning of humans, though it left open the pursuit of therapeutic cloning.

Similarly, in 2015, researchers who had developed technologies for gene editing, which enabled scientists to customize an organism's genetic makeup by altering specific bases in its DNA sequence, called for a moratorium on the application of the technologies in humans. The debate over gene editing renewed earlier discussions about the ethical and social impacts of genetic engineering in humans, especially its potential to be used to alter traits such as intelligence and appearance.

By the 21st century, many areas of study in the biological sciences cross the boundaries that traditionally separated the various branches of the sciences. In biophysics, for example, researchers apply the principles and methods of physics to investigate and find solutions to problems in biology. Evolutionary biologists and paleontologists are familiar with the principles of geology and may even work closely with geologists while attempting to determine the age of biological remains. Likewise, anthropologists and archaeologists apply knowledge of human culture and society to biological findings in order to more fully understand humankind. Astrobiology arose through the activities of the scientists and engineers concerned with the exploration of space. As a result, the field of biology has received contributions from and made contributions to many other disciplines, in the humanities as well as in the sciences.
(Based on: https://www.britannica.com/science/biology/The-history-of-biology)

AFTER READING

4. Answer the following questions.

1. What technology allowed the scientists to study the genetic blueprints properly?
2. How are next generation sequencing technologies different from the first-generation ones?
3. For what purpose were genetically modified (GM) mice and other animals developed for?
4. What is the role of Recombinant DNA technology in the modern-day science?
5. Why did scientists begin to pay more attention to the biotic and abiotic environments in the 20th century?
6. What ethical problems did the 20th-century scientists have to revise their judgments about?
7. What concerns have arisen with the emergence of genetic engineering?
8. What was the result of ethical and moral concerns about cloning technologies?
9. Can you give the examples of the convergence of different scientific disciplines?
10. What do anthropologists and archaeologists have in common?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Just as the 19th century can be considered the age of cellular biology, the 20th and 21st centuries were characterized primarily by developments in molecular biology.

2. New concepts of cellular function were produced due to the use of X-ray diffraction and electron microscopy methods which allow to explore the ultrastructure of the cell.

3. Genetic engineering technology enabled researchers to recombine nucleic acids modifying organisms' genetic codes and eliminating undesirable traits in them.

4. Together, recombinant DNA technology and reproductive cloning (the method used to produce a living animal clone) facilitated great progress in the development of genetically modified crops.

5. The cloning technologies led to the generation in 1996 of Dolly the sheep, the first clone of an adult mammal.

6. Recombinant DNA technology involves several steps in a specific sequence.

7. The 20th and 21st centuries also saw major advances in areas of biology dealing with ecosystems, the environment, and conservation.

8. The development of conservation biology and conservation genetics occurred because of the climate change and its impact on ecosystems.

9. Such techniques as whole genome sequencing, cloning and genome editing raising the possibility of the de-extinction of species.

10. Many areas of study in the biological sciences cross the boundaries that traditionally separated the various branches of the sciences.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

X-ray diffraction techniques, DNA sequencing, polymerase chain reaction, genetic makeup, recombinant DNA technology, genetically modified crops, genome editing, reproductive cloning, whole genome sequencing, somatic cell nuclear transfer.

7. Match the words with the definitions.

1	ultrastructure	A	to completely remove or get rid of (something)
2	recombine	B	prevention of wasteful use of a resource; a careful protection of something
3	de-extinction	C	a plan or set of proposals that shows how it is expected to work

4	reproductive	D	to make partial or minor changes to (something)
5	blueprint	E	to combine again, especially to reassemble the parts of something previously taken apart in a different manner
6	conservation	F	fine structure within a cell, that can be seen only with the high magnification obtainable with an electron microscope
7	modify	G	relating to or effecting reproduction, or capable of reproduction
8	findings	H	a temporary prohibition of an activity
9	moratorium	I	information discovered as the result of an inquiry or investigation
10	eliminate	J	the process of resurrecting species that have died out, or gone extinct a resurrection biology, also called resurrection biology

8. Find the equivalents for the following words in the text.

Higher-ranking, structure, techniques, profitability, to mix things again, to alter, to get rid of, features, replication, protection.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	eliminate	A	to start to do or use something that was done or used in the past
2	spring	B	a thin thread of something, often one of a few, twisted around each other to make a string or rope:
3	dwindle	C	to move about or travel, especially without a clear idea of what you are going to do
4	bring smth back	D	revival or renewal; the act of bringing something that had disappeared or ended back into use or existence
5	roam	E	to join two pieces of rope (film) together at their ends in order to form one long piece
6	wipe out	F	to introduce something new that is necessary or helpful to a situation or process
7	resurrection	G	to completely remove or get rid of (something)
8.	strand	H	to start something or cause it to happen
9	splice	I	to become smaller in size or amount, or fewer in number

10	inject	J	to destroy something completely

11. Listen to the recording 'Extinction May Not Be Forever'. Try to understand the general idea and fill in the gaps.

Endangered, de-extinction, dwindling, saber-tooth, habitat, genes, extinct, roam, DNA, resurrection, eliminated, strands, woolly, drawer, bring back, springing, half-life, injecting, wiped out, splice.

De-extinction. What if plants and animal species 1. _____ of existence could be brought back? That's the novel notion 2. _____ from recent advances in synthetic biology.

The idea is simple. Find samples, like the mummified passenger pigeon discovered recently in a museum desk 3. _____, and collect its 4. ___. Compare said DNA to that of its closest living relatives to see what specific 5. _____ make a passenger pigeon unique. Then 6. _____ those crucial genes into the living relative's DNA 7. ____ to produce a genetic copy of the 8. ____ animal. 9. _____.

The restoration potential is not limited to plants and animals that we have just recently 10. _____. We could also potentially 11. ____ species like 12. _____ mammoths or 13. _____ cats. Not dinosaurs though, since DNA has a 14. _____ of just 521 years or so.

Of course, successfully bringing back the mammoth might also require restoration of its 15. ____, so it has a home to 16. ____. But even without the reappearance of charismatic megafauna, such techniques will find uses from agriculture to 17. ____ a bit more genetic diversity into 18. ____ populations of 19. ____ species. The biggest contribution of the new biotechnology may not be 20. ____, but preventing extinction in the first place.

(Based on: https://www.scientificamerican.com/podcast/podcast.mp3?fileId=7A658BA9-502B-4B05-A458D11B06B6430A)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

At present, neither therapeutic cloning nor the iPSC method has yet managed to overcome all the technical obstacles that would allow these technologies to move beyond experimental trials towards widespread use in regenerative medicine.

(Based on: https://www.bbvaopenmind.com/en/science/bioscience/cloning-video-infographic)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. The structure of DNA by Francis Crick and others.
2. Penicillin: An accidental discovery changed the course of medicine.
3. The history of cloning.
4. Human Genome Project: since 1990 until now.
5. Genome engineering using the CRISPR-Cas9 technology.

Unit 3. BIOTECHNOLOGY AND GENETIC ENGINEERING

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- discuss the most important problems of biotechnology and genetic engineering;
- know more about the development of biotechnology industry.

PRE-READING

1. Study the essential vocabulary before reading the text.

antibody (*n)*	[ˈæntibɒdi]	антитело
beverage *(n)*	[ˈbevərɪdʒ]	напиток
bioinformatics *(n)*	[[baɪəʊɪnfəˈmætɪks]	биоинформатика
biotechnology *(n)*	[ˌbaɪəʊtekˈnɒlədʒi]	биотехнология
catalyst *(n)*	[ˈkætəlɪst]	катализатор
cloning *(adj)*	[ˈkləʊnɪŋ]	клонирование
controversial *(adj)*	[ˌkɒntrəˈvɜːʃl]	противоречивый, неоднозначный
disparate *(adj)*	[ˈdɪspərət]	непохожий, различный
enzyme (*v)*	[ˈenzaɪm]	фермент
emerge *(v)*	[ɪˈmɜːdʒ]	появляться, возникать
equipment (*n)*	[ɪˈkwɪpmənt]	оборудование
fledgling (*adj*)	[ˈfledʒlɪŋ]	развивающийся, молодой
genetics (*n*)	[dʒəˈnetɪks]	генетика
harnessing (*n)*	[ˈhɑːnəsɪŋ]	использование
interferon (*n)*	[ˌɪntəˈfɪərɒn]	интерферон, ИФН
proteomics (*n)*	[prəˈtɒmɪks]	протеомика
scarcity (*n)*	[ˈskeəsəti]	нехватка, дефицит
stem cell (*n)*	[stem sel]	стволовая клетка

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What is biotechnology?
2. Who discovered genetic engineering?
3. When did modern biotechnology develop?

3. Read the text and do your essential assignments.

People have been harnessing biological processes to improve their quality of life for some 10,000 years, beginning with the first agricultural communities. Approximately 6,000 years ago, humans began to tap the biological processes of microorganisms in order to make bread, alcoholic beverages, and cheese and to preserve dairy products. But such processes are not what is meant today by biotechnology, a term first widely applied to the molecular and cellular technologies that began to emerge in the 1960s and ’70s. A fledgling “biotech” industry began to coalesce in the mid- to late 1970s, led by Genentech, a pharmaceutical company established in 1976 by Robert A. Swanson and Herbert W. Boyer to commercialize the recombinant DNA technology. Early companies such as Genentech, Amgen, Biogen, Cetus, and Genex began by manufacturing genetically engineered substances primarily for medical and environmental uses. For more than a decade, the biotechnology industry was dominated by recombinant DNA technology, or genetic engineering. This technique consists of splicing the gene for a useful protein (interferon) into production cells such as yeast, bacteria, or mammalian cells in culture, which then begin to produce the protein in volume. Interferon is a rare blood protein that increases human resistance to viral infection, and medical scientists have been interested in its possible usefulness in cancer therapy. This possibility was difficult to investigate before 1980, however, because purification of the large amounts of interferon required for clinical testing would have been prohibitively expensive, given interferon’s scarcity in the blood. An inexpensive way to produce interferon was needed, and introducing the gene responsible for its production into a bacterial cell made that possible. The cell that had acquired the human interferon gene proceeded to produce interferon at a rapid rate, and to grow and divide. Soon there were millions of interferon-producing bacteria in the culture, all of them descendants of the cell that had originally received the human interferon gene.

This procedure of producing a line of genetically identical cells from a single altered cell, called cloning**,** made every cell in the culture a miniature factory for producing interferon. The human insulin gene has also been cloned in bacteria, and now large amounts of insulin, a hormone essential for treating some forms of diabetes, can be manufactured at relatively little expense. Beyond these clinical applications, cloning and related molecular techniques are used to obtain basic information about how genes are put together and regulated. The interferon experiment and others like it marked the beginning of a new genetics.

Biotechnology has numerous applications, particularly in medicine and agriculture. Examples include the use of biotechnology in merging biological information with computer technology (bioinformatics), exploring the use of microscopic equipment that can enter the human body (nanotechnology), and possibly applying techniques of stem cell research and cloning to replace dead or defective cells and tissues (regenerative medicine). Companies and academic laboratories integrate these disparate technologies in an effort to analyze downward into molecules and also to synthesize upward from molecular biology toward chemical pathways, tissues, and organs. In addition to being used in health care, biotechnology has proved helpful in refining industrial processes through the discovery and production of biological enzymes that spark chemical reactions (catalysts); for environmental cleanup, with enzymes that digest contaminants into harmless chemicals and then die after consuming the available "food supply"; and in agricultural production through genetic engineering.

Agricultural applications of biotechnology have proved the most controversial. Some activists and consumer groups have called for bans on genetically modified organisms (GMOs) or for labeling laws to inform consumers of the growing presence of GMOs in the food supply. Studies by the National Academy of Sciences, the European Union, regulatory agencies, and other organizations have found GMO foods to be safe, but skeptics contend that it is still too early to judge the long-term health and ecological effects of such crops. In the late 20th and early 21st centuries, the land area planted in genetically modified crops increased dramatically. The majority of genetically modified crops were grown in the Americas.

The biotechnology industry has also expanded its research into the development of traditional pharmaceuticals and monoclonal antibodies that stop the progress of a disease. Successful production of monoclonal antibodies was one of the most important techniques of biotechnology to emerge during the last quarter of the 20th century. The specificity of monoclonal antibodies and their availability in quantity have made it possible to devise sensitive assays for an enormous range of biologically important substances and to distinguish cells from one another by identifying previously unknown marker molecules on their surfaces. Such advances were made possible through the study of genes (genomics), the proteins that they encode (proteomics), and the larger biological pathways in which they act.

(Based on: Raven Johnson et al. Biology. – 6th Edition. – McGraw-Hill Science, 2001, p.390-395; Connie Rye et al. Biology. – Rice University, 2017, p.439-445; https://www.britannica.com/technology/biotechnology/Applications-of-biotechnology)

AFTER READING

4. Answer the following questions.

1. What is Genentech famous for?
2. What are the various examples of biotechnology application?
3. What is the difference between biotechnology and genetic engineering?
4. Why is genetic engineering important nowadays?
5. What was one of the most important techniques of biotechnology to emerge during the last quarter of the 20th century?
6. What does the term “proteomics” mean?
7. What does the term “genomics” mean?
8. Can you describe your attitude to “food supply”?
9. What stands for GMO?
10. Why are people afraid of GMOs?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. The interferon experiment and others like it marked the beginning of a new era of biological science.
2. The biotechnology industry has also expanded its research into the development of traditional agriculture and monoclonal antibodies.
3. The majority of genetically modified crops were grown in the Americas.
4. The concept of biotechnology encompasses a wide range of procedures for modifying living organisms according to human purposes.
5. This possibility was not difficult to investigate before 1980, however, because purification of the large amounts of interferon required for clinical testing would have been prohibitively expensive, given interferon’s scarcity in the blood.
6. The biotechnology industry was dominated by recombinant DNA technology, or genetic engineering.
7. Agricultural applications of biotechnology have proved the most important.
8. A fledgling “biotech” industry began to coalesce in the mid- to late 1970s.
9. Long before the time of evolutionary works, naturalists had already used selective breeding.
10. The specificity of monoclonal antibodies and their availability in quantity have made it possible to devise sensitive assays.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

the growing presence of GMOs, food supply, downward into molecules, agricultural applications of biotechnology, the National Academy of Sciences, the long-term health, genetically modified crops, environmental cleanup, the discovery and production of biological enzymes, a line of genetically identical cell.

7. Match the words with their definitions.

1	biotechnology	A	the large-scale study of proteins
2	genomics	B	the activity of changing the genes (= parts of cells which control particular characteristics) in the cells of plants or animals
3	proteomics	C	a broad term that involves different laboratory techniques to study, modify or isolate cells etc.
4	clone	D	a broad term that involves different laboratory techniques to study or modify DNA, RNA, or proteins.
5	genetic engineering	E	produced by combining genetic material from different places
6	molecular technology	F	a part of the DNA in a cell that controls the physical development, behaviour, etc. of an individual plant or animal and is passed on from its parents
7	cellular technology	G	an area of science that deals with developing and producing extremely small tools and machines by controlling the arrangement of separate atoms
8	recombinant	H	an interdisciplinary field of biology focusing on the structure, function, evolution, mapping, and editing of genomes
9	gene	I	an exact copy of a plant or animal that scientists make by removing one of its cells
10	nanotechnology	J	the use of living cells and bacteria in chemical processes, especially in the food and medical industries

8. Find the equivalents for the following words in the text.

procedure, nascent, to explore/ to study, copying, impedance, to merge/to unite, drink, manufacture, data, researcher.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	contamination	A	a type of bacteria that lives inside humans and some animals, some forms of which can cause food poisoning
2	germ	B	to clean something using a substance that kills bacteria
3	E. coli	C	the simplest and smallest forms of life
4	test	D	solid or liquid material that the body gets rid of
5	disinfect	E	to organize and/or do a particular activity
6	waste	F	a scientist who studies microbiology
7	bacteria	G	the process or fact of making a substance or place dirty or no longer pure by adding a substance that is dangerous or carries disease
8	conduct	H	a very small living thing that can cause infection and disease
9	microbiologist	I	to discover whether or how well something works, or to find out more information about it
10	hygiene	J	the practice of keeping yourself and your living and working areas clean in order to prevent illness and disease

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Waste, bacteria, to conduct, microbiologist, hygiene, disinfect, to test, germ, E.coli, contamination

A new study into 1._____ the of supermarkets has found that shopping carts are dirtier than the store's bathrooms. 2. _____ Dr Charles Gerba of the University of Arizona 3._____ research on the handles of 85 carts in four American states. He reportedly found 4. _____ from human 5._____ on the handles of 72 per cent of them. "That's more than you find in a supermarket's toilet," Dr Gerba said. He explained: "That's because stores use disinfecting cleaners in the restrooms. Nobody seems to routinely clean and 6. _____ shopping carts." Further, half of the carts in Dr Gerba's study 7. _____ positive 8. _____ for bacteria, a nasty 9. _____ that can cause diarrhoea, vomiting and serious infection.

Professor Gerba is known as “Dr Germ” because of the number of studies he has done on bacteria and everyday objects. His previous studies warned of bacteria on reusable shopping bags, airplane seat-back trays, ground-floor elevator buttons, water fountain toggles, computer keyboards, iPads and playground equipment. He said just about anything touched by children has a high chance of 10._____ He advised people to wash reusable shopping bags after use, otherwise they’ll become full of “bacterial swamps”. He added: “It’s like wearing the same underwear every day.” Gerba said the best way to avoid getting sick from shopping trolleys is to wipe the handle with a disinfectant cloth and wash your hands often.
(Based on: https://dl-hum.spbstu.ru/mod/assign/view.php?id=95613)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.
Canadian fisheries scientists have inserted recombinant growth hormone genes into developing salmon embryos, creating the first transgenic salmon. Not only do these transgenic fish have shortened production cycles, they are, on an average, 11 times heavier than nontransgenic salmon! The implications for the fisheries industry and for worldwide food production are obvious.
(Based on Raven Johnson et al. Biology. – 6th Edition. – McGraw-Hill Science, 2001, p.393).

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.
1. DNA technology
2. Modern biotechnology.
3. The history of genetic engineering.
4. Application of genetic engineering.

Unit 4. INHERITANCE

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- discover important scientific facts about inheritance;
- know more about genes and chromosomes.

PRE-READING

1. Study the essential vocabulary before reading the text.

allele *(n)*	[əˈliːl]	аллель, аллельный ген
breeding *(n)*	[ˈbriːdɪŋ]	разведение, размножение, выращивание
female (*adj)*	[ˈfiːmeɪl]	женский
fertilization *(n)*	[ˌfɜːtəlaɪˈzeɪʃn]	оплодотворение
gamete *(n)*	[ˈgæmiːt]	гамета
genetics *(n)*	[dʒəˈnetɪks]	генетика
heredity *(n)*	[həˈredəti]	наследственность
hybrid *(n)*	[ˈhaɪbrɪd]	гибрид, помесь
male (*adj)*	[meɪl]	мужской
mask (*v)*	[mɑːsk]	подавлять
monk *(n)*	[mʌŋk]	монах
petal *(n)*	[ˈpetl]	лепесток
pollen *(n)*	[ˈpɒlən]	пыльца, цветочная пыльца
pollination *(n)*	[ˌpɒləˈneɪʃn]	опыление
reproduction *(n)*	[ˌriːprəˈdʌkʃn]	воспроизводство, размножение, репродукция, продолжение рода
segregation *(n)*	[segrɪˈgeɪʃn]	сегрегация
trait *(n)*	[treɪt]	черта, особенность, признак
zygote *(n)*	[ˈzaɪgəʊt]	зигота

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What is inheritance?
2. What is the composition of gene?
3. What do you know about genetic code?

3. Read the text and do your essential assignments.

Gregor Mendel, an Austrian monk, discovered important facts about heredity. Heredity is the passing on of characteristics from parents to offspring. These characteristics are called traits. Mendel was the first person to predict which traits would be passed from parents to offspring. The study of heredity is called genetics. Mendel used garden peas for his experiments. Garden peas produce male and female sex cells called gametes. Fertilization occurs when the male sex cell unites, or joins, with the female sex cell. The united gametes form a new fertilized cell called a zygote. The zygote becomes part of a seed. In garden peas, as with most flowers, the male sex cells are the grains of pollen. When pollen is transferred from the male reproductive organ to the female reproductive organ, it is called pollination. Garden peas are self-pollinators. That means the pollen from a flower pollinates the female sex cells within that same flower. The seeds that develop carry the traits of that plant.

This was important for Mendel. When he wanted to have the gametes of different plants unite, opened the petals of a flower and removed the male reproductive organs on one plant, and dusted the female reproductive organ with the pollen from a different plant. This is cross-pollination. The seeds that develop from cross-pollination have traits of the two different plants. Crossing a tall pea plant with a short pea plant produced offspring called hybrids. A hybrid is the offspring of parents that have different forms of a trait, such as tall and short height. The first hybrids that Mendel produced are known as monohybrid crosses. Mono means one. Since the parent plants that Mendel used differed from each other by only one trait height the offspring are called monohybrids. The results of Mendel's experiment were interesting. He allowed the offspring, known as the first generation, to self-pollinate. Mendel planted the seeds from the first generation. There were more than 1000 plants in the second generation. Three-fourths of the plants were as tall as the tall parent plant. One-fourth of the plants were as tall as the short parent plant. The short trait had reappeared. The ratio of tall to short plants in the second generation was three tall plants for every one short plant. Mendel called the observed trait dominant and the trait that disappeared recessive. A dominant allele will mask, or cover up, a recessive allele. Mendel took the facts that he learned from his experiments to create rules or laws to explain heredity. The first of his laws is law of dominance states that: "When parents with pure, contrasting traits are crossed together, only one form of trait appears in the next generation. The hybrid offspring will exhibit only the dominant trait in the phenotype." The second of his laws is called the law of segregation. This law says that every organism has two alleles of

each gene and when gametes are produced the alleles separate. Each gamete receives one of these alleles. During fertilization, these gametes randomly pair to produce four combinations of alleles. His third law of heredity, known as the law of independent assortment**,** states that genes for different traits are inherited independently of each other. From these results Mendel determined that each organism has two factors that control each of its traits. Today we know that these factors are genes.

All living things have thousands of genes. Genes determine individual traits. The genes do not just float around in a cell. They are lined up on chromosomes. A typical chromosome can have thousands of genes. If you took a cell from one of Mendel's pea plants, you would see that it has 14 chromosomes, or seven pairs. In the body cells of most living things, chromosomes come in pairs. One of the chromosomes in each pair comes from the male parent. The other chromosome comes from the female parent. A cell that has two of each kind of chromosome is called a diploid cell. Using microscopes, scientists can now see the paired chromosomes and know that an allele for each trait is located on each paired chromosome. A diploid cell is a body cell. Organisms also produce a different kind of cell called a haploid cell. This cell contains only one of each kind of chromosome. A gamete, or sex cell, is a haploid cell. Every living thing has a set number of chromosomes. For example, every dog has 78 chromosomes, every human has 46 chromosomes, and every tomato plant has 24 chromosomes. As you can see, the number of chromosomes is not related to how complex an organism is. When the organism reproduces, it only passes on half the number of chromosomes. In a diploid cell the two chromosomes of each pair are called homologous chromosomes. Each chromosome of the pair has genes for the same traits in the same order. Because there are different alleles for the same gene, it is possible that two chromosomes of a homologous pair will not be identical to each other.
(Based on Biology - The Dynamics of Life. – Glencoe Science, 2005, p.114-124)

AFTER READING

4. Answer the following questions.

1. How many chromosomes does pea plant have?
2. What do you call a cell with two of each kind of chromosome?
3. What is the difference between diploid and haploid cell?
4. What does microscope serve for?
5. What is called pollination?
6. What does the law of independent assortment state?
7. What does the law of segregation mean?

8. What do genes determine?
9. What are known as monohybrid crosses?
10. What were the results of Mendel's experiment?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Centromeres consist of a complex combination of proteins and DNA. They are essential to the division of cells and ensure the accurate segregation of chromosomes.
2. Every living thing has a certain set number of chromosomes.
3. Mendel was the third person to predict which traits would be passed from parents to offspring.
4. Submetacentric chromosomes have the centromere slightly offset from the center leading to a slight asymmetry in the length of the two sections. Human chromosomes 4 through 12 are submetacentric.
5. One of the chromosomes in each pair comes from the male parent.
6. When pollen is transferred from the female reproductive organ to the male reproductive organ, it is called self-pollination.
7. Inheritance is the passing on of characteristics from parents to offspring.
8. Some living things have thousands of genes.
9. Every organism has two alleles of each gene.
10. There were more than 100 plants in the first generation.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

Dominant trait, parent plant, passing on characteristics, garden pea, female sex cell, law of dominance, reproductive organ, monohybrid crosses, first generation, number of chromosomes.

7. Match the words with their definitions.

1	zygote	A	fine powder, usually yellow, that is formed in flowers and carried to other flowers of the same kind by the wind or by insects
2	seed	B	a living thing that grows in the earth and usually has a stem,

			leaves and roots
3	pollen	C	having parents of different species or varieties
4	self-pollinator	D	the process of applying pollen from one flower to the pistils of another flower
5	plant	E	one of two or more possible forms of a gene that are found at the same place on a chromosome
6	cross-pollination	F	the set of characteristics of a living thing, resulting from its combination of genes and the effect of its environment
7	hybrid	G	the act of separating
8	allele	H	the small hard part produced by a plant, from which a new plant can grow
9	phenotype	I	a form of pollination in which pollen from the same plant arrives at the stigma of a flower
10	segregation	J	a single cell that develops into a person or animal, formed by the joining together of a male and a female gamete

8. Find the equivalents for the following words in the text.

feature, inheritance, man, case, progeny, gender, woman, insemination.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	corkscrew	A	bent so that the original shape is changed or destroyed
2	twisted	B	(a length of) rope or string made of twisted threads
3	cell	C	famous for something
4	horn	D	the chemical, present at the centre of the cells of living things, that controls the structure and purpose of each cell and carries genetic information during reproduction
5	cord	E	the particular physical form or appearance of something
6	DNA	F	an organism’s set of genes
7	renowned	G	a shape like a spiral or a line curved around a cylinder or cone
8	shape	H	the smallest basic unit of a plant or animal
9	genetic make-up	I	a hard, pointed, often curved part that grows from the top of the head of some animals, or the hard substance of which a horn is made

10	helix	J	turned around on itself

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Corkscrew, shape, DNA, genetic make-up, horn, twisted, helix, renowned, cord, cell

I'd like to turn now to the object which is the main point of this talk: the 1. _____. This is a fascinating mathematical object which touches many parts of our lives. Movement, the natural world, the manufactured world and our 2. _____ are all connected to the 3. _____ of the helix.

A helix is a type of three-dimensional curve that goes around a central cylindrical shape in the form of a spiral, like a 4. _____ or a spiral staircase. The helix is a very popular shape in nature because it is very compact. In fact, helices are sometimes referred to as 'nature's space saver'. In architecture too, the helix shape of a spiral staircase is an attractive option in buildings where space is very restricted.

The most 5. _____ type of helix is probably the double helix of 6._____, or deoxyribonucleic acid. DNA is made of two helices that curve around each other, a bit like a 7._____ ladder. DNA contains the genetic information or 'code' that determines the development and functioning of all known living things. The helix shape is a very efficient way to store a long molecule like DNA in the limited space of a 8. _____ . There are different types of helices. Helices can twist clockwise, right-handed, or anti-clockwise, left-handed. An interesting experiment is to hold a clockwise helix, such as a corkscrew, up to a mirror. The clockwise helix appears to become counterclockwise.

We can perceive examples of helices in many areas of our world. Spiral staircases, cables, screws and ropes can be right-handed or left-handed helices. A helix that goes around a cone is called a conical helix. Examples of conical helices are screws or the famous spiral ramp designed by the architect Frank Lloyd Wright in the Guggenheim Museum in New York.

Helices are also prevalent in the natural world. The 9._____of certain animals, viruses, seashells and the structure of plants, flowers and leaves can all contain helices. The human umbilical 10._____ is in fact a triple helix.

With the discovery that the helix is the shape of the DNA molecule, it is not surprising that the helix is found in so many areas. It's one of the most natural shapes in nature.

Let's turn our attention now to the mathematical description of the helix. You'll need a pen and paper for the next part of the talk as I am going to give you some variables to write down. Take your time to notice the different. (Based on: https://learnenglish.britishcouncil.org/skills/listening/c1-listening/the-helix)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

The number of genes in an organism's genome (the entire set of chromosomes) varies significantly between species. For example, whereas the human genome contains an estimated 20,000 to 25,000 genes, the genome of the bacterium Escherichia coli houses precisely 5,416 genes. Arabidopsis thaliana the first plant for which a complete genomic sequence was recovered has roughly 25,500 genes; its genome is one of the smallest known to plants. Among extant independently replicating organisms, the bacterium Mycoplasma genitalium has the fewest number of genes, just 517.

(Based on https://www.britannica.com/science/gene)

14. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. Phenotypes and Genotypes.
2. Homozygous and heterozygous alleles.
3. Dihybrid Crosses.
4. Punnett Squares.
5. The role of Mendel's experiments

UNIT 5 CELL

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- describe the main ideas of the cell theory;
- compare the structures of animal and plant cells as seen with a light microscope.

PRE-READING

1. Study the essential vocabulary before reading the text.

amino acid (*n*)	[əˈmiːnəʊ ˈæsɪd]	аминокислота
accomplish (*v*)	[əˈkʌmplɪʃ]	выполнить
blueprints (*n, pl*)	[blueprints]	чертежи
cell wall (*n*)	[sel wɔːlz]	клеточная стенка
cell-based (*adj*)	[sel-beɪst]	сотовый
cellular (*adj*)	['seljʊlə]	клеточный
cytology (*n*)	[saɪˈtɒlədʒɪ]	цитология
ensure (*v*)	[ɪnˈʃʊə]	гарантировать
hereditary (*n*)	[hɪˈredɪtərɪ]	наследственность
maintain (*v*)	[meɪnˈteɪn]	поддерживать
multicellular (*adj*)	[mʌltɪˈseljʊlər]	многоклеточный
nutrients (*n, pl*)	[ˈnjuːtrɪənts]	питательные вещества
offspring (*n*)	[ˈɒfsprɪŋ]	потомство
otherwise (*adv*)	[ˈʌðəwaɪz]	иначе
replication (*n*)	[replɪˈkeɪʃn]	репликация
shallow (*adj*)	[ˈʃæləʊ]	пустые, мелкие
single-celled (*adj*)	[sɪŋgl-seld]	одноклеточный
unaided (*adj*)	[ʌnˈeɪdɪd]	невооруженным глазом
unicellular (*adj*)	[juːnɪˈseljʊlə]	одноклеточный
xylem (*n*)	[ˈzaɪləm]	ксилема

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What is a cell?
2. Who discovered cells?
3. Do plant cells differ from animal cells?

3. Read the text and do your essential assignments.

CELL THEORY

Cell biology or **cytology** is a branch of biology that deals with studies related to the structure and function of a cell-based on the concept that the cell is the fundamental unit of life.

The word *cell* comes from the Latin *cellula*, a small room. It is a membrane-enclosed body that is the structural and functional unit of living organisms, being the smallest unit that can carry on all life processes, including maintenance, growth, replication, and self-repair. As such, it is sometimes called the "building block of life" (Alberts et al. 2002).

Etymology.

One day, the British scientist and "natural philosopher" Robert Hooke bent over a microscope that he had constructed himself. He had studied plenty of objects under the microscope before—the tip of a needle, a printed dot, snowflakes—but when he sketched and named this particular observation, he would take a word previously known for its religious connotations and bring it into the world of science.

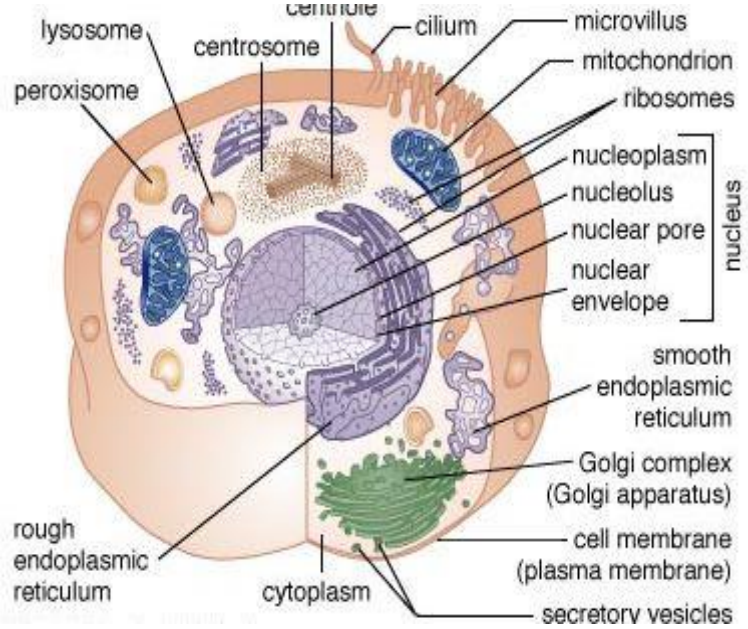
When magnified, Hooke saw that the cork had a series of shallow, walled boxes or "pores." We now know that Hooke was seeing the xylem structure, or specialized tissue in vascular plants, of the dead cork. The story goes that the small boxes reminded the scientist of the rooms that monks stayed in, which were called *cellula.* Later, when Hooke wrote about and illustrated what he saw under the microscope in his 1665 book *Micrographia: Or Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses with Observations and Inquiries Thereupon*, he used the word *cell* to describe what he was seeing—the first known person to do so in this context. While cell theory as we know it today wouldn't begin to develop for another century and a half, his book is the reason we use the word cell to describe the smallest functional unit capable of life.

Hooke began by examining inanimate objects, then turned his eye to living creatures. Science Friday recently got a chance to see an original copy of *Micrographia* at the New York Academy of Medicine and see some of the wonders he examined first-hand.

Properties and functions of a cell.

Some organisms, such as bacteria, are unicellular consisting of a single cell. Other organisms, such as humans, are multicellular. Humans have an estimated 100 trillion or 10^{14} cells; a typical cell size is 10 μm, a typical cell mass 1 nanogram. However, while general characteristics of cells is that they are microscopic in size, biological cells also include vertebrate eggs (or ovum, the female reproductive cell),

which commonly are visible to the unaided human eye, as well as nerve cells that can be very long in some organisms (perhaps 12 meters or 39 feet in the giant squid); there also are single-celled algae (genus *Caulerpa*) up to 3 meters or 10 feet in length.



(Image: © https://cdn.britannica.com/34/72134-004-16996CD2/Cytoplasm-cell-structures-organelles-Ribosomes-sites-protein.jpg)

All living organisms, with the exception of viruses (and there is debate whether or not they can be considered living organisms), consist of cells, demonstrating the unity, harmony, and interconnectedness of life.

The cell theory, first developed in 1839 by Matthias Jakob Schleiden and Theodor Schwann, states that all organisms are composed of one or more cells; all cells come from preexisting cells; all vital functions of an organism occur within cells, and cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.

How cells work.

In order to accomplish them, they must have:

1) Cell membrane that separates the inside of the cell from the outside. By concentrating the chemical reactions of life inside a small area within a membrane, cells allow the reactions of life to proceed much faster than they otherwise would.

2) Genetic material which is capable of passing on traits to the cell's offspring. In order to reproduce, organisms must ensure that their offspring have all the information that they need to be able to carry out all the functions of life. All modern cells accomplish this using DNA, whose base-pairing properties allow cells to make accurate copies of a cell's "blueprints" and "operating system." Some scientists think that the first cells might have used RNA instead.

3)Proteins that perform a wide variety of structural, metabolic, and reproductive functions.

Plant cells.

Plant cells are eukaryotic cells that are part of multicellular, photosynthetic organisms. They have chloroplast organelles, which contain pigments that absorb photons of light and harvest the energy of those photons.

Chloroplasts have the remarkable ability to turn light energy into cellular fuel, and use this energy to take carbon dioxide from the air and turn it into sugars that can be used by living things as fuel or building material.

In addition to having chloroplasts, plant cells also typically have a cell wall made of rigid sugars, to enable plant tissues to maintain their upright structures such as leaves, stems and tree trunks.

Plant cells also have the usual eukaryotic organelles including a nucleus, endoplasmic reticulum, and Golgi apparatus.

Animal cells.

Animal cells are the basic unit of life in organisms of the kingdom Animalia. They are eukaryotic cells, meaning that they have a true nucleus and specialized structures called organelles that carry out different functions. Animal cells do not have plant-specific organelles like cell walls, which support the plant cell, or chloroplasts, the organelle that carries out photosynthesis.

Eukaryotic cells are distinguished from prokaryotic cells by the presence of a defined nucleus and other membrane-bound organelles, such as the mitochondria, endoplasmic reticulum, and Golgi apparatus. Prokaryotic cells do not have a defined nucleus (instead, a region of the cytoplasm – called the nucleotide – holds the genetic material). They also lack membrane-bound organelles.

Animal cells have a variety of different organelles that work together to allow the cell to perform its functions. Each cell can be thought of as a large factory with many departments, like manufacturing, packaging, shipping, and accounting. Different organelles represent each of these departments.

There are lots of different animal cells that each carry out specialized functions. Therefore**,** not every animal cell has all types of organelles, but in general, animal cells do contain most (if not all) of the following organelles. Additionally, some organelles will be highly abundant in certain cells and not others.

(Based on: The Editors of Encyclopaedia Britannica; Alberts, B. (2004). Essential cell biology. New York, NY: Garland Science Pub.)

AFTER READING

4. Answer the following questions.

1. When were cells discovered?
2. How did Robert Hooke discover cells?
3. What is called the cell theory?
4. What are the main ideas of the cell theory?
5. What is the structure of a typical animal cell?
6. How do plant cells differ from animal cells?
7. Is it possible for an animal cell to "spring a leak" and, if so, how would they repair themselves?
8. Are cells specific colours or can they be any color?
9. If an organism dies, do all of its cells immediately die too?
10. Why is exercise good for your cells?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Amino acids always come in tiny sizes, tiny shapes, and with different properties such as polarity, ionic charge, and hydrophobicity.
2. Cells can create physical machinery to perform just one function.
3. The functioning of a cell depends upon its ability to extract and use chemical energy stored in organic molecules.
4. Some scientists think that the first cells might have used DNA to accomplish some vital functions, and then moved to much more versatile amino acids to do the job as the result of a mutation.
5. Chloroplasts do not have the remarkable ability to turn light energy into cellular fuel.
6. In order to reproduce, organisms must ensure that their offspring have all the information that they need to be able to carry out all the functions of life.
7. Plants cells have chloroplast organelles, which contain pigments that absorb photons of light and harvest the energy of those photons.
8. Prokaryotic cells have a defined nucleus.
9. Animal and plant cells typically have a cell wall made of rigid sugars.
10. Animal cells have all types of organelles.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

a ball-shaped nucleus, a cell surface membrane, a compound light microscope, exposed to light, a fibrous material, the functioning unit of life, to have certain features in common, a sap-filled cavity, to serve structures, small rod-like structures.

7. Match the words with their definitions.

1	chlorophyll	A	the chemical reactions of life
2	cytoplasm	B	breaks down food into easily digestible sugars
3	a digestive tract	C	are eukaryotic cells that are part of multicellular, photosynthetic organisms
4	fibre	D	the chemical reactions of life
5	genetic material	E	the contents consist of a central ball-shaped nucleus surrounded by material
6	metabolism	F	parts of plants that you can eat but cannot digest, which help food to move quickly through your body
7	plant cells	G	depends upon its ability to extract and use chemical energy stored in organic molecules
8	storage	H	the act of keeping or putting something in a special place while is not being used
9	the functioning of a cell	I	do not consist of cells
10	viruses	J	is capable of passing on traits to the cell's offspring

8. Find the equivalents for the following words in the text.

a lot of; an essential ability; complex; to accomplish; to get energy; generally; the main unit.

9. **Render the text using the plan in Appendix C.**

LISTENING

10. Watch and listen to the video. Fill in the gaps.

Cell membrane (x2), cell wall, chloroplasts, cytoplasm, endoplasmic, Golgi apparatus, membrane, mitochondria, nucleus, organelles (x2), reticulum, ribosomes, vacuole, vacuoles, vesicles

1) *Fill the gap:* Hello friends, today we'll learn about _____ structure.

2) *Fill the gap:* A cell is the smallest functional and structural unit of an _____ that is capable of carrying out essential life processes.
3) *Fill the gap:* According to the cell theory, _____ organisms are composed of either one or more cells.
4) *Fill the gap:* The cell is the basic unit of _____ cells arise from pre-existing cells.
5) *Fill the gap:* All the cells vary in terms of shape _____ and _____
6) *Fill the gap:* Although there are lots of _____ kinds of cells,
7) *Fill the gap:* There are three main regions of the _____ cell, the outside protection or envelope of the cell.
8) *Fill the gap:* The _____ are whipped like appendages that can help the cell to move all prokaryotic cells, don't have flagella.
9) *Fill the gap:* Now we'll learn about the _____ cells.
10) *Fill the gap:* These are typically a lot _____ in size and more _____ than prokaryotic cells.
11) *Fill the gap:* we find in _____ and _____ let's see the component of cells membrane.
12) *Fill the gap:* It allows some substances in and keeps the extras out _____
13) *Fill the gap:* The cell gets _____ from this, the human body food.
14) *Fill the gap:* We have digested reacts with oxygen in the mitochondria to make _____ for the cell.
15) *Fill the gap:* _____ ribosomes are like tiny factories that make different things.
16) *Fill the gap:* The other components of the cell float around in the _____ and it's, mostly water _____
17) *Fill the gap:* These guys, _____ up the place, getting rid of waste and other unwanted substances that may get into the cell.

Video Link: *All About Cells and Cell Structure*.
(Based on: https://www.youtube.com/watch?v=3nBtY6LR030).

SPEAKING

11. Share your view with the rest of the class on the following scientific fact.

Cell "commit suicide".

When a cell becomes damaged or undergoes some type of infection, it will self-destruct by a process called apoptosis. Apoptosis works to ensure proper development and to keep the body's natural process of mitosis in check. A cell's inability to undergo apoptosis can result in the development of cancer.
(Based on: Reece, Jane B., and Neil A. Campbell. *Campbell Biology*. Benjamin Cummings, 2011).

12. **Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.**

1. The main principles of a cell theory.
2. Robert Hooke and his discovery.
3. The difference between plant and animal cells.

UNIT 6 CELL DIVISION

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- describe the main stages of the cell cycle;
- distinguish between mitosis and meiosis.

PRE-READING

1. Study the essential vocabulary before reading the text.

amino acid (*n*)	[əˈmiːnəʊ ˈæsɪd]	аминокислота
arise (*v*)	[əˈraɪz]	возникать
binary fission (*n*)	[ˌbaɪnərɪˊfɪʃ(ə)n]	деление надвое
chromatin (*n*)	[ˈkɪəʊmətɪn]	хроматин
cytokinesis (*n*)	[ˌsaɪtəʊkɪˈniːsɪs]	цитокинез
eucaryote (*n*)	[juːˈkærɪˌɒt]	эукариот
fertilize (*v*)	[ˈfɜːtəlaɪz]	оплодотворить
gamete (*n*)	[ˈgæmiːt]	гаметы
homologous (*adj*)	[həˈmələgəs]	гомологичный
meiosis (*n*)	[maɪˈəʊsiːz]	мейоз
mitosis (*n*)	[maɪˈtəʊsɪs]	митоз
plasmid (*n*)	[ˈplæzmɪd]	плазмиды
prophase (*n*)	[prəʊfeɪz]	профаза
prokaryotic (*adj*)	[prəʊkrɪˈɒtɪk]	прокариотический
ribosome (*n*)	[ˈraɪbəsəʊm]	рибосома
strand (*n*)	[strænd]	прядь; нить; жила
tangled (*adj*)	[tæŋgld]	замысловатый
undergo (*v)*	[ʌndəˈgəʊ]	претерпевать
worn out (*adj*)	[wɔːn aʊt]	износившийся
zygote (*n*)	[ˈzaɪgəʊt]	зигота

2. With a partner consider the following questions and try to answer them. Then quickly scan the text to check your answers.

1. What is the basis of reproduction?
2. How many chromosomes does each human cell contain?
3. Can you describe the main stages of a cell cycle?

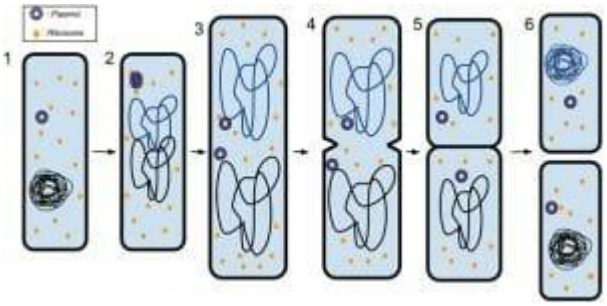
3. Read the given text and make your essential assignments:

One of the most important concepts in biology is that cells arise only by the division of existing cells. Cell division is essential to all life. It enables a multicellular organism to grow and to replace worn out or damaged cells. It is also the basis of reproduction in every organism.

There are several types of cell division, depending upon what type of organism is dividing. Organisms have evolved over time to have different and more complex forms of cell division. Most prokaryotes, or bacteria, use binary fission to divide the cell. Eukaryotes of all sizes use *mitosis* to divide. Sexually-reproducing eukaryotes use a special form of cell division called *meiosis* to reduce the genetic content in the cell. This is necessary in sexual reproduction because each parent must give only half of the required genetic material, otherwise the offspring would have too much DNA, which can be a problem. These different types of cell division are discussed below.

Types of cell division: prokaryotic and eukaryotic.

Prokaryotes replicate through a type of cell division known as *binary fission*. Prokaryotes are simple organism, with only one membrane and no division internally. Thus, when a prokaryote divides, it simply replicates the DNA and splits in half. The process is a little more complicated than this, as DNA must first be unwound by special proteins. Although the DNA in prokaryotes usually exists in a ring, it can get quite tangled when it is being used by the cell. To copy the DNA efficiently, it must be stretched out. This also allows the two new rings of DNA created to be separated after they are produced. The two strands of DNA separate into two different sides of the prokaryote cell. The cell then gets longer, and divides in the middle. The process can be seen in the image below:



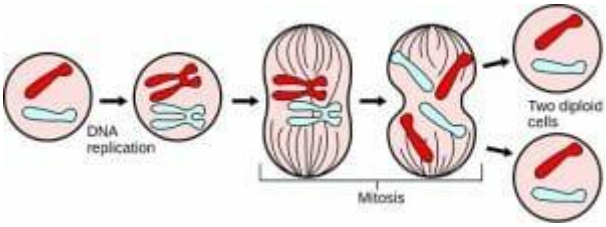
(Image: © https://biologydictionary.net/wp-content/uploads/2016/12/Binary-Fission-2.jpg)

The DNA is the tangled line. The other components are labeled. Plasmids are small rings of DNA that also get copied during *binary fission* and can be picked up in the environment, from dead cells that break apart. These plasmids can then be further replicated. If a plasmid is beneficial, it will increase in a population.

Eukaryotic cell division: Mitosis.

Eukaryotic organisms have membrane bound organelles and DNA that exists on chromosomes, which makes cell division harder. Eukaryotes must replicate their DNA, organelles, and cell mechanisms before dividing. Many of the organelles divide using a process that is essentially *binary fission*, leading scientist to believe that eukaryotes were formed by prokaryotes living inside of other prokaryotes.

After the DNA and organelles are replicated during *interphase* of the cell cycle, the eukaryote can begin the process of mitosis. The process begins during prophase, when the chromosomes condense. If mitosis proceeded without the chromosomes condensing, the DNA would become tangled and break. Eukaryotic DNA is associated with many proteins which can fold it into complex structures. As mitosis proceeds to *metaphase* the chromosomes are lined up in the middle of the cell. Each half of a chromosome, known as *sister chromatids* because they are replicated copies of each other, gets separated into each half of the cell as mitosis proceeds. At the end of mitosis, another process called *cytokinesis* divides the cell into two new daughter cells.



(Image: © https://biologydictionary.net/wp-content/uploads/2016/12/Major-events-in-mitosis-1.jpg)

All eukaryotic organisms use mitosis to divide their cells. However, only single-celled organisms use mitosis as a form of reproduction. Most multicellular organisms are sexually reproducing and combine their DNA with that of another organism to reproduce. In these cases, organisms need a different method of cell division. Mitosis yields identical cells, but meiosis produces cells with half the genetic information of a regular cell, allowing two cells from different organisms of the same species to combine.

Eukaryotic cell division: Meiosis.

Some plants can exist with too many copies of the genetic code, but in most organisms, it is highly detrimental to have too many copies. Humans with even one extra copy of one chromosome can experience detrimental changes to their body. To counteract this, sexually reproducing organisms undergo a type of cell division known as *meiosis*. As before mitosis, the DNA and organelles are replicated. The process of meiosis contains two different cell divisions, which happen back-to-back. The first meiosis, *meiosis I*, separates homologous chromosomes. The homologous chromosomes present in a cell represent the two alleles of each gene an organism has.

These alleles are recombined and separated, so the resulting daughter cells have only one allele for each gene, and no homologous pairs of chromosomes. The second division, *meiosis II*, separated the two copies of DNA, much like in mitosis. The end result of meiosis in one cell is 4 cells, each with only one copy of the genome, which is half the normal number.

Organisms typically package these cells into *gametes*, which can travel into the environment to find other gametes. When two gametes of the right type meet, one will fertilize the other and produce a *zygote*. The zygote is a single cell that will undergo mitosis to produce the millions of cells necessary for a large organism. Thus, most eukaryotes use both mitosis and meiosis, but at different stages of their lifecycle.

In cell division (also called cytokinesis) the cytoplasm divides to form two daughter cells. The duration of the cell cycle varies according to conditions such as temperature and the type of cell. The cell cycle of some plant cells (for example, stamen cells of Tradescantia) takes less than 30 minutes at 45°C, but more than two hours at 10°C. Cells in the growing root tip of an onion divide every 22 hours at 20°C. Some cells such as human nerve cells do not divide at all, once they have become specialized. In meiosis the nucleus divides twice. This produces four haploid nuclei. The number of chromosomes is therefore halved during meiosis. Moreover, homologous chromosomes within a pair can exchange genetic material before being separated. The daughter cells are therefore genetically different from the parent cell (and from each other).

Meiosis is the basis of sexual reproduction, occurring at some point in the life cycle of organisms that reproduce sexually. The haploid gametes produced by meiosis fuse during fertilization. This means that the new fertilized cell has the diploid number of chromosomes. Without meiosis in the life cycle, the number of chromosomes of a sexually reproducing species would be doubled in each generation. (Based on: Cell Division - Definition, Stages and Types | Biology Dictionary; Verma, P. S., & Agrawal, V. K. (2006). Cell Biology, Genetics, Molecular Biology, Evolution & Ecology (1 ed.). S. Chand and company Ltd.)

AFTER READING

4. Answer the following questions.

1. How does cell division work?
2. What two forms of nuclear division do you know?
3. What provides continuity between one generation of cells and the next?
4. How many chromosomes does each human cell have?
5. What do chromosomes consist of?

6. What is known as homologous pairs?
7. What is the difference between diploid and haploid cells?
8. What are the main stages of cell cycle?
9. How does the duration of the cell cycle vary?
10. Why is meiosis so important?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Cell division enables a multicellular organism to grow and to replace worn out or damaged cells.
2. The cell cycle of some plant cells takes less than 30 minutes at 45°C.
3. The chromatids containing replicated DNA are separated from each other and are redistributed as chromosomes in the nuclei of a new daughter cell.
4. Mitosis doubles the number of cells with changing the genetic information.
5. In meiosis the nucleus divides twice and produces four haploid nuclei.
6. Homologous chromosomes within a pair can exchange genetic material before being separated.
7. In meiosis the nucleus divides only once.
8. The number of chromosomes is halved during mitosis.
9. The haploid gametes produced by meiosis fuse during fertilization.
10. The cytoplasm divides to form two daughter cells.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

A cell surface membrane, a centromere, haploid gametes, homologous, multicellular, nucleus, to replicate, to reproduce, a sap-filled cavity, stamen cells.

7. Match the words with their definitions.

1	asexual	A	the act or process of producing young animals or plants
2	cell cycle	B	the central part of an atom, made up of neutrons, protons, and other elementary particles
3	fertilization	C	a group of animals or plants which are all similar and can breed together to produce young animals or plants of the same kind as them
4	gamete	D	more than one cell
5	mutation	E	the sequence of events that occurs between one cell division

			and the next cycle
6	multicellular	F	to make sperm join an egg so that a young baby or animal develop
7	nucleus	G	a type of cell which joins with another cell, starting the development of a baby or other young creature
8	reproduction	H	not having sexual organs or having sex
9	species	I	a watery fluid containing salts and sugars
10	vacuole	J	a change in the genetic structure of an animal or plant, that makes it different from others of the same type

8. Find the equivalents for the following words in the text:

alteration; breed; connect; consists of; decrease; divided; important; injured; usually; occur.

9. Render the text by using the plan in Appendix C.

LISTENING

10. Listen to the recording. Try to understand the general idea and fill in the gaps.

Daughter cells; shed light; 'polar ejection forces' (2); dead or damaged; a clever laser technique; sets of chromosomes; size; high speed lasers; to understand genetic diseases.

1) We need new cells in our body to replace _____.
2) Now scientists at the University of Michigan have used a _____to get an even closer insight into how mitosis works.
3) In mitosis, cells copy all their DNA, line up these two _____in the middle of the cell, thanks to a microscopic scaffold-like structure called the spindle.
4) If this goes wrong, then the new _____may end up with the wrong number of chromosomes, which is bad news for the cell.
5) The Michigan team used _____to slice off tiny pieces of chromosomes from within living, dividing newt cells, and watched what happened.
6) Previously, researchers have though that something called _____are at working in dividing cells, helping to maintain the pull across the_____, and ensure that an equal number of chromosomes go to each new cell.

7) Hunt suspected that these forces should be directly related to the _____of the chromosomes.
8) They also discovered that these _____are an important physical cue that helps to directly control_____, and the direction of chromosome movements.
9) Not only does this discovery _____on cancer – and on chemotherapy, which often works by blocking mitosis in cancer cells.
10) But it could also help us to _____such as Down's Syndrome, which are caused by an incorrect number of chromosomes during egg formation.
(based on: Cutting chromosomes gives clues to cell division | Science News | Naked Scientists (thenakedscientists.com)

SPEAKING

11. Share your view with the rest of the class on the following scientific fact.

WHAT HAPPENS WHEN CELLS MAKE MISTAKES?

Mistakes in the cell cycle happen all the time. Flawed copies of DNA are usually repaired during the G2 stage of interphase, but if they're not the cell can go on to be dysfunctional. Damages in DNA are known as *mutations*. Additionally, there's a dangerous moment during anaphase. If the centromeres do not separate properly, one daughter cell will end up having one extra chromosome while the other is missing one.

These mutations can result in all kinds of problems, or no problems at all! One of the worst cell mutations is the disease we know as cancer. Fortunately, our cells are able to perform their job perfectly almost all of the time keeping us healthy as our bodies continue to function according to plan.
(Based on: Cell Division Facts – Laney Lee (laney-lee.com)

12. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. Three types of cell division.
2. Phases of meiosis and mitosis.
3. Cell cycle progression.

UNIT 7 ACELLULAR ENTITIES (VIRUSES, PRIONS, VIROIDS)

LEARNING OBJECTIVES

By the end of this section, you will have completed the following objectives:

- describe viruses and their basic properties;
- define viroids from viruses and their targets of infection.

PRE-READING

1. Study the essential vocabulary before reading the text.

apparently (*adv*)	[əˈpærəntlɪ]	по-видимому, вероятно
archaea (*n. pl.)*	[ɑ:'ki:ə]	археи
considerable (*adj*)	[kənˈsɪd(ə)rəb(ə)]	значительный, важный
crux (*n*)	[krʌks]	затруднение, трудный вопрос
fungus, pl. fungi (*n*)	['f ŋgəs] ['f ŋgi:]	гриб, поганка; плесень
hyphae (*n. pl*.)	[ˊhaɪfi:]	гифы
identify (*v*)	[aɪˈdentɪfaɪ]	опознавать, устанавливать личность
intestine (*n*)	[ɪnˊtestɪn]	кишка, кишечник
invade (*v*)	[ɪnˈveɪd]	вторгаться
merge (*v*)	[mɜ:ʤ]	сливать(ся), соединять(ся)
nucleic acid	[nju:ˈkli:ɪk ˈæsɪd]	нуклеиновая кислота
pathogen (*n*)	[ˈpæθə|dʒ(ə)n]	патогенный, болезнетворный
polio (*n*)	[ˈpəʊlɪəʊ]	полиомиелит, детский паралич
porcelain (*adj*)	[ˈpɔ:slɪn]	фарфоровый
rabies (*n*)	[ˈreɪbi:z]	бешенство, водобоязнь
rejoin (*v*)	[rɪˈʤɔɪn]	воссоединять(ся)
relate to (*v*)	[rɪˈleɪt tu:]	устанавливать связь
rickettsia (*n*)	[rɪˈketsɪə]	риккетсия
smallpox (*n*)	[ˈsmɔ:lpɒks]	оспа
split apart	[splɪt əˈpɑ:t]	расщеплять
spring (*n*)	[sprɪŋ]	пружина
tuber (*n*)	[ˈtju:bə(r]	клубень
typhus (*n*)	[ˈtaɪfəs]	сыпной тиф
upper (*adj*)	[ˈʌpə]	верхний
viroid (*n*)	['vʌɪrɔɪd]	вироид

weaken (*v*)	[ˈwiːkən]	ослаблять

2. With a partner consider the following questions and try to answer them. Then quickly scan the text to check your answers.

1. What do you know about acellular entities?
2. How does a virus cause disease?
3. What are the main characteristics of prions?

3. Read the given text and do your essential assignments.

Acellular tissues or organisms are those that are not made up of discrete cells or cannot split into cells, such as the hyphae of certain fungi.

It refers to something that is organic and lacks cells. These particles, in fact, lack virtually most of the fundamental components that characterize life. Prions, viruses and certain biological products like vaccines are examples of acellular particles. Most descriptive definitions of life have assumed that an organism must be formed of one or more cells; however, this is no longer regarded as required in contemporary criteria.

Acellular does not imply unicellular. A biological creature made up of a single cell is referred to as unicellular. Bacteria, archaea and protozoa are examples of single-celled (unicellular) organisms. Whereas acellular refers to ‘non-cellular’ structures.

A virus is a tiny parasite living, growing and reproducing its kind inside a host cell. When viruses damage or destroy the cells they invade, they produce virus diseases; polio, smallpox and rabies are typical examples. Viruses are the smallest microbes.

“Virus,” or “the virus”, has also become a fashionable medical diagnosis. It is usually applied to minor disturbances of the stomach or intestines (“stomach flu”) and to upper respiratory tract infections related to the common cold. It is as good an explanation as any for transitory infections, of unproved origin, which make a per-son, feel miserable and weaken him for a considerable length of time.

Nature of viruses. Viruses were first discovered in 1892 by a Russian scientist, D. Iwanowski, who noted infective agents that would pass through a filter that stopped ordinary bacteria. Hence, they were originally called *filterable viruses*. First to be discovered was the tobacco mosaic virus, a plant virus that puts spots on tobacco leaves. In 1898, Loeffler and Frosch discovered the virus that causes hoof-and-mouth disease in cattle and in 1901, Walter Reed and his associates found the virus that causes yellow fever in man. Since them, a great many viruses, all parasites on the cells of plants, lower animals or human beings, have been identified.

Viruses that are parasites on bacteria are called *bacteriophage* (phage). Closely related to viruses are *rickettsia*, microbes which are parasites on host cells but which are too large to pass through the porcelain filters that let viruses through. The principal rickettsial disease is *typhus*.

The exact nature of viruses has not yet been settled. They are on the border-line between the living and the dead. A "live" virus can apparently be reconstituted out of inorganic chemicals (the tobacco mosaic virus) and will multiply or replicate itself within cells. This is the area where chemistry and biology seem to merge.

The crux of the matter appears to lie in the nucleus of the virus, made up of nucleic acid and nucleoproteins. The outer coat of the virus, which can be stripped, is a protein. The nucleic acids – chemicals – have a special configuration in their molecular form. They are twin spirals, like spiral springs, one turning to the right, the other to the left.

Under certain circumstances of virus reproduction, they split apart and then join together again. This is much the same process that occurs when the chromosomes in the nucleus of a living cell split apart and rejoin to form new cells. In other words, viruses act much like genes, and greater similarities between them may be found. The process of wild multiplication of cancer cells also has much in common with virus duplication.

How big are viruses? They are unbelievably small – millionths of an inch in length, breadth and thickness. The largest known virus that of parrot fever (psittacosis) – measuring 450 millimicrons – is only about 1 /20th the size of a red blood cell. The smallest virus that of hoof-and-mouth disease, measures only 10 millimicrons. Viruses come in all kinds of shapes – spheres, balls, ovals (egg-shaped), cubes, rhomboids, commas, and rods.

Viroids

In 1971, Theodor Diener, a pathologist working at the Agriculture Research Service, discovered an acellular particle that he named a viroid, meaning "virus-like." Viroids consist only of a short strand of circular RNA capable of self-replication. The first viroid discovered was found to cause *potato tuber spindle disease*, which causes slower sprouting and various deformities in potato plants Like viruses, potato spindle tuber viroids (PSTVs) take control of the host machinery to replicate their RNA genome. Unlike viruses, viroids do not have a protein coat to protect their genetic information.

Viroids, in general, can be dispersed mechanically during crop maintenance or harvesting, vegetative reproduction, and possibly via seeds and insects, resulting in a severe drop in food availability and devastating economic consequences.

Virusoids

A second type of pathogenic RNA that can infect commercially important agricultural crops are the virusoids**,** which are subviral particles best described as non–self-replicating ssRNAs. RNA replication of virusoids is similar to that of viroids but, unlike viroids, virusoids require that the cell also be infected with a specific "helper" virus. There are currently only five described types of virusoids and their associated *helper viruses*. The helper viruses are all from the family of *Sobemo viruses*. An example of a helper virus is the subterranean clover mottle virus, which has an associated virusoid packaged inside the viral capsid. Once the helper virus enters the host cell, the virusoids are released and can be found free in plant cell cytoplasm, where they possess ribozyme activity. The helper virus undergoes typical viral replication independent of the activity of the virusoid. The virusoid genomes are small, only 220 to 388 nucleotides long. A virusoid genome does not code for any proteins, but instead serves only to replicate virusoid RNA.

Virusoids belong to a larger group of infectious agents called *satellite RNAs*, which are similar pathogenic RNAs found in animals. Unlike the plant virusoids, satellite RNAs may encode for proteins; however, like plant virusoids, satellite RNAs must coinfect with a helper virus to replicate. One satellite RNA that infects humans and that has been described by some scientists as a virusoid is the *hepatitis delta virus (HDV)*, which, by some reports, is also called hepatitis delta virusoid. Much larger than a plant virusoid, HDV has a circular, ssRNA genome of 1,700 nucleotides and can direct the biosynthesis of HDV-associated proteins. The HDV helper virus is the *hepatitis B virus (HBV)***.** Coinfection with HBV and HDV results in more severe pathological changes in the liver during infection, which is how HDV was first discovered.

Prions

At one time, scientists believed that any infectious particle must contain DNA or RNA. Then, in 1982, Stanley Prusiner, a medical doctor studying scrapie (a fatal, degenerative disease in sheep) discovered that the disease was caused by proteinaceous infectious particles, or *prions***.** Because proteins are acellular and do not contain DNA or RNA, Prusiner's findings were originally met with resistance and skepticism; however, his research was eventually validated, and he received the Nobel Prize in Physiology or Medicine in 1997.

A prion is a misfolded rogue form of a normal protein (PrPc) found in the cell. This rogue prion protein (PrPsc), which may be caused by a genetic mutation or occur spontaneously, can be infectious, stimulating other endogenous normal proteins to become misfolded, forming plaques (see Figure 2). Today, prions are known to cause

various forms of *transmissible spongiform encephalopathy (TSE)* in human and animals. (Based on: Acellular Organisms - Meaning, Types and Function (byjus.com)

AFTER READING

4. Answer the following questions.

1. Where do viruses exist?
2. What is "the virus" usually applied to?
3. What does this fashionable diagnosis help us explain?
4. When were viruses first discovered?
5. What are viruses that are parasites on bacteria called?
6. What are rickettsia?
7. How can a "live" virus be reconstituted?
8. What is the configuration of the nucleic acids?
9. When do they split apart and then join together again?
10. How much does the largest known virus measure?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Viruses are the largest microbes.
2. "The virus" diagnosis is seldom used.
3. Ordinary bacteria can pass through a filter.
4. Yellow fever in man is caused by a virus.
5. The principal rickettsial disease is smallpox.
6. We know what the exact nature of viruses is.
7. The configuration of nucleic acids is unknown.
8. There are no similarities between genes and viruses.
9. The largest known virus is as big as a red blood cell.
10. Viruses come in only two kinds of shapes – spheres and balls.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

Crux, endogenous, hoof-and-mouth disease, intestine, minor disturbance, on the border-line, Psittacosis, to split apart, the subterranean clover mottle virus, upper respiratory tract

7. Match the words with their definitions.

1	archaea	A	refer to microorganisms that cannot be seen by naked eyes but can only be seen under a microscope
2	bacteriophages	B	are essentially viroids that have been encapsulated by a helper virus coat protein
3	diagnosis	C	is the site of most chemical digestive processes and the place where digested food materials are absorbed for use by the body
4	intestine	D	are ubiquitous viruses, found wherever bacteria exist
5	microbe	E	contain flagella, cilia, or pseudopodia means they are motile
6	nucleic acid	F	the process of determining the nature of a disease or disorder and distinguishing it from other possible conditions
7	prion	G	encode structural proteins to enclose their genetic material, which are therefore distinct from the structural proteins of their helper viruses
8	protozoa	H	long chainlike molecules composed of a series of nearly identical building blocks called nucleotides
9	satellite viruses	I	can enter the brain through infection, or they can arise from mutations in the gene that encodes the protein
10	virosoid	J	are free-living single-celled eukaryotes

8. Find the equivalents for the following words in the text:

eliminate; livestock; perhaps; change; inheritance; lethal; to contrast; quickly; however; pathological.

9. **Render the text by using the plan in Appendix C.**

LISTENING

10. Listen to the recording. Try to understand the general idea and fill in the gaps.

A tiny amount; species; virus particles; the size of viruses; of complex life; enormously important role; positive; stretch for; would weigh; piggyback on.

Do viruses prey on other viruses?

1) I found an interesting fact that if you lay all of the viruses on earth end to end, they would _____ a hundred million light years.

2) It's so hard to get one's head around both the _____, but also the enormous number of viruses in the world.
3) If you take a liter of seawater, it's a hundred billion _____ in that liter.
4) They only actually kind of represent a _____ of the tree of life.
5) The vast majority of _____ are bacteria and archaea.
6) A kind of single-celled organisms on the whole, and only a few twigs of the tree of life really are made up of _____ like animals, fungi and plants.
7) But actually, if you took all the bacteria on the planet and weighed the mass of them, they _____a hundred times more than all the humans on the planet.
8) And these actually play an _____in the way the whole ecosystem works because they kill an estimated 20 to 40% of bacteria on the planet every single day.
9) But viruses can play _____ as well as kind of disease carrying roles.
10) There are viruses that _____ other viruses and infect viruses. (Based on: Do viruses prey on other viruses? | Questions | Naked Scientists (thenakedscientists.com)

SPEAKING

11.Share your view with the rest of the class on the following scientific fact.

Examine Life.

A minimum estimate of the number of species of insects in the world is 750,000. Perhaps, then, it would not surprise you to see a fly with eyes on stalks as long as its wings, a dragonfly with a wingspread greater than 1 meter, an insect that can revive after being frozen at -35°C, and a wasp that can push its long, hairlike, egg-laying tool directly into a tree. Only the dragonfly is not presently living, but it once was. What other curious features of this fascinating group can you discover? Have you looked at a common beetle under magnification? It will hold still if you chill it. (Based on: Thinking Critically (mheducation.com)

12.Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. Viruses and viroids.
2. Prions.
3. How viruses like SARS-CoV-2 can evolve to become serious threats.

UNIT 8 BACTERIA

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- describe the main types of bacteria;
- describe the structure of bacteria cells.

PRE-READING

1. Study the essential vocabulary before reading the text.

anthrax *(n)*	[ˈænθræks]	сибирская язва
biotechnology *(n)*	[baɪətekˈnɒlədʒɪ]	биотехнология
carbohydrate *(n)*	[kɑːbə(ʊ)ˈhaɪdr(e)ɪt]	углевод
crescent *(n)*	[ˈkres(ə)nt]	полумесяц, полукруг, серп
crystal violet dye	[krɪstl ˈvaɪəlɪt daɪ]	кристаллический фиолетовый краситель
crucial (*adj*)	[ˈkruːʃəl]	ключевой, критический, важный
decomposition *(n)*	[diːkɒmpəˈzɪʃn]	разложение
digestive system	[dɪˈdʒestɪv ˈsɪstɪm]	пищеварительная система
elongated (*adj*)	[ˈiːlɒŋgeɪtɪd]	удлиненный, продолговатый
engulfing (*adj*)	[ɪnˈgʌlfɪŋ]	охватывающий, поглотивший
enzyme *(n)*	[ˈenzaɪm]	фермент
escherichia coli	[ˌeshəˈrikēə ˈkəʊlaɪ]	кишечная палочка
estimated (adj)	[ˊestɪmeɪtɪd]	оцененный, предполагаемый
fermentation *(n)*	[fɜːmenˈteɪʃn]	ферментация
fission *(n)*	[fɪʃn]	расщепление, деление, распад
flagella *(n)*	[fləˈdʒelə]	жгутики
gut *(n)*	[gʌt]	кишка
lineage *(n)*	[ˈlɪnɪɪdʒ]	родословная, происхождение
nitrate *(n)*	[ˈnaɪtreɪt]	нитрат
persist (*v*)	[pəˈsɪst]	сохраниться, оставаться
plague *(n)*	[pleɪg]	чума
plant fiber	[plɑːnt faɪbə]	растительное волокно
predecessor *(n)*	[ˈpriːdɪsesə]	предшественник
strep throat	[strep θrəʊt]	острый фарингит
vital (*adj*)	[ˈvaɪtl]	жизненно важный

whooping cough	[ˈhuːpɪŋ kɒf]	коклюш

2. Before you read discuss the questions with your partner. **Then quickly scan the text to check your answers.**

1. Where are bacteria found?
2. What is the structure of bacteria?
3. How many types of bacteria do you know?

3. Read the given text and do your essential assignments.

BACTERIA

Bacteria are small single-celled organisms. Bacteria are found almost everywhere on Earth and are vital to the planet's ecosystems. Some species can live under extreme conditions of temperature and pressure. The human body is full of bacteria, and in fact is estimated to contain more bacterial cells than human cells. Most bacteria in the body are harmless, and some are even helpful. A relatively small number of species cause disease.

Bacteria are microorganisms that come in various shapes. They can be spheres, they can be rods, or they can be spirals. There are bad, pathogenic bacteria that cause diseases, but there are also good bacteria. As an example, in our digestive system, in the gut, we have bacteria that are very necessary to help our bodies function in a normal way. What's interesting about bacteria is that in our bodies we have 10 times more bacterial cells than we have human cells.

Why are bacteria so important?

Bacteria are important for a number of reasons. They perform functions that make them important to other life forms plus they are important economically in a number of industries.

Some species of bacteria cause disease and infections, but far more commonly, bacteria are beneficial. They are so important in our own bodies that if all of the bacteria from inside our bodies were removed, we would die without their help.

Bacteria that live inside the stomachs and intestines of animals help with digestion. Bacteria have enzymes that are able to digest tough foods, such as plant fibers, that animals are unable to digest.

Bacteria also play a role in important ecological processes. They are one of the main players in the decomposition of dead plants and help to recycle nutrients back into ecosystems. They are also able to take gases from the atmosphere and turn them into usable nutrients such as carbohydrates and nitrates.

Certain industrial processes utilize the metabolism of bacteria. Bacteria are responsible for the fermentation that leads to the production of foods such as cheese and yogurt. Bacteria are also used in waste treatment facilities to help speed up the process of breaking down human waste, food waste and cleaning products.

A cell wall of bacteria.

Bacteria are prokaryotic organisms. They all have only one cell and that cell doesn't have a 'true' nucleus or organelles.

A key feature of bacteria cells is a cell wall. The cell wall surrounds a bacteria cell and provides protection. It also maintains the shape of the cell and prevents it from bursting open.

Compared to the cell walls of plants which are made from cellulose, bacteria cell walls have multiple layers of made from different compounds. Different species of bacteria have cell walls with different structural make up. Differences in the structure of cell walls is what separate bacteria into gram-positive and gram-negative bacteria.

It is the cell wall that is often targeted by antibiotics to kill bacteria.

Although bacteria cells don't have organelles, they do have sub-cellular structures called ribosomes and flagella. Ribosomes are used to produce proteins using information provided by DNA.

Gram-positive and gram-negative bacteria.

Differences in the structure of cell walls can separate bacteria into two different groups: gram positive and gram negative. To identify which group a bacterium belongs to it is stained with a crystal violet dye. Gram-positive and gram-negative bacteria can be distinguished by the color they become after being stained.

Gram-positive bacteria stain a blue or purple colour after the dye is washed off. Gram-negative bacteria become red or pink in colour.

The two groups of bacteria stain different colours because of different thicknesses of a compound in their cell walls called 'peptidoglycan'. Gram-positive bacteria have a thick layer of peptidoglycan in their cell wall. The thick layer of peptidoglycan stains blue or purple after being exposed to a crystal violet dye.

Gram-negative bacteria don't have a thick layer of peptidoglycan in their cell wall. When they are stained with a crystal violet dye their cell walls are unable to retain the color of the dye and instead turn red or pink.

The cell walls of gram-negative bacteria are more complex than those of gram-positive bacteria. Gram-negative bacteria have an outer membrane that surrounds the cell wall. This outer membrane makes gram-negative bacteria harder to kill with antibiotics.

Different shapes of bacteria cells.

Three common shapes of bacteria cells are known: round, rod-shaped and spiral shaped. Round, or cocci, are spherical shaped prokaryotic cells. They include a number of very small bacteria, often smaller than 1 μm, and often live in association with other round shaped bacteria cells.

Rod shaped cells are known as bacilli. Being elongated means that bacilli have larger surface areas relative to their volume so they are able to grow larger. Well-known bacillus bacteria include those found in yogurt marketed as 'probiotics' and *Bacillus anthracis*, the bacteria that causes anthrax.

Spiral shaped cells are known as spirilla or spirochetes. Spirilla bacterial cells vary in the amount of spiralling between species. Some bacteria may be almost a crescent shape whilst others will form loose and tight coils.

Reproduction of bacteria.

The reproduction of bacteria cells is not yet fully understood. Bacteria are able to reproduce in a number of ways and they can reproduce very quickly. Research done on the *E. coli* bacteria has shown that they can reproduce every 20 minutes in ideal conditions.

Bacteria cells commonly reproduce via binary fission, where one cell splits into two cells. Some species are able to spit into a number of fragments and each fragment has the potential to grow into fully developed bacteria.

Some bacteria produce long-living cells called 'endospores' that are able to survive through harsh environmental conditions for long periods. Once the environment improves the endospore reproduces normal bacteria cells and the bacterial population can begin to grow again.

Short generations and large genetic variability allow bacteria to evolve quickly to changing environments. Their ability to adapt to their environment is verified by the fact that they have persisted for over 3.5 billions of years.

Bacteria are simple in structure compared to eukaryotes but they are not primitive with respect to evolution. They are highly evolved organisms and well-adapted to a massive suite of environments.

By fixing atmospheric nitrogen and carbon dioxide, cyanobacteria changed the environment of Earth. They put oxygen into the atmosphere and made nitrates available to other organisms.

It is also believed that cyanobacteria are the predecessor to all plants. The most popular theory is that green algae evolved from a eukaryotic cell engulfing a cyanobacterium cell. The cyanobacteria became an organelle called a 'chloroplast' and over time green algae evolved into land plants.

(Based on: Archaea vs Bacteria – What are the Similarities, Differences, and Examples - Rs' Science (rsscience.com)

AFTER READING

4. Answer the following questions.

1. How many types of bacteria do you know?
2. How do bacteria differ from viruses?
3. Do all bacteria cause diseases?
4. What are the different shapes and arrangement of bacterial cells?
5. How can gram-positive and gram-negative bacteria be distinguished?
6. How quickly do bacteria reproduce?
7. What role do bacteria play in ecological processes?
8. What are the dangers of cyanobacteria in good conditions?
9. What living organisms can be pathogens for humans?
10. How can bacteria survive adverse conditions?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Bacteria are the most numerous microscopic microorganisms.
2. Your body harbored bacteria at the moment you were born.
3. Bacteria reproduce by fission.
4. All bacteria cause diseases.
5. The cocci come in pairs.
6. Many bacteria live inside us.
7. Bacteria cells do not act as a barrier against pathogens.
8. Bacteria are not able to digest the hydrocarbons in petroleum.
9. Some bacteria are our fermenters, converting sugars into bread, beer, sauerkraut, etc.
10. Bacteria are the workhorses of molecular biology, genetics, biochemistry.

6. Give Russian equivalents to the following English terms:

to be exposed to, to be harmful, to be removed, to be unable to digest, to break down human waste, to break down human waste, to convert into, to evolve into, in return, a massive suite of environments, under extreme conditions, vast majority of smth, the well-being of smth

7. Match the words with their definitions.

1	bacteria	A	an infectious microorganism or agent (a virus, bacterium, protozoan, prion, viroid, or fungus)
2	endospore	B	are bacteria that do not retain the crystal violet stain used in the gram staining method of bacterial differentiation
3	fermentation	C	is a polyatomic ion with the chemical formula NO^{-3}
4	gram-negative bacteria	D	is acute or chronic inflammation of the protective membranes covering the brain and spinal cord
5	gram-positive bacteria	E	is suggestive of a spore or seed-like form
6	gut	F	is pharyngitis (an infection of the pharynx, the back of the throat) caused by Streptococcus pyogenes, a gram-positive group A Streptococcus
7	meningitis	G	are ubiquitous, mostly free-living organisms
8	nitrate	H	the alimentary canal, especially the intestine
9	pathogens	I	are bacteria that give a positive result in the Gram stain test
10	strep throat	J	process that produces chemical changes in organic substances through the action of enzymes

8. Find the equivalents for the following words in the text:

to carry out; comparatively; to develop; favourable; huge; to make; poisonous; sickness; widespread; wrapped.

9. **Render the text by using the plan in Appendix C.**

LISTENING

10. Listen to the recording. Try to understand the general idea and fill in the gaps.

Inactivate; inside the cancerous cells; the long isoform; positive bacteria to demonstrate; to degrade the drug; a specific enzyme; completely resistant (2); pancreatic cancers.

Bacteria block cancer chemotherapy.

1) They can either come from the bloodstream, the tumours, or because we were exploring _____, they might come from the gastrointestinal tract.
2) We found that bacteria can _____the drug by cutting it.
3) We also can show with mice models with a cancer and bacteria, the cancer of the mice becomes _____ to chemotherapy.
4) We know that these bacteria have the genes they need _____ but it's hard to know what would be the effect of eradicating these bacteria from human tumours.
5) Bacteria were found between the cells and even _____ and we know, as we said before, that these bacteria have the right capacity to degrade gemcitabine.
6) The one thing in common to all these bacteria were that they all have _____called CDD, which stands for Cytidine Deaminase, and can come in a short or long isoform.
7) We found that only bacteria with _____ of CDD can degrade the drug gemcitabine.
8) We also isolated these bacteria and were able _____ that bacteria isolated from pancreatic cancer patients, from the pancreatic tumours.
9) We took mice models of cancer, and if we put inside the bacteria with the long CDD isoform, these mice models of cancer become _____ to therapy.
10) We took mice models of cancer, put bacteria inside of them, but we changed one very small piece in the DNA of these bacteria making CDD _____ into these CDD negative bacteria.

(Based on: Bacteria block cancer chemotherapy | Interviews | Naked Scientists (thenakedscientists.com).

SPEAKING

11. Share your view with the rest of the class on the following scientific fact.

Drying your hands with paper towel will reduce the bacterial count by 45 – 60% on your hands. However, using a hand dryer will increase the bacteria on your hands by up to 255% because it blows out bacteria already living in the, conveniently, warm moist environment. (Based on: 'Hygienic' hand dryer hypothesis blows hot air › Dr Karl's Great Moments In Science (ABC Science)

12. **Choose one of the topics to make a presentation on one of these topics (see useful language in Appendix C):**

a. The nature of bacteria.
b. Different types of bacteria.
c. Positive bacteria versus pathogens.

EXTRA IDEA. For thought

Two bacteria were left on kitchen counter after Sunday dinner. Using your knowledge, answer the question: how many bacteria do you have at the end of 4 hours?
It is known that the representative of cyanobacteria Chlorella vulgaris contains various biologically active substances and many macro and micro elements necessary for humans. However, it should not be used as a dietary supplement for humans. Why?

UNIT 9 PROTISTS

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- describe the structure of protists;
- know all about different types of protists.

PRE-READING

1. Study the essential vocabulary before reading the text.

accomplish (*v*)	[əˈkʌm.plɪʃ]	выполнять
anchor (*v*)	[ˈæŋkə]	якорь
armour (*n*)	[ˈɑːmə]	броня
blob (*n*)	[blɒb]	двоичный объект
decomposer (*n*)	[ˌdiːkəmˈpəʊzə(r)]	устройство для разложения
elaborate (*v*)	[ɪˈlæbərət]	разрабатывать
execute (*v*)	[ˈeksɪkjuːt]	выполнять
germination (*n*)	[dʒɜmɪˈneɪ.ʃən]	всхожесть
glide (*v*)	[glaɪd]	скользить
hydrogenosome (*n*)	[haɪdrəˈdʒənəsəm]	гидрогеносома
motile (*adj*)	[ˈməʊ.taɪl]	подвижный
osmotroph (*n*)	[ˈosmətrof]	осмотроф
pellicle (*n*)	[ˈpelɪkl]	кожица, пленка
phagotroph (*n*)	[ˈfagətrof]	фаготроф
predominately (*adv*)	[prɪˈdɒmɪnətli]	главным образом
silica (*n*)	[ˈsɪlɪkə]	кремнезем
slug (*n*)	[slʌg]	слизень
temporary (*adj*)	[ˈtemprəri]	временный
undergo (*v*)	[ˌʌndəˈgəʊ]	претерпевать
wholly (*adv*)	[ˈhəʊl-li]	полностью

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What do you know about protists?

2. Can you describe their cell structure?
3. How are they classified?

3.Read the given text and do your essential assignments.

PROTISTS

Protists are the oldest eukaryotic microorganisms, having a nucleus and other membrane-bound organelles. Since they do not wholly fit into other groups like plants, animals, bacteria, or fungi, they are categorized under a separate kingdom called Protista. The members of this diverse kingdom are primarily unicellular and less complex in structure than other eukaryotes.

In 1866, German scientist Ernst Haeckel introduced the term "Protista," meaning "primordial" or "first of all." He suggested placing Protista as a third taxonomic kingdom, with Plantae and Animalia consisting of all "primitive forms" of organisms, including bacteria.

However, the emergence of better genetic study has led to a clearer understanding of evolutionary relationships among different groups of protists, thus dismissing this classification system.

Cell Structure.

The protist cells are among the most elaborate and diverse of all cells. Most of them are microscopic and unicellular, but some true multicellular forms also exist.

As mentioned, protists are eukaryotes. So, they possess a characteristic central compartment called the nucleus, which encloses their genetic material, DNA. They also have several membrane-bound cellular organelles that execute defined functions within the cell, such as, mitochondria, ribosomes, Golgi apparatus, endoplasmic reticulum, and lysosomes. Some protists contain chloroplasts that serve as the site of photosynthesis.

Some protists, such as *Trichomonas vaginalis* living in anoxic conditions, use an extensively modified version of mitochondria, called hydrogenosome, for some of their energy production. Some protists even have an eyespot, an organelle that helps them to detect light, so they can move toward or away from light as desired.

All of their cellular components remain enveloped within a cell membrane or cell wall. In other protists, glassy silica-based shells or pellicles of interlocking protein strips also encase them. The pellicle acts as a flexible coat of armor, preventing the protist from external damage without compromising its range of motion.

Habitat.

Most protists exist in various aquatic environments, including freshwater, marine environments, damp soil, and even snow. Some get attached to rocks and

reside on the bottom. In contrast, others float on the water's surface, taking advantage of photosynthesis. In addition to aquatic protists, several protist species reside in host cells within plants and animals as parasites, thus infecting them. Other protists live on dead organisms or their wastes and contribute to their decay.

Metabolism: How Do They Obtain Energy.

Protists gain nutrition in different ways. They can be of two major types: photosynthetic or heterotrophs. The protists belonging to a group of photoautotrophs obtain energy by photosynthesis as they have chloroplasts. Other protists, called heterotrophs, consume organic materials to obtain nutrition.

These heterotrophs further fall into two groups: phagotrophs and osmotrophs. Phagotrophs surround and swallow food using their cell body, while osmotrophs absorb nutrients from the surrounding environment.

Though most protists predominately acquire nutrition by absorbing nutrients from their environment, some may exhibit photosynthetic and heterotrophic nutrient acquisition forms.

Locomotion.

The majority of protists are motile, but their modes of movement differ from each other. For instance,

1. Amoeba form temporary cytoplasmic extensions called pseudopodia anywhere on the cell. They anchor themselves to a surface with it and pull their body forward.

2. Paramecia are covered in rows of tiny cilia that they beat to swim through water.

3. Euglena have one or more flagella, which they rotate or whip to generate movement.

4. Some protists show taxis, i.e., move toward or away from a stimulus. For instance, protists accomplish phototaxis, the movement toward the light, by coupling their locomotion strategy with a light-sensing organ.

Types: How Are They Classified?

Protists are a diverse kingdom. The organisms in this group vary significantly in size, shape, mode of nutrition, and reproduction. They can be unicellular, multicellular, or colonial. All these are reasons why protists are difficult to classify.

For ease of study, the kingdom Protista is divided into three sub-categories according to similar behaviors: animal-like, plant-like, and slime mold. Let us explore these sub-categories below:

Animal-like Protists (Protozoa)

Animal-like protists or protozoa are heterotrophic and can move around in their environments to search for food. Out of them, some are herbivores, grazing on algae, while others are predators, preying upon other unicellular organisms. They can be decomposers and parasitic too, consuming dead organic matter and residing in or on living hosts respectively. (Based on: General Characteristics of Protista (sciencing.com); What is kingdom Protista? Characteristics and Importance - Read Biology)

AFTER READING

4. Answer the following questions.

1. Who first introduced the term 'Protista'?
2. Why are protist cells among the most elaborate and diverse of all cells?
3. How can you describe their cell structure?
4. What protists can live in anoxic conditions?
5. How do protists obtain energy?
6. How do they move?
7. What are the sub-categories of protists?
8. How are protists classified?
9. Why are protists difficult to classify?
10. What are the main features of animal-like protists?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. In 1966, German scientist Ernst Haeckel introduced the term 'Protista'.
2. All of them are multicellular.
3. Protists are eukaryotes.
4. Protists are easy to classify.
5. Protists may exhibit photosynthetic and heterotrophic nutrient acquisition forms.
6. They can be of three major types.
7. Protists accomplish phototaxis, the movement toward the light, by coupling their locomotion strategy with a light-sensing organ.
8. Animal-like protists or protozoa are photoautotrophic and can move around in their environments to search for food.

9. Some of them are herbivores, grazing on algae, while others are predators, preying upon other unicellular organisms.
8. They are not able to be decomposers and parasitic.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

aquatic environment, acquisition forms, Euglena, eyespot, interlock protein strips, light-sensing organ, light-sensing organ, Paramecia, to obtain nutrition, to pull a body forward, slime mold

7. Match the words with the definitions.

1	armour	A	a small creature with a soft body, that moves very slowly and eats garden plants
2	blob	B	the process of a seed starting to grow, or the act of causing a seed to start growing
3	bud	C	is a free-living, motile, single-cell (unicellular) organism belonging to the kingdom Protista
4	cellular organelles	D	are surrounded by a plasma membrane to keep their internal fluids separate from the cytoplasm of the rest of the cell
5	decomposer	E	a strong layer or shell that protects some plants and animals
6	flagella	F	a young tightly rolled-up flower or leaf before it opens
7	germination	G	include both membrane and non-membrane bound organelles, present within the cells and are distinct in their structures and functions
8	membrane-bound organelles	H	are primarily essential as an organelle of locomotion in different organisms besides helping in gathering food and circulation
9	paramecia	I	are responsible for the breaking down of the organic and nutrient matter of the dead
10	slug	J	a fat, round drop, usually of something sticky or thick

8. Find the equivalents for the following words in the text:
carry out; completely; decay; drop; hunt; pack; resist; scattered; shell; sprout.

9. Render the text by using the plan in Appendix C.

LISTENING

10. Listen to the recording. Try to understand the general idea and fill in the gaps.

Eukaryotes; to sustain the chemistry; functions; marine microbes; devastating effect; nutritional value; the impact; research effort; oil spill; to mitigate; is performed; translucent; degrade.

What have marine microbes ever done for us?

1) When you first look at seawater, it's this _____ liquid.
2) You talk about 10 million viruses and million bacteria or a thousand microbes and _____ that we call protists and that literally is one drop in the ocean.
3) They help us to digest food and we wouldn't really be able to get the same _____from food that we would without those gut microbes. Microbes in the ocean are sort of similar.
4) They're diverse, and they all have really important _____ that really help the ocean to work.
5) They're performing all of the chemical reactions that are needed _____ of the ocean and the chemistry of our atmospheres.
6) So basically, half of the global photosynthesis _____ by these phytoplankton.
7) But the other big function that _____ have is this base of the marine food chain.
8) Thinking about change and _____ that humans have on the marine environment, there's evidence that actually, microbes can respond to that and actually help _____ that we have.
9) All this oil was produced and had a _____ on the ecosystems in the area. But one of the really interesting things that happened was, immediately after the _____, microbes increased in abundance.
10) So, there's a huge _____ at the moment to try and see if any of these marine microbes are actually able to _____plastic.

(Based on: What have marine microbes ever done for us? | Interviews | Naked Scientists (thenakedscientists.com)

SPEAKING

11. Share your view with the rest of the class on the following scientific fact.

The ecological importance of protista.

Many people believe that the whole life cycle depends on a protist as these eukaryotes are an essential part of ecology. Many people speculate that if these protists disappear, the whole ecology would be disturbed. Let's see what the ecological importance of the kingdom Protista is.

Protists observe symbiosis. This means helping their host in exchange for their survival. For example, thick kelp protects otters from predators. In return, the otters eat sea urchins that otherwise feed on the kelp. Plant-like protist organisms are said to produce almost half of the Earth's oxygen through the process of photosynthesis. The nutrients that we need to live are recycled and decomposed by protists.

The oxygen that these species produce can be used as biofuel. Phytoplankton, a protist, is one of the only food sources for some whales. Protists that are autotrophs carry out the world's 40% photosynthesis, thus helping maintain the world's carbon levels. Mixotrophs are a very important part of the aquatic food cycle.

Bacteria and microbes are the food of many protists, and hence they help control the population of these harmful bacteria and microbes.

(Based on: Kingdom Protista Facts: Are These Really The Oldest Known Organisms? | Kidadl).

12. Choose one of the topics to make a presentation on one of these topics (see useful language in Appendix C):

1. The role of protists in our life.
2. Discovery of protists.
3. Classification of protists.

Unit 10. FISH

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- describe the main types of fish;
- distinguish the main features of fish.

PRE-READING

1. Study the essential vocabulary before reading the text.

abundant *(adj)*	[əˈbʌndənt]	распространенный
acclimate *(v)*	['æklɪmeɪt]	привыкать к новой среде, климату
agnatha *(n)*	['ægneiθə]	бесчелюстные
alter *(v)*	[ˈɔːltər]	изменяться
bladder *(n)*	[ˈblædər]	мочевой пузырь
camouflage (*n)*	[ˈkæməflɑːʒ]	маскировка
captivity (*n)*	[kæpˈtɪvəti]	плен, нахождение в неволе
cartilage *(n)*	[ˈkɑːtɪlɪdʒ]	хрящ
chondrichthyes (*n*)	['kɔndriθiz]	хрящевые (класс рыб)
coldblooded *(adj)*	[ˌkəʊldˈblʌdɪd]	холоднокровный
cord (*n)*	[kɔːd]	мозг
correlate *(v)*	[ˈkɒrəleɪt]	находиться в соотношении
curb *(v)*	[kɜːb]	контролировать; сократить
distinct (*adj)*	[dɪˈstɪŋkt]	различный, разный, отчетливый
dorsal *(adj)*	['dɔːs(ə)l]	спинной
enhancement (*n)*	[ɪn'hɑːnsmənt]	улучшение, усиление
extant *(adj)*	[ekˈstænt]	сохранившийся до настоящего времени, дошедший до нас
feature (*n)*	['fiːʧə]	черта; характеристика; свойство
fertilize *(v)*	['fɜːtɪlaɪz]	оплодотворить
flounder (*n)*	['flaundə]	камбала
gill (*n)*	[gɪl]	жабры
girdle (*n)*	[gɜːdl]	пояс; кольцо
habitat (*n)*	['hæbɪtæt]	среда обитания
hagfish (*n)*	['hægfɪʃ]	миксиновые

to hatch *(v)*	[hætʃ]	высиживать
hollow *(adj)*	[ˈhɒl.əʊ]	пустой; полый
lamprey (*n*)	[ˈlæm.pri]	миноговые
larvae *(n)*	['lɔ:vi:]	зародыш; личинка
lateral *(adj)*	[ˈlæt.ər.əl]	боковой
marlin (*n*)	['mɑ:lin]	марлиновые (парусниковые)
notochord (*n)*	['nəutəkɔ:d]	спинная струна
moderate *(adj)*	[ˈmɒd.ər.ət]	небольшой; умеренный
nocturnal *(adj)*	[nɒkˈtɜː.nəl]	ведущий ночной образ жизни
operculum (*n)*	[ɔ'pɜ:kjuləm]	жаберная крышка
overlap (*v)*	['əuvə'læp]	перекрывать; заходить один на другой
pouch (n)	[paʊtʃ]	сумка; защечный мешок
puffer (n)	['pʌfə]	фугу (иглобрюхие)
range (from) *(v)*	[reɪndʒ]	изменяться в определённых пределах
jawless *(adj)*	[ˈdʒɔ:ləs]	бесчелюстный
ray (*n)*	[reɪ]	скат
reduce *(v)*	[rɪˈdʒu:s]	понижать; уменьшать
rod (*n)*	[rɒd]	ствол; стержень
scale (*n)*	[skeɪl]	чешуя
scatter *(v)*	[ˈskæt.ər]	разбросать; рассыпать
seahorse (*n)*	['si:hɔ:s]	морской конек
share *(v)*	[ʃeər]	иметь что-то общее
shark (n)	[ʃɑ:k]	акула
skate (n)	[skeɪt]	скат
slit (n)	[slɪt]	отверстие, щель
sole (n)	[səul]	морской язык
sunfish (n)	['sʌn'fɪʃ]	солнечная рыба
stimulus (n)	['stɪmjuləs]	раздражитель
tail (n)	[teɪl]	хвост

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. Which came first, cartilaginous or bony fish?
2. What is the oldest fish in the world?
3. What's the most common deep-water fish in the ocean?

3. Read the text and do your essential assignments.

Fish

Fish (*Pisces*)**,** any of approximately 34,000 species of vertebrate animals found in the fresh and salt waters of the world. Living species range from the primitive jawless lampreys and hagfishes through the cartilaginous sharks, skates, and rays to the abundant and diverse bony fishes. Most fish species are coldblooded; however, one species, the opah (*Lampris guttatus*), is warm-blooded.

Fish share certain features with other vertebrates. These features are gill slits at some point in the life cycle, a notochord, or skeletal supporting rod, a dorsal hollow nerve cord, and a tail.

Living fishes represent some five classes, which are as distinct from one another as are the four classes of familiar airbreathing animals – amphibians, reptiles, birds, and mammals.

For example, the jawless fishes (*Agnatha*) have gills in pouches and lack limb girdles. Extant agnathans are the lampreys (*Petromyzontidae*) and the hagfishes (*Myxini*).

The skeletons of fishes of the class *Chondrichthyes* (sharks, skates, and rays) are made entirely of cartilage. Modern fish of this class lack a swim bladder, and their scales and teeth are made up of the same placoid material.

The bony fishes (*Osteichthyes*) are by far the largest class (the seahorse, blue marlin, soles and flounders, puffers and ocean sunfishes). Unlike the scales of the cartilaginous fishes, those of bony fishes, when present, grow throughout life and are made up of thin overlapping plates of bone. Bony fishes also have an operculum that covers the gill slits.

Fishes are of interest to humans for many reasons, the most important being their relationship with and dependence on the environment. A more obvious reason for interest in fishes is their role as a moderate but important part of the world's food supply. This resource is now realized to be finite and in delicate balance with the biological, chemical, and physical factors of the aquatic environment.

Another practical reason for studying fishes is their use in disease control. As predators on mosquito larvae, they help curb malaria and other mosquito-borne diseases.

Fishes are valuable laboratory animals in many aspects of medical and biological research. For example, the readiness of many fishes to acclimate to captivity has allowed biologists to study behaviour, physiology, and even ecology under relatively natural conditions.

Research on fishes has provided a broad base for the understanding of the more flexible behaviour of the higher vertebrates. The zebra fish is used as a model in studies of gene expression.

Many fishes are able to alter their coloration – some for the purpose of camouflage, others for the enhancement of behavioral signals.

Almost all natural bodies of water bear fish life, the exceptions being very hot thermal ponds and extremely salt-alkaline lakes. Major habitat differences are marine and freshwater.

Correlated with their adaptation to an extremely wide variety of habitats is the extremely wide variety of life cycles that fishes display. The great majority hatch from relatively small eggs a few days to several weeks or more after the eggs are scattered in the water. Larval life is often very short, usually less than a few weeks, but it can be very long. The methods of reproduction in fishes are varied, but most fishes lay a large number of small eggs, fertilized and scattered outside of the body.

Fishes perceive the world around them by the usual senses of sight, smell, hearing, touch, and taste and by special lateral line water-current detectors. One or another of these senses often is emphasized at the expense of others, depending upon the fish's other adaptations. In fishes with large eyes, the sense of smell may be reduced; others, with small eyes, hunt and feed primarily by smell (such as some eels).

Communication is often chemical, signals being sent by specific chemicals called pheromones. Many fishes communicate with each other by producing sounds in their swim bladders, in their throats by rasping their teeth, and in other ways. The mode of communication may be visual, as between the small so-called cleaner fish and a large fish of a very different species.

The skin of a fish must serve many functions. It aids in maintaining the osmotic balance, provides physical protection for the body, serves as protection through the control of coloration, contains sensory receptors, and, in some fishes, functions in respiration.

An important sensory system in fishes that is absent in other vertebrates (except some amphibians) is the lateral line system. It allows a fish to sense changes in water currents and pressure, thereby helping the fish to orient itself to the various changes that occur in the physical environment.

There remains much to learn about both living and fossil fishes. The geographical distribution given for a poorly known fossil group usually represents only the location of fossil finds, not necessarily the true distribution of the group.

(Based on: https://www.britannica.com/animal/fish)

AFTER READING

1. Answer the following questions.

1. What features do fish share with other vertebrates?
2. What distinct features do three classes of living fish have?
3. What are the reasons for interest in fishes?
4. What are the essential fish habitats?
5. What is the difference between jawless and jawed fish?
6. What are the distinguishing features of sharks and rays compared to other modern fishes?
7. What is the peculiarity of fish's senses?
8. How do fish communicate?
9. What are the functions of the fish skin?
10. What is the function of the lateral line system in fish that is absent in other vertebrates?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Most fish species are warm blooded.
2. Overfishing, pollution, and alteration of the environment are the chief enemies of proper fisheries management, both in fresh waters and in the ocean.
3. Fish have been especially important in the study of animal behaviour.
4. Sharks, skates, and rays are examples of the bony fish.
5. The seahorse, blue marlin, soles and flounders, puffers and ocean sunfishes are examples of cartilaginous fish.
6. The study of fish is valuable for the research of the behaviour of the higher vertebrates.
7. Fishes range in adult length from less than 10 mm (0.4 inch) to more than 20 metres (60 feet) and in weight from about 1.5 grams (less than 0.06 ounce) to many thousands of kilograms.
8. Major habitat differences are marine and freshwater.
9. Fish communicate by gesture and mouth.
10. There is still the necessity of studying both living and fossil fishes.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

jawless fishes, cartilaginous fishes, bony fishes, gill, larval life, to acclimate to captivity, swim bladder, lateral line system, aquatic environment, to curb malaria.

7. Match the words with the definitions.

1	larvae	A	occurring at night
2	abundant	B	having no jaws or lacking a jaw
3	acclimate	C	to extend or lie partly over (each other)
4	extant	D	the state of being kept imprisoned or enclosed.
5	bony	E	having a skeleton made up mainly of cartilage, as any of a class (Chondrichthyes) of fishes, including sharks, rays, and skates
6	overlap	F	an immature free-living form of many animals that develops into a different adult form by metamorphosis
7	nocturnal	G	still in existence; surviving.
8	cartilaginous	H	something that is present in large quantities
9	captivity	I	having a skeleton of bone rather than cartilage
10	jawless	J	to become used to a new climate

8. Find the equivalents for the following words in the text.

to fluctuate, plentiful, stimulant, to have something in common, to separate and move in different directions, to make something smaller in size or amount, or less in degree, different, sea, hue, to correspond to.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	unearth	A	skillful or effective
2	incipient	B	thin horny or bony plates protecting the skin of fish and reptiles, typically overlapping one another
3	nifty	C	(of something old) having remained in good condition
4	specimen	D	a visible impression on a surface, such as a spot or scratch

5	scales	E	to discover facts or evidence with difficulty
6	well-preserved	F	resembling or characteristic of a digit (body part)
7	mark	G	a living creature; an animal
8.	fin	H	a single plant or animal which is an example of a particular species or type and is examined by scientists
9	digitlike	I	a thin vertical part sticking out of the body of especially a fish or an aircraft that helps balance and movement
10	critters	J	starting to happen or develop; imperfectly formed

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Evolved, unearthed, incipient, limb, nifty, tetrapods, specimen, missed, scales, well-preserved, fishy, pull up, fingers, fossilized, grab, distinct, marks, digitlike, critters.

Fingers are pretty 1. ___. They let you to 2. __ a latte, type on a keyboard, even 3. ___ your pants. But did you ever wonder: where do fingers come from? In the 1990s, scientists gave this problem a lot of thought. And they concluded that fingers were pretty much invented by the first 4. ___: that is, 5. ___ with four 6. ___. One reason they thought that is because a 7. ___ skeleton of an ancient fish didn't appear to have any 8. ___. Or at least any 9. ___ digits in its pectoral 10. __. But tetrapods, which 11. ___ from fish, did.

Now scientists writing in the September 21st online issue of *Nature* say that that thinking was…a little 12. ___. Because they've 13. ___ evidence that suggests that that ancient fish did indeed have fingers in its fins. The researchers did a CT scan on a 14. ___ about 380 million years old. And they found that the fish's right fin, which was unusually 15. __, does appear to have 16. ___ bones. The reason other researchers previously 17. ___ them, they think, is because in their samples the fingers were hidden behind 18. ___ left by the fish's 19. ___. So, fish, too, seem to have 20. ___ fingers. A finding we give two thumbs up.

(Based on:
https://www.scientificamerican.com/podcast/podcast.mp3?fileId=7B2127B0-7FE4-4931-9C93943A9C6C69C7)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

Specialized behaviour is primarily concerned with the three most important activities in the fish's life: feeding, reproduction, and escape from enemies. Schooling behaviour

of sardines on the high seas, for instance, is largely a protective device to avoid enemies, but it is also associated with and modified by their breeding and feeding requirements.
(Based on: https://www.britannica.com/animal/fish/Behaviour)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. Evolution of fish.
2. Jawless Fish. Hagfish. Lamprey (general characteristics, habitats).
3. Cartilaginous Fish (general characteristics, habitats).
4. Bony Fish (general characteristics, habitats).
5. Marine fish and freshwater fish (differences).

Unit 11. AMPHIBIANS

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- discuss the differences between amphibians and reptiles;
- compare the life cycle of amphibians and other vertebrates.

PRE-READING

1. Study the essential vocabulary before reading the text.

aquatic (*adj*)	[ə'kwætɪk]	водный
ancestor (*n*)	['ænsəstə]	предок
biphasic (adj)	[bai'feizik]	двухфазный
breeder (*n*)	['bri:də]	производитель
burrow (*v*)	['bʌrəu]	рыть нору
caecilian (*n*)	[siːˈsɪlɪən]	безногое земноводное
cutaneous (*adj*)	[kju:'teɪnɪəs]	кожный
derive (from) (*v*)	[dɪ'raɪv]	происходить; наследовать
discriminate (*v*)	[dɪs'krɪmɪneɪt]	различать; отличать
diverge (*v*)	[daɪ'vɜ:ʤ]	расходиться; приобретать отличие
dweller (*n*)	['dwelə]	обитатель
earthworm (n)	['ɜ:θwɜ:m]	дождевой червь; земляной червь;
embed (*v*)	[ɪm'bed]	закладывать
exploit (*v*)	['ekspləɪt]	использовать; эксплуатировать
extinct (*adj*)	[ɪk'stɪŋkt]	вымерший; исчезнувший
frog (*n*)	[frɔg]	лягушка
habitat (*n*)	['hæbɪtæt]	среда обитания
hatch (*v*)	[hæʧ]	вылупливаться (из яйца);
hind (*adj*)	[haɪnd]	задний
hue (*n*)	[hju:]	цвет; оттенок; тон;
larva (*n*)	['lɑ:və]	личинка, зародыш
leap (*v*)	[li:p]	скакать; припрыгнуть
Lissamphibian (*n*)	[liˌsæm'fɪbɪən]	беспанцирные
mode (*n*)	[məud]	образ; режим
moist (*adj*)	[mɔɪst]	мокрый; влажный
newt (*n*)	[nju:t]	тритон

obligate (*adj*)	[ˈɒblɪgeɪt]	необходимый; существенный
order (*n*)	['ɔ:də]	отряд
oviduct (*n*)	['əuvɪdʌkt]	маточная труба (фаллопиева)
pedicellate (*adj*)	['pedɪ'selɪt]	расположенный на ножке
predator (*n*)	['predətə]	хищник
retina (*n*)	['retɪnə]	сетчатая оболочка (глаза)
rod *(n)*	[rɔd]	палочка (сетчатой оболочки глаза)
stock (*n*)	[stɔk]	племя
subclass (*n*)	['sʌbklɑ:s]	подкласс
squat (*v*)	[skwɔt]	приседать
tadpole (*adj*)	['tædpəul]	головастик (личинка бесхвостых земноводных)
taxon (*n*)	['tæksɔn]	таксон (систематическая группа любой категории)
terrestrial (*adj*)	[tə'restrɪəl]	земной; наземный
tetrapod (*n*)	['tetrəpɔd]	четвероногое животное
toad (*n*)	[təud]	жаба
trait (*n*)	[treɪ(t)]	характерная черта; особенность; свойство;
vary (*v*)	['ve(ə)rɪ]	варьироваться; меняться
vertebrate (*n*)	['vɜ:tɪbrət]	позвоночное (животное)

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What's the difference between amphibians and reptiles?
2. What does the expression “raining frogs” mean? Why can it rain frogs?
3. What do frogs and toads do when the environmental temperature approaches freezing?

3. Read the text and do your essential assignments.

Amphibians

Amphibian (class Amphibia), any member of the group of vertebrate animals characterized by their ability to exploit both aquatic and terrestrial habitats. The name amphibian, derived from the Greek *amphibios* meaning “living a double life,” reflects this dual life strategy – though some species are permanent land dwellers, while other

species have a completely aquatic mode of existence. Approximately 8,100 species of living amphibians are known. First appearing about 340 million years ago during the Middle Mississippian Epoch, they were one of the earliest groups to diverge from ancestral fish-tetrapod stock during the evolution of animals from strictly aquatic forms to terrestrial types.

Today amphibians are represented by frogs and toads (order Anura), newts and salamanders (order Caudata), and caecilians (order Gymnophiona). These three orders of living amphibians are thought to derive from a single radiation of ancient amphibians, and although strikingly different in body form, they are probably the closest relatives to one another. As a group, the three orders make up subclass Lissamphibia. Neither the lissamphibians nor any of the extinct groups of amphibians were the ancestors of the group of tetrapods that gave rise to reptiles.

Though some aspects of the biology and anatomy of the various amphibian groups might demonstrate features possessed by reptilian ancestors, amphibians are not the intermediate step in the evolution of reptiles from fishes. Modern amphibians are united by several unique traits. They typically have a moist skin and rely heavily on cutaneous (skin-surface) respiration. They possess a double-channeled hearing system, green rods in their retinas to discriminate hues, and pedicellate (two-part) teeth. Some of these traits may have also existed in extinct groups.

Members of the three extant orders differ markedly in their structural appearance. Frogs and toads are tailless and somewhat squat with long, powerful hind limbs modified for leaping. In contrast, caecilians are limbless, wormlike, and highly adapted for a burrowing existence. Salamanders and newts have tails and two pairs of limbs of roughly the same size; however, they are somewhat less specialized in body form than the other two orders.

One similar tendency among amphibians has been the evolution of direct development, in which the aquatic egg and free swimming larval stages are eliminated. Development occurs fully within the egg capsule, and juveniles hatch as miniatures of the adult body form. Many amphibians are obligate breeders in standing water. Eggs are laid in water, and the developing larvae are essentially free-living embryos; they must find their own food, escape predators, and perform other life functions while they continue to develop. As the larvae complete their embryonic development, they adopt an adult body plan that allows them to leave aquatic habitats for terrestrial ones.

Some taxa have aquatic eggs and larvae, whereas others embed their eggs in the skin on the back of the female; these eggs hatch as tadpoles or miniature frogs. In other groups, the young develop within the oviduct, with the embryos feeding on the wall of the oviduct. In some species, eggs develop within the female’s stomach.

The three living orders of amphibians vary greatly in size and structure.

Heterochrony, the change in the timing and rate of developmental events, is a widespread feature in amphibian evolution, particularly in salamanders. It also explains the presence of larval traits in adults of the salamander families Cryptobranchidae (hellbenders) and Proteidae (olms and mud puppies). Heterochrony is not confined to salamanders.

Many amphibians have a biphasic life cycle involving aquatic eggs and larvae that metamorphose into terrestrial or semiaquatic juveniles and adults. Egg size and water temperature are important factors that influence an embryo's development time.

Adult amphibians consume a wide variety of foods. Earthworms are the main diet of burrowing caecilians, whereas anurans and salamanders feed primarily on insects and other arthropods. Large salamanders and some large anurans eat small vertebrates, including birds and mammals. Most anurans and salamanders locate prey by sight, although some use their sense of smell. The majority of salamanders and diurnal (that is, active during daylight) terrestrial anurans are active foragers, but many other anurans employ a sit-and wait technique.

Amphibians occur widely throughout the world, even edging north of the Arctic circle in Eurasia; they are absent only in Antarctica, most remote oceanic islands, and extremely xeric (dry) deserts.

Amphibians, especially anurans, are economically useful in reducing the number of insects that destroy crops or transmit diseases. Frogs are exploited as food, both for local consumption and commercially for export.

(Based on: https://www.britannica.com/animal/amphibian)

AFTER READING

4. Answer the following questions.

1. When did the fish-tetrapod transition take place?
2. What were the ancestors of three orders of living amphibians?
3. What kind of unique traits do amphibians have?
4. How do the three modern orders of amphibians differ from one another?
5. What is the direct development in amphibians characterized by?
6. What is a widespread feature in amphibian evolution?
7. What is a life cycle of amphibians?
8. What kind of food do amphibians consume?
9. What is the difference between the life cycle of amphibians and the life cycles of other vertebrates?
10. What is the economic importance of amphibians?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Amphibians are vertebrate tetrapods.
2. Amphibians exploit both aquatic and terrestrial habitats.
3. Both the lissamphibians and some of the extinct groups of amphibians were the ancestors of the group of tetrapods that gave rise to reptiles.
4. Amphibians are the intermediate step in the evolution of reptiles from fishes.
5. Frogs and toads have tails.
6. Salamanders and newts have tails and two pairs of limbs of roughly the same size.
7. Amphibians are absent in the extremely xeric (dry) deserts and the most remote oceanic islands.
8. Egg size and water temperature influence the development time of amphibians' embryo.
9. Heterochrony is confined to salamanders.
10. Most species of lungless salamanders (family Plethodontidae), the largest salamander family, some caecilians, and many species of anurans have direct development.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

Reptilian ancestors, make up subclass, aquatic mode of existence, to embed smb's eggs, cutaneous respiration, aquatic and terrestrial habitats, ancestral, free-living embryos, powerful hind limbs, Caecilians.

7. Match the words with the definitions.

1	exploit	A	any genetically controlled difference in the timing, rate, or duration of a developmental process in an organism compared to its ancestors or other organisms
2	diverge	B	any tropical limbless cylindrical amphibian of the order Apoda (or Gymnophiona), resembling earthworms and inhabiting moist soil
3	tetrapod	C	relating to, or affecting the skin
4	limb	D	to come from
5	eliminate	E	the natural home or environment of an animal, plant, or other organism
6	derive from	F	to make full use of and derive benefit from (a resource)

7	cutaneous	G	an arm or leg of a person or four-legged animal, or a bird's wing
8	habitat	H	to completely remove or get rid of (something)
9	heterochrony	I	any vertebrate that has four limbs
10	caecilian	J	to separate from another route and go in a different direction

8. Find the equivalents for the following words in the text.

Inhabitant, watery, breed, to install, to bounce, humid, rear, two-stage,
to crouch, (of parts) to compose or constitute a whole

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	trap	A	a very small fish found in lakes and rivers
2	lure	B	the act of catching or the state of being caught
3	track	C	any similar flap, such as a piece of paper attached to a file for identification
4	rate	D	(of pools) seasonal, providing habitat for distinctive plants and animals
5	minnow	E	a piece of wood shaped for a special purpose
6	capture	F	a device or enclosure designed to catch and retain animals
7	vernal	G	marked or decorated with spots
8	tab	H	to persuade someone to do something or go somewhere by offering them something exciting
9	spotted	I	the speed of progress or change
10	stick	J	to follow the trail of (a person or animal)

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Tabs, minnow, trapped, wood, captures, salamanders, track, sensitive, critters, spotted, productive, rates, red-spotted, amphibians, sticks, vernal, tracked, newt, traps, lured.

Populations of frogs, salamanders and other 1. ___ are declining around the world – even in protected areas, like U.S. national parks. Ecologists needed a simple method to 2. ___ the animals' numbers. Now, researchers have found an effective way to keep

3.___ on amphibians – using that concert and party favorite: glow 4. ___. Green glow sticks, to be specific.

“What we do know is that their eyes are particularly 5. ___ to green light.”

David Munoz, a PhD candidate in the ecology program at Penn State University.

To test the idea, Munoz and colleagues set up 6. ___ traps with and without glow sticks at a dozen 7. ___ pools in Centre County, Pennsylvania. The 8. ___ gather at the pools to breed.

For a month, they 9. ___ and 10.___ numbers of the Jefferson salamander, the 11. ___ salamander, the 12.___ frog and the eastern red-spotted 13. ___. “Right before we left for the day, around 4 p.m., we’d activate the glow stick and hang it on the little minnow trap, come back the next day to see what we got.”

Traps with glow sticks were vastly more 14. __. “We were really surprised by how strong of an effect our glow sticks had on our 15.___. So, by just putting a glow stick in one of these minnow 16. ___ we increased the capture 17. ___ for our spotted 18.___ and our Jefferson salamanders between on average two to four times.” And for the eastern 19. ____ newt, the glow stick traps 20. ___ six times as many.

(Based on:
https://www.scientificamerican.com/podcast/podcast.mp3?fileId=12B2BCA9-6F53-455B-A7A11EE02D5504B1)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

Habitat destruction has had a severe impact on the distribution and abundance of numerous amphibian species.

(Based on: https://amphibiaweb.org/declines/habitat.html)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. The evolution of amphibians.
2. Different structural forms of the three living orders.
3. Amphibians’ various combinations of branchial and pulmonary strategies to breathe.
4. The morphology of salamanders, caecilians and anurans.
5. The different sized eardrums in the American bullfrog (Lithobates catesbeianus) as the examples of hypermorphism in male bullfrogs.

Unit 12. REPTILES

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- describe the general features of reptiles;
- discuss the evolutionary history of various groups of reptiles.

PRE-READING

1. Study the essential vocabulary before reading the text.

account (for) (*v*)	[ə'kaunt]	составлять
altitude (*n*)	['æltɪtju:d]	возвышенность; высота над уровнем моря
amniotic *(adj)*	['æmnɪ'ɔtɪk]	амниотический; околоплодный
armoured *(adj)*	['ɑ:məd]	защитный
diversity *(n)*	[daɪ'vɜ:sɪtɪ]	разнообразие; многообразие
ectothermic *(adj)*	[ɛktəʊˈθɜːmɪk]	холоднокровный
elevate *(v)*	['elɪveɪt]	поднимать; повышать
elevation *(n)*	['elɪ'veɪʃ(ə)n]	высота над уровнем моря
endothermic *(adj)*	['endə(u)'θɜ:mɪk]	теплокровный
external *(adj)*	[ɪk'stɜ:n(ə)l]	внешний
evolve *(v)*	[ɪ'vɔlv]	развивать; вырабатывать
fertilization *(n)*	['fɜ:tɪlaɪ'zeɪʃ(ə)n]	оплодотворение
flexibility *(n)*	['fleksə'bɪlɪtɪ]	подвижность; маневренность
internal *(adj)*	[ɪn'tɜ:nl]	внутренний
latitude *(n)*	['lætɪtju:d]	широта
lizard *(n)*	['lɪzəd]	ящерица; большая рептилия
maintenance *(n)*	['meɪnt(ə)nəns]	поддержание
misleading *(adj)*	[mɪs'li:d]	вводящий в заблуждение; обманчивый
reptile (*n*)	['reptaɪl]	рептилия; пресмыкающееся
secrete *(v)*	[sɪ'kri:t]	выделять
shelled *(adj)*	[ʃeld]	в оболочке; в скорлупе
snake *(n)*	[sneɪk]	змея
tuatara *(n)*	['tu:ə'tɑ:rə]	гаттерия; туатара
turtle *(n)*	['tɜ:tl]	черепаха

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. Why are reptiles the oldest animals on Earth?
2. Can reptiles live on every continent?
3. Why do chameleons change their color?

3. Read the text and do your essential assignments.

Reptiles

Reptile, any member of the class Reptilia, the group of air-breathing vertebrates that have internal fertilization, amniotic development, and epidermal scales covering part or all of their body. The major groups of living reptiles – the turtles, tuatara, lizards and snakes, and crocodiles – account for over 8,700 species.

The majority of modern reptiles possess an ectothermic (cold-blooded) physiology. They have no internal mechanism for the production of heat and maintenance of an elevated body temperature; they are dependent upon heat from their surroundings.

Most reptiles have a continuous external covering of epidermal scales.

Reptile scales contain a unique type of keratin called beta keratin; the scales and interscalar skin also contain alpha keratin, which is a trait shared with other vertebrates.

Asexual reproduction by parthenogenesis also occurs in some groups. Development may be internal, with embryos retained in the female's oviducts, and embryos of some species may be attached to the mother by a placenta. However, development in most species is external, with embryos enclosed in shelled eggs.

Reptiles have a significant economic value for food and ecological services (such as insect control) at the local level, and they are valued nationally and internationally for food, medicinal products, leather goods, and the pet trade.

Some reptile groups, such as most lizards and all crocodiles, possess strongly developed limbs, whereas other groups, such as the worm lizards and snakes, are limbless. Reptilian body flexibility ranges from the highly flexible forms found in snakes to the inflexible armoured bodies of turtles.

Reptiles are mainly animals of Earth's temperate and tropical regions, and the greatest number of reptilian species live between 30° N and 30° S latitude.

Other species of snakes, lizards, and turtles also live at high latitudes and altitudes and have evolved lifestyles that allow them to survive and reproduce with

little more than three months of activity each year. Reptile activity is strongly dependent on the temperature of the surrounding environment. Reptiles are ectothermic – that is, they require an external heat source to elevate their body temperature. They are also considered cold-blooded animals, although this label can be misleading, as the blood of many desert reptiles is often relatively warm. Reptiles occur in most habitats, from the open sea to the middle elevations in mountainous habitats.

The evolution of amniotic development and the shelled egg enabled vertebrates to become fully terrestrial. These two evolutionary advances required the previous development of internal fertilization.

Avoidance, the most common form of defense in the animal kingdom, is also the most common form of defense in reptiles. The display of bright colours is often defensive. **S**ome reptiles use musk-secreting glands when other defensive measures fail.

With few exceptions, modern reptiles feed on some form of animal life (such as insects, mollusks, birds, frogs, mammals, fishes, or even other reptiles). Land tortoises are vegetarians, eating leaves, grass, and even cactus in some cases.

The skeletons of reptiles fit the general pattern of vertebrates. They have a bony skull, a long vertebral column that encloses the spinal nerve cord, ribs that form a protective bony basket around the viscera, and a framework of limbs.

Modern reptiles do not have the capacity for the rapid sustained activity found in birds and mammals. It is generally accepted that this lower capacity is related to differences in the circulatory and respiratory systems.

Today’s reptiles represent only a fraction of the reptile groups and species that have lived; thus, reptilian classification depends upon fossil remains. As such, the higher levels of reptilian classification rely heavily on skeletal characters. Reptiles (class Reptilia) and mammals (class Mammalia) are the two surviving branches of the Amniota, which is a group characterized by the presence of amniotic membranes.

The regular discovery of new fossil reptiles (as well as the discovery of more complete specimens of known types), the introduction of new tools (such as X-ray computed tomography scanning and DNA sequencing), and new data analysis techniques all provide fresh insights into the evolutionary history of various groups of reptiles. Often, the newly proposed phylogeny differs from the previous one and entails changes in classification.

(Based on: https://www.britannica.com/animal/reptile)

AFTER READING

4. Answer the following questions.

1. What trait do reptiles share with other vertebrates?
2. How do they differ from birds and mammals?
3. What are the general features of reptiles?
4. What is the main component of reptilian scale?
5. Do all reptiles have asexual reproduction?
6. Why are reptiles economically valued?
7. What is the life cycle of reptiles?
8. What kind of defensive behaviour do they show?
9. What are the feeding habits of reptiles?
10. What factors explain the evolutionary history of various groups of reptiles?
11. What does reptilian classification depend upon?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. The majority of reptiles are homothermic or warm-blooded.
2. Reptiles always reproduce sexually with internal fertilization.
3. Keratin is the main component of reptilian scales.
4. Turtles, lizards, snakes, crocodile are harvested as food for local consumption in many tropical areas.
5. Reptiles are mainly animals of subtropical regions.
6. The body size of living reptiles varies widely.
7. Many lizards control insect pests in homes and gardens.
8. Modern reptiles have the capacity for the rapid sustained activity found in birds and mammals.
9. Most reptiles are measured from snout to vent.
10. Reptilian classification depends upon fossil remains.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

amniotic membranes, epidermal scale, asexual reproduction, strongly developed limbs, worm lizard, surrounding environment, shelled egg, to become fully terrestrial, internal fertilization, musk-secreting glands

7. Match the words with the definitions.

1	ectothermic	A	(of a cell, gland, or organ) to produce and discharge (a substance)
2	terrestrial	B	small, thin horny or bony plates protecting the skin of fish and reptiles, typically overlapping one another
3	evolve	C	(of an animal) dependent on or capable of the internal generation of heat
4	elevate	D	(of some animals and plants) having a protective layer or shell
5	secrete	E	an animal that lives on land or on the ground rather than in the sea, in trees, or in the air
6	endothermic	F	related to the bag and liquid that surround the embryo of a mammal, bird, or reptile inside its mother
7	amniotic	G	to develop gradually
8	keratin	H	to raise to a more important or impressive level
9	scales	I	(of an animal) having a body temperature that depends on external sources, such as sunlight or a heated rock surface
10	armoured	J	a fibrous protein that occurs in the outer layer of the skin and in hair, nails, feathers, hooves, etc.

8. Find the equivalents for the following words in the text.

Intramural, to fend, to comprise, altitude, leg or arm, cold-blooded, mild, to excrete, warm-blooded, conservation.

9. **Render the text using the plan in Appendix C.**

LISTENING

10. Check your understanding: match the definition with the correct word.

1	culprit	A	to cause something to start
2	puny	B	a situation in which something no longer exists
3	impact	C	to be hurt, killed, damaged, or destroyed by
4	fall victim	D	to separate something from other things with which it is connected or mixed
5	rainforest	E	a sudden increase in something, especially for a short period
6	fall apart	F	weak; not physically strong
7	burst	G	to break into pieces; to disintegrate
8	isolate	H	a forest with a lot of tall trees where it rains a lot
9	extinction	I	the effect that a person, event, or situation has on someone or

			something
10	trigger	J	the cause of a problem or defect

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Mammals, drier, explosion, puny, evolve, culprit, expansive, dominated, impact, extinction, warming, rainforests, diversity, victim, triggered, equator, increase, reptile, isolated, burst.

The November 26th issue of the journal *Science* included a study showing that the 1) ____ of the dinosaurs some 65 million years ago allowed 2) ___ mammals to get really big. But well before all that happened, another event 3) ____ a different 4) ___ of evolutionary activity.

A new study finds that about 300 million years ago, the tropical 5) __ along the equator fell apart. The familiar 6) ___ – global warming.

Present-day Europe and North America were on the 7) ___ back then, and were covered with rainforests. But global 8) ___ made things even hotter and 9) ___.

The 10) ___ rainforests broke up into smaller fragments, and 11) ___ populations became 12) ____ from each other in the fragments. Such geographical isolation allows different populations to 13) ___ in different directions, which led to a great 14) ___ in reptile 15) ____. The research appears in the journal *Geology*.

The 16) ____ in reptiles ultimately led to the evolution of the dinosaurs, which 17) ___ the planet until they fell 18) ___ to the massive 19) ____ that allowed us 20) ____ to take over. As Vonnegut would say, so it goes.

(Based on: https://www.scientificamerican.com/podcast/podcast.mp3?fileId=56F8ED8E-59D1-4707-AA345174E9746192)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

Birds (class Aves) share a common ancestor with crocodiles in subclass Archosauria and are technically one lineage of reptiles, but they are treated separately.

(Based on: https://www.britannica.com/animal/reptile)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. North temperate zone reptiles.
2. Central and South America reptiles.
3. Reptiles of Asia.
4. Reptiles of Australia.
5. Reptiles of Africa.

Unit 13. BIRDS

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- classify the maim species of birds;
- discuss the main characteristics that set birds apart from other modern vertebrates.

PRE-READING

1. Study the essential vocabulary before reading the text.

auk (*n*)	[ɔ:k]	гагарка (птица)
to alternate (*v*)	[ɔ:lˈtɜ:nɪt]	чередовать; сменять
to attract (*v*)	[ə'trækt]	притягивать; привлечь
beak (*n*)	[bi:k]	клюв
breeding (*n*)	['bri:dɪŋ]	размножение
brood (*n*)	[bru:d]	выводок (птиц)
bud (*n*)	[bʌd]	почка
clavicle (*n*)	['klævik(ə)l]	ключица
convergent (*adj*)	[kən'vɜ:ʤ(ə)nt]	конвергентный; сходящийся в одной точке
coot (*n*)	[ku:t]	лысуха (птица)
decaying (*adj*)	[dɪ'keɪɪŋ]	начинающий засыхать
diurnal (*adj*)	[daɪ'ɜ:nl]	дневной
drag (*n*)	[dræg]	торможение
endothermic (*adj*)	['endə(u)'θɜ:mɪk]	теплокровный
to expel (*v*)	[ɪkˈspel]	выталкивать, вытеснять
feather (n)	['feðə]	перо птиц
to flap (v)	[flæp]	взмахивать
finch (n)	[fɪnʧ]	вьюрок; мелкая птица
forearm (*n*)	['fɔ:r'ɑ:m]	предплечье
forelimb (*n*)	['fɔ:rlim]	передняя конечность
gallinule (*n*)	['gælɪnju:l]	водяная курочка; камышница
to generate *(v)*	['ʤenəreɪt]	произвести; вырабатывать
grebe (*n*)	[gri:b]	поганка (птица)
hard-shelled (*adj*)	['hɑ:d'ʃeld]	имеющий твердую оболочку; с твердой скорлупой
to hatch (*v*)	[hæʧ]	вылупиться из яйца; насиживать

		яйца
to incubate (*v*)	['ɪŋkjubeɪt]	выводить; выращивать
inferior (*adj*)	[ɪn'fɪ(ə)rɪə]	незначительный
to insulate (*v*)	['ɪnsjuleɪt]	отделять
keen (*adj*)	[ki:n]	острый; обостренный; цепкий
keel (*n*)	[ki:l]	грудная кость (у птицы)
lobe (*n*)	[ləub]	выступающая часть
mandible (*n*)	['mændəb(ə)l]	челюсть
megapode (*n*)	['megəˌpəud]	большеног
molt (*n*)	[məʊlt]	линька (птиц)
mound (*n*)	[maund]	насыпь; холм
ostrich (*n*)	['ɔstrɪʧ]	южноамериканский страус
perch (*n*)	[pɜ:ʧ]	жердочка; шест
petrel (*n*)	['petrəl]	буревестник
plumage (*n*)	['plu:mɪʤ]	оперение; перья
prenuptial (*adj*)	[ˌpri:'nʌpʃəl]	добрачный
propulsion (*n*)	[prə'pʌlʃ(ə)n]	движение вперед; толчок
spear-like (*adj*)	[ˈspɪəˌlaɪk]	копьевидный
to stab (*v*)	[stæb]	вонзить, прокалывать
sternum (*n*)	['stɜ:nəm]	грудина; грудь
swift (*n*)	[swɪft]	стриж
subspecies (*n*)	['sʌbˌspi:ʃi:z]	подвид
toe (n)	[təu]	лапка
to trap (v)	[træp]	захватывать
upward (*adj*)	['ʌpwəd]	движущийся вверх
urate (*adj*)	['ju(ə)reɪt]	мочекислый
vegetation (*n*)	['veʤɪ'teɪʃ(ə)n]	растительность
web (*n*)	[web]	перепонка (на лапах водоплавающей птицы)
wing (*n*)	[wɪŋ]	крыло
wishbone (*n*)	['wɪʃbəun]	вилочковая кость
to warn (off) (*v*)	[wɔ:nəf]	отпугнуть

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. How many species of birds are there in the world?
2. What are 4 flightless birds?
3. Why do bird eggs come in different colors?

3. Read the text and do your essential assignments.

Birds

Bird, (class Aves), any of the more than 10,400 living species unique in having feathers. Birds are more related to reptiles than to mammals and they have a four chambered heart (as do mammals), forelimbs modified into wings (a trait shared with bats), a hard-shelled egg, and keen vision, the major sense they rely on for information about the environment. Their sense of smell is not highly developed, and auditory range is limited. Most birds are diurnal in habit.

Like mammals, which are also endothermic, birds have an insulating covering that keeps heat in the body: feathers. The presence of feathers, which are modified scales, is the most obvious characteristic that sets birds apart from other modern vertebrates.

Because of their body structure and their feathered covering, birds are the best fliers among animals, better than insects and bats. Like the scales of reptiles, and those on the feet of birds, feathers are made of keratin, a fibrous protein also found in hair. Specialized feathers called down feathers are especially insulating, trapping air in spaces between each feather to decrease the rate of heat loss. Flight feathers are asymmetrical, which affects airflow over them and provides some of the lifting and thrusting force required for flight. Two types of flight feathers are found on the wings, primary feathers and secondary feathers. Primary feathers are located at the tip of the wing and provide thrust. Secondary feathers are located closer to the body, attach to the forearm portion of the wing and provide lift. Contour feathers are the feathers found on the body, and they help reduce drag produced by wind resistance during flight.

The contour feathers are shed and replaced (molted) at least once a year, usually just after the breeding season. In addition, many birds have at least a partial molt before the breeding season. A typical series of molts and plumages would be juvenal plumage, postjuvenal molt, first winter plumage, first prenuptial molt, first nuptial plumage, first postnuptial molt, second winter (or basic) plumage.

Flapping of the entire wing occurs primarily through the actions of the chest muscles. These muscles are highly developed in birds and account for a higher percentage of body mass than in most mammals. These attach to a blade-shaped keel, like that of a boat, located on the sternum. The sternum of birds is larger than that of other vertebrates, which accommodates the large muscles required to generate enough upward force to generate lift with the flapping of the wings. Another skeletal modification found in most birds is the fusion of the two clavicles, forming the wishbone.

An important requirement of flight is a low body weight. As body weight increases, the muscle output required for flying increases. The largest living bird is the ostrich, and while it is much smaller than the largest mammals, it is flightless.

Several modifications are found in birds to reduce body weight, including pneumatization of bones. Pneumatic bones are bones that are hollow, rather than filled with tissue. They are not found in all birds, and they are more extensive in large birds than in small birds.

Other modifications that reduce weight include the lack of a urinary bladder. Birds possess a cloaca, a structure that allows water to be reabsorbed from waste back into the bloodstream. Uric acid is not expelled as a liquid but is concentrated into urate salts, which are expelled along with fecal matter. In this way, water is not held in the urinary bladder, which would increase body weight. Most bird species only possess one ovary rather than two, further reducing body mass.

Long winged swifts and frigate birds move from their perches only to fly, never to walk. Most birds alternate some walking or swimming with their flying. Some birds have completely lost the power of flight during the course of evolution.

Birds differ from mammals in being able to move the upper mandible rather than the lower, relative to the cranium. The bipedal gait of birds, dictated by modification of the forelimbs for flight, necessitates manipulation of food by the bill and feet. Some birds (auks, diving petrels, and certain ducks) use the wings for propulsion underwater as well as in the air. Swimming in birds is usually correlated with webbed feet, but coots and grebes, with only lobes on their toes, also swim and dive, and gallinules, with neither webs nor lobes, commonly swim.

Auditory signals, like visual ones, are almost universal among birds. Birdsong is a conspicuous sound that is used, especially early in the breeding season, to attract a mate, to warn off another bird of the same sex, or both.

All birds incubate their eggs, except megapodes (mound builders), which depend on the heat generated by decaying vegetation or other external sources, and brood parasites such as cuckoos and cowbirds, which lay their eggs in the nests of

other species. The length of time that parents care for young birds varies widely. Ground-nesting birds tend to take less and hole-nesting birds more time than the average.

Of the many kinds of birds that feed on plant material, most use seeds, fruit, or nectar, which are high in food value; leaves and buds are eaten by fewer species. While some kinds of birds feed entirely on a single kind of food, others may take a wide range of foods, and many have seasonal changes in diet.

Most of the living bird species and subspecies in the world have probably been described; but because of inadequacies in the fossil record and repeated cases of convergent evolution within the group, our knowledge of the phylogenetic relationships between orders, suborders, and families of birds is inferior to that of mammals and reptiles.

(Based on: https://www.britannica.com/animal/bird-animal)

AFTER READING

4. Answer the following questions.

1. What is the main characteristic that sets birds apart from other modern vertebrates?
2. Which modifications are found in birds to reduce body weight?
3. How do birds fly?
4. Is there flightlessness among birds?
5. How do they swim and dive?
6. What is swimming in birds usually correlated with?
7. How do birds usually nest?
8. How often does bird molting take place?
9. Are feeding habits the same of different bird species?
10. Why is the knowledge of the phylogenetic relationships between orders, suborders, and families of birds is inferior to that of mammals and reptiles?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Birds are cold blooded vertebrates.
2. There are considerable differences in flying abilities among various birds.
3. For birds that do fly, reduction in body weight makes flight easier.
4. The mountain quail of California make their annual migrations up and down the mountains on foot.
5. For birds that do fly, reduction in body weight makes flight more difficult.

6. In order to fly, large amounts of energy are required for birds, necessitating a high metabolic rate.
7. A low body weight is an important requirement of flight.
8. The guillemots of the Greenland coast migrate southward by swimming.
9. Pneumatic bones are not found in all birds, and they are more extensive in large birds than in small birds.
10. Birds are one of the best known of animal groups.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

Contour feather, reducing body mass, secondary feather, wind resistance, innate behaviour, flight feather, keen vision, sense of smell, to attract a mate, primary feather.

7. Match the words with the definitions.

1	incubate	A	to produce or create
2	subspecies	B	being active or happening during the day rather than at night
3	hatch	C	to occur in turn repeatedly
4	flap	D	having a hole or empty space inside
5	keel	E	a loss of feathers, hair, or skin, especially as a regular feature of an animal's life cycle
6	diurnal	F	to sit on (eggs) in order to keep them warm and bring them to hatching
7	molt	G	to move the wings up and down when flying or preparing to fly
8	generate	H	a ridge along the breastbone of many birds to which the flight muscles are attached
9	hollow	I	to (cause an egg to) break in order to allow a young animal to come out
10	alternate	J	a taxonomic category that ranks below species

8. Find the equivalents for the following words in the text.

Mating, sharp, patagium, rising, feathers, minor, to isolate, drive, to hurt, to scare

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	stiff	A	strong enough to withstand adverse conditions or rough handling
2	wing	B	having an empty space inside
3	wind up	C	a bone framework enclosing the brain of a vertebrate
4	beasty	D	having parts that are close together so that it is difficult to go or see through
5	skull	E	an insect or other small animal
6	discrepancy	F	to stop operating permanently
7	tough	G	a modified forelimb that bears large feathers and is used for flying.
8	sort out	H	an illogical or surprising lack of compatibility or similarity between two or more facts.
9	dense	I	not easily bent or changed in shape; rigid
10	hollow	J	to resolve a problem or difficulty

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Denseness, rodents, limb, beasties, discrepancy, winding, lighten, bats, skulls, creatures, wings, sort out, tough, dense, hollow, songbirds. delicate

For earthbound creatures like us, flight just seems so fantastical. How do birds and bats and other flying 1. _____ manage to get off and stay off the ground? Well, having 2. ___ obviously helps. And bird bones are 3. ___ and seem 4. _____, which should help 5.___ the load.

Or so you'd think. But a new study shows that 6. ___' bones are actually pretty 7.____. In fact, they're more 8. ___ than the bones of mammals of the same size. The results appear in the *Proceedings of the Royal Society: Biological Sciences*.

For centuries, biologists have known that bird bones are thin and hollow. Yet bird skeletons don't actually weigh any less than the skeletons of similarly sized mammals. To 9. ___ this seeming 10. ____, Elizabeth Dumont of the University of Massachusetts Amherst studied the 11. ___ and 12. ___ bones of song birds, 13. ___ and 14. ___.

And she found that, on average, bird bones are the densest, with bat bones coming in a close second.
That 15. ___ makes Tweety's thin little bones surprisingly strong and 16. ___, good structural features for flight. And thus for keeping those bones from 17. ___ up in the mouth of a hungry mammal. Sorry, Sylvester.

(Based on: https://www.scientificamerican.com/podcast/podcast.mp3?fileId=1B811E39-61C2-41C2-91D74F3280BBCDE7)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

The species of the ground finch observed by Darwin on the Galapagos Islands had a graded series of beak sizes and shapes with very small differences between the most similar. He realized that the varied beaks of each finch helped the birds acquire a specific type of food. For example, seed-eating finches had stronger, thicker beaks for breaking seeds, and insect eating finches had spear-like beaks for stabbing their prey.

(Based on: https://openoregon.pressbooks.pub/nonmajorsenvirobiology/chapter/5-2-origin-of-biodiversity)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. The evolutionary history of birds.
2. Fossil birds and modern birds.
3. The derived characteristics in birds that facilitate flight.
4. Nesting and feeding habits of birds.
5. Colouration of birds.

Unit 14. MAMMALS

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- compare different species of mammals;
- describe the main characteristics of each type of mammals.

PRE-READING

1. Study the essential vocabulary before reading the text.

anestrus (*n*)	[æ'ni:strəs]	период полового покоя
blubber (*n*)	[ˈblʌbə(r)]	подкожный жир
to breed (*v*)	[bri:d]	размножаться
carnivore (*n*)	['kɑ:nɪvɔ:]	плотоядное животное; хищное млекопитающее
cold-blooded (*adj*)	['kəuld'blʌdɪd]	холоднокровный
combat (*n*)	['kɔmbæt]	схватка; сражение
conserve (v)	[kənˈsɜ:v]	сохранять; сберегать
crustacean *(n)*	[krʌsˈteiʃən]	ракообразное
diurnal (*adj*)	[daɪ'ɜ:nl]	дневной
dormant (*adj*)	['dɔ:mənt]	находящийся в спяке
estrous (*adj*)	['estrəs]	эстральный; в состоянии охоты
estrus (*n*)	['estrəs]	половая охота
estivation (*n*)	[esti'veiʃ(ə)n]	летний покой; летняя спячка
evolve (v)	[ɪ'vɔlv]	эволюционировать; развиваться
facilitate (v)	[fə'sɪlɪteɪt]	облегчать
fetal (*adj*)	['fi:tl]	зародышевый, эмбриональный
gestation (*n*)	[ʤe'steɪʃ(ə)n]	период беременности, созревание
herbivore (*n*)	['hɜ:bɪvɔ:]	травоядное (животное)
hibernation (*n*)	['haɪbə'neɪʃ(ə)n]	зимняя спячка; спячка
invertebrate (*n*)	[ɪn'vɜ:tɪbrət]	беспозвоночное (животное)
maintain (v)	[meɪn'teɪn]	сохранять; поддерживать
marsupial (*n*)	[mɑ:'s(j)u:piəl]	сумчатое (животное)
microhabitat (*n*)	[ˌmaikrəu'hæbitæt]	микросреда для обитания
monoestrous (*adj*)	[ˌmənə'estrəs]	моноэстральный (виды животных, для которых характерен однократный репродуктивный

		период в году)
monotreme (*n*)	[ˈmɔ:nəutri:m]	однопроходное яйцекладущее животное
nourish (v)	[ˈnʌriʃ]	кормить, питать
omnivore (*n*)	['ɔmnɪvɔ:]	всеядное животное
placental (n)	[plə'sentl]	плацентарное млекопитающее
platypus (*n*)	['plætɪpəs]	утконос
polyestrous (*adj*)	[ˌpɔli'i:strəs]	полиэструсный (с несколькими половыми циклами в течение года)
postpartum (*n*)	[pəʊst'pɑ:təm]	послеродовый период
rodent (*n*)	['rəud(ə)nt]	грызун
torpor (*n*)	['tɔ:pə]	ступор; оцепенение
species (*n*)	['spi:ʃi:z]	разновидность; тип; вид; группа; род
shrew (*n*)	[ʃru:]	землеройка
spine (*n*)	[spaɪn]	позвоночник
vertebrate (*n*)	['vɜ:tɪbrət]	позвоночное (животное)
viviparous (*adj*)	[vɪ'vɪpərəs]	живородящий
voracious (*adj*)	[vəˈreɪ.ʃəs]	прожорливый, ненасытный
womb (*n*)	[wu:m]	утроба; чрево

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. How many species of mammals are there on the Earth?
2. Why can warn-blooded mammals remain active in colder climates?
3. How do mammals give their young survival skills?

3. Read the text and do your essential assignments.

Mammals

Mammal, (class Mammalia), any member of the group of vertebrate animals in which the young are nourished with milk from special mammary glands of the mother. In addition to these characteristic milk glands, mammals are distinguished by several other unique features.

Hair is a typical mammalian feature, although in many whales it has disappeared except in the fetal stage. The mammalian lower jaw is hinged directly to the skull, instead of through a separate bone (the quadrate) as in all other vertebrates. A chain of three tiny bones transmits sound waves across the middle ear. A muscular diaphragm separates the heart and the lungs from the abdominal cavity. Only the left aortic arch persists. (In birds the right aortic arch persists; in reptiles, amphibians, and fishes both arches are retained.) Mature red blood cells (erythrocytes) in all mammals lack a nucleus; all other vertebrates have nucleated red blood cells.

Except for the monotremes (an egg-laying order of mammals comprising echidnas and the duck-billed platypus), all mammals are viviparous – they bear live young. In the placental mammals (which have a placenta to facilitate nutrient and waste exchange between the mother and the developing fetus), the young are carried within the mother's womb, reaching a relatively advanced stage of development before birth. In the marsupials (e.g., kangaroos, opossums, and wallabies), the newborns are incompletely developed at birth and continue to develop outside the womb, attaching themselves to the female's body in the area of her mammary glands.

There are three types of mammals: monotremes, marsupials and placental. Mammals that breed only once a year are termed monoestrous and exhibit a long anestrus; those that breed more than once a year are termed polyestrous. In many polyestrous species the estrous cycle ceases during gestation and lactation (milk production), but some rodents have a postpartum estrus and mate immediately after giving birth. All mammals have different lengths of gestation periods depending on the need of their species.

The dependence of the young mammal on its mother for nourishment has made possible a period of training. Such training permits the nongenetic transfer of information between generations. The ability of young mammals to learn from the experience of their elders has allowed a behavioral plasticity unknown in any other group of organisms and has been a primary reason for the evolutionary success of mammals. The possibility of training is one of the factors that has made increased brain complexity a selective advantage. Increased associational potential and memory extend the possibility of learning from experience, and the individual can make adaptive behavioral responses to environmental change. Individual response to short-term change is far more efficient than genetic response. Some types of mammals are solitary except for brief periods when the female is in estrus. Others, however, form social groups. Such groups may be reproductive or defensive, or they may serve both functions. In those cases that have been studied in detail, a more or less strict hierarchy of dominance prevails. Within the social group, the hierarchy may be maintained

through physical combat between individuals, but in many cases stereotyped patterns of behaviour evolve to displace actual combat, thereby conserving energy while maintaining the social structure.

Territoriality is more important in the behaviour of birds than of mammals, but data for the latter are available primarily for diurnal species. Frequently territories of mammals are "marked," either with urine or with secretions of specialized glands, as in lemurs.

Mammals may react to environmental extremes with acclimatization, compensatory behaviour, or physiological specialization. One way for a mammal to endure stressful environmental conditions is to become dormant. Dormancy is the general term that relates to the reduced metabolic activity adopted by many organisms under conditions of environmental stress. Physiological responses to adverse conditions include torpor, hibernation (in winter), and estivation (in summer).

Behavioral response to adverse conditions may involve the selection or construction of a suitable microhabitat, such as the cool, moist burrows of desert rodents. Th latitudinal migration is a second kind of behavioral response.

In most terrestrial and some aquatic communities, carnivorous mammals are the top predators. Herbaceous mammals often serve as primary consumers in most ecosystems. The voracious shrews, smallest of mammals, sometimes prey on vertebrates larger than themselves. The largest of vertebrates, the blue whale (Balaenoptera musculus), feeds on minute planktonic crustaceans called krill.

There are more than 5,500 species of living mammals, arranged in about 125 families and as many as 27-29 orders (familial and ordinal groupings sometimes vary among authorities).

(Based on: https://www.britannica.com/animal/mammal)

AFTER READING

4. Answer the following questions.

1. What are the typical features of mammals?
2. What distinguishes them from other vertebrates?
3. What are the distinguishing features of the three main groups of mammals?
4. Are the mammals' newborns completely developed at birth?
5. What is the difference between monoestrous and polyestrous mammals?
6. What factor has increased their brain complexity?
7. What kind of social groups do mammals form?
8. How do mammals react to environmental cycles?

9. What are the food habits of mammals?
10. How many species of mammals are there?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. There are three types of mammals: monotremes mammals, marsupial mammals and placental mammals.
2. Animals without backbones are called vertebrates.
3. Mammals stay in the womb for different time periods.
4. Vertebrates are animals with backbones.
5. When a mammal is pregnant with its young it is called the ‘gestation period’.
6. Carnivore is an organism that only eats plants.
7. Herbivore us an organism that only eats animals.
8. Some North American Mammalian groups became extinct as the result of competition with more advanced groups.
9. Mammals are cold-blooded vertebrates.
10. Mammals feed their babies with their own milk.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

the group of vertebrate animals, monotreme, marsupials, placental, viviparous, to breed once a year, to nourish with milk, increased brain complexity, territoriality, to learn from experience.

7. Match the words with the definitions.

1	cold-blooded	A	an animal that eats a variety of food of both plant and animal origin
2	herbivore	B	an animal that feeds on other animals
3	species	C	all the conditions that surround a person, animal, or plant and affect its life
4	warm-blooded	D	an animal whose body temperature changes with the temperature of their environment
5	environment	E	to develop gradually
6	evolve	F	an animal whose body temperature stays the same in hot and

			cold weather
7	carnivore	G	an animal that feeds on plants
8	marsupial	H	egg-laying toothless animal with a single opening (cloaca)
9	monotreme	I	a group of animals that are alike in certain ways
10	omnivore	J	a type of mammal that is not completely developed when it is born and is carried around in a body part like a pocket

8. Find the equivalents for the following words in the text.

protective, characteristic, reaction, battle, superiority, to enhance, alone, harmful, live, resettlement.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1.	bump	A.	having become a fossil (something preserved in rock for a very long period)
2.	molar	B.	a living creature; an animal
3.	creature	C.	a prolonged period of abnormally low rainfall, leading to a shortage of water
4.	fossilized	D.	a grinding tooth at the back of a mammal's mouth
5.	extinct	E.	a round, raised area on a surface or on the body
6.	drought	F.	any large or small living thing that can move independently
7.	critter	G.	a hole or tunnel dug by a small animal
8.	huddle	H.	(of a species, family, or other group of animals or plants) having no living members; no longer in existence
9.	seek out	I.	to search for and find (someone or something)
10.	burrow	J.	to crowd together; nestle closely

11. Listen to the recording 'Early Mammals Had Social Lives, Too'. Try to understand the general idea and fill in the gaps.

Diggers, mammal, molars, drought, dinosaurs, huddled, chipmunk, "multituberculates", critters, burrow, placental, extinct, sought out, creatures, rodent, bumps, monotremes, paleobiologist, fossilized, marsupials.

Seventy-six million years ago, a group of small mammals 1) ___ in a 2) ___ in what's now Montana. They were good 3) ___ – most likely furry – and petite.

"They could sit comfortably in the palm of your hand. These things, if you saw them running around today, you'd think it's a small 4) _____ – a 5) _____ or mouse."

Lucas Weaver is a mammal 6) _____ at University of Washington.

These little 7) _____ didn't belong to any of the three main 8) ____ groups on the planet today – which are the 9) ____ mammals (like us), 10) ____ (like the platypus) and 11) _____ (like koalas and kangaroos). Instead, they belonged to another, now 12) ____ group called the 13) _____ .

"They have these really bizarre 14) _____ with multiple bumps, which is where they get their name. Multituberculate. just means 'many 15) _____".

Weaver and his colleagues have studied the 16) ____ skulls and skeletons of these animals, dug up in Montana, and they've given them a name: Filikomys primaevus (friendly or neighborly mouse). The details are in the journal *Nature Ecology & Evolution.*

Weaver says 17) _____ or climate change may have killed the animals, though it's hard to be sure. But the 18) _____ were fossilized together in ways that suggest they 19) _____ each others' company. That's a big deal because it's commonly thought that social behaviour didn't arise in mammals until after the death of the 20) ____, 10 million years after these small critters hung out together.

"The narrative, for decades, has been that mammals living during the time of dinosaurs were mostly solitary ratlike creatures scuttling in the night under dinosaurs. And so, the fact we're finding these multituberculate mammals—a totally unrelated group of mammals—exhibiting social behavior means this was probably not uncommon among these early Mesozoic mammals. And it changes the narrative that sociality is somehow unique to placental mammals."

Even today, social behavior is relatively rare among mammals. But these findings suggest the need for company in some mammalian species is an ancient evolutionary invention.

(Based on:
https://www.scientificamerican.com/podcast/podcast.mp3?fileId=5D6358AC-73FB-48C1-AD37B5A5FF384997)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

Scientists believe that the ancestors of mammals emerged in the north, then migrated south.

(Based on: https://www.nationalgeographic.com/science/article/rise-mammals)

13. Choose one of the topics to make a report and present it in front of the class. See useful language in Appendix C.

1. Rabbits and hares: what's the difference?
2. Mammals have big brains.
3. Mammals don't have the same diets.
4. Mammals lived alongside dinosaurs.
5. Mammals have incredible biological diversity.

Unit 15. EVOLUTION THEORIES

LEARNING OBJECTIVES

By the end of this section, you should be able to:

- discuss the new evolution theories;
- classify various forms of structural adaptation.

PRE-READING

1. Study the essential vocabulary before reading the text.

alter (*v)*	[ˈɔːltə(r)]	изменять
artificial (*adj)*	[ɑːtɪˈfɪʃəl]	искусственный
breeding (*n)*	[ˈbriːdɪŋ]	разведение, размножение, выращивание
claw *(n)*	[klɔː]	лапа, коготок
desirable (*adj)*	[dɪˈzaɪərəbl]	желательный, желаемый
evidence *(n)*	[ˈevɪdəns]	доказательство, свидетельство
evolution *(n)*	[ˌiːvəˈluːʃn] [ˌevəˈluːʃn]	доказательство, свидетельство
fossil *(n)*	[ˈfɒsl]	ископаемое, окаменелость
island *(n)*	[ˈaɪlənd]	остров, островок
pigeon *(n)*	[ˈpɪdʒɪn]	голубь, почтовый голубь, голубка
progeny *(n)*	[ˈprɒdʒəni]	потомство, потомок
selection *(n)*	[sɪˈlekʃn]	отбор, выборка
struggle *(n)*	[ˈstrʌgl]	борьба
thorn *(n)*	[θɔːn]	шип, колючка
trait (*n)*	[treɪt]	черта, особенность, признак
voyage (*n)*	[ˈvɔɪɪdʒ]	морское путешествие, странствие

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What do you know about evolution theories?
2. What is evolution?
3. Have you ever heard about neo-Lamarckism?

3. Read the text and do your essential assignments.

Evolution theories

Evolution by natural selection describes a mechanism for how species change over time. That species change had been suggested and debated well before Darwin began to explore this idea. The view that species were static and unchanging was grounded in the writings of Plato, yet there were also ancient Greeks who expressed evolutionary ideas.

In the early nineteenth century, Jean-Baptiste Lamarck published a book that detailed a mechanism for evolutionary change. This mechanism is now referred to as an inheritance of acquired characteristics by which modifications in an individual are caused by its environment, or the use or disuse of a structure during its lifetime, could be inherited by its offspring and thus bring about change in a species. While this mechanism for evolutionary change was discredited, Lamarck's ideas were an important influence on evolutionary thought.

Although Darwin was born more than 200 years ago, the publication of Darwin's best-known book, **On the Origin of Species by Means of Natural Selection**, commonly referred to as **The Origin of Species**, launched the era of evolutionary biology. Charles Darwin, an English naturalist who lived from 1809 to 1882. Darwin spent five years on a research voyage around the world. He became interested in how species might be related to one another. While in the Galapagos Islands off the west coast of South America, Darwin saw many species of plants and animals. He noted that these species looked similar to species he had seen in other places. He wondered if a species might be able to change over time. But at the time, he could not explain how such changes might happen. After returning to England, Darwin spent twenty years doing research. He bred pigeons and saw that there were small differences, or variations, in traits of individual pigeons. He also noticed that these traits could be inherited by offspring. Eventually, he conducted an experiment where he bred pigeons that had certain desirable traits. He observed that their offspring were born with the same desirable traits. Breeding organisms with a certain trait to produce offspring with identical traits is called artificial selection. Darwin decided that there must be a process in the natural world that works like artificial selection. Using evidence from his research, Darwin decided that process in nature was natural selection. In **natural selection,** organisms with favorable traits are able to reproduce and pass their traits on to their offspring, who then reproduce. Those without such favorable traits are more likely to die out before reproducing. For example, suppose fish that are slow get eaten before they can reproduce, while fish that are fast survive and reproduce. These offspring inherit the trait of speed from their parents. This way, they too are more

likely to survive and pass on that trait to their offspring, so this process summed up as "survival of the fittest".

Charles Darwin's theory of evolution had three main components: that variation occurred randomly among members of a species; that an individual's traits could be inherited by its progeny; and that the struggle for existence would allow only those with favorable traits to survive. An adaptation is anything that gives an organism a better chance of survival. The two main types of adaptations are structural adaptations and physiological adaptations. Structural adaptations take many different forms. Thorns, teeth, hair, beaks, and color are examples of structural adaptations that are inherited. Some adaptations take millions of years to become widespread in a population. Mole rats developed large teeth and claws. This structural adaptation helps them dig holes and protect themselves. Some animals develop coloring that helps them blend with their surroundings. This is an example of a subtle structural adaptation called **camouflage**. **Mimicry** is another type of structural adaptation. It occurs when one species looks like another species. In one form of mimicry, a harmless species takes on the look of a dangerous species. Physiological adaptations are changes in an organism's metabolic processes. Some insects and weeds also have evolved to the point where they are not affected by chemical sprays.

More than a century has elapsed since Darwin's death in 1882. During this period, the evidence supporting his theory has grown progressively stronger. There have also been many significant advances in our understanding of how evolution works. Although these advances have not altered the basic structure of Darwin's theory, they have taught us a great deal more about the mechanisms by which evolution occurs. Structural and physiological adaptations are considered direct evidence of evolution. But most of the evidence to support evolution is indirect. It comes from fossils and sciences such as anatomy, embryology, and biochemistry.

(Based on: Raven Johnson et al. Biology. – 6th Edition. – McGraw-Hill Science, 2001, p.10-15; Biology - The Dynamics of Life. – Glencoe Science, 2005, p. 163-170 ; Reece J. B. et al. Campbell biology: concepts & connections. – San Francisco, CA :Benjamin Cummings, 2012. – p. 258-268)

AFTER READING

4. Answer the following questions.

1. Who discovered evolution?
2. Can you name scientists who studied evolutionary theories?
3. Who published a book that detailed a mechanism for evolutionary change?
4. Who was the founder of modern evolutionary theory?

5. What forms the basis of modern evolutionary theory?
6. What is the difference between artificial and natural selection?
7. What does “camouflage” mean?
8. Which structural adaptation helps mole rats dig holes and protect themselves?
9. What is an example of a subtle structural adaptation?
10. What are various forms of structural adaptation?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. In the late 18th century, naturalist George Louis Leclerc suggested that life on Earth was 75,000 years old and that men had descended from apes.
2. The evidence for evolution comes from fossils and sciences.
3. Darwin decided that process in nature was artificial selection.
4. Organisms with favorable traits are able to reproduce and pass their traits on to their offspring, who then reproduce.
5. Carolus Linnaeus spent twenty years doing research.
6. In the 18th century, Swedish botanist Carolus Linnaeus based his categorization of species on the theory of unchanging life created by God. Initially, he believed that all organisms appeared on Earth in their present form and never changed.
7. In the early nineteenth century, Charles Darwin published a book that detailed a mechanism for evolutionary change.
8. Mole rats developed large teeth and claws.
9. Thorns, teeth, hair, beaks, and color are examples of physiological adaptations that are inherited.
10. Artificial selection is the process by which plants, animals, etc. that can adapt to their environment survive and produce young, while the others disappear.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

natural selection, mechanism of evolution, significant advances, physiological adaptations, harmless species, chance of survival, English naturalist, survival of the fittest, origin of species, metabolic process.

7. Match the words with their definitions.

1	century	A	the parts of a dead animal or a plant that have become hard and turned into rock
2	evidence	B	the slow steady development of plants, animals, etc. during the history of the earth, as they adapt to changes in their environment
3	evolution	C	any of the periods of 100 years before or after the birth of Christ
4	adaptation	D	the scientific study of the physical structure of humans, animals or plants
5	fossil	E	the scientific study of the development of embryos
6	anatomy	F	the scientific study of the chemistry of living things
7	embryology	G	a creature that is not a bird, a fish, a reptile, an insect or a human
8	biochemistry	H	one of the sharp curved nails on the end of an animal's or a bird's foot
9	animal	I	the action or process of changing something, or of being changed, to suit a new purpose or situation
10	claw	J	the facts, signs or objects that make you believe that something is true

8. Find the equivalents for the following words in the text.

masking, fatality, fight, being, offspring, replicating, bug, life expectancy, dove, synthetic.

9. Render the text using the plan in Appendix C.

LISTENING

10. Check your understanding: match the definition with the correct word.

1.	mind	A.	an animal like a large monkey with no tail, that uses its arms to move through trees
2.	crawl out	B.	one of the parts of the body of a human or animal that is used for standing or walking
3.	leg	C.	an idea or a principle that is connected with something

			abstract
4.	ability	D.	to change and become someone or something different, or to make someone or something do this
5.	ape	E.	it was proposed by Charles Darwin
6.	turn into	F.	the principle that only the people or things that are best adapted to their environment will continue to exist
7.	theory of evolution	G.	a set of animals or plants in which the members have similar characteristics to each other and can breed with each other
8.	survival of the fittest	H.	the part of a person that makes it possible for him or her to think, feel emotions, and understand things
9.	species	I.	the physical or mental power or skill needed to do something
10.	concept	J.	to appear after having been hidden or not active for a long time

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Concept, species, survival of the fittest, theory of evolution, turn into, ape, ability, leg, crawl out, mind.

I learnt all about evolution when I was about ten years old. I remember it clearly. I thought it was amazing. My 1._____ was full of images of strange creatures 2. _____ of a green, soupy lake. Fish that had somehow developed 3._____ and the 4._____ to breathe air. Then these creatures 5._____ all kinds of animals. All the books I read said we came from 6._____. Scientists are still not sure how. There's a missing link. When I think about it now, 7._____ is a clever 8._____. The man who thought of it, Charles Darwin, said nature is all about 9._____. Only the strongest 10._____ survive. We are still evolving. Scientists believe we will look quite different a million years from now. I wonder what we'll look like.

(Based on: https://listenaminute.com/e/evolution.html)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

In Darwin's time, most people believed that the various kinds of organisms and their individual structures resulted from direct actions of the Creator (and to this day many

people still believe this to be true). Species were thought to be specially created and unchangeable, or immutable, over the course of time. In contrast to these views, a number of earlier philosophers had presented the view that living things must have changed during the history of life on earth.

(Based on: Raven Johnson et al. Biology. – 6th Edition. – McGraw-Hill Science, 2001, p.10)

13. Choose one of the topics to make a report and present it in front of the class.

1. Homologies in biology.
2. Divergent evolution and convergent evolution.
3. Patterns of evolutionary theory.
4. Biochemistry as a direct evidence of evolution.
5. Comparative anatomy.

SUPPLEMENTARY READING

I HUMAN ANATOMY AND PHYSIOLOGY

PRE-READING

1. Study the essential vocabulary before reading the text.

appendage (*n)*	[əˈpendɪdʒ]	придаток, отросток
appendicular *(adj)*	[æpənˈdɪkjʊlə]	аппендикулярный
axial (*adj)*	[ˈæksiəl]	осевой, продольный
biceps (*n)*	[ˈbaɪseps]	двуглавая мышца плеча
bloodstream (*n)*	[ˈblʌdstriːm]	кровоток, кровообращение
bronchial tube (*n)*	[ˈbrɒŋkiəl tjuːb]	бронхи
cranium (*n)*	[ˈkreɪniəm]	череп, черепная коробка
dural sinuse (*n)*	[ˈkreɪniəm]	дуральный венозный синус, дуральная пазуха, пазуха головного мозга
extracellular (*adj)*	[ˈkreɪniəm]	внеклеточный
fascicle (*n)*	[ˈfæsɪkl]	пучок
female (*adj)*	[ˈfiːmeɪl]	женский
gland (*n)*	[glænd]	железа, секреция
hyoid bone (*n)*	[ˈhaɪɔɪd bəʊn]	подъязычная кость
integumentary system (*n)*	[ɪnˈteg.jə.məntərɪ ˈsɪs.təm]	покровная система
kidney (*n)*	[ˈkɪdni]	почка
larynx *(n)*	[ˈlærɪŋks]	глотка, гортань
limb *(n)*	[lɪm]	конечность
locomotion *(n)*	[ˌləʊkəˈməʊʃn]	передвижение, локомоция
lung *(n)*	[lʌŋ]	легкое
male (*adj)*	[meɪl]	мужской
myofibril *(n)*	[ˌmaɪəʊˈ faɪbrɪl]	миофибрил
myofilament *(n)*	[ˌmaɪəʊˈˈfiləmənt]	миофиламент
node *(n)*	[nəʊd]	узел, пучок
pharynx *(n)*	[ˈfærɪŋks]	носоглотка
pelvic girdle *(n)*	[ˈpelvɪk gɜːdl]	тазовый пояс
rib *(n)*	[rɪb]	ребро

sacrum *(n)*	[ˈseɪkrəm]	крестец
sebum *(n)*	[ˈsiːbəm]	секрет сальных желез, себум
shoulder girdle *(n)*	[ˈʃəʊldə gɜːdl]	плечевой пояс
skull *(n)*	[skʌl]	череп, черепная коробка
sternum *(n)*	[ˈstɜːnəm]	грудина
sweat *(n)*	[swet]	пот, потоотделение
tissue *(n)*	[ˈtɪʃuː]	ткань
trachea *(n)*	[trəˈkiːə]	трахея
urinary meatus *(n)*	[ˈjʊərɪnərɪ miːts]	мочевой канал
vertebrae *(n)*	[ˈevɪdəns]	позвонок
vessel *(n)*	[ˈvesl]	сосуд
viscera *(n)*	[ˈvɪsərə]	внутренние органы, кишки

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What do you know about human anatomy and physiology?
2. Who was the first scientist dissected the human body?
3. What is the chemical composition of the human body?

3. Read the text and do your essential assignment.

Human anatomy and physiology

The human body consists of physiological systems that span multiple regions and are composed of many anatomical structures. Systemic anatomy, subdivides the body into discrete organ systems that work together towards a common goal or function.

The integumentary system consists of the skin and epidermal derivatives (or epidermal appendages), such as hair and hair follicles, nails, sweat glands, and sebaceous glands. Skin forms the outer covering of the body and is the largest organ of the body, accounting for 15%-20% of the total body weight. Collectively, skin and epidermal derivatives regulate body temperature and water loss, provide a nonspecific barrier to external environmental factors (e.g., microorganisms), synthesize vitamin D, absorb ultraviolet (UV) irradiation, convey sensory information, play a role in antigen presentation, and secrete sweat and sebum.

The skeletal system is divided into the axial skeleton and the appendicular

skeleton. The axial skeleton consists of bones of the cranium (or skull), hyoid bone, ribs, sternum, vertebrae, and sacrum. The appendicular skeleton consists of the bones of the upper and lower limbs, shoulder girdle, and pelvic girdle. The skeleton is composed of cartilage and bone. The 200 bones of the human body act as a scaffold, providing support, protection, facilitating locomotion, and even storing various cells and substances. The bones are the pulley systems onto which muscles act, the latter being capable of contracting and relaxing, ultimately producing movement. Muscles of the human body comprise three types: cardiac, smooth, and skeletal. Cardiac muscle forms the walls of the heart. Cardiac muscle cells are striated but smaller than skeletal muscle cells and have a single nucleus per cell. Smooth muscle is primarily found in the walls of hallow viscera and blood vessels. Smooth muscle cells lack striations, have one nucleus per cell, and are small and narrow in appearance. The gross skeletal muscle cells are striated and converge to form skeletal muscles of varied shapes and sizes. It (e.g., biceps) consists of numerous fascicles, which consist of numerous skeletal muscle cells (also called skeletal muscle fibers). A skeletal muscle cell, in turn, consists of numerous myofibrils comprising thick and thin myofilaments.

The cardiovascular system consists of the heart and blood vessels that circulate blood throughout the body. The three general types of blood vessels are arteries, capillaries, and veins, which distribute blood throughout the body. The circulatory system is responsible for keeping us alive by providing oxygenated, arterial blood, to every part of the human body. The key player is the heart, an organ that pumps oxygenated blood into arteries, which then returns back to the heart via veins as deoxygenated blood.

The lymphatic system comprises an overflow system that drains surplus extracellular tissue fluid and leaked plasma proteins and returns them back into the venous bloodstream. In addition, the lymphatic system functions in the absorption and transport of dietary fat along with immune defense. All regions of the body have lymphatic drainage, even the dural sinuses of the brain. The system consists of lymphatic capillaries, superficial and deep lymphatic vessels, lymphatic trunks, right lymphatic duct, thoracic duct, and superficial and deep lymph nodes.

The nervous system can be anatomically divided into the central nervous system (CNS) and the peripheral nervous system (PNS). Nerves are responsible for transporting electrical impulses, which permit communication between the brain, spinal cord, our senses, and every peripherical anatomical structure. This communication allows humans to interact with their environment, sense, feel emotions, think, and perform many other complex cognitive tasks.

The endocrine system consists of glands that release substances called hormones

into the bloodstream. These hormones allow chemical communication between anatomical structures, inducing various regulatory effects upon reaching their targets.

The respiratory system consists of nose, pharynx (throat), larynx (voice box), trachea (windpipe), bronchial tubes, lungs. The main function of the system is to keep us alive via the inhalation of oxygen and elimination of carbon dioxide. The lungs and alveoli represent the site of gases exchange, which involve a series of convoluted air passages and membranes.

The digestive system is essentially a hollow system with two openings consisting of several organs such as mouth, esophagus, stomach, intestines (small and large), liver, gallbladder, pancreas. Food is ingested via the mouth, it is processed and absorbed inside the system, and the resulting solid wastes called feces are eliminated via the anus.

The urinary (excretory) system is the major filtering unit of the human body, being responsible for purifying the blood and eliminating wastes. The individual organs are listed next: kidneys, ureters, urinary bladder, urethra and the urinary meatus. The entire blood is continuously passed through the kidneys and the resulting unwanted or toxic substances are passed to the bladder, ultimately being eliminated via the urethra.

The main responsibility of the reproductive system is to facilitate the generation of new offspring and to pass on our genes. The female system produces the eggs and nourishes the developing fetus until birth, while the male system synthesizes sperm and delivers it towards the egg to aid fertilization.

(Based on: Kelly M. Harrell, Lippincott Illustrated Reviews: Anatomy. – Wolters Kluwer, 2019, p.12-30; https://www.kenhub.com/en/library/education/the-human-anatomy)

AFTER READING

4. Answer the following questions.

1. How many systems of the human body are there?
2. What are the characteristics of the digestive system?
3. What does the lymphatic system serve for?
4. What are the parts of the endocrine system?
5. What is the major filtering unit of the human body?
6. Skeletal muscle cell and smooth muscle cell: what’s the difference?
7. What are the parts of urinary system?
8. What does nervous system consist of?

9. What are the characteristics of the lymphatic system?
10. What is the main organ of the integumentary system?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Backbone of the human body act as a scaffold.
2. Food is ingested via the mouth.
3. Physiology is the study of how living organisms' function. Thus, human physiology deals specifically with the physiological attributes of the human body at various levels of organization, i.e. from cellular to tissue and ultimately, physiology at the biological system level.
4. The digestive system is essentially a hollow system with two openings consisting of several organs such as mouth, esophagus, stomach, heart, liver, gallbladder, pancreas.
5. Specialized cells perform an indispensable function. Neurons, for instance, generate and send electric signals to elicit response.
6. The endocrine system consists of glands that release substances called hormones into the bloodstream.
7. Comparative anatomy, subdivides the body into discrete organ systems.
8. The nervous system can be anatomically divided into the central nervous system CNS and PNS.
9. Muscle forms the outer covering of the body.
10. The excretory system is the major filtering unit of the human body.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

esophagus, hollow system, stomach, reproductive system, intestine, digestive system, liver, gallbladder, bladder, pancreas.

7. Match the words with their definitions.

1	sweat	A	a collection of cells that form the different parts of humans, animals and plants
2	viscera	B	protein filament of myofibrils in muscle cells
3	tissue	C	the tube that carries liquid waste out of the body. In men and male animals sperm also flows along this tube.
4	myofilament	D	drops of liquid that appear on the surface of your skin when you are hot, ill or afraid
5	limb	E	the large organs inside the body, especially the intestines

6	urethra	F	a basic rod-like organelle of a muscle cell
7	gland	G	any of the curved bones that are connected to the spine and surround the chest
8	myofibril	H	any of the hard parts that form the skeleton of the body of a human or an animal
9	rib	I	an organ in a person's or an animal's body that produces a substance for the body to use; a part in the body that is similar to this, especially a lymph node
10	bone	J	an arm or a leg; a similar part of an animal, such as a wing

8. Find the equivalents for the following words in the text.

cranium, skeleton, item, progeny, feeling, spinal column, obstacle, network, breastbone.

9. Render the text using the plan in Appendix 3.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	bacteria	A	the line of short hairs above each eye in humans
2	biology	B	the smallest basic unit of a plant or animal
3	human	C	the food and drink usually eaten or drunk
4	cell	D	very small organisms that are found everywhere and are the cause of many diseases
5	die	E	the scientific study of the natural processes of living things
6	diet	F	any of the short hairs that grow along the edges of the eye
7	experiment	G	to change food in your stomach into substances that your body can use
8	eyelash	H	being, relating to, or belonging to a person or to people as opposed to animals
9	digest	I	a test done in order to learn something or to discover if something works or is true
10	eyebrow	J	to stop being alive, either suddenly or slowly

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Bacteria, biology, human, cell, die, diet, experiment, eyelash, digest, eyebrow.

A: Hey, I'm reading this really interesting article about the 1. _____ body.
B: Yeah? Well, we know all about that from 2. _____ lessons.
A: No, we didn't learn much at all at school! They're discovering loads more things all the time. Really amazing things! Did you know that only about one tenth of the 3. _____ in your body are really you? The rest are bacteria.
B: What? I'm not really me?
A: No, of course you are you, but you also have millions, or trillions, of 4. _____ in you.
B: Eeeeuuugh!
A: No, they're mostly really helpful. Someone did an 5. _____ to see if animals can live without bacteria, and he found that a lot of them 6. _____ or had to have a special 7. _____. Animals need bacteria 8. _____ food, you see. So, we're better off with bacteria.
B: Unless the bacteria are bad.
A: Unless they are bad, but they're nearly all good. Oh yeah, and going back to cells, do you know how many cells you have in your body?
B: Quite a lot, I'd say. A good few.
A: Yeah, but how many?
B: I don't know. I'm not mathematical.
A: 7 octillion! That's 7 plus 27 noughts.
B: I knew it was a lot.
A: OK, that's an amazingly huge number, almost impossible to imagine. But the really weird thing is that most of the atoms are empty space, just air or nothingness. And if you took out the empty space, you could fit your body inside a tiny cube which measures one 500th of a centimetre on either side. That's a box measuring 0.002 of a centimetre on each side. You'd be much too small to see.
B: Mmm, I can imagine that. It sounds like something that would happen in a really bad Hollywood movie. You know, a mad scientist goes: (*funny voice*) 'I'm going to extract all the air from your body'. OK, enough facts for one day.
A: Don't go! One last thing, did you know …
B: No.
A: Did you know that you probably have mites in your eyelashes?
B: Mites in my eyelashes? What are mites exactly anyway?
A: Yeah, they're very small creatures, like insects, only not insects. They're about a third of a millimetre long, so you can't really see them. These particular mites live in 9. _____ and 10. _____.

B: But in mine?
A: Well, maybe not. Only about 50% of people have them, and more older people. So, you might not have any. Anyway, they're completely harmless, they just eat dead skin.
B: Yeah, right, harmless. I really would have preferred not to know that.
A: Sorry.
B: I mean, really!
(Based on: https://learnenglishteens.britishcouncil.org/skills/listening/b1-listening/amazing-facts)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

The human body is a complex and intricate piece of engineering in which every structure plays a precise role. There are approximately 200 bones, 650 muscles, 79 organs, and enough blood vessels to circle the Earth twice.

(Based on: https://www.kenhub.com/en/library/education/the-human-anatomy)

13. Choose one of the topics to make a report and present it in front of the class.
1. Blood cells and blood circulation.
2. Epidermal derivatives.
3. Neuromuscular junction.
4. The somatic nervous system and the autonomic (or visceral) nervous system.
5. Human reproductive system.

II PALEOBIOLOGY

PRE-READING

1. Study the essential vocabulary before reading the text.

amber (*n*)	[ˈæmbər]	янтарь
ancestor (*n*)	[ˈænsestə(r)]	предок
biota (*n*)	[baɪˈəʊ.tə]	биота
biometry (*n*)	[baɪˈɔmɪtrɪ]	биометрия
decay *(v*)	[dɪˈkeɪ]	распадаться, разлагаться, гнить
divergence (*n*)	[daɪˈvɜːdʒəns]	дивергенция, отклонение, различие
clay (*n*)	[kleɪ]	глина, глинозем
evidence (*n*)	[ˈevɪdəns]	доказательство, свидетельство
evolution (*n*)	[ˌiːvəˈluːʃn] [ˌevəˈluːʃn]	доказательство, свидетельство
fossil (*n*)	[ˈfɒsl]	ископаемое, окаменелость
hominin (*n*)	[ˈhɒm.ɪ.nɪn]	гоминин
mud (*n*)	[mʌd]	грязь
paleoanthropology (*n*)	[pælɪəʊˈænθrəpɒlədʒɪ]	палеоантропология
paleobiology (*n*)	[ˌpælɪɒbaɪˈɒlədʒi]	палеобиология
paleontology (*n*)	[ˌpælɪɒnˈtɒlədʒi]	палеонтология
paleophysiology (*n*)	[ˌpælɪɒfɪziˈɒlədʒi]	палеофизиология
strata (*n*)	[ˈstrɑːtə]	пласт, наслоение

2. Before you read discuss the questions with your partner. Then quickly scan the text to check your answers.

1. What do you know about paleobiology?
2. What is the difference between paleobiology and ontology?
3. What does a scientist study in this field?

3. Read the text and do your essential assignment.

Paleobiology

The founder or "father" of modern paleobiology was Baron Franz Nopcsa (1877 to 1933), a Hungarian scientist trained at the University of Vienna. He initially termed the discipline "paleophysiology". However, credit for coining the word paleobiology itself should go to Professor Charles Schuchert. He proposed the term in 1904 so as to initiate "a broad new science" joining "traditional paleontology with the evidence and insights of geology and isotopic chemistry."

Paleobiology is an interdisciplinary field that combines the methods and findings found in both the earth sciences and the life sciences. Paleobiology is not to be confused with geobiology, which focuses more on the interactions between the biosphere and the physical Earth. Paleobiological research uses biological field research of current biota and of fossils millions of years old to answer questions about the molecular evolution and the evolutionary history of life. In this scientific quest, macrofossils, microfossils and trace fossils are typically analyzed. An investigator in this field is known as a paleobiologist.

Paleoanthropology, the study of human origins and evolution, focuses on the tiny slice of biological history that has occurred since the divergence of human and chimpanzee lineages from their common ancestor. Paleoanthropologists have unearthed fossils of approximately 20 species of extinct hominins, species that are more closely related to humans than to chimpanzees and are therefore on the human branch of the evolutionary tree. These fossils have shown that many of the characters that distinguish humans from other apes were present in earlier hominins; they are not unique to Homo sapiens. Thousands of hominin fossils have been discovered, and each new find sheds light on the story of human evolution.

Paleontology, the scientific study of life of the geologic past that involves the analysis of plant and animal fossils, including those of microscopic size, preserved in rocks. It is concerned with all aspects of the biology of ancient life forms: their shape and structure, evolutionary patterns, taxonomic relationships with each other and with modern living species, geographic distribution, and interrelationships with the environment. Paleontology is mutually interdependent with stratigraphy and historical geology because fossils constitute a major means by which sedimentary strata are identified and correlated with one another. Its methods of investigation include that of biometry (statistical analysis applied to biology), which is designed to provide a description of the forms of organisms statistically and the expression of taxonomic relationships quantitatively. Paleontology has played a key role in

reconstructing Earth's history and has provided much evidence to support the theory of evolution. Data from paleontological studies, moreover, have aided petroleum geologists in locating deposits of oil and natural gas. The occurrence of such fossil fuels is frequently associated with the presence of the remains of certain ancient life-forms. Often, fossils formed when plants or animals died in mud, sand, or clay. They became covered with more mud, sand, or clay. Over time, the area where the living thing died became compressed or packed down. It hardened into a type of rock called sedimentary rock. In a similar way, fossils are forming today at the bottoms of lakes, streams, and oceans. Fossils are also found frozen in ice or hardened into a tree sap called amber. Most fossils, though, are found in sedimentary rock. When scientists discover a fossil, they want to know how old it is. There are several ways to figure out the age of fossils. One is a method called relative dating. Sedimentary rocks form in layers, with new or younger layers added on top of older layers. Fossils in lower layers are thought to be older than fossils in higher layers This does not tell scientists the exact age of the fossil. However, it does tell scientists the fossil's age in relation to other fossils above it or below it.

To find the specific age of a fossil or rock, scientists use radiometric dating techniques. These methods measure the rate of decay, or breakdown, of radioactive isotopes within the rocks. Sedimentary rocks cannot be dated this way. For that reason, scientists use other kinds of rocks that are near the sedimentary rocks. A radioactive isotope is an atom with an unstable nucleus. The nucleus breaks down, or decays, over time, giving off radiation. When the nucleus is completely decayed, a new radioactive isotope has formed. Scientists use the decay rate like a clock. Scientists try to find out the age of a rock by comparing the amount of radioactive isotope it contains and the amount of new isotope it forms after decaying. Let's say there is a rock that contains a radioactive isotope that decays to half its original amount in one million years. That means that the half-life of that particular isotope is one million years. If the rock has equal amounts of the original isotope and the new isotope, it must be one million years old. The two most common isotopes that scientists use to date fossils and rocks are potassium-40 and carbon-14. Both are radioactive isotopes.

(Based on Biology - The Dynamics of Life. – Glencoe Science, 2005, p. 151-158;https://www.britannica.com/science/paleontology;
https://en.wikipedia.org/wiki/Paleobiology)

AFTER READING

4. Answer the following questions.

1. Who discovered paleobiology?
2. Who was the father of modern paleobiology?
3. What is the difference between paleobiology and geobiology?
4. What does paleobiologist study?
5. What do you know about paleoanthropology?
6. What does paleoanthropologist study?
7. What does fossil's age tell?
8. What is the method of rock exploration?
9. What are the most common isotopes that scientists use to date fossils?
10. What methods of rock exploration can you name?

5. Decide if these statements are true, false or not stated. Explain your opinion according to the text.

1. Thousands of apes fossils have been discovered, and each new find sheds light on the story of human evolution.
2. Fossils are the remains of plants, animals, fungi, bacteria, and single-celled living things that have been replaced by rock material or impressions of organisms preserved in rock.
3. Professor Charles Schuchert proposed the term in 1904 so as to initiate "a broad new science" joining "traditional paleontology with the evidence and insights of geology and isotopic chemistry.
4. Paleontological research uses biological field research of current biota and of fossils millions of years old to answer questions about the molecular evolution and the evolutionary history of life.
5. Most fossils, though, are found in sedimentary rock.
6. Paleobotanists study the fossils of ancient plants. These fossils can be impressions of plants left on rock surfaces, or they can be parts of the plants themselves, such as leaves and seeds, that have been preserved by rock material.
7. In this scientific quest, macrofossils, microfossils and trace fossils are typically analyzed.
8. The behavior of organisms can also be deduced from fossil evidence.
9. Baron Franz Nopcsa was the founder or "father" of modern paleoanthropology.
10. Micropaleontology is the study of fossils of microscopic organisms, such as protists, algae, tiny crustaceans, and pollen.

6. Give Russian equivalents for the following words and word combinations. Write down the sentences of your own.

The earth sciences, the sedimentary rocks, the specific age, the rate of decay, ancient life form, reconstructing Earth's history, preserved in rocks, evolutionary pattern, sedimentary strata, the fossil's age

7. Match the words with their definitions.

1	geobiology	A	the animals and plants living in a particular place, time, or habitat (= one type of natural environment
2	paleobiology	B	the study of fossils (= the parts of dead animals or plants in rocks) as a guide to the history of life on earth
3	paleontology	C	a relatively new scientific field that incorporates earth sciences and biology to investigate how the physical Earth affects and interacts with the biosphere
4	paleophysiology	D	the use of detailed information about someone's body, for example the patterns of colour in their eyes, in order to prove who they are
5	biota	E	a layer that has formed under the ground, especially over a long period
6	biometrics	F	wet, sticky earth
7	deposit	G	the dry solid part of the earth's surface, or any large piece of this that sticks up out of the ground or the sea
8	mud	H	a human, or an early form of human
9	rock	I	the scientific study of the evolutionary basis of animal physiology
10	hominin	J	an interdisciplinary field that combines the methods and findings found in both the earth sciences and the life sciences

8. Find the equivalents for the following words in the text.

petrifaction, creator, destruction, researcher, stratum, confirmation, development, deviation, forefather, sphere/direction

9. Render the text using the plan in Appendix 3.

LISTENING

10. Check your understanding: match the definition with the correct word.

1	icecap melting	A	the round hole at the top of a volcano, or a hole in the ground similar to this
2	geophysicist	B	a soft substance that is like a wet powder and consists of very small pieces of a solid material that have fallen to the bottom of a liquid
3	earthquake	C	become liquid due to an overall increase in the average temperature on Earth
4	sediment	D	a level of material, such as a type of rock or gas, that is different from the material above or below it, or a thin sheet of a substance
5	crater	E.	a small piece or amount of something that is left from a larger original piece or amount
6	layer	F	to destroy something completely
7	remnant	G	a type of reptile that became extinct about 65,000,000 years ago. There were many different types of dinosaur, some of which were extremely large
8	wipe out	H	the way something is naturally made of dry solid part of the earth's surface
9	dinosaur	I	a sudden violent movement of the earth's surface, sometimes causing great damage
10	rock formation	J	a person who studies geophysics

11. Listen to the recording. Try to understand the general idea and fill in the gaps.

Icecap melting, geophysicist, earthquake, sediment, crater, layer, remnant, wipe out, dinosaur, rock formation.

Scientists say they have unearthed details of how the 1. _____ were 2. _____ 65 million years ago. A team of 3. _____ is analyzing 4. _____ in a crater under the seabed off Mexico. The rocks contain the 5. _____of the cataclysmic aftermath of a gigantic asteroid impacting with Earth. The scientists say the 6. _____ of rock they have extracted reveal a step-by-step account of the destruction that happened after the impact as rock and 7. _____ settled on top of each other in revealing layers.

Geophysicist Jay Melosh from Purdue University said: "It tells us what went on inside the 8. _____ on that day of doom that killed the dinosaurs. All of this mayhem is directly recorded in the core."

Scientists say the asteroid was around three to four kilometers wide. It smashed into the ocean and created a hole 160kms wide and 20kms deep. This triggered a chain reaction of 9. _____, tsunami, 10. _____, landslides and fires that forever changed the geology and life forms on Earth, killing off the dinosaurs. The asteroid's impact hurled out rock and minerals and created a massive crater. Molten rock fell back into the crater, which was then filled with ocean water from tidal waves. This water was full of soil, vegetation, animal life and other debris, all of which settled in layers ready for scientists to analyze millions of years later. The scientists say this layer-forming process took just a few hours.

(Based on https://breakingnewsenglish.com/1909/190912-dinosaurs-5l.html)

SPEAKING

12. Share your view with the rest of the class on the following scientific fact.

Scientists hypothesize that two things happened before life could appear on Earth. The first is that there had to be organic molecules, molecules containing carbon. The second is that the organic molecules must have formed into more complex molecules such as proteins, carbohydrates, and nucleic acids. These are the materials that are absolutely necessary for life. Scientists think that the early atmosphere of Earth did not contain any free oxygen. Instead, the atmosphere was made of water vapor, carbon dioxide, nitrogen, methane, and ammonia. How did this mixture combine and form the organic molecules that are found in all living things today?

(Based on: Biology - The Dynamics of Life. – Glencoe Science, 2005, p.159)

13. Choose one of the topics to make a report and present it in front of the class.

1. Modern paleontology.
2. Paleoanthropology.
3. Paleozoology.
4. History of paleobiology.
5. Paleoecology.

APPENDIX A. GLOSSARY

A

agnathan (n) (superclass Agnatha), any member of the group of primitive jawless fishes that includes the lampreys (order Petromyzoniformes), hagfishes (order Myxiniformes), and several extinct groups.

amniotic (adj) related to the bag and liquid that surround the embryo (developing young animal) of a mammal, bird, or reptile inside its mother.

anestrus (n) the period of sexual quiescence between two periods of sexual activity in cyclically breeding mammals.

B

beak (n) also called Bill, stiff, projecting oral structure of certain animals.

biometrics (n) the use of detailed information about someone's body, for example the patterns of colour in their eyes, in order to prove who they are

biota (n) the animals and plants living in a particular place, time, or habitat (= one type of natural environment).

biotechnology (n) the use of living things, especially cells and bacteria, in industrial processes.

biotic (adj) relating to living things in the environment.

bladder (n), membranous sac in animals that serves as the receptacle of a fluid or gas.

breeding (n) the process of sexual reproduction, typically plants or animals, to produce offspring.

brooding (n) pattern of behaviour of certain egg-laying animals, especially birds, marked by cessation of egg laying and readiness to sit on and incubate eggs.

C

caecilian (n) any of an order (Gymnophiona) of chiefly tropical burrowing limbless amphibians resembling worms

carnivore (n) плотоядное животное; хищное млекопитающее

cartilaginous (adj) having a skeleton composed either entirely or mainly of cartilage, as vertebrates of the class Chondrichthyes, which includes the sharks, rays, and skates.

clavicle (n) curved anterior bone of the shoulder (pectoral) girdle in vertebrates

cloning (n) the process of generating a genetically identical copy of a cell or an organism. Cloning happens often in nature – for example, when a cell replicates itself asexually without any genetic alteration or recombination.

CRISPR technology (**clustered regularly interspaced short palindromic repeats)** short palindromic repeating sequences of DNA, found in most bacterial genomes, that are interrupted by so-called spacer elements, or spacers – sequences of genetic code derived from the genomes of previously encountered bacterial pathogens.
cutaneous (adj) relating to, or affecting the skin

D

deduction the process of reaching a decision or answer by thinking about the known facts, or the decision that is reached
de-extinction (n) also called resurrection biology, the process of resurrecting species that have died out, or gone extinct.
diurnal (adj) active chiefly in the daytime
DNA sequencing technique used to determine the nucleotide sequence of DNA (deoxyribonucleic acid).
dormancy (n) state of reduced metabolic activity adopted by many organisms under conditions of environmental stress or, often, as in winter, when such stressful conditions are likely to appear.

E

earthquake (n) a sudden violent movement of the earth's surface, sometimes causing great damage.
ectotherm (n) any so-called cold-blooded animal – that is, any animal whose regulation of body temperature depends on external sources, such as sunlight or a heated rock surface.
endotherm (n) warm-blooded animals; that is, those that maintain a constant body temperature independent of the environment.
estrus (adj) the period in the sexual cycle of female mammals, except the higher primates, during which they are in heat – i.e., ready to accept a male and to mate.
estivation (n) the state or condition of torpidity or dormancy induced by the heat and dryness of summer.
extinct (adj) no longer existing.

F

feather (n) the component structure of the outer covering and flight surfaces of all modern birds.

fertilization (n) union of a sperm nucleus, of paternal origin, with an egg nucleus, of maternal origin, to form the primary nucleus of an embryo.
fetal (adj) relating to a fetus (a young human being or animal before birth).
fossil (n) the parts of a dead animal or a plant that have become hard and turned into rock.

G
gene editing (n) the ability to make highly specific changes in the DNA sequence of a living organism, essentially customizing its genetic makeup.
genetically modified organism (GMO), organism whose genome has been engineered in the laboratory in order to favour the expression of desired physiological traits or the generation of desired biological products.
gestation (n) (in mammals) the time between conception and birth, during which the embryo or fetus is developing in the uterus.

H
habitat (n) place where an organism or a community of organisms' lives, including all living and nonliving factors or conditions of the surrounding environment.
to hatch (v) to (cause an egg to) break in order to allow a young animal to come out.
herbivore (n) animal adapted to subsist solely on plant tissues/
hibernation (n) a state of greatly reduced metabolic activity and lowered body temperature adopted by certain mammals as an adaptation to adverse winter conditions.
hypothesis (n) an idea or explanation for something that is based on known facts but has not yet been proved.

I
icecap melting become liquid due to an overall increase in the average temperature on Earth.
incubation (n) the maintenance of uniform conditions of temperature and humidity to ensure the development of eggs or, under laboratory conditions, of certain experimental organisms, especially bacteria.
induction (n) the process of discovering a general principle from a set of facts.
invertebrate (n) any animal that lacks a vertebral column, or backbone, in contrast to the cartilaginous or bony vertebrates.
iPSC method, induced pluripotent stem cells (also known as iPS cells or iPSCs) are a type of pluripotent stem cell that can be generated directly from a somatic cell.

K

keel (n) the breastbone of a bird or the lower two petals of a pea flower) that is like a ship's keel in form or use

L

lamprey (n) agnathan vertebrate, any of about 43 species of primitive fishlike jawless vertebrates placed with hagfishes in the class Agnatha.

limb (n) arm, in zoology, either of the forelimbs or upper limbs of ordinarily bipedal vertebrates, particularly humans and other primates.

M

mandible (n) in a person or animal, the lower jaw bone

marsupial (n) any of more than 250 species belonging to the infraclass Metatheria (sometimes called Marsupialia), a mammalian group characterized by premature birth and continued development of the newborn while attached to the nipples on the mother's lower belly.

molt (n) biological process of molting (moulting) – i.e., the shedding or casting off of an outer layer or covering and the formation of its replacement.

N

nocturnal (adj) being active or happening at night rather than during the day.

notochord (n) flexible rodlike structure of mesodermal cells that is the principal longitudinal structural element of chordates and of the early embryo of vertebrates, in both of which it plays an organizational role in nervous system development.

O

operculum (n) gill cover.

osteichthyes (n) bony fish.

P

paleontology (n) the study of fossils (= the parts of dead animals or plants in rocks) as a guide to the history of life on earth.

plumage (n) collective feathered covering of a bird. It provides protection, insulation, and adornment and also helps streamline and soften body contours, reducing friction in air and water.

pollination (n) the process in which pollen is taken from one plant or part of a plant to another so that new plant seeds can be produced.
polymerase chain reaction (PCR) a technique used to make numerous copies of a specific segment of DNA quickly and accurately.
progeny (n) the young or offspring of a person, animal, or plant.
proteomics (n) the large-scale study of proteins.

R

recombination (n) a process by which pieces of DNA are broken and recombined to produce new combinations of alleles. This recombination process creates genetic diversity at the level of genes that reflects differences in the DNA sequences of different organisms.
recombinant DNA technology the joining together of DNA molecules from two different species (molecules of DNA from two different species that are inserted into a host organism to produce new genetic combinations that are of value to science, medicine, agriculture, and industry).
remnant (n) a small piece or amount of something that is left from a larger original piece or amount.
retina (n) layer of nervous tissue that covers the inside of the back two-thirds of the eyeball, in which stimulation by light occurs, initiating the sensation of vision.

S

secretion (n) production and release of a useful substance by a gland or cell; also, the substance produced.
segregation (n) the act of separating people or things from a larger group.
sequencing (n) the process of discovering the order in which nucleotides (chemical substances) are combined within DNA.
scale (n) a small plate or shield forming part of the outer skin layers of certain animals.
somatic cell nuclear transfer (SCNT) technique in which the nucleus of a somatic (body) cell is transferred to the cytoplasm of an enucleated egg (an egg that has had its own nucleus removed).
sternum (n) the flat bone in the middle of the chest.
T
tetrapod (n) a vertebrate (such as an amphibian, a bird, or a mammal) with two pairs of limbs.

V

viviparous (adj) giving birth to young that have already developed inside the mother's body, rather than producing eggs.

W

web (n) the skin connecting the toes of some birds and other animals living by or on water that helps them when swimming.

whole genome sequencing the act of deducing the complete nucleic acid sequence of the genetic code, or genome, of an organism or organelle (specifically, the mitochondrion or chloroplast).

womb (n) the organ in the body of a woman or other female mammal in which a baby develops before birth.

X

X-ray diffraction techniques is a technique for analysing the atomic or molecular structure of materials.

Z

zygote (n) a single cell that develops into a person or animal, formed by the joining together of a male and a female gamete (= a cell that is provided by each parent).

APPENDIX B. SCIENTIFIC ROOT WORDS, PREFIXES AND SUFFIXES

ROOTS

The Latin roots *vit* and *viv* mean "life". The word *vitamin*, for example, means "a substance needed by the body for normal growth and health."

1. Read the list of words containing *vit* or *viv*. Then write a letter to match each word with its meaning. Use a dictionary if you need help.

a. _____ **survive** a. clear; bright; strong
b. _____ **vital** b. lively, spirited, energetic
c. _____ **vivid** c. to continue to live or exist
d. _____ **vivacious** d. necessary to life
e. _____ **revival** e. act of bringing back to life

2. Write sentences of your own, using the five boldface words above.

The Greek root *gen* means "birth".

3. Draw a line to match each word on the left with its meaning on the right.
a. **generation** a. children or offspring
b. **genealogy** b. to renew or give new life to
c. **regenerate** c. all the people born about the same time
d. **progeny** d. a family tree or list of ancestors

4. Write sentences of your own, using the five boldface words above.

The Greek root *therm*, meaning "heat" appears in a number of English words.

5. Complete each sentence with a familiar English word containing this root. Add consonants to complete the words.
a. __ __ e __ __ a __ underwear helps to hold in body heat.
b. Taylor's __ __ e __ __ o __ bottle keeps her vegetable soup hot until lunchtime.
c. Bradley uses the __ __ e __ __ o __ __ a __ to turn the furnace

on and off.
d. If the __ __ e __ __ o __ e __ e __ reading is 100°, you have a fever.

The Greek root *meter* means "measure".

6. Add consonants to complete the words containing this root.
a. The __ i a __ e __ e __ of a circle is a straight line passing through its center.
b. A unit of length called a __ e __ __ i ___ e __ e __ is one one-hundredth of a meter.
c. Because it measures atmospheric pressure, a __ a __ o __ e __ e __ is used to help forecast the weather.
d. An aircraft's a __ __ i __ e __ e __ shows height above sea level.

PREFIXES

The prefix *kilo-* means "thousand" and the prefix *mega-* means "million".

7. Use this information to help you complete the following sentences.
a. The word *kilometer* must mean _____ *meters*.
b. A _____ must be equal to one million *tons*.
c. A _____ must be one one-millionth of a *megaton*.
d. A *megawatt* of electrical power must be equal to one million _____.
e. Something that weighs one *kilogram* must be equal to _____ *grams*.
f. A *megabyte* must be equal to one million _____ of computer memory.

The prefix *dis-* has three meanings: (1) away, away from, or out of; (2) the opposite of; (3) to fail, stop, or refuse to.

8. Read the words listed below. Then write 1, 2, or 3 to show the meaning of the prefix in that word. If you're not sure, check a dictionary.
1. _____ disbelief 6. _____ disregard
2. _____ dislocate 7. _____ dissatisfied

3. _____ disagree 8. _____ disqualified
4. _____ dishonest 9. _____ disown
5. _____ displace 10. _____ disobey

The prefix *inter-* means "between," and the prefix *off-* means "away from".

9. Write a word from the reading that begins with each prefix.

a. _____ _____

Now replace each scrambled word in the sentences below with a new word that begins with *inter-* or *off-*. The first one has been done for you.

b. Tom said the tree house is MILSTI _____ until he repairs the floor.

c. That science fiction story is about TALCGAIC _____ warfare in outer space.

d. The actor waited GATES _____ until he heard his cue.

e. Route 66 is a well-known ETAST _____ highway.

The prefix *mid-* means "middle or middle part".

10. Complete the sentences below with a word beginning with *mid-*. Use a dictionary if you need help.

a. The two small planes met in a _____ collision.

b. _____ is the halfway point between dusk and dawn.

c. Chicago, Illinois and Omaha, Nebraska are _____cities.

d. Students take _____ tests halfway through the semester.

e. The cafeteria serves lunch at _____.

SUFFIXES

SUFFIXES MEANING "one who".

In the reading, the suffix *-ist* changes the word *botany* (the science of plants) into *botanist* – one who practices botany. But many other suffixes are also used to show "one who does, practices, or works with" something.

12. Complete the sentences with words that contain the suffixes in the box. Check a dictionary if you need help.

Ex.: A scientist who studies matter, energy, and force is called a *physicist.*

-ist -ian -ant -or -er -ar -ent

a. An _____ practices art.
b. A _____ is one who paints.
c. One who assists is an _____.
d. One who begs is a _____.
e. An _____ is one who edits.
f. One who resides is a _____.
g. One who practices magic is a _____.
h. An _____ is one who acts.

SUFFIXES. WORD FORMATION

13. What word form will correctly complete each phrase? Rewrite each boldface word, adding the correct suffix.

1. **hazard** _____ waste site
2. signed an **agree** _____
3. measure temperature **fast** _____
4. new **digit** _____ thermometers

Suffixes can be used to turn many words into adjectives (describing words).

14. Rewrite the words below. Make them adjectives by adding one of these suffixes: *-y, -ic, -al,* or *-ful*.

1. dream _____ 5. history _____
2. music _____ 6. guilt _____
3. peace _____ 7. atmosphere _____
4. ice _____ 8. environment _____

(Retrived from: https://hashemadnan.files.wordpress.com/2016/03/vocabulary-science-and-technology.pdf)

APPENDIX C. SIGNPOSTING LANGUAGE

The language of presentations

Introduction
Good morning, everyone.
Thank you for inviting me to speak on…
Today I am going to talk about…

Introducing your talk
I would like to start by…
I shall begin by…
Then I will speak about…
Thirdly I will talk about…
And lastly…

The main part of the talk
Let us begin with…
However, …
As far as ….is concerned…
Moving on to…
My third point deals with …
And last but not least…

Summing up/conclusion
So, in conclusion, you can see that…

Saying thank you and ending your talk
Thank you all for listening so attentively.
I hope I have been able to tell you a little about…
Before I sit down, I would first like to thank …for…
Does anyone have any questions?

Recommendations for preparing a PowerPoint presentation

- Use visual aids (incorporate photos or videos in your slides)
- Make sure things are cohesive and logical
- Don’t read everything off the slide
- Follow the 10-20-30 rule (the best slideshow presentations are less than 10 slides, last no longer than 20 minutes, and use a font size of 30)
- Smile and make eye contact with the audience

The plan for rendering the text

	Expressions for rendering the text
1. About the text (title, author, story)	I have read the text about … The title of the text is… The author of the text is …. The text is taken from...
2. The main idea	The main idea of the text is …
3. The contents (facts, names, characters, plot, parts, conclusion)	The author starts telling the readers about/that… The author writes/thinks that … The text describes… According to the text… The text can be divided into … parts The first/second/third part tells/describes/states … In conclusion I can say … The author comes to the conclusion…
4. Your opinion of the text	I find the text interesting (uninteresting, important, boring, useful, informative, worth of reading, worth of studying, hard for reading) because it is … I think that … I suppose (that) … I agree/disagree with the author … I am of the same opinion as the author… I am sure/ am not sure To/in my mind To/in my opinion

APPENDIX D. AUDIOSCRIPTS

Unit 1. THE SCIENCE OF BIOLOGY AND THE SCIENTIFIC METHOD

In today's lecture we're going to be talking about experiments, and I thought it might be interesting for you all to learn about the world's oldest continuously running laboratory experiment that is still going today. In fact, it holds the Guinness World Record for being the longest-running experiment. This experiment began in 1927 and has been going ever since. It's called the 'pitch drop' experiment and it was created by Professor Thomas Parnell at the University of Queensland, Australia. Parnell was the university's first physics professor, and he wanted to show in this experiment that everyday materials, such as pitch, can have quite surprising properties. You see, when pitch is at room temperature, it feels solid. You can easily break it with a hammer.

However, it isn't in fact solid. At room temperature, pitch is many billions of times more viscous than water, but it's actually fluid. In 1927, Professor Parnell took a sample of pitch. He heated it and poured it into a glass funnel. He allowed the pitch to cool and settle – for three years. He then turned the funnel upside down and cut the top off it. Since then, the pitch has slowly dropped out of the funnel. How slowly? Well, the first drop took eight years to fall. It took another forty years for another five drops to fall. Today it's been almost 90 years since the experiment started. Only nine drops have fallen from the funnel. The last drop fell in April 2014 and the next one is expected to fall in the 2020s. The experiment has a tragic story associated with it.

Professor Parnell died without seeing a pitch drop. His replacement, Professor John Mainstone, became responsible for the pitch drop experiment from 1961. He held the job for 52 years, and missed seeing the drop fall three times – by a day in 1977, by just five minutes in 1988 and finally in 2000, when the webcam that was recording the experiment suffered a power outage for 20 minutes, during which time the pitch dropped. The pitch drop experiment is something we can all participate in now. There's a live web stream that allows anyone to watch the glass funnel and wait for the fateful moment. A similar experiment to the Queensland pitch drop was set up in Dublin, and the video of the moment the pitch actually dropped went viral on the internet. It's interesting to see how a very slow event can spread news so quickly.

Unit 2. BIOLOGY IN THE 20TH AND 21ST SENTURIES

Extinction May Not Be Forever

De-extinction. What if plants and animal species wiped out of existence could be brought back? That's the novel notion springing from recent advances in synthetic biology.

The idea is simple. Find samples, like the mummified passenger pigeon discovered recently in a museum desk drawer, and collect its DNA. Compare said DNA to that of its closest living relatives to see what specific genes make a passenger pigeon unique. Then splice those crucial genes into the living relative's DNA strands to produce a genetic copy of the extinct animal. Resurrection.

The restoration potential is not limited to plants and animals that we have just recently eliminated. We could also potentially bring back species like woolly mammoths or saber-tooth cats. Not dinosaurs though, since DNA has a half-life of just 521 years or so.

Of course, successfully bringing back the mammoth might also require restoration of its habitat, so it has a home to roam. But even without the reappearance of charismatic megafauna, such techniques will find uses from agriculture to injecting a bit more genetic diversity into dwindling populations of endangered species. The biggest contribution of the new biotechnology may not be de-extinction, but preventing extinction in the first place.

Unit 3. BIOTECHNOLOGY AND GENETIC ENGINEERING

Shopping Carts Covered in Bacteria (5th March, 2011)

A new study into the hygiene of supermarkets has found that shopping carts are dirtier than the store’s bathrooms. Microbiologist Dr Charles Gerba of the University of Arizona conducted research on the handles of 85 carts in four American states. He reportedly found bacteria from human waste on the handles of 72 per cent of them. "That's more than you find in a supermarket's toilet," Dr Gerba said. He explained: "That's because stores use disinfecting cleaners in the restrooms. Nobody seems to routinely clean and disinfect shopping carts." Further, half of the carts in Dr Gerba’s study tested positive for E. coli bacteria, a nasty germ that can cause diarrhoea, vomiting and serious infection.

Professor Gerba is known as “Dr Germ” because of the number of studies he has done on bacteria and everyday objects. His previous studies warned of bacteria on reusable shopping bags, airplane seat-back trays, ground-floor elevator buttons, water fountain toggles, computer keyboards, iPads and playground equipment. He said just about anything touched by children has a high chance of contamination. He advised

people to wash reusable shopping bags after use, otherwise they'll become full of "bacterial swamps". He added: "It's like wearing the same underwear every day." Gerba said the best way to avoid getting sick from shopping trolleys is to wipe the handle with a disinfectant cloth and wash your hands often.

Unit 4. INHERITANCE

I'd like to turn now to the object which is the main point of this talk: the helix. This is a fascinating mathematical object which touches many parts of our lives. Movement, the natural world, the manufactured world and our genetic make-up are all connected to the shape of the helix.

A helix is a type of three-dimensional curve that goes around a central cylindrical shape in the form of a spiral, like a corkscrew or a spiral staircase. The helix is a very popular shape in nature because it is very compact. In fact, helices are sometimes referred to as 'nature's space saver'. In architecture too, the helix shape of a spiral staircase is an attractive option in buildings where space is very restricted.

The most renowned type of helix is probably the double helix of DNA, or deoxyribonucleic acid. DNA is made of two helices that curve around each other, a bit like a twisted ladder. DNA contains the genetic information or 'code' that determines the development and functioning of all known living things. The helix shape is a very efficient way to store a long molecule like DNA in the limited space of a cell.

There are different types of helices. Helices can twist clockwise, right-handed, or anti-clockwise, left-handed. An interesting experiment is to hold a clockwise helix, such as a corkscrew, up to a mirror. The clockwise helix appears to become counterclockwise.

We can perceive examples of helices in many areas of our world. Spiral staircases, cables, screws and ropes can be right-handed or left-handed helices. A helix that goes around a cone is called a conical helix. Examples of conical helices are screws or the famous spiral ramp designed by the architect Frank Lloyd Wright in the Guggenheim Museum in New York.

Helices are also prevalent in the natural world. The horns of certain animals, viruses, seashells and the structure of plants, flowers and leaves can all contain helices. The human umbilical cord is in fact a triple helix.

With the discovery that the helix is the shape of the DNA molecule, it is not surprising that the helix is found in so many areas. It's one of the most natural shapes in nature. Let's turn our attention now to the mathematical description of the helix. You'll need a pen and paper for the next part of the talk as I am going to give you some variables to write down. Take your time to notice the different.

Unit 6. CELL DIVISION

Cutting chromosomes gives clues to cell division

When we need new cells in our body, for example, to replace dead or damaged cells, they don't just appear from nowhere - they are created by the division of one cell into two new daughters. This process is called mitosis. Now scientists at the University of Michigan have used a clever laser technique to get an even closer insight into how mitosis works, and how it might go wrong in diseases like cancer, where cells divide out of control.

Normally in mitosis, cells copy all their DNA, then line up these two sets of chromosomes in the middle of the cell, thanks to a microscopic scaffold-like structure called the spindle. The spindle grows from each side of the cell, and attaches to the chromosomes, eventually pulling them apart in opposite directions. If this goes wrong, then the new daughter cells may end up with the wrong number of chromosomes, which is bad news for the cell.

For many years, researchers have tried to understand how the cell manages to divide its chromosomes equally between daughters, and now new research in this week's edition of Current Biology by Alan Hunt and his team may help to explain why. The Michigan team used high speed lasers to slice off tiny pieces of chromosomes from within living, dividing newt cells, and watched what happened. The pulses of laser light lasted for only a femtosecond -a billionth of a millionth of a second, but they were enough to cut the chromosomes.

Previously, researchers have though that something called 'polar ejection forces' are at working in dividing cells, helping to maintain the pull across the spindle, and ensure that an equal number of chromosomes go to each new cell. Hunt suspected that these forces should be directly related to the size of the chromosomes, so cutting off measurable pieces should have proportionally measurable effects on cell division - and that's what they found. They also discovered that these polar ejection forces are an important physical cue that helps to directly control mitosis, and the direction of chromosome movements.

Not only does this discovery shed light on cancer - and on chemotherapy, which often works by blocking mitosis in cancer cells - but it could also help us to understand genetic diseases such as Down's Syndrome, which are caused by an incorrect number of chromosomes during egg formation.

Unit 7. ACELLULAR ENTITIES

Do viruses prey on other viruses?

Question

I saw online this claim and haven't fact checked it. So, take this with a pinch of salt. It says there's an estimated one followed by 31 zeros of individual viruses on earth. Now that's a big number, but as the old saying goes, even fleas have fleas. So, are there viruses that prey on viruses?

Answer

Jonathan - Yeah. So, I think that number is correct. I saw it quoted in nature microbiology too, and I found an interesting fact that if you lay all of the viruses on earth end to end, they would stretch for a hundred million light years.

Chris - I mean, that's really saying something when we're talking about a flu virus which is one 10,000th of a millimeter across. So, that's a lot of viruses, isn't it?

Jonathan - Yeah, I think it's so hard to get one's head around both the size of viruses, but also the enormous number of viruses in the world. So, you know, for example, it might be easier to conceptualize. If you take a liter of seawater, it's a hundred billion virus particles in that liter. Or if you take a kilogram of soil from the earth, there's about a trillion. So that's a million million virus particles in just a kilo of soil. It's just absolutely mind blowing. But I think the thing to remember is that animals and plants and fungi, although they dominate our view of what the tree of life is, they only actually kind of represent a tiny, tiny amount of the tree of life. The vast majority of species are bacteria and archaea. So, kind of single celled organisms on the whole, and only a few twigs of the tree of life really are made up of complex life like animals, fungi and plants. So, I saw some studies where it says that there's less than 10 million species of complex life, but there's about 1 trillion types of bacteria and archaea. So, it's really, it's really mind blowing. And you might say, oh, well these are just tiny little insignificant things. But actually, if you took all the bacteria on the planet and weighed the mass of them, they would weigh a hundred times more than all the humans on the planet. So, they're still really, really significant. But to come back to the question, the vast majority of viruses are viruses that infect bacteria. So what we call bacteriophage, phages from the Greek to devour. And these actually play an enormously important role in the way the whole ecosystem works because they kill an estimated 20 to 40% of bacteria on the planet every single day. And this allows the world or the ecosystem to maintain its balance. So, yeah super important. But viruses can play positive as well as kind of disease carrying roles.

Chris - Well, we talked the other day in our program about tuberculosis, about the use of these bacteria phages to kill those TB bugs. But returning to the question

which are the viruses that prey on viruses? They have been discovered, haven't they? There are so-called viral phages. There are viruses that piggyback on other viruses and infect viruses. So, when a virus is growing in a cell, you can get another virus that comes in and gets into the process and steals some of the resources the other virus is making for itself. So, it can basically parasitize a parasite. Yeah, so viruses are incredible things, aren't they?

Jonathan - Mind blowing, mind blowing stuff.

Chris - Yeah. Thank you very much, John.

Unit 8. BACTERIA AND ARCHAEA

Bacteria block cancer chemotherapy.

Interview with Ravid Straussman, Weizmann Institute.

Ravid - They can either come from the bloodstream, the tumours, or because we were exploring pancreatic cancers, they might come from the gastrointestinal tract. We can see them in different methods, we can characterise them, we know which bacteria they are, and we know it can really affect the sensitivity of these cancer cells to chemotherapy.

Chris - How do you know that it is the bacteria that are doing that and it’s not just that the bacteria are there like a bystander because you’ve got abnormal cancer tissue, the bacteria has settled there, and they’ve got nothing to do with the resistance to the drugs?

Ravid - We know in the laboratory that when we take cancer cells and we put chemotherapy on them it’s really easy to kill them but, when we add specific types of bacteria into this culture of cancer cells, the cancer cells become completely resistant to chemotherapy. We found that bacteria can inactivate the drug by cutting it. We also can show with mice models with a cancer and bacteria, the cancer of the mice becomes completely resistant to chemotherapy. But, if you treat these mice with antibiotics, then you can re-sensitise these tumours to chemotherapy.

We do see the same bacteria in human patients. We know that this bacteria have the genes they need to degrade the drug but it’s hard to know what would be the effect of eradicating these bacteria from human tumours.

Chris - So your hypothesis is that people who don’t respond very well to their chemotherapy or develop drug resistance, at least a subset of those patients may well have tumours in which they’ve got bacteria in the tumour and the bacteria are breaking down the chemotherapy drugs so that they don’t kill the cancer cells?

Ravid - Right. We profiled the 113 pancreatic patients and we found bacteria in the majority of them. Bacteria were found between the cells and even inside the

cancerous cells and we know, as we said before, that these bacteria have the right capacity to degrade gemcitabine. From here one can only postulate that if you have bacteria inside the cancerous cell and it can degrade gemcitabine, probably it is going to protect the cancerous cells from chemotherapy, but someone would need to do clinical trials in order to validate how important this mechanism really is.

Chris - What specifically where the bugs that you found?

Ravid - We found many bugs, many types of bacteria; some of these you know like e coli or salmonella. The one thing in common to all these bacteria were that they all have a specific enzyme called CDD, which stands for Cytidine Deaminase, and can come in a short or long isoform. We found that only bacteria with the long isoform of CDD can degrade the drug gemcitabine. When we looked into these patients, in the tumours of these patients, we found that many of them have the bacteria of long CDD isoform.

Chris - So that means that particular flavor is capable of breaking down the drug, it's in those bacteria, so it puts the weapon, the smoking gun, at the scene of the crime and in the hand of the bacterial criminal, doesn't it?

Ravid - Yes. We also isolated these bacteria and were able to demonstrate that bacteria isolated from pancreatic cancer patients, from the pancreatic tumours, can degrade gemcitabine that we add in the lab to these cells.

Chris - What about doing the experiment where you take tumours and add bacteria to those tumours that have this drug degrading ability, can you then confer on the cancer resistance to the chemotherapy by adding only the bacteria?

Ravid - We did a few of these experiments. We took mice models of cancer, and if we put inside the bacteria with the long CDD isoform, these mice models of cancer become completely resistant to therapy. Then, if we treat them with antibiotics, together with gemcitabine, then we can make these tumours go away. Another type of experiment that we did, we took mice models of cancer, put bacteria inside of them, but we changed one very small piece in the DNA of these bacteria making CDD positive bacteria into these CDD negative bacteria. Then, all of a sudden, these mice are responding to chemotherapy.

Unit 9. PROTISTS

What have marine microbes ever done for us?

Our lives ultimately depend upon some of the smallest life forms on Earth - the constituents of the ocean microbiome.

Our lives ultimately depend upon some of the smallest life forms on Earth - the constituents of the ocean microbiome. But what microbes are there in the sea, what are

they doing there, and how do they impact us? Katie Haylor spoke to Michael Cunliffe from the University of Plymouth and the Marine Biological Association...

Michael - When you first look at seawater, it's this translucent liquid. If you're lucky, you might see a fish, you might see a whale. But actually, within that seawater are a huge number of marine microbes. You talk about 10 million viruses and million bacteria or a thousand microbes and eukaryotes that we call protists and that literally is one drop in the ocean.

Katie - These billions of microbes together are known as the ocean microbiome. This is a concept we're quite familiar with, the microbes both on and inside us make up our own unique human microbiome.

Michael - So particularly, the microbes that are in our gut. They help us to digest food and we wouldn't really be able to get the same nutritional value from food that we would without those gut microbes. Microbes in the ocean are sort of similar. There's lots of them. They're diverse, and they all have really important functions. It's those functions that really help the ocean to work.

Katie - What are they actually doing in the water? According to Michael, both the ocean and us would be pretty stuffed without them.

Michael - Collectively, we could consider the marine microbes to be environmental chemists. They're performing all of the chemical reactions that are needed to sustain the chemistry of the ocean and the chemistry of our atmospheres. Microalgae, phytoplankton photosynthesise in the same way that plants and trees are on the dry land, and the scale that this happens is huge. So basically, half of the global photosynthesis is performed by these phytoplankton. So that means, half of the oxygen that we breathe comes from these little unicellular plants that live in surface water. But the other big function that marine microbes have is this base of the marine food chain. All of the larger organisms that live in the sea rely either directly or indirectly on microbes.

Katie - As microbes in the ocean are so fundamental to the life in the seas, understanding the effects that humans might be having on these tiny creatures is big business.

Michael - Thinking about change and the impact that humans have on the marine environment, there's evidence that actually, microbes can respond to that and actually help to mitigate the impact that we have.

Katie - So they're cleaning up our mess essentially.

Michael - Yeah, to a certain extent. There's a really brilliant example of that and that was the Deepwater Horizon oil spill that occurred in the Gulf of Mexico – absolute horrendous environmental disaster. All this oil was produced and had a

devastating effect on the ecosystems in the area. But one of the really interesting things that happened was, immediately after the oil spill, microbes increased in abundance. They were specialists in degrading oil. They played a major role in reducing the impact that the oil pollution had.

Katie - What about plastic because plastic seems to be a real problem in the oceans?

Michael - This is a Holy Grail really at the moment to marine microbiology. If you put plastic in seawater, very, very quickly, microbes colonise plastic and work has been done at these different locations around the planet, looking at different types of plastic showing that different sorts of microbes grow on them. So, there's a huge research effort at the moment to try and see if any of these marine microbes are actually able to degrade plastic. If they are, we could maybe look at the enzyme systems that they use and see if we could exploit that to try and deal with this pollution problem.

Katie - There's so much we don't know about this mysterious environment under the waves. Perhaps ocean microbes could hold the key to a treasure chest of untapped scientific potential and scientists are scouring the seas in search of the next novel compound – a process known as bioprospecting.

Michael - There's a whole area of marine microbiology now where people are looking at the functional roles that microbes have say, "Well actually, can we bring them into the lab? Can we bring them into industry? Can we bring them to biotechnology? Can we actually use them to our advantage?" One of the really exciting areas is basically looking at marine microbes as a source of antimicrobial compounds. So I'm sure everyone is familiar with the major problems that we have at the moment with microorganisms that cause disease, that are resistant to antibiotics, and the problems that people have especially when they're in hospital. There's a real demand now to try and deal with that. Scientists are looking at microbes that live in the ocean and seen if they have any solutions. So, are any of these organisms producing antimicrobial compounds? One of my colleagues at the University of Plymouth is looking at marine sponges and they're trying to identify – are there any antimicrobial-producing microbes in marine sponges?

Unit 10. FISH

Fish Gave Us the Finger.

Fingers are pretty nifty. They let you to grab a latte, type on a keyboard, even pull up your pants. But did you ever wonder: where do fingers come

from? In the 1990s, scientists gave this problem a lot of thought. And they concluded that fingers were pretty much invented by the first tetrapods: that is, critters with four limbs. One reason they thought that is because a fossilized skeleton of an ancient fish didn't appear to have any fingers. Or at least any distinct digits in its pectoral fin. But tetrapods, which evolved from fish, did.

Now scientists writing in the September 21st online issue of *Nature* say that that thinking was…a little fishy. Because they've unearthed evidence that suggests that that ancient fish did indeed have fingers in its fins. The researchers did a CT scan on a specimen about 380 million years old. And they found that the fish's right fin, which was unusually well-preserved, does appear to have digitlike bones. The reason other researchers previously missed them, they think, is because in their samples the fing ers were hidden behind marks left by the fish's scales. So fish, too, seem to have incipient fingers. A finding we give two thumbs up.

Unit 11. AMPHIBIANS

Glow Sticks Help Ecologists Study Amphibians

Populations of frogs, salamanders and other amphibians are declining around the world – even in protected areas, like U.S. national parks. Ecologists needed a simple method to track the animals' numbers. Now, researchers have found an effective way to keep tabs on amphibians – using that concert and party favorite: glow sticks. Green glow sticks, to be specific.

"What we do know is that their eyes are particularly sensitive to green light."

David Munoz, a PhD candidate in the ecology program at Penn State University.

To test the idea, Munoz and colleagues set up minnow traps with and without glow sticks at a dozen vernal pools in Centre County, Pennsylvania. The critters gather at the pools to breed.

For a month, they trapped and tracked numbers of the Jefferson salamander, the spotted salamander, the wood frog and the eastern red-spotted newt. "Right before we left for the day, around 4 P.M., we'd activate the glow stick and hang it on the little minnow trap, come back the next day to see what we got."

Traps with glow sticks were vastly more productive. "We were really surprised by how strong of an effect our glow sticks had on our captures. So, by just putting a glow stick in one of these minnow traps we increased the capture rates for our spotted salamanders and our Jefferson salamanders between on average two to four times." And for the eastern red-spotted newt, the glow stick traps lured six times as many.

"You know, these salamanders and these amphibians are going to these sites to breed. And so, what are they looking for? They're looking for other individuals…and

so what we think is that the glow stick is either making the movement of other salamanders more apparent, or it's potentially just a simple visual cue…their eyes are sensitive to this type of light, so they might be attracted to it."

Regardless of the reason, Munoz hopes his team's glowing discovery will benefit amphibians. "In order to help manage those species, and help bring them back, or reverse those declines, we need to understand what's causing those declines. And the way we do that is by monitoring populations."

Another nice thing about glow sticks: they're cheap. "It gives scientists a new tool, and essentially a better tool to help achieve that monitoring on a cost effective basis."

Unit 12. REPTILES

Ancient Rainforest Collapse Increased Reptile Diversity

The November 26th issue of the journal *Science* included a study showing that the extinction of the dinosaurs some 65 million years ago allowed puny mammals to get really big. But well before all that happened, another event triggered a different burst of evolutionary activity.

A new study finds that about 300 million years ago, the tropical rainforests along the equator fell apart. The familiar culprit – global warming.

Present-day Europe and North America were on the equator back then, and were covered with rainforests. But global warming made things even hotter and drier.

The expansive rainforests broke up into smaller fragments, and reptile populations became isolated from each other in the fragments. Such geographical isolation allows different populations to evolve in different directions, which led to a great increase in reptile diversity. The research appears in the journal *Geology*.

The explosion in reptiles ultimately led to the evolution of the dinosaurs, which dominated the planet until they fell victim to the massive impact that allowed us mammals to take over. As Vonnegut would say, so it goes.

Unit 13. BIRDS

The Bearable Density of Bird Bones

For earthbound creatures like us, flight just seems so fantastical. How do birds and bats and other flying beasties manage to get off and stay off the ground? Well, having wings obviously helps. And bird bones are hollow and seem delicate, which should help lighten the load.

Or so you'd think. But a new study shows that songbirds' bones are actually pretty tough. In fact, they're more dense than the bones of mammals of the same size. The results appear in the *Proceedings of the Royal Society: Biological Sciences*.

For centuries, biologists have known that bird bones are thin and hollow. Yet bird skeletons don't actually weigh any less than the skeletons of similarly sized mammals. To sort out this seeming discrepancy, Elizabeth Dumont of the University of Massachusetts Amherst studied the skulls and limb bones of song birds, rodents and bats. And she found that, on average, bird bones are the densest, with bat bones coming in a close second.

That denseness makes Tweety's thin little bones surprisingly strong and stiff, good structural features for flight. Thus, for keeping those bones from winding up in the mouth of a hungry mammal. Sorry, Sylvester.

Unit 14. MAMMALS

Early Mammals Had Social Lives, Too

Seventy-six million years ago, a group of small mammals huddled in a burrow in what's now Montana. They were good diggers – most likely furry – and petite.

"They could sit comfortably in the palm of your hand. These things, if you saw them running around today, you'd think it's a small rodent – a chipmunk or mouse."

Lucas Weaver is a mammal paleobiologist at University of Washington.

These little creatures didn't belong to any of the three main mammal groups on the planet today – which are the placental mammals (like us), monotremes (like the platypus) and marsupials (like koalas and kangaroos).

Instead, they belonged to another, now extinct group called the "multituberculates."

"They have these really bizarre molars with multiple bumps, which is where they get their name. Multituberculate. just means 'many bumps.'"

Weaver and his colleagues have studied the fossilized skulls and skeletons of these animals, dug up in Montana, and they've given them a name: *Filikomys primaevus* (friendly or neighborly mouse).

The details are in the journal *Nature Ecology & Evolution*. [Lucas N. Weaver et al., Early mammalian social behaviour revealed by multituberculates from a dinosaur nesting site]

Weaver says drought or climate change may have killed the animals, though it's hard to be sure. But the critters were fossilized together in ways that suggest they sought out each others' company. That's a big deal because it's commonly thought

that social behavior didn't arise in mammals until after the death of the dinosaurs, 10 million years after these small critters hung out together.

"The narrative, for decades, has been that mammals living during the time of dinosaurs were mostly solitary ratlike creatures scuttling in the night under dinosaurs. And so the fact we're finding these multituberculate mammals – a totally unrelated group of mammals – exhibiting social behavior means this was probably not uncommon among these early Mesozoic mammals. And it changes the narrative that sociality is somehow unique to placental mammals."

Even today, social behavior is relatively rare among mammals. But these findings suggest the need for company in some mammalian species is an ancient evolutionary invention.

Unit 15. EVOLUTION THEORIES

I learnt all about evolution when I was about ten years old. I remember it clearly. I thought it was amazing. My mind was full of images of strange creatures crawling out of a green, soupy lake. Fish that had somehow developed legs and the ability to breathe air. Then these creatures turned into all kinds of animals. All the books I read said we came from apes. Scientists are still not sure how. There's a missing link. When I think about it now, the theory of evolution is a clever concept. The man who thought of it, Charles Darwin, said nature is all about the survival of the fittest. Only the strongest species survive. We are still evolving. Scientists believe we will look quite different a million years from now. I wonder what we'll look like.

SUPPLEMENTARY READING

I HUMAN ANATOMY AND PHYSIOLOGY

A: Hey, I'm reading this really interesting article about the human body.
B: Yeah? Well, we know all about that from biology lessons.
A: No, we didn't learn much at all at school! They're discovering loads more things all the time. Really amazing things! Did you know that only about one tenth of the cells in your body are really you? The rest are bacteria.
B: What? I'm not really me?
A: No, of course you are you, but you also have millions, or trillions, of bacteria in you.
B: Eeeeuuugh!
A: No, they're mostly really helpful. Someone did an experiment to see if animals can live without bacteria, and he found that a lot of them died or had to have a special diet. Animals need bacteria to digest food, you see. So, we're better off with bacteria.
B: Unless the bacteria are bad.
A: Unless they are bad, but they're nearly all good. Oh yeah, and going back to cells, do you know how many cells you have in your body?
B: Quite a lot, I'd say. A good few.
A: Yeah, but how many?
B: I don't know. I'm not mathematical.
A: 7 octillion! That's 7 plus 27 noughts.
B: I knew it was a lot.
A: OK, that's an amazingly huge number, almost impossible to imagine. But the really weird thing is that most of the atoms are empty space, just air or nothingness. And if you took out the empty space, you could fit your body inside a tiny cube which measures one 500th of a centimetre on either side. That's a box measuring 0.002 of a centimetre on each side. You'd be much too small to see.
B: Mmm, I can imagine that. It sounds like something that would happen in a really bad Hollywood movie. You know, a mad scientist goes: (*funny voice*) 'I'm going to extract all the air from your body'. OK, enough facts for one day.
A: Don't go! One last thing, did you know …
B: No.
A: Did you know that you probably have mites in your eyelashes?
B: Mites in my eyelashes? What are mites exactly anyway?
A: Yeah, they're very small creatures, like insects, only not insects. They're about a third of a millimetre long, so you can't really see them. These particular mites live in

eyelashes and eyebrows.
B: But in mine?
A: Well, maybe not. Only about 50% of people have them, and more older people. So you might not have any. Anyway, they're completely harmless, they just eat dead skin.
B: Yeah, right, harmless. I really would have preferred not to know that.
A: Sorry.
B: I mean, really!

II PALEOBIOLOGY

Scientists say they have unearthed details of how the dinosaurs were wiped out 65 million years ago. A team of geophysicists is analyzing rock formations in a crater under the seabed off Mexico. The rocks contain the remnants of the cataclysmic aftermath of a gigantic asteroid impacting with Earth. The scientists say the layers of rock they have extracted reveal a step-by-step account of the destruction that happened after the impact as rock and sediment settled on top of each other in revealing layers. Geophysicist Jay Melosh from Purdue University said: "It tells us what went on inside the crater on that day of doom that killed the dinosaurs. All of this mayhem is directly recorded in the core."

Scientists say the asteroid was around three to four kilometers wide. It smashed into the ocean and created a hole 160kms wide and 20kms deep. This triggered a chain reaction of earthquakes, tsunami, icecap melting, landslides and fires that forever changed the geology and life forms on Earth, killing off the dinosaurs. The asteroid's impact hurled out rock and minerals and created a massive crater. Molten rock fell back into the crater, which was then filled with ocean water from tidal waves. This water was full of soil, vegetation, animal life and other debris, all of which settled in layers ready for scientists to analyze millions of years later. The scientists say this layer-forming process took just a few hours.

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