ПЕРМСКИЙ
ГОСУДАРСТВЕННЫЙ
НАЦИОНАЛЬНЫЙ
ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ

Е. Г. Катаева

THINKING, DOING, TALKING SCIENCE

ИЗДАТЕЛЬСКИЙ ЦЕНТР
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МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
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НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ»

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физического факультета, изучающих курс
«Thinking, Doing, Talking Science»*

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Пособие адресовано слушателям факультативного курса «THINKING, DOING, TALKING SCIENCE», изучающим физику в рамках своей учебной программы, а также всем, кто имеет интерес к физике как науке.

Целью данного пособия является формирование навыков чтения оригинальных текстов с использованием терминологии английского языка по изучаемой специальности, а также развитие коммуникативных умений.

Учебно-методическое пособие состоит из трех частей: первая часть содержит тексты по специальности. Темы данного пособия не зависят друг от друга и могут изучаться в любом порядке. Во вторую часть пособия включен справочный грамматический материал, представленный теоретической частью и упражнениями по основным грамматическим темам. Третья часть содержит полезную информацию общенаучного характера, в частности рекомендации по переводу, оформлению презентаций и ведению дискуссий.

Данное пособие позволит студентам интенсивно и эффективно освоить учебный материал, ориентированный на студентов высших учебных заведений, выполняя задания на сопоставление и заполнение пропусков, на разные виды чтения и упражнения на словообразование, грамматику за короткий период времени по дисциплине «Иностранный язык (английский)», и повысить уровень владения английским языком.

Представляется целесообразным использовать данное пособие как для групповой аудиторной, так и внеаудиторной работы студентов.

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PART I

UNIT 1 WHAT IS PHYSICS?

	**Underline every word in the list you don't know and check for the meanings:**
• term(n) • matter (n) • energy (n) • relate (to) (v) • manifest (v) • particle (n) • quantity (n) • pertain (n) • measure (v) • value (n) • accurate (adj) • precise (adj) • light (n) • motion (n)	• appreciate (v) • law (n) • govern (v) • realm (n) • observe (v) • establish (v) • predict (v) • occurrence (n) • complement (v) • keep abreast of sth (phrasal verb) • validate (v) • challenge (v) • unrelenting (adj) • advance (n)

1. Read the following quotes about physics. Can you explain what they mean? Discuss them with your partner using the expressions from the box below:

a. I need physics more than friends. (J. Robert Oppenheimer)
b. Physics is the most fundamental, and least significant, of the sciences.
c. (Ken Wilber)
d. Physics is, hopefully, simple. Physicists are not. (Edward Teller)
e. It would be better for the true physics if there were no mathematicians on earth. (Daniel Bernoulli)

f. Physics is about questioning, studying, probing nature. You probe, and, if you're lucky, you get strange clues. (Lene Hau)

Useful expressions (Expressing opinions):	
✓ As far as I understand… ✓ I guess that … ✓ The way I see it, ….	✓ It seems to me that… ✓ I tend to think that….

2. Match the following words with their definition:

1. matter (n) 2. manifest (v) 3. particle (n) 4. quantity (n) 5. measure (n) 6. law (n) 7. value (n) 8. precise (n) 9. hypothesis (n) 10. concept (n) 11. predict (v)	to show something c a. learly, through signs or actions b. exact and accurate c. a principle or idea d. the amount or number of something, especially that can be measured e. any of the basic units of matter and energy f. to discover the exact size, amount, etc. of something, g. physical substance in the universe h. the number or amount that a letter or symbol represents i. a general rule that states what always happens when the same conditions exist . j. to say that an event or action will happen in the future. k. an idea or explanation for something that is based on known facts but has not yet been proven.

3. *Read the text and do the tasks that follow*:

Just what is physics? To sum it all up in the easiest of terms, physics is the study of matter and energy, and how they relate to one another. Energy may manifest itself in many forms, such as light, motion, gravity, radiation, electricity, and others. Matter, on the other hand, covers any and every physical manifestation, from the smallest particles such as atoms and sub-atomic particles, further into larger physical groups such as stars, universes, and galaxies.

Physics can also be described as the science dealing with physical quantities. In this regard, physics is widely considered to be the most fundamental (and important) of all the natural sciences. After all, physics pertains to the quantification of almost all matter that exists in this world. It is any aspect of nature that can be expressed, measured or calculated in specific terms. In this regard, physics and mathematics are closely related to one another. It could be said that mathematics is the language of physics. Numerical values, units of measurement, and similar concepts are all mathematical in nature, and are used to describe physical quantities in the most accurate and precise manner.

Thus, these physical quantities form the basis of study of other branches of science, such as chemistry, biology, engineering, and others. The information, facts, and concepts covered in these sciences can all be appreciated and explained only through physical quantities and physical laws. Biology as the study of living things would also necessitate an understanding of the physical laws that govern nature, humans, animals, their body parts, organs, systems-after all, they are all physical manifestations of their existence here on earth. Chemistry, on the other hand, is the study of processes, reactions, and interaction among physical elements on the subatomic level-which is again a realm of physics.

The importance of physics as a fundamental science can also be appreciated by its basic processes, which are either experimental or theoretical. Experimental physics makes use of the scientific method of creating a hypothesis, testing the hypothesis, observing the results, and coming to a conclusion regarding the natural

world. The end-goal of these experiments is to establish scientific laws, which seek to understand and predict phenomena and occurrences in the natural world.

Theoretical physics is closely related to experimental physics in that the former is what seeks to explain the results of experimental data and observations, through mathematical formulas, scientific models, and other concepts. Experimental physics and theoretical physics actually complement each other. Experimental physicists normally keep abreast of the current physical theories in the scientific world and seek to validate or challenge them; while theoretical physicists are constantly on the lookout for experimental data and new concepts that would seek to interpret experimental findings.

People today may still continue to ask what is physics especially with unrelenting advances and discoveries in its various fields of study, such as astronomy, electromagnetism, geophysics, meteorology, optics, relativity, and a whole lot more others. The answer is simple-physics is all these. Physics being the study of physical quantities covers all these topics and fields of study, and a whole lot more. As long as it has got something to do with the study of physical matter and its observable concepts and behavior, it can be classified under the fundamental natural science of physics.

(Available at: http://www.teachnology.com/teachers/subject_matter/science/physics/)

4. Say which sentences are true or false. Correct the false sentences:

a. Physics deals with the combination of matter and energy.
b. Matter manifests from the smallest particles such as itself in many forms, such as light, motion, gravity, radiation, electricity, and others.
c. Physics and mathematics are closely linked.
d. Physics creates a foundation for other natural sciences.
e. Numerical values, units of measurement, and similar concepts are all physical in nature.
f. Theoretical physics is the science of making observations and testing the hypothesis.

5. Answer the following questions to the text:

a. How can physics be defined?
b. What forms do energy and matter manifest in?
c. How is physics related to other branches of science?
d. What is experimental physics?
e. What does theoretical physics formulate on the basis of experimental data?
f. What fields is physics divided into?

6. Use the Internet to look for some hot research topics in physics. Make a short report on one of them.

FOCUS ON VOCABULARY:

7. Give the nouns corresponding to the following verbs:

a. manifest - ……..	f. interact - …….
b. quantify - …….	g. discover - …….
c. calculate - …….	h. observe - …….
d. measure - …….	i. conclude - …….
e. exist - …….	j. occur - …….

8. ***Complete the sentences with the appropriate form of the words from ex. 7*****:**

a. Energy may ……. itself in many forms.
b. The ……. of a black hole was first suggested as far back as the late 1700s.
c. Based on all of this information, you can come to a logical ……. .
d. How can we ……. the distance to the sun?
e. Thunderstorms are characterized by the ……. of lightning.
f. Electrically charged particles can ……. with the electromagnetic field.
g. Radio telescopes around the world will conduct a nearly continuous 33-hour ……. of three quasars today and tomorrow.

9. Find English equivalents to the following words and word combinations:

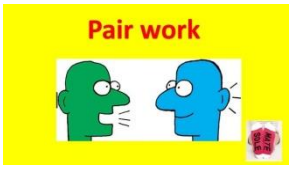
Материя и энергия, относиться к, проявляться в разных формах, свет, движение, гравитация, электричество, мельчайшие частицы, численная величина, в конкретных выражениях, естественная наука, точным способом,

раздел науки, физический закон, на субатомном уровне, использовать научный метод, проверять гипотезы, наблюдать результаты, экспериментальные данные, дополнять друг друга, прогнозировать появление, прийти к выводу.

10. Translate the sentences into English:

- Физика – фундаментальная наука о природе.
- Физика имеет дело с различными областями науки, такими как астрономия, математика, химия и т.д.
- Математика - это язык, на котором разговаривает физика.
- Очевидно, что числовое значение величины напрямую зависит от выбранной единицы измерения.
- Физика делится на две большие области: экспериментальную физику и теоретическую физику.
- Экспериментальная физика – это наука о проведении наблюдений и постановке экспериментов, которые дают нам точные знания о физических явлениях.
- Теоретическая физика формулирует законы и предсказывает поведение природных явлений.
- Физика имеет дело с явлениями, которые могут быть точно описаны с помощью понятий материи и энергии.
- Теории формулируются, разрабатываются и проверяются в соответствии с научным методом.

REVISION:

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

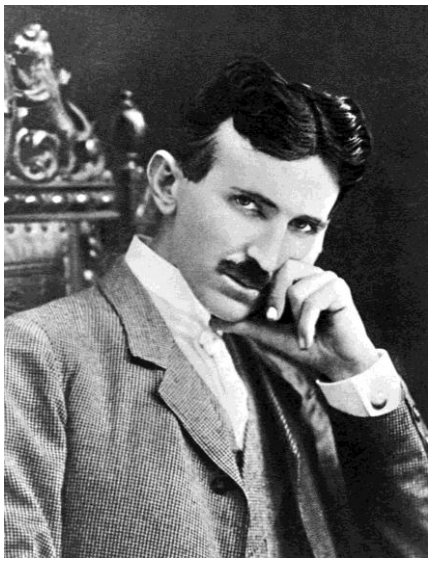
UNIT 2

FAMOUS PHYSICISTS

WordBag Carry your vocabulary with you! WB	**Underline every word in the list you don't know and check for the meanings:**
• heritage (n) • genius (n) • fascinate (v) • obsession(n) • electrical motor • power (v) • direct current • transfer (v) • rotating (adj) • alternating current • shaft (n)	• friction (n) • conceive (v) • significant (adj) • improvement (n) • power generator • advance (n) • (in)efficient (adj) • electrocution (n) • stored (adj) • shut off (phrasal verb) • inventor (n)

1. Look at the photo. Do you know who this person is?

How much do you know about him?



2. ***Read the text and do the tasks that follow*****:**

Born in 1856 in Smiljan Croatia of Serbian heritage, Nikola Tesla was a true genius. As a child, he was fascinated with physics and mathematics. This fascination transformed into an obsession with electricity. He studied Electrical Engineering at the Austrian Polytechnic in Graz and the Charles Ferdinand University in Prague. Then in 1881, he worked in Budapest and Paris on the new telephone and electrical systems. At that time, all electrical motors were powered by direct current (DC) with brushes that transferred the electrical current to the rotating shaft. These primitive motors had many problems. The brushes created friction in the motor and DC was an inefficient means of transporting electricity. However, Tesla conceived of a brushless motor that used alternating current (AC). He was walking with a friend through a park when the concept of the rotating magnetic field flashed through his mind. He stopped and sketched a diagram in the sand with a stick while explaining the principle to his friend. This vision was to lead him to many great inventions and success later in his life. In 1884, he arrived in America looking to develop his ideas with the successful inventor Thomas Alva Edison. Tesla handed Edison a recommendation letter from his former supervisor, Charles Batchelor. The letter said: "I know two great men and you are one of them; the other is this young man." Edison hired Tesla immediately to work for his Edison Machine Works. Tesla made significant improvements to Edison's power generator designs. However, Tesla fought with Edison over the use of AC in the electrical systems. Edison had invested too much time and money into his DC system. Tesla knew that AC was more efficient and it would allow for more electrical innovation in the future. Switching to Tesla's AC system would be too expensive in the short term and it would also cost Edison his pride. Tesla left Edison's workshop to work for one of Edison's rivals, George Westinghouse Jr. Thus began a personal as well as scientific battle between Tesla and Edison over Alternating Current AC versus Direct Current DC. This conflict was known as the "War of the Currents." The battle quickly shifted onto the political stage. It involved public events and demonstrations with the media. Edison was a successful businessman and a celebrity. He would publicly demonstrate the

harmful effects of AC on livestock. To further his political war, he attempted to coin the phrase for electrocution as “getting Westing housed”. These cruel demonstrations were intended to frighten the public and have shivers run down their spine upon hearing the words “Alternating Current.” Ironically today, Edison’s Direct Current is generally considered more dangerous because electricity can remain stored long after the power has been shut off. The Chicago World’s Fair of 1893 was the symbolic end to the “War of the Currents”. The fair resembled a great white city that was designed to glow with electric light. Tesla and Edison competed for the chance to provide electrical power for the first time to such an event. Edison’s inefficient DC design required a heavy price compared to Westinghouse and Tesla’s AC generators. The winning design would light the white city.

(Available at: http://www.physicscentral.com/experiment/physicsquest/upload/pq08-manual.pdf)

3. Put the events in the correct order. Which of the events are not in the story?

a. In 1884 decided to leave Europe for America.
b. After studying at the Polytechnic Institute in Graz, Austria and the University of Prague he worked on the new telephone and electrical systems.
c. When Nikola Tesla was walking in the park, the idea of the AC motor was born.
d. George Westinghouse and Nikola Tesla defeat Edison in “Currents War”.
e. Nikola Tesla was born in Smiljan, Croatia, on July 10, 1856.
f. The battle quickly shifted onto the political stage.
g. Tesla left Edison’s workshop to because of a conflicting relationship known as the “Currents War”.
h. He later invented and patented Tesla Coil, which is till date used in radio, telephones, cell phones and television.
i. Edison hired Tesla, and the two men were soon working alongside each other, making improvements to Edison's inventions.

4. ***Answer the following questions to the text:***

a. Where did Tesla come from?
b. What subjects was Nikola Tesla initially interested in?
c. Where did he study electrical engineering?
d. What idea did he come up with while on a walk?
e. Why did he move to America?
f. Why was Nikola Tesla's association with Edison very brief?
g. Why is Edison’s direct current generally considered more dangerous?
h. Who won the war of currents?

5. ***Discuss the following questions with your partner:***

a. What got you interested in physics? What areas in science do you find the most interesting?
b. How is your country in physics?
c. Do you think anyone can be a physicist? Why/Why not?
d. Who is the scientist that played a major role in this field? What is he/she famous for?

FOCUS ON VOCABULARY:

6. Find the words and expressions in the text that mean the following:

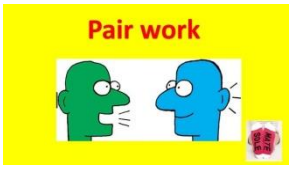
a. _____ - an electric current flowing in one direction only.
b. _____ - an electric current that reverses its direction many times a second at regular intervals, typically used in power supplies.
c. _____ - a long cylindrical rotating rod for the transmission of motive power in a machine.
d. _____ - the resistance that one surface or object encounters when moving over another.
e. _____ - moving in a circle round an axis or centre.
f. _____ - achieving maximum productivity with minimum wasted effort or expense.
g. _____ - the injury or killing of someone by electric shock.

h. _____ a person who creates or discovers a new method, form, device or other useful means.

7. ***Complete the sentences with the appropriate word/word expression from the box*:**

generator	efficient	rotates
improvements	power	current
shut off		magnetic field

a. A _____transforms mechanical energy into electric energy.
b. Electricity is used in homes to _____electrical appliances.
c. He realized he could make significant _____on the method.
d. I know almost nothing about how electric _____travels through wires.
e. There are many different energy _____devices you can use in your building to save costs and energy.
f. The rotor of an electric motor s _____at the constant rate ω1 = 1800 rpm.
g. Electric generators rotate coils of wires through _____ created by permanent or electric magnets.
h. In some areas, the power cut has caused water to be_____ as well.

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

UNIT 3

STANDARD UNITS AND SYSTEMS OF UNITS

	**Underline every word in the list you don't know and check for the meanings:**
• phenomenon-phenomena (n) • in terms of • physical quantity • length (n) • mass (n) • time (n) • measure (v) • reference (n) • standard unit • reproducible (adj) • value (n) • accurate (adj) • distance (n) • define (v) • platinum–iridium bar • foot (n) • convenience (n) • slug (v)	• weight (n) • pound (n) • give rise to (phrasal verb) • confusion (n) • gravitational attraction (n) • celestial (adj) • acronym (n) • comprehension (n) • contain (v) • flow (n) • electric charge • mole (n) • candela (n) • luminous intensity • decimal (adj) • inch (n) • conversion (n)

1. Answer the following questions:

- What systems of units and measurements do you know?
- What is the difference between fundamental and derived units?

2. Complete the table using the terms below: meter, kilogram, the second; the ampere, the kelvin, the mole, the candela

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7.	is unit of	luminous intensity electric current length mass amount of pure substance thermodynamic temperature time

***3. Read the text and do the tasks that follow*:**

A great many objects and phenomena can be described in terms of the fundamental physical quantities of length, mass, and time. To measure these fundamental quantities, we compare them with a reference, or standard, that is taken to be a standard unit. That is, a standard unit is a fixed and reproducible value for the purpose of taking accurate measurements. A group of standard units and their combinations is called a system of units. Two major systems of units in use today are the British system and the metric system. The latter is used throughout most of the world.

Length

The standard unit of length in the metric system is the meter (m), from the Greek metron, “to measure.” It was defined originally as one ten-millionth of the distance from the Earth’s equator to the geographic North Pole. From 1889 to 1960, the standard meter was defined as the length of a platinum–iridium bar kept at the International Bureau of Weights and Measures in Paris, France.

The standard unit of length in the British system is the foot, which historically was referenced to the human foot. Other early units commonly were referenced to parts of the body.

Mass

The standard metric unit of mass is the kilogram (kg). Originally, this amount of matter was related to length and was defined as the amount of water in a cubic container 0.10 m, or 10 cm, on a side. However, for convenience, the mass standard was referenced to a material standard (an artifact, or human-made object). Currently the kilogram is defined to be the mass of a cylinder of platinum–iridium kept at the International Bureau of Weights and Measures in Paris.

The unit of mass in the British system is the slug, which you've probably never heard of. This is because a quantity of matter in the British system is expressed in terms of weight on the surface of the Earth and in units of pounds. (The British system is sometimes said to be a gravitational system.)

Unfortunately, weight is not a fundamental quantity, and its use often gives rise to confusion. Certainly a fundamental quantity should be the same and not change. However, weight is the gravitational attraction on an object by a celestial body, and this attraction changes for different celestial bodies (with different masses).
For now, keep in mind that mass, not weight, is the fundamental quantity.

Time

The standard unit of time is the same in both the metric and British systems—the second (s).

The standard units for length, mass, and time in the metric system give rise to an acronym—the mks system. The letters mks stand for meter, kilogram, and second. These are also standard units for a modernized version of the metric system, called the International System of Units (abbreviated SI).

More on the Metric System

The SI was established in 1960 to make comprehension and the exchange of ideas among the people of different nations as simple as possible. It now contains seven base units: the meter (m); the kilogram (kg); the second (s); the ampere (A), to measure the flow of electric charge; the kelvin (K), to measure temperature; the mole (mol), to measure the amount of a substance; and the candela (cd), to measure luminous intensity.

One of the major advantages of the metric system is that it is a decimal (base-10) system. The British system is a duodecimal (base-12) system, as in 12 inches to the foot. The base 10 allows easy expression and conversion to larger and smaller units.

(Adopted from An Introduction to Physical Science by James Shipman, Jerry D. Wilson, Charles A. Higgins)

4. Find the sentences that can't be found in the text:

a. A standard unit is an invariable.
b. There are many more than two systems of measurement.
c. The Greek word metron means "measure".
d. The standard unit of volume is the liter.
e. The British system and metric system share units measuring time.
f. The joule is a derived unit of energy in the International System of Units.
g. In the MKS system conversions of one unit to another can be carried out by shifts of a decimal points.

5. Answer the following questions to the text:

a. What are the three fundamental units?
b. What is a standard unit?
c. How was the meter originally defined?
d. What systems of measurement are mentioned in the text?
e. What are the seven SI base units?
f. Why is the SI system widely used all over the world?

FOCUS ON VOCABULARY:

6. Find English equivalents to the following words and word combinations:

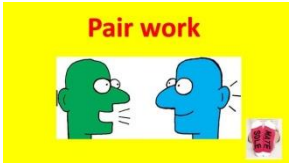
Явление, физическая величина, сравнивать с, стандартная единица, проводить точные измерения, расстояние, вес, длина, усовершенствованная версия, выражен в категориях, гравитационное притяжение, небесное тело, электрический заряд, преобразование (единиц).

7. Complete the sentences with the words and word expressions from ex 6. There are some words that are not needed.

a. There are many _____besides planets and moons traveling around the Sun.
b. The strength of _____ _____is determined by an object's mass and how close it is to another (more mass and closer together means increased force).
c. The metric system, also called the decimal system, is designed for easy _____.
d. All mechanical quantities can be expessed _____these three quantities.
e. There are two-types of _____positive and negative (commonly carried by protons and electrons respectively).
f. Therefore the _____for the distance is meters.

8. Fill in the gaps with the appropriate preposition:

a. To measure these fundamental quantities, we compare them _____ a reference, or standard.
b. From 1889 to 1960, the standard meter was defined _____ the length of a platinum–iridium bar
c. A standard unit is a fixed value _____ the purpose of taking accurate measurements.
d. Originally, this amount of matter was related _____ length.
e. Weight is not a fundamental quantity, and its use often gives rise _____ confusion.

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

UNIT 4

NEWTON'S LAWS OF MOTION

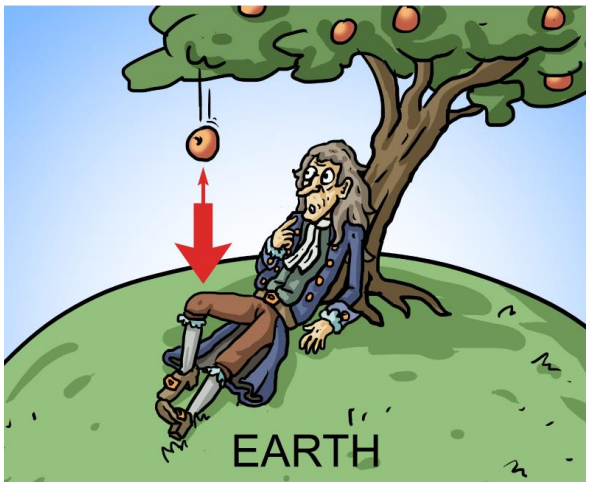
	**Underline every word in the list you don't know and check for the meanings:**
• motion (n) • interact (v) • influential (adj) • gravity (n) • seminal (adj) • external (adj) • force (n) • simplify (n) • treatment (n) • rotation (n) • friction (n) • resistance (n) • property (n) • solely (adv) • precisely (adv) • rigid (adj) • accurate (adj) • approximation (n) • pertain (v) • inertia (n) • inertial (adj)	• reference frame (n) • 3-dimensional (adj) • stationary (n) • linear (adj) • direction (n) • equal (to) (adj) • acceleration (n) • quantity (n) • constant (adj) • velocity (n) • at a constant rate • at rest • apply to (v) • opposite (adj) • exert (v) • push (v) • anchor • impart (v) • verify (v) • encounter (v)

1. Answer the following questions:

What do you know about motion?

What did Newton discover?

Can you state in your own words each of Newton's Three Laws of Motion.



2. Read the text and do the tasks that follow:

Sir Isaac Newton's three laws of motion describe the motion of massive bodies and how they interact. Newton was one of the most influential scientists of all time. He studied optics, astronomy and math — he invented calculus. (German mathematician Gottfried Leibniz is also credited with developing it independently at about the same time.)

Newton is perhaps best known for his work in studying gravity and the motion of planets. He published his laws in 1687, in his seminal work "Philosophiæ Naturalis Principia Mathematica" (Mathematical Principles of Natural Philosophy) in which he formalized the description of how massive bodies move under the influence of external forces.

In formulating his three laws, Newton simplified his treatment of massive bodies by considering them to be mathematical points with no size or rotation. This allowed him to ignore factors such as friction, air resistance, temperature, material properties, etc., and concentrate on phenomena that can be described solely in terms of mass, length and time. Consequently, the three laws cannot be used to describe precisely the behavior of large rigid or deformable objects; however, in many cases they provide suitably accurate approximations.

Newton's laws pertain to the motion of massive bodies in an inertial reference frame, sometimes called a Newtonian reference frame, although Newton himself never described such a reference frame. An inertial reference frame can be described as a 3-dimensional coordinate system that is either stationary or in uniform linear motion., i.e., it is not accelerating or rotating. He found that motion within such an inertial reference frame could be described by three simple laws.

The First Law of Motion states, "A body at rest will remain at rest, and a body in motion will remain in motion unless it is acted upon by an external force." This simply means that things cannot start, stop, or change direction all by themselves. It takes some force acting on them from the outside to cause such a change. This property of massive bodies to resist changes in their state of motion is sometimes called *inertia*.

The Second Law of Motion describes what happens to a massive body when it is acted upon by an external force. It states, "The force acting on an object is equal to the mass of that object times its acceleration." This is written in mathematical form as $\mathbf{F} = m\mathbf{a}$, where **F** is force, *m* is mass, and **a** is acceleration. The bold letters indicate that force and acceleration are *vector* quantities, which means they have both magnitude and direction. The force can be a single force, or it can be the vector sum of more than one force, which is the net force after all the forces are combined.

When a constant force acts on a massive body, it causes it to accelerate, i.e., to change its velocity, at a constant rate. In the simplest case, a force applied to an object at rest causes it to accelerate in the direction of the force. However, if the object is already in motion, or if this situation is viewed from a moving reference frame, that body might appear to speed up, slow down, or change direction depending on the direction of the force and the directions that the object and reference frame are moving relative to each other.

The Third Law of Motion states, "For every action, there is an equal and opposite reaction." This law describes what happens to a body when it exerts a force on another body. Forces always occur in pairs, so when one body pushes against

another, the second body pushes back just as hard. For example, when you push a cart, the cart pushes back against you.

If one object is much, much more massive than the other, particularly in the case of the first object being anchored to the Earth, virtually all of the acceleration is imparted to the second object, and the acceleration of the first object can be safely ignored.

The three laws have been verified by countless experiments over the past three centuries, and they are still being widely used to this day to describe the kinds of objects and speeds that we encounter in everyday life. They form the foundation of what is now known as *classical mechanics*, which is the study of massive objects that are larger than the very small scales addressed by quantum mechanics and that are moving slower than the very high speeds addressed by relativistic mechanics.
(Adapted from https://www.livescience.com/46558-laws-of-motion.html)

3. Complete the sentences with the appropriate information from the text:

Newton's 1st Law	⟹	A body at rest will remain _____, and a body in motion _____ unless it is acted _____."
Newton's 2nd Law	⟹	The force acting on an object is equal to _____. This can be stated mathematically by the formula: F=_____*_____
Newton's 3rd Law	⟹	For every action, there is _____. When one body pushes against another, the second body _____.

4. Answer the following questions to the text:

1. What is Isaac Newton famous for?
2. What do three laws of motion describe?
3. What is inertial reference frame?
4. What does Newton's first law of motion state?
5. How is the term 'inertia' defined in physics?

6. What does Newton's second law describe?
7. What causes an object to slow down or speed-up?
8. What does Newton's third law of motion concern?
9. What does classical mechanics study?

5. Give some more examples of Newton's laws in everyday life using the expressions from the box below:

Useful expressions (Giving examples):
✓ For example, …
✓ For instance, ….
✓ To illustrate my point, I would like to tell you about…
✓ One example of …. could be….
✓ Let us take the case of ….

FOCUS ON VOCABULARY:

6. Unscramble words with the letters provided. Get definitions for the words found in the text:

a. *erefrecne frmae* - an abstract coordinate system and the set of physical reference points.
b. *ryagvit* - the natural force that causes things to fall toward the earth.
c. *cnfritio* - the resistance to motion of one object moving relative to another.
d. *cfore* - a push or pull upon an object resulting from the object's interaction with another object.
e. *vtyolcie* - quantity that indicates distance per time and direction.
f. *ctvreo* - a quantity or phenomenon that has two independent properties: magnitude and direction.
g. *ceaertilnaco* - the rate of change of velocity of an object with respect to time.
h. *aietnri* - the resistance of any physical object to any change in its velocity.
i. *tioomn* - the change in position of an object.

7. Fill in the sentences with the appropriate prepositions:

a. Newton is perhaps best known _____ his work in studying gravity and the motion of planets.
b. He formalized the description of how massive bodies move _____ the influence of external forces.
c. Newton's laws pertain _____ the motion of massive bodies _____ an inertial reference frame.
d. An inertial reference frame can be described _____ a 3-dimensional coordinate system that is either stationary or in uniform linear motion
e. A body _____ rest will remain at rest, and a body _____ motion will remain in motion unless it is acted upon _____ an external force.
f. The force acting on an object is equal _____ the mass of that object times its acceleration."
g. A force applied _____ an object at rest causes it to accelerate in the direction of the force.

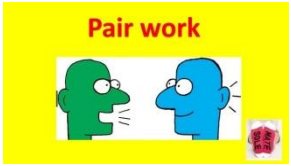
8. Find English equivalents to the following words and word combinations:

Законы движения, влиятельный ученый, гравитация, внешние силы, вращение, трение, сопротивление воздуха, точное приближение, система координат, линейное движение, оставаться в состоянии покоя, направление, постоянная сила, ускорение; сила, приложенная к объекту, скорость.

9. ***Translate the following sentences into English:***

a. Три основных закона называются законами движения Ньютона, который сформулировал их в 17 веке, вместе с законом всемирного тяготения.
b. В природе не существует отдельных изолированных тел. Любое тело взаимодействует с окружающими телами.
c. Первый закон движения гласит, что если на тело не действуют другие тела, то оно либо находится в покое, либо движется равномерно прямолинейно.

d. Согласно второму закону Ньютона, наличие внешней силы, действующей на тело, неминуемо приводит к появлению ускорения у последнего.
e. Чем больше сумма приложенных к телу внешних сил, гласит этот закон, тем большее ускорение приобретает тело.
f. Третий закон движения гласит, что если одно тело оказывает воздействие на второе тело, то второе тело воздействует с равной и противоположно направленной силой на первое.
g. При падении любого предмета с высоты, сила тяжести сообщает ему ускорение g = 9,81 м/с2.
h. Три закона Ньютона дали физикам инструменты, необходимые для начала комплексного наблюдения всех явлений, происходящих в нашей Вселенной.

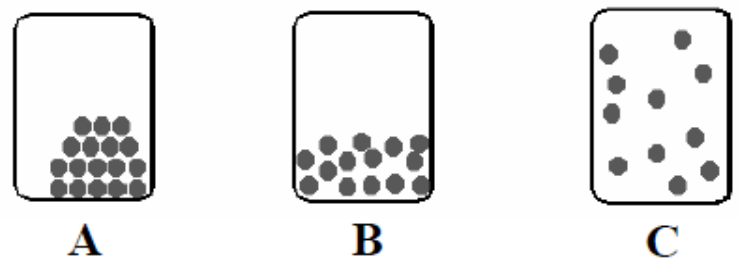
	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

UNIT 5

STATES OF MATTER

	**Underline every word in the list you don't know and check for the meanings:**
• states of matter • take up (v) • space (n) • solid (n) • liquid (n) • gas (n) • plasma (n) • maintain (v) • (in)definite (adj) • volume (n) • shape (n) • oscillatory motion • closely packed • intermolecular (adj) • force (n) • vibrate (v) • iron (n) • aluminium (n) • copper (n)	• transform into (v) • melting (n) • freezing (n) • sublimation (n) • adapt to (v) • pressure (n) • constant (adj) • heating (n) • boiling point • reduction (n) • evaporation (n) • expand (v) • vapour (n) • compression (n) • cooling (n) • electrically conductive • magnetic field • electric current

1. The diagram shows the arrangement of particles in the three states of matter. Label the pictures with gas, liquid and solid. What is the fourth state of matter?



2. Decide if the words/word expressions in the box describe gas, solid, water or plasma. Discuss them with your partner using the expressions from the box below:

definite volume | indefinite shape | weak intermolecular forces
strong intermolecular forces | electrically conductive | dense | hard to compress
ionized

Useful expressions (Agreeing/Disagreeing with an opinions):		
agreement	***partial agreement***	***disagreement***
I completely agree with you You are absolutely right I couldn't agree more	I agree up to a point, but That's partly true but I see you point but	I cannot share that. I totally disagree That's not the same thing at all

3. Read the text and do the tasks that follow:

All matters have a mass, and take up space, the state of matter is one of the distinct forms that matter takes on, and there are four states of matter observable in our life which are solid, liquid, gas and plasma.

The solid state

The solid is the state in which matter maintains a definite (fixed) volume and shape, the motion of its particles is limited motion (oscillatory motion), they are packed closely together .

The intermolecular forces between the solid particles are very strong that the particles cannot move freely, they can only vibrate, some examples of solid state such as iron, aluminum and copper.

The solid has very small intermolecular spaces, it can transform into a liquid through melting process, the liquid can change into a solid by freezing process, and the solid can change into gas by sublimation process.

The liquid state

The liquid is the state in which matter adapts to the shape of its container but varies only slightly in volume, the liquid state has definite volume and indefinite shape if the temperature and pressure are constant.

Motion of the liquid particles is more free, the intermolecular spaces between its particles are relatively large, and the intermolecular forces are relatively weak, examples of liquid state such as the water, the oil, the milk and the juice.

Liquid can be changed to gas by heating at constant pressure to the substance's boiling point or through reduction of pressure at constant temperature, and it is called the evaporation process .

The gaseous state

The gas is the state in which matter expands to occupy the volume and shape of its container and it has indefinite shape and indefinite volume. The motion of gas molecules is completely free (unlimited), the intermolecular spaces are very large and the intermolecular forces are very weak or almost not existed.

The gas can be called a vapour at a temperature below its critical temperature, and the vapour can be liquefied through compression without cooling, examples of gaseous state such as carbon dioxide, oxygen and the water vapour .

The plasma state

The plasma does not have definite shape or volume, it is electrically conductive, it produces magnetic fields and electric currents, and respond strongly to electromagnetic forces.

Lighting, electric sparks, the fluorescent lights, neon lights, plasma televisions, some types of flame and the stares are examples of illuminated matter in the plasma state.

(Available at: https://www.online-sciences.com/the-matter/the-states-of-matter-solid-liquid-gas-plasma/)

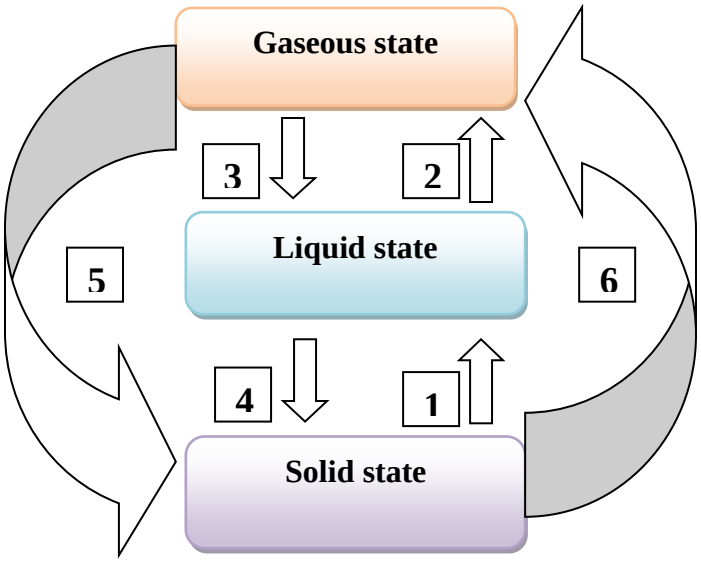
4. Look through the text and find:

a. four fundamental states of matter
b. four ways a substance can change between these three phases

5. Answer the following questions in details:

a. How is a state of matter defined?
b. What are the characteristics of solid, liquid gas and plasma?
c. Why cannot the shape of solid matter change on its own?
d. Are gases similar to liquids? What makes them similar?
e. How can matter change from a liquid to a gas?
f. How can matter change from a liquid to a solid?
g. What are properties of plasma?
h. Can you add two more ways a substance can change between these three phases except those mentioned in ex 4b?

6. Label the changes from one state to another one:



FOCUS ON VOCABULARY:

7. Define the following words from the text:

a. volume-_____
b. freezing-_____
c. vapour-_____
d. constant-_____
e. compression-_____
f. boiling point-_____

8. Choose the proper word to complete the sentence:

a. The solid is the state in which matter maintains a *definite/indefinite* volume and shape.
b. The particles of a solid *are packed closely together/move freely*.
c. The solid can change into gas by *evaporation/sublimation*.
d. The liquid state has definite volume and indefinite shape if *the temperature and pressure are constant/ the temperature and pressure are increased*.
e. Molecules of a liquid have more freedom of movement than those in *a solid/in a gas.*
f. Liquid can be changed to gas by heating at constant pressure to the substance's *feezing point/boiling point.*
g. The molecules in *a gas/a liquid* have very large intermolecular spaces.
h. The example of plasma is *lightning/carbon dioxide*.

9. Fill in the sentences with the appropriate prepositions:

a. Four states of matter are observable _____ everyday life: solid, liquid, gas, and plasma.
b. Solids can transform _____ a liquid through melting process.
c. The liquid is the state in which matter adapts _____ the shape of its container but varies only slightly in volume.
d. Liquid can be changed to gas by heating _____ constant pressure to the substance's boiling point.
e. The vapour can be liquefied _____ compression without cooling.

f. Plasma is electrically conductive so that it responds strongly _____ electromagnetic fields.

10. Find English equivalents to the following words and word combinations:

Занимать пространство, состояние вещества, твердое вещество, жидкость, сохранять объем, (не)определенный, форма, движение частиц, колебательное движение, силы межмолекулярного притяжения, постоянное давление, точка кипения, плавление, испарение, расширяться, пар, электропроводящий.

11. Translate the sentences into English:

1. Вещества могут находиться в четырех состояниях.
2. Самые распространенные на Земле состояния – газообразное, жидкое, твердое.
3. Плазму принято считать четвертым состоянием вещества, после твердого, жидкого и газообразного.
4. Жидкость принимает форму сосуда, в которой находится.
5. В газе силы межмолекулярного взаимодействия между молекулами очень малы.
6. Твёрдые тела сохраняют форму и объём.
7. При нормальном атмосферном давлении температура кипения воды равна примерно 100° С.
8. Сублима́ция (возго́нка) — переход вещества из твёрдого состояния сразу в газообразное, минуя жидкое.
9. Во время кипения (100 °С) вода меняет свое привычное состояние и превращается в пар.

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

EXTENSION WORKSHEET

1. Study the list of some unusual phases of matter. Do you know anything about them? Share your knowledge with your classmates.

2. Match the examples of unusual states of matter with their explanations.

1. Amorphous solids 2. Superfluid 3. Bose-Einstein Condensate 4. Jahn-Teller Metals 5. Supercritical Fluids	a. a state of matter in which extremely cold atoms clump together and act as if they were a single atom. b. an unusual state of matter noted only in liquid helium cooled to near absolute zero and characterized by apparently frictionless flow c. highly compressed gases which combine properties of gases and liquids in an intriguing manner. d. a new state of matter in a material that appears to be an insulator, superconductor, metal and magnet all rolled into one e. any noncrystalline solid in which the atoms and molecules are not organized in a definite lattice pattern.

***3. Read the text about super-fluid and write the best word from the box for each blank*:**

superfluid	temperature	liquid helium
laws of gravity	absolute zero	solid
***	thermodynamic	***

A superfluid is a state of matter that exists when certain isotopes of helium, rubidium, and lithium are cooled to almost _____. This is similar to a Bose-Einstein condensate (BEC), but there are slight differences. Some Bose-Einstein

condensates are superfluids and some superfluids are Bose-Einstein condensates, but not all of each class fits into the other.

The most common superfluid is _____. When helium is cooled to the "lambda point" of 2.17 degrees Kelvin, part of the liquid becomes a_____. When most substances are cooled down to a certain point, the attraction between atoms will overcome the heat vibrations in the substance, allowing the substance to form a _____structure. But helium atoms interact with each other so weakly that it can stay a liquid up until absolute zero. In fact, at that _____, the characteristics of the individual atoms overlap, creating the strange properties of superfluids.

For starters, a superfluid does not have internal viscosity. Superfluids placed in a test tube will begin to creep up the sides of the tube, seemingly violating _____ and surface tension. Liquid helium leaks very easily because it can leak through any microscopic hole. Superfluids also exhibit strange _____ properties. They have zero thermodynamic entropy and are infinitely thermally conductive. This means that two superfluids cannot have a thermal differential. If heat is introduced to a superfluid it will conduct so quickly that thermal waves are created, a property that does not exist for normal liquids.

(https://listverse.com/2015/08/03/10-unusual-states-of-matter/)

4. Answer the questions to the text:

What is a super-fluid?

What is the only known example of super-fluid?

What happens at the lambda point of Helium?

How can helium be a liquid at absolute zero

What are some characteristics of super-fluids?

5. Use the Internet to look for some information on unusual states of matter. Make a short report on one of them.

UNIT 6

ENERGY BASICS

	**Underline every word in the list you don't know and check for the meanings:**
• ability (n) • light (n) • heat (n) • motion (n) • potential (adj) • kinetic (adj) • stored (adj) • bond (n) • convert (v) • engine (n) • tension (n) • compressed (adj) • stretched (adj) • rubber (adj) • nuclear (adj) • nucleus (n) • hold (v)	• release (v) • split apart (v) • fission (n) • fusion (n) • confined (adj) • wire (n) • substance (n) • transverse (adj) • fuel (n) • collide (v) • uncontrolled instant • longitudinal (adj) • compression (n) • rarefaction (n) • conservation (n) • energy efficiency • specific heat capacity

1. Answer the following questions:

- What is energy?
- Where does energy come from?
- How do we use energy?

2. Identify each of the following forms of energy as either potential energy (P) or kinetic energy (K). Then read the text and check your answers:

_____ Sound	_____ Chemical
_____ Nuclear	_____ Gravitational
_____ Elastic	_____ Thermal
_____ Electric	_____ Electromagnetic

3. Read the text and do the tasks that follow:

Scientists define energy as the ability to do work. Every time something gets warm, cools down, moves, grows, makes a sound or changes in any way, it uses energy. It is found in different forms including light, heat, chemical, and motion. There are many forms of energy, but they can all be put into two categories: potential and kinetic.

Potential Energy

Potential energy is stored energy and the energy of position — gravitational energy. There are several forms of potential energy.

Chemical Energy is energy stored in the bonds of atoms and molecules. Biomass, petroleum, natural gas, and coal are examples of stored chemical energy. Chemical energy is converted to thermal energy when we burn wood in a fireplace or burn gasoline in a car's engine.

Mechanical Energy is energy stored in objects by tension. Compressed springs and stretched rubber bands are examples of stored mechanical energy.

Nuclear Energy is energy stored in the nucleus of an atom — the energy that holds the nucleus together. Very large amounts of energy can be released when the nuclei are combined or split apart. Nuclear power plants split the nuclei of uranium atoms in a process called fission. The sun combines the nuclei of hydrogen atoms in a process called fusion.

Gravitational Energy is energy stored in an object's height. The higher and heavier the object, the more gravitational energy is stored. When you ride a bicycle down a steep hill and pick up speed, the gravitational energy is being converted to

motion energy. Hydropower is another example of gravitational energy, where the dam "piles" up water from a river into a reservoir.

Electrical Energy is what is stored in a battery, and can be used to power a cell phone or start a car. Electrical energy is delivered by tiny charged particles called electrons, typically moving through a wire. Lightning is an example of electrical energy in nature, so powerful that it is not confined to a wire.

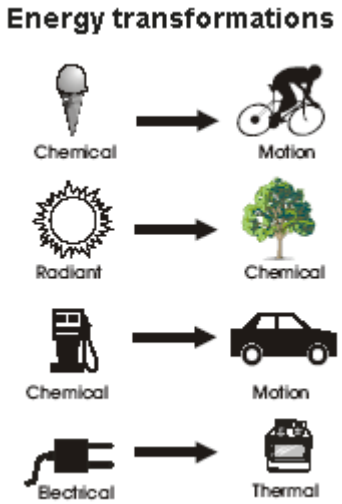
Kinetic Energy

Kinetic energy is motion — of waves, molecules, objects, substances, and objects.

Radiant Energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Light is one type of radiant energy. Sunshine is radiant energy, which provides the fuel and warmth that make life on Earth possible.

Thermal Energy, or heat, is the vibration and movement of the atoms and molecules within substances. As an object is heated up, its atoms and molecules move and collide faster. Geothermal energy is the thermal energy in the Earth.

Motion Energy is energy stored in the movement of objects. The faster they move, the more energy is stored. It takes energy to get an object moving and energy is released when an object slows down. Wind is an example of motion energy. A dramatic example of motion is a car crash, when the car comes to a total stop and releases all its motion energy at once in an uncontrolled instant.



Sound is the movement of energy through substances in longitudinal (compression/rarefaction) waves. Sound is produced when a force causes an object or substance to vibrate — the energy is transferred through the substance in a wave. Typically, the energy in sound is far less than other forms of energy.

To scientists, "conservation of energy" does not mean saving energy. Instead, the law of conservation of energy says that energy is

neither created nor destroyed. When we use energy, it doesn't disappear. We change it from one form of energy into another.

A car engine burns gasoline, converting the chemical energy in gasoline into mechanical energy. Solar cells change radiant energy into electrical energy. Energy changes form, but the total amount of energy in the universe stays the same.

"Energy efficiency" is the amount of useful energy you get from any type of system. A perfectly energy-efficient machine would change all the energy put in it into useful work. In reality, converting one form of energy into another form always involves a loss of useable energy.

In fact, most energy transformations are not very efficient. The human body is a good example. Your body is like a machine, and the fuel for your machine is food. Food gives you the energy to move, breathe, and think. But your body isn't very efficient at converting food into useful work. Your body is less than 5 % efficient most of the time. The rest of the energy is lost as heat.

In the International System of Units (the SI system), the unit of energy is the joule. The specific heat capacity (or just specific heat) of a material is defined as the amount of heat required to raise the temperature of one gram (g) of the material one degree Celsius (ºC). It takes 4.18 joules (J) to raise the temperature of 1 g of water 1ºC (at a temperature of 25ºC). One kilojoule (kJ) equals 1,000 joules (J) and is the amount of the heat required to raise the temperature of 239g of water by 1ºC. As an example, a piece of buttered toast contains about 315 kilojoules, which gives you enough energy to ride your bike for 10 minutes or run for 6 minutes.

(Available at: http://www.environment.gen.tr/what-is-energy/)

4. Decide if the sentences are true or false:

a. Energy can be defined as the ability to do work.
b. The first is kinetic energy or stored energy, the second is potential energy or energy of motion.
c. Physicists classify energy into several types: kinetic, potential, heat, sound, radiant energy and electrical, chemical and nuclear energy.
d. Sound can be considered as a special form of kinetic energy.

e. "Energy efficiency" is the amount of heat required to raise the temperature of one gram (g) of the material one degree Celsius (ºC).
f. The law of conservation of energy states that energy can be neither be created nor destroyed but only changed.
g. Energy conversions occur without loss or gain in useable energy.
h. In the International System of Units (the SI system), the unit of energy is thermal unit.

5. Answer the following questions to the text:

a. How do scientists define energy?
b. What forms is energy found in?
c. What is the difference between kinetic and potential energy?
d. What forms of kinetic energy do you know?
e. What are forms of potential energy?
f. What is meant by conservation of energy?
g. What is "Energy efficiency"?
h. What is the unit of energy in the International System of Units?

FOCUS ON VOCABULARY

6. Find the words in word search puzzle which means:

a. _____(n) - the force holding atoms together in a molecule.
b. _____(n)- the central part of an atom, usually made up of protons and neutrons.
c. _____(n)- an elastic device, such as a coil of wire that regains its original shape after being compressed or extended.
d. _____(n)- the splitting of the nucleus of an atom into nuclei of lighter atoms accompanied by the release of energy.
e. _____(n)- a nuclear reaction in which nuclei combine to form more massive nuclei with the simultaneous release of energy.
f. _____(v)- (especially of moving objects) to hit something violently.
g. _____(v)- to (cause something or someone to) change in form or character.

h. _____(n)- the state of being tight and stiff.

i. _____ (n) -a unit of energy or work done.

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

7. Match the halves to make phrases from the text:

1. stored	a. waves
2. charged	b. efficiency
3. transverse	c. energy
4. visible	d. of energy
5. conservation	e. particle
6. solar	f. light
7. energy	g. heat capacity
8. the specific	h. cells

8. Complete the text with the appropriate words from the box. There are two words that are not needed:

useful	radiant	energy	industrial revolution
forms	conversion	convert	potential
***	kinetic	conserve	***

Energy exists in many _____ all around us. The development of our modern society has been accomplished because scientists and engineers have learned to capture some of that_____ and transform it into ways to do _____ work. The conversion of energy from a chunk of coal into steam and then into mechanical engines that could do heavy work was a critically important role for engineers in the 19th century that helped to start the _____. An engineer must know where to "find" energy resources and then how to _____ them into forms that are more useful for all of the machines and gadgets we use in our daily lives. Look around this room, what tools or devices are using energy? Light fixtures are a good example. They convert electrical energy into light (_____) energy. What about this cup of water (hold up a cup of water), does it have energy? It has a state of energy called _____energy because it is held up at an elevation. If the water is poured into a pail, the potential energy is released as the water now is moving with some velocity. This is a _____ state of energy.

9. Translate the sentences into English:

a. Ученые-исследователи изучили и обозначили множество видов энергии в физике. Это электрическая, химическая, атомная, гравитационная энергия и так далее.
b. Двигающиеся и вибрирующие объекты обладают кинетической энергией.
c. Кинетическая энергия зависит от массы тела и его скорости.
d. Потенциальной энергией обладает всякое упругое деформированное тело.

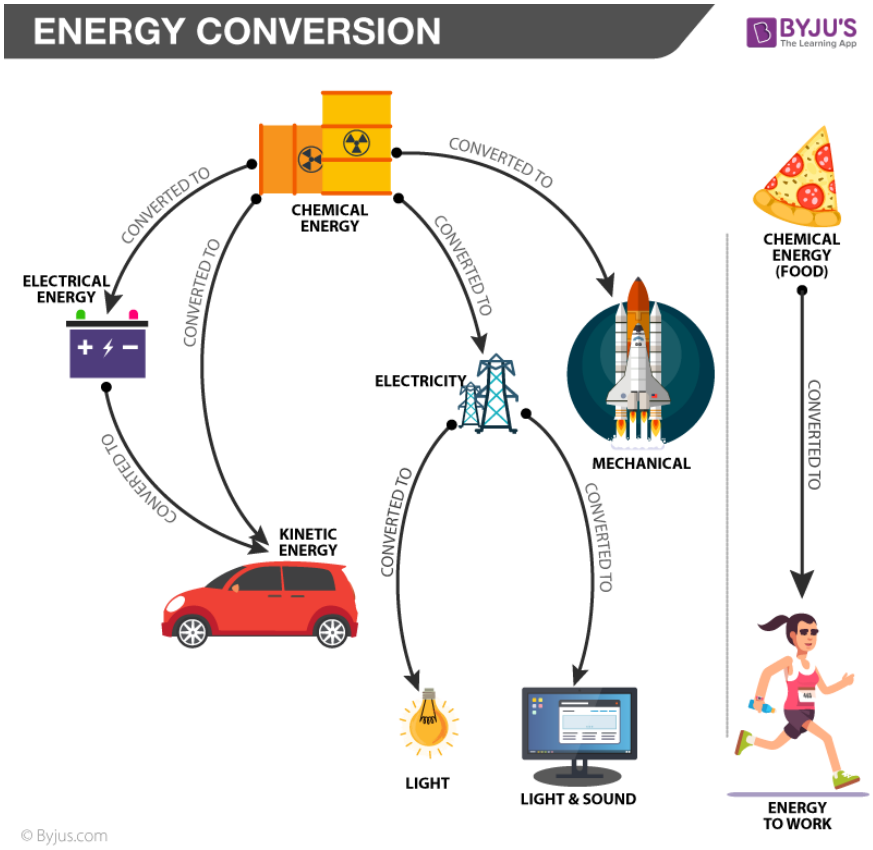
e. Летящий самолет обладает относительно Земли и кинетической и потенциальной энергией.

f. Солнечную энергию можно собрать при помощи солнечных батарей и затем преобразовать, например, в электричество.

g. Энергия не может исчезать в никуда, или появляться из ниоткуда, она только переходит из одного вида в другой.

h. В джоулях измеряется работа, энергия и количество теплоты.

10. Look at the mind map and give some more examples of every day energy transformations:



Pair work	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

EXTENSION WORKSHEET

1. Read the definitions of renewable and non-renewable sources of energy. Classify the following energy resources into two categories: Oil, coal, solar, wind power, natural gas, nuclear, biomass, geothermal, hydroelectric power, tidal power.

Renewable - energy produced from sources that do not deplete or can be replenished within a human's life time.	***Non-renewable*** - source of energy that will eventually run out.

2. Read the text about solar power and write the best word from the box for each blank.

source	conversion	pressure
mirrors	store	solar panels

Solar power can be an energy _____ in two main ways: through the capture of the heat energy in sunlight, or through _____ directly into electricity. The energy of the sun can be captured with lenses and _____ and concentrated enough to heat buildings or even make steam _____ for electricity. Solar thermal can heat homes easily with inexpensive pipes on the roof and the heat can be easily stored. Solar energy can also be converted directly into electricity with photovoltaics (PV) as _____. Solar PV is low impact and becoming cheaper every day. While it is difficult to _____ the electrical energy produced by these panels, as a small scale distributed source of power it is one of the

most cost effective. Almost all other sources of energy are derived from the Sun, solar is just the most direct way to use the sun's power.

3. Find out some information about other sources of energy. Answer the following questions:

a. What is the source of your type of energy?
b. Where can the source for this energy found?
c. How is this type of energy converted into other useful forms of energy?
d. What are benefits of this source of energy?
e. What are drawbacks of this source of energy?

ROLE PLAY

Role A –Solar. You think solar is the best form of power. Tell the others three reasons why. Tell them things that are wrong with their things.

Role B –Wind. You think wind is the best form of power. Tell the others three reasons why. Tell them things that are wrong with their things.

Role C –Wave. You think wave is the best form of power. Tell the others three reasons why. Tell them things that are wrong with their things.

Role D –Oil. You think oil is the best form of power. Tell the others three reasons why. Tell them things that are wrong with their things.

Role E – your option.

UNIT 7
WHAT IS ELECTROMAGNETISM?

Underline every word in the list you don't know and check for the meanings:

- branch (n)
- deal with (v)
- interact(v)-interaction (n)
- electricity (n)
- magnetism (n)
- extensive (adj)
- application (n)
- field (n)
- produce (v)
- charged (adj)
- wave (n)
- X-ray (n)
- frequency (n)
- motion (n)
- electric charge
- law of induction
- theory of relativity
- convert (v)
- contribution (n)
- scholar (n)
- deflect (v)
- magnetic needle
- conjecture (n)
- force (n)
- propagate (v)
- particle (n)
- give rise to (v)
- medium (n)
- transparent (adj)
- substance (n)
- confirm (v)
- equation (n)
- derive (v)
- differentiate (v)
- coherent (adj)
- obstacle (n)
- advancement (n)
- electroweak force
- switch (n)
- polarity (n)
- direction (n)
- reverse (v)
- current (n)
- repel (v)
- disease (n)
- occur (v)

1. Answer the following questions:

- What do you know about electromagnetism?
- Can you name any famous scientists who contributed to the study of electromagnetism?
- Why is electromagnetism important in today's society?

2. Read the end, predict the beginning. Discuss it with your partner:

a. _____ electricity and magnetism and the interaction between them.

b. _____ are all electromagnetic fields in a certain range of frequency.

c. _____ century, and this led to the discovery of the "special theory of relativity" by Albert Einstein.

d. _____is known as "Faraday's law of Induction."

e. _____ in today's world of science and physics.

3. Read the text and do the tasks that follow:

Electromagnetism is the branch of physics that deals with electricity and magnetism and the interaction between them. It was first discovered in the 19th century and has extensive application in today's world of physics.

Electromagnetism is basically the science of electromagnetic fields. An electromagnetic field is the field produced by objects that are charged electrically. Radio waves, infrared waves, ultraviolet waves, and x-rays are all electromagnetic fields in a certain range of frequency. Electricity is produced by the changing of magnetic field. The phenomenon is also called "electromagnetic induction." Similarly the magnetic field is produced by motion of electric charges.

The basic law of electromagnetism is known as "Faraday's law of Induction." The phenomenon of electromagnetism was discovered in the 19th century, and this led to the discovery of the "special theory of relativity" by Albert Einstein. According to his theory, electric and magnetic fields could be converted into one another with a relative motion. This phenomenon and its applications were discovered because of the many contributions from great scientists and physicists such as Michael Faraday, James Clerk Maxwell, Oliver Heaviside, and Heinrich Hertz. In 1802, an Italian

scholar demonstrated the relationship between electricity and magnetism by deflecting a magnetic needle with electrostatic charges.

Electromagnetism is basically a conjecture of a combined expression of an underlying force, known as "electromagnetic force." This force can be seen when an electric charge is moving. This movement produces magnetism. This idea was presented by James Clerk Maxwell who published the theory of electricity and magnetism in 1865. Based on this theory many applications and other effects were discovered by other scientists. Electromagnetism has been extended to the area of quantum physics as well where light propagates as a wave and interacts as a particle.

It has been proved that electricity can give rise to magnetism and vice versa. A very simple example is that of an "electric transformer." The exchanges take place inside the transformer that gives rise to electromagnetic waves. Another fact about these waves is that they do not need a medium to propagate although their speed is relatively slower when traveling through transparent substances.

Electromagnetic Waves

Electromagnetic waves were first discovered by James Clerk Maxwell and they were confirmed afterwards by Heinrich Hertz. Afterward, a wave form of electric and magnetic equations was derived by Maxwell which showed that the electric and magnetic fields had wave-like nature. The factors which differentiate electromagnetic waves from each other are frequency, amplitude and polarization. For example, a laser beam is coherent and the radiation is of only one frequency. There are other types of waves varying with their frequencies such as radio waves which are at very low frequencies and gamma rays and x-rays of very high frequency. Electromagnetic waves can propagate to very long distances and they are not affected by any kind of obstacles whether they are huge walls or towers.

This special interaction of electricity and magnetism has led to great advancements in modern science and technology, and efforts are being made to discover more about electromagnetism and its applications. Other forces are gravitational forces, strong and weak forces. Electromagnetism has also been combined with the weak force which is known as "Electroweak force."

Applications of Electromagnetism

Electromagnetism has numerous applications in today's world of science and physics. The very basic application of electromagnetism is in the use of motors. The motor has a switch that continuously switches the polarity of the outside of motor. An electromagnet does the same thing. We can change the direction by simply reversing the current. The inside of the motor has an electromagnet, but the current is controlled in such a way that the outside magnet repels it.

Another very useful application of electromagnetism is the "CAT scan machine." This machine is usually used in hospitals to diagnose a disease. As we know that current is present in our body and the stronger the current, the strong is the magnetic field. This scanning technology is able to pick up the magnetic fields, and it can be easily identified where there is a great amount of electrical activity inside the body.

The work of the human brain is based on electromagnetism. Electrical impulses cause the operations inside the brain and it has some magnetic field. When two magnetic fields cross each other inside the brain, interference occurs which is not healthy for the brain.

(Available at: https://www.brighthubengineering.com/commercial-electrical-applications/62105-what-is-electromagnetism-and-its-applications/)

3. Decide if the sentences are true or false:

a. Electromagnetism is the branch of physics that deals with electricity and magnetism and the interaction between them.
b. An electric current produces magnetism, and a magnet can produce an electric current.
c. Radio waves, infrared waves, ultraviolet waves, and x-rays have the same frequency range.
d. Electromagnetic waves require a certain medium to propagate.
e. Electric and magnetic fields had wave-like nature.
f. Electromagnetism is of limited use in today's world of physics.
g. The work of the human brain is based on electromagnetism.

4. Answer the following questions to the text:

a. What does electromagnetism mean?
b. When was electromagnetism discovered?
c. Who contributed to the discovery of electromagnetism?
d. What is James Clerk Maxwell famous for?
e. What is a basic law of electromagnetism?
f. What are electromagnetic waves properties?
g. Where can electromagnetism be applied?

FOCUS ON VOCABULARY

5. Find the words in the text which mean:

a. to turn aside, especially from a straight course or fixed direction (v)
b. a condition or environment in which something may function or flourish (n)
c. to be the origin of; to produce; to result in (v)
d. capable of transmitting light so that objects or images can be seen as if there were no intervening material (adj)
e. the maximum absolute value of a periodically varying quantity (n)
f. to turn around to the opposite direction (v)

6. Match an adjective from column A with a noun in column B.

column A	column B
1. infrared	a. the direction
2. a magnetic	b. extensive application
3. wave-like	c. waves
4. charged	d. nature
5. have	e. relativity
6. theory of	f. needle
7. a certain range of	g. frequency
8. change	h. electrically

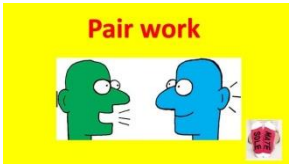
7. Find English equivalents in the text:

раздел физики, электромагнитное поле, электрически заряженные объекты, определенный диапазон частот**,** приводить к ч-л, преобразовать в, распространяется как волна, среда для распространения, прозрачное вещество, низкая частота, переключать полярность, направление тока, отталкивать.

8. Translate the sentences into English:

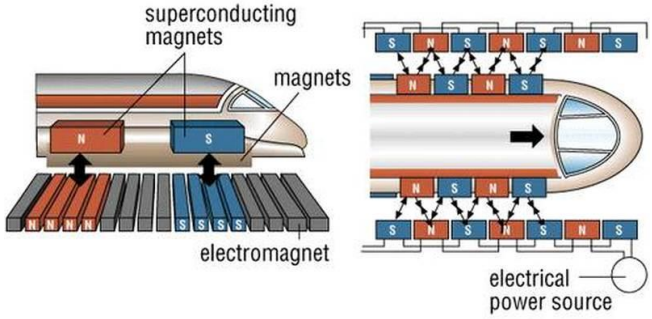
a. Электромагнетизм — это раздел физики, который занимается электричеством, магнетизмом и взаимодействием между ними.
b. Электромагнитное поле — это поле, создаваемое электрически заряженными объектами.
c. Радиоволны, инфракрасные волны, ультрафиолетовые волны и рентгеновские лучи — это электромагнитные поля в определенном диапазоне частот.
d. Основной закон электромагнетизма известен как «закон индукции Фарадея»**.**
e. Электромагнетизм распространился и на область квантовой физики, где свет распространяется как волна и взаимодействует как частица.
f. Было доказано, что электричество может вызвать магнетизм и наоборот.
g. Факторами, которые отличают электромагнитные волны друг от друга, являются частота, амплитуда и поляризация.

Make five questions to this text and let a classmate answer the questions.

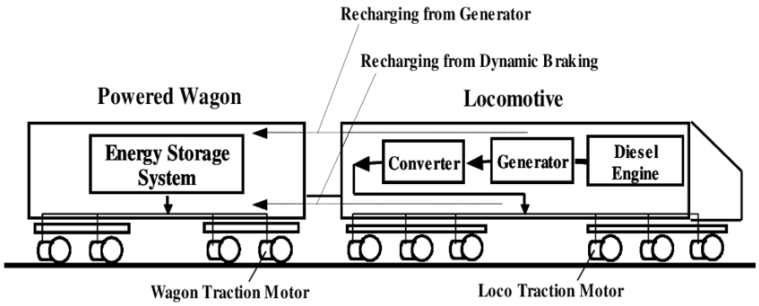
	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

EXTENSION WORKSHEET

1. Study these diagrams of a maglev train and a conventional train. What differences can you note between them? Discuss them with your partner using the expressions from the box below:



VS



Useful expressions (Expressing contrast):	
✓ unlike ✓ in contrast to ✓ as opposed to	✓ different from ✓ whereas ✓ while

2. Read the text about maglev trains and write the best word from the box for each blank.

magnetic fields copper polarity	repel coil friction	propulsion lift

Magnetic levitation is a technology that uses _____to make the train move. With magnets, opposite poles attract and like poles _____ each other. This is the basic principle behind electromagnetic _____. Electromagnets are similar to other magnets in that they attract metal objects, but the magnetic pull is temporary. A small electromagnet can be made by connecting the ends of a _____ wire to the positive and negative ends of an AA, C or D-cell battery. This creates a small magnetic field. If the wire is disconnected from either end of the battery, the magnetic field is taken away.

The magnetized _____ running along the track, called a guideway, repels the large magnets on the train's undercarriage. This allows the train to _____ between 0.39 and 3.93 inches (1 to 10 centimeters) above the guideway. Once the train is lifted, power is supplied to the coils within the guideway walls. This creates a unique system of magnetic fields that pull and push the train along the guideway. The electric current supplied to the coils in the guideway walls is constantly alternating to change the _____ of the magnetized coils. This change in polarity causes the magnetic field in front of the train to pull the vehicle forward, while the magnetic field behind the train adds more forward thrust.

Maglev trains float on a cushion of air, which removes _____. The trains have an aerodynamic design. This allows them to reach speeds of more than 310 mph (500 kph), or twice as fast as Amtrak's fastest commuter train.

3. Answer the questions to the text:

1. What is magnetic levitation?
2. What basic principle is used to levitate a maglev train?
3. How do magnetic levitation trains work?
4. What is the primary reason that maglev vehicles can reach extremely high speeds?
5. Find some more information about advantages/disadvantages of maglevs. Discuss them with your partner.

UNIT 8

THE NARURE OF LIGHT

	**Underline every word in the list you don't know and check for the meanings:**
• stream (n) • particle (n) • emit (v) • source (n) • sight (n) • reflection (n) • refraction (n) • propose (v) • immediate acceptance • medium (n) • wave (n) • bend (v) • obstacle (n) • edge (n) • diffraction (n) • wavelength (n) • evidence (n) • reject (v) • adhered (to) (adj) • condition (n) • exhibit (v)	• interference (n) • frequency (n) • property (n) • subsequent (adj) • assumption (n) • photoelectric effect • exposed (to) (adj) • ultraviolet light • light quanta • composed (of) (adj) • corpuscle (n) • discontinuous (adj) • photon (n) • emphasize (v) • constant (adj) • retain (v) • imply (v) • dual nature • propagation • assume (v)

1. Answer the following questions:

- Why is light so important for us? What does it give us?
- Give some examples for:

a) natural light:_____

b) man-made light :_____

2. List what you already know about the nature of light in the "What I Know" column.

What I know	What I wonder	What I learned

3. Generate some questions you hope to learn more about it in the "Want to know" column.

4. Read the text and do the tasks that follow:

Until the beginning of the nineteenth century, light was modeled as a stream of particles emitted by a source that stimulated the sense of sight on entering the eye. The chief architect of the particle theory of light was Newton. With this theory, he provided simple explanations of some known experimental facts concerning the nature of light, namely, the laws of reflection and refraction.

Most scientists accepted Newton's particle theory of light. During Newton's life-time, however, another theory was proposed. In 1678 Dutch physicist and astronomer Christian Huygens (1629–1695) showed that a wave theory of light could also explain the laws of reflection and refraction.

The wave theory didn't receive immediate acceptance for several reasons. First, all the waves known at the time (sound, water, and so on) traveled through some sort of medium, but light from the Sun could travel to Earth through empty

space. Further, it was argued that if light were some form of wave, it would bend around obstacles; hence, we should be able to see around corners. It is now known that light does indeed bend around the edges of objects. This phenomenon, known as diffraction, is difficult to observe because light waves have such short wavelengths. Even though experimental evidence for the diffraction of light was discovered by Francesco Grimaldi (1618–1663) around 1660, for more than a century most scientists rejected the wave theory and adhered to Newton's particle theory, probably due to Newton's great reputation as a scientist.

The first clear demonstration of the wave nature of light was provided in 1801 by Thomas Young (1773–1829), who showed that under appropriate conditions, light exhibits interference behavior. Light waves emitted by a single source and traveling along two different paths can arrive at some point and combine and cancel each other by destructive interference. Such behavior couldn't be explained at that time by a particle model because scientists couldn't imagine how two or more particles could come together and cancel one another.

The most important development in the theory of light was the work of Maxwell, who predicted in 1865 that light was a form of high-frequency electromagnetic wave. His theory also predicted that these waves should have a speed of 33 108 m/s, in agreement with the measured value.

Although the classical theory of electricity and magnetism explained most known properties of light, some subsequent experiments couldn't be explained by the assumption that light was a wave. The most striking experiment was the photoelectric effect, discovered by Hertz. Hertz found that clean metal surfaces emit charges when exposed to ultraviolet light.

In 1905, Einstein published a paper that formulated the theory of light quanta ("particles") and explained the photoelectric effect. He reached the conclusion that light was composed of corpuscles, or discontinuous quanta of energy. These corpuscles or quanta are now called photons to emphasize their particle-like nature. According to Einstein's theory, the energy of a photon is proportional to the frequency of the electromagnetic wave associated with it, or E=hf where h= 6.63*3

10^{-34} J s is Planck's constant. This theory retains some features of both the wave and particle theories of light. As we discuss later, the photoelectric effect is the result of energy transfer from a single photon to an electron in the metal. This means the electron interacts with one photon of light as if the electron had been struck by a particle. Yet the photon has wave-like characteristics, as implied by the fact that a frequency is used in its definition.

In view of these developments, light must be regarded as having a dual nature: In some experiments light acts as a wave, and in others it acts as a particle. Classical electromagnetic wave theory provides adequate explanations of light propagation and of the effects of interference, whereas the photoelectric effect and other experiments involving the interaction of light with matter are best explained by assuming light is a particle. So in the final analysis, is light a wave or a particle? The answer is neither and both: light has a number of physical properties, some associated with waves and others with particles.

(College Physics, Eleventh EditionRaymond A. Serway and Chris Vuille)

5. Match scientists with their discoveries:

1. Newton 2. Christian Huygens 3. Francesco Grimaldi 4. Thomas Young 5. James Clerk Maxwell 6. Henry Hertz **7.** Albert Einstein	a. showed that a wave theory of light could also explain the laws of reflection and refraction. b. found that clean metal surfaces emit charges when exposed to ultraviolet light c. showed that under appropriate conditions, light exhibits interference behavior d. was the chief architect of the particle theory of light e. predicted in 1865 that light was a form of high-frequency electromagnetic wave f. published a paper that formulated the theory of light quanta ("particles") and explained the photoelectric effect **g.** discovered experimental evidence for the diffraction of light.

6. Answer the following questions to the text:

- How was light was defined until the beginning of the nineteenth century?
- What two rival theories of light were proposed in the 17th century? Provide some more details on each theory.
- What is diffraction?
- When does photoelectric effect occur?
- What are the properties of light mentioned in the text?
- What is meant by the dual nature of light?

FOCUS ON VOCABULARY:

7. Match the halves to make phrases from the text:

1. the sense of	a. reflection and refraction
2. laws of	b. effect
3. exhibits	c. electromagnetic wave
4. high-frequency	d. sight
5. photoelectric	e. nature
6. dual	f. interference behavior

8. Fill in the phrases with the correct preposition:

a. light was modeled _____ a stream of particles.

a. traveled _____ some sort of medium

b. bend _____ obstacles

c. in agreement _____ the measured value

d. exposed _____ ultraviolet light.

e. composed _____ corpuscles

8. proportional _____ the frequency of the electromagnetic wave

9. Find English equivalents to the following word combinations:

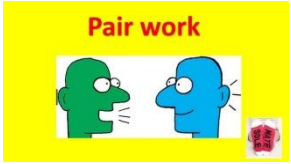
Поток частиц, излучать, источник, природа света, законы отражения и преломления света, среда, преломляться, длина волны, высокочастотные электромагнитные волны, ультрафиолетовый свет, корпускулы, частота электромагнитных волн, двойственная природа света, корпускулярная,

волновая теория света, распространение света, взаимодействие света с веществом.

10. Translate the sentences into English:

- Первые теории о природе света - корпускулярная и волновая - появились в середине 17 века. Согласно корпускулярной теории свет представляет собой поток частиц (корпускул), которые испускаются источником света.
- В 1865 году Максвеллом, который пришел к выводу, что свет - электромагнитная волна.
- Согласно современным представлениям, свет имеет двойственную корпускулярно-волновую природу. В одних явлениях свет обнаруживает свойства волн, а в других - свойства частиц.
- Луч света состоит из летящих с огромной скоростью частиц, которые называются фотонами. Скорость полета частиц света 300 000 километров в секунду.
- Наши глаза воспринимают электромагнитное излучение в определенном диапазоне длин волн: это видимый свет (его источники — Солнце и электрические светильники).
- Центральное место в геометрической оптике занимают законы отражения и преломления света.
- Открытие и изучение явления фотоэффекта стало важным шагом в развитии представлений человека о природе света.

Make five questions to this text and let a classmate answer the questions.

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

EXTENSION WORKSHEET

1. The interplay of light with things around us gives rise to several beautiful phenomena. Match names of optical phenomena with the pictures given below: aurora, rainbow, halo, sundog, Brocken spectre, light pillar.

		
a)	b)	c)
		
d)	e)	f)

2. Read the text about a rainbow. Complete the text with the proper word. There is one extra word you don't need.

rays	secondary	dispersion
intensity	light	angle
rainbow	raindrop	corpuscle

The _____ is an example of the dispersion of sunlight by the waterdrops in the atmosphere. This is a phenomenon due to combined effect of _____, refraction and reflection of sunlight by spherical water droplets of rain. The conditions for observing a rainbow are that the sun should be shining in one part of the sky (say near western horizon) while it is raining in the opposite part of the sky

(say eastern horizon). An observer can therefore see a rainbow only when his back is towards the sun.

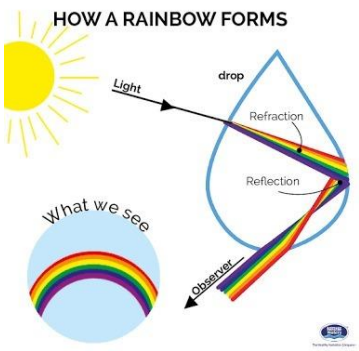
Sunlight is first refracted as it enters a _____, which causes the different wavelengths (colours) of white _____ to separate. Longer wavelength of light (red) are bent the least while the shorter wavelength (violet) are bent the most. Next, these component _____ strike the inner surface of the water drop and get internally reflected if the angle between the refracted ray and normal to the drop surface is greater than the critical _____ (48º, in this case). The reflected light is refracted again as it comes out of the drop as shown in the figure. It is found that the violet light emerges at an angle of 40º related to the incoming sunlight and red light emerges at an angle of 42º. For other colours, angles lie in between these two values.

When light rays undergo two internal reflections inside a raindrop, instead of one as in the primary rainbow, a _____ rainbow is formed. The _____ of light is reduced at the second reflection and hence the secondary rainbow is fainter than the primary rainbow. Further, the order of the colours is reversed in it.

3. Answer the following questions:

- What is a rainbow?
- What conditions must be met in order for you to see a rainbow?
- How is a rainbow formed?
- Why is red on the outside of a rainbow and blue inside?
- Why are there sometimes two rainbows?

4. Use the Internet to look for some optical phenomena produced by light. Make a short report on one of them.



UNIT 9

WHAT IS RADIOACTIVITY

	**Underline every word in the list you don't know and check for the meanings:**
• radioactivity (n) • radiation (n) • emit (v) • spontaneously (adv) • atomic nucleus (n) • (un)stable (adj) • configuration (n) • shift (v) • devote to (v) • nuclear (adj) • decay (n, v) • lead to (v) • particle (n) • neutron (n) • proton (n) • electron (n) • ray (n) • discard (v) • detect (v) • disintegration (n) • shorthand (n)	• curie (n) • becquerel (n) • constant (adj) • random (adj) • half-life (n) • vary (v) • unravel (v) • chain (n) • nuclear weapon • naturally (adv) • artificially • induced (adj) • intervention (n) • fission (n) • split (v) • capture therapy (n) • brain cancer (n) • contain (v) • absorb (v) • treatment (n) • controversial (adj) • split (v)

1. Look at the sign. What does it warn about?

2. Read the questions given below. Discuss your answers with your partner:

a) Is radioactivity spontaneous and random?

- Yes
- No

b) Which type of radioactive decay doesn't change the atomic number?

- Alpha
- Beta
- Gamma
- All forms

c) What is Half-life?

- The time it takes for the number of protons to halve
- The distance it takes for the number of nuclei to halve
- The time it takes for the number of nuclei to halve

d) Which of these is an *artificial* source of background *radiation*?

- Cosmic rays
- Rocks and soil
- Neutron activation

e) A 10-hour plane flight is about the same exposure as

- 1 chest X-ray
- 5 chest X-ray
- 10 chest X-ray

3. Read the text and do the tasks that follow:

A. As its name implies, radioactivity is the act of emitting radiation spontaneously. This is done by an atomic nucleus that, for some reason, is unstable; it "wants" to give up some energy in order to shift to a more stable configuration. During the first half of the twentieth century, much of modern physics was devoted to exploring why this happens, with the result that nuclear decay was fairly well understood by 1960. Too many neutrons in a nucleus lead it to emit a negative beta particle, which changes one of the neutrons into a proton. Too many protons in a nucleus lead it to emit a positron (positively charged electron), changing a proton into a neutron. Too much energy leads a nucleus to emit a gamma ray, which discards great energy without changing any of the particles in the nucleus. Too much mass leads a nucleus to emit an alpha particle, discarding four heavy particles (two protons and two neutrons).

B. *Radioactivity* is a physical, not a biological, phenomenon. Simply stated, the radioactivity of a sample can be measured by counting how many atoms are spontaneously decaying each second. This can be done with instruments designed to detect the particular type of *radiation* emitted with each "decay" or disintegration. The actual number of disintegrations per second may be quite large. Scientists have agreed upon common *units* to use as a form of shorthand. Thus, a curie (abbreviated "Ci" and named after Pierre and Marie Curie, the discoverers of radium) is simply a shorthand way of writing "37,000,000,000 disintegrations per second," the rate of disintegration occurring in 1 gram of radium. The more modern International System of Measurements (SI) unit for the same type of measurement is the *becquerel* (abbreviated "Bq" and named after Henri Becquerel, the discoverer of radioactivity), which is simply a shorthand for "1 disintegration per second."

C. Being unstable does not lead an atomic nucleus to emit radiation immediately. Instead, the probability of an atom disintegrating is constant, as if unstable nuclei continuously participate in a sort of lottery, with random drawings to decide which atom will next emit radiation and disintegrate to a more stable state. The time it takes for half of the atoms in a given mass to "win the lottery"--that is,

emit radiation and change to a more stable state--is called the *half-life*. Half-lives vary greatly among types of atoms, from less than a second to billions of years. For example, it will take about 4.5 billion years for half of the atoms in a mass of uranium 238 to spontaneously disintegrate, but only 24,000 years for half of the atoms in a mass of plutonium 239 to spontaneously disintegrate. Iodine 131, commonly used in medicine, has a half-life of only eight days.

D. Stability may be achieved in a single decay, or a nucleus may decay through a series of states before it reaches a truly stable configuration, a bit like a Slinky toy stepping down a set of stairs. Each state or step will have its own unique characteristics of half-life and type of radiation to be emitted as the move is made to the next state. Much scientific effort has been devoted to unraveling these decay chains, not only to achieve a basic understanding of nature, but also to design nuclear weapons and nuclear reactors.

E. Radioactivity can occur both naturally and through human intervention. An example of artificially induced radioactivity is *neutron activation*. A neutron fired into a nucleus can cause nuclear *fission* (the splitting of atoms). This is the basic concept behind the atomic bomb. Neutron activation is also the underlying principle of boron-neutron capture therapy for certain brain cancers. A solution containing boron is injected into a patient and is absorbed more by the cancer than by other cells. Neutrons fired at the area of the brain cancer are readily absorbed (captured) by the boron nuclei. These nuclei then become unstable and emit radiation that attacks the cancer cells. Simple in its basic physics, the treatment has been complex and controversial in practice and after half a century is still regarded as highly experimental.

(Available at: https://ehss.energy.gov/ohre/roadmap/achre/intro_9_2.html)

4. Skim the paragraphs of the text. Match the paragraphs (A-E) with the headings (1-5) below:

1. Radioactive half-life
2. Radioactive decay chain
3. Causes of radioactivity

4. The units of measure for radioactivity
5. Sources of radioactivity

5. Give answers to the following questions:

1. How would you define radioactivity?
2. How are alpha particles produced?
3. What causes a beta particle to form?
4. What are characteristics of gamma particles?
5. What are the units of measure for radioactivity? What do they represent?
6. How can we determine half life?
7. What is a radioactive decay chain?
8. What are the main sources of radiation? What are examples of artificially induced radioactivity?

FOCUS ON VOCABULARY:

6. Guess the words from the definition:

_____ (n) the act of emitting radiation spontaneously.

_____ (n) the anti-particle of the electron.

_____ (n)changing to a different form, producing radiation

_____ (v) to send out light, sound, or a smell, or a gas or other substance

_____ (adj) happening, done, or chosen by chance rather than according to a plan

_____ (n) the length of time needed for the radioactivity of a radioactive substance to be reduced by half

_____(n) a large machine that uses nuclear fuel to produce power

_____(n) the process of dividing the nucleus of an atom, resulting in the release of a large amount of energy :

_____ (adj) made or produced by human beings rather than occurring naturally

_____ (v) to (cause to) divide into two or more parts

7. Match an adjective from column A with a noun in column B:

stable	nucleus
heavy	particles
common	configuration
atomic	units
single	phenomenon
nuclear	weapons
physical	decay

8. Fill in the gaps with the proper phrase from ex. 7:

a. Radioactivity is the _____ in which the nucleus of an excited (high energy) atom loses its energy by emitting ionizing radiation.
b. Atomic nuclei that are not stable, tend to approach _____ .
c. Beta is _____, so it has low energy and cannot penetrate like gamma or neutrons
d. The two most _____ of radioactivity are Becquerels and Curies. Becquerels are metric and curies are British.
e. Radioactive decay occurs when an unstable _____ loses energy.
f. Stability may be achieved in a _____, or a nucleus may decay through a series of states before it reaches a truly stable configuration.
g. Detonating _____ above ground sends radioactive materials as high as 50 miles into the atmosphere.

9. Find English equivalents to the following words and word combinations:

Радиоактивность, испускать (радиацию), атомное ядро, (не)стабильный, смещаться к, ядерный распад, положительно заряженный, приводить к, самопроизвольно, условное обозначение, постоянный, случайный, период полураспада, цепочка радиоактивного распада, ядерное оружие, ядерный реактор, вмешательство человека, нейтронное облучение, ядерный распад, сугубо экспериментальный.

10. Translate the following sentences into English:

a. Почти 90 % из 2500 известных атомных ядер нестабильны.
b. Явление радиоактивности было открыто в 1896 году французским физиком А. Беккерелем.
c. Мария Склодовски Кюри и Пьер Кюри доказали, что радиоактивные излучения испускаются не только атомами урана, но и атомами некоторых других элементов.
d. В 1898 г. Э. Резерфорд выделил два вида лучей: α-лучи — тяжелые положительно заряженные частицы (ядра атомов гелия) и β-лучи — легкие отрицательно заряженные частицы (тождественны электронам).
e. *Гамма-лучи были открыты* французским физиком П. Виллардом в 1900 году при изучении испускаемого радием излучения.
f. Испускание радиоактивных частиц называется радиоактивным распадом.
g. Период полураспада – основная величина, характеризующая скорость процесса.
h. Например, атом урана в результате радиоактивного распада превращается в два атома – атом тория и атом гелия.
i. Различают альфа-распад (с испусканием альфа-частиц), бета-распад (с испусканием бета-частиц), термина "гамма-распад" не существует.
j. Альфа-частицы испускаются только тяжелыми ядрами, т.е. содержащими большое число протонов и нейтронов.
k. Явление бета-распада состоит в том, что ядра некоторых элементов самопроизвольно испускают электроны и элементарную частицу очень малой массы - антинейтрино.
l. В системе СИ *единица кюри* заменена на *единицу беккерель* (Бк), определяемую как 1 распад в 1 с.

11. What are golden rules for working with radiation? Make your own rules using the phrases:

Useful expressions (Expressing obligation):	
✓ I **have to** …….. ✓ I **must** …….. ✓ It **is obligatory**……..	✓ It **is necessary** that …….. ✓ X is/are required to……..

Example: It is necessary that you understand the nature of the hazard.

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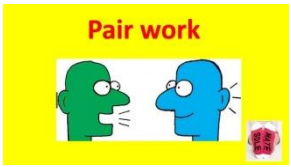
	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

EXTENSION WORKSHEET

1. What are the most radioactive items in your house? Rank them:

- Smoke detectors
- Bananas
- Granite countertops

- Cigarettes
- Your body
- Your grandma’s dinnerware

2. Read the text about radioactivity of bananas. Complete the text with the proper word. There is one word you don’t need.

naturally occurring	becquerels	exposure
dose	radioactive	rich
potassium	power plant	unstable

Nuclear proponents often make the silly-sounding claim that a person gets a greater annual _____ of radiation from eating a banana than by standing beside a nuclear _____. The claim is false. While it is true that bananas are naturally radioactive, eating a banana does not increase a person's annual radiation _____.

Bananas are _____ in potassium (chemical symbol K), and a very small fraction of that naturally-occurring potassium is in fact radioactive –about one-hundredth of one percent (actually 120 parts per million).The radioactive variety of potassium is potassium-40 (K-40, 0.012 % of total potassium). The much more abundant non-radioactive varieties of potassium found in the body are potassium-39 (K-39, 93 % of total K) and potassium-41 (K-41, 7 % of total K).These percentages are the same the whole world over, they never change. Every tiny bit of _____potassium has the same three varieties in the same exact percentages. Since the bodies of all animals including humans require potassium to function properly, all animals, including humans, are slightly _____. It is a fact of life. Bananas and other foods rich in potassium are also radioactive for the same reason.

The average banana contains about half a gram of _____. The K-40 in such a banana will hold about 15 _____ of radioactivity. Nevertheless, eating that banana does not add to the annual radiation dose of the human being who eats it. That's because the body already has a lot of "natural" potassium including K-40 [which is unavoidable], and any new "natural" potassium ingested is balanced by

eliminating a comparable amount of "natural" potassium to maintain the "homeostasis" of the body.

(Adapted from: http://mentalfloss.com/article/63768/7-most-radioactive-items-your-home)

3. Answer the following questions to the text:

a. Is it true that bananas are radioactive?
b. What element makes bananas radioactive?
c. Does human body contain radioactive elements?
d. Does eating a banana increase your radiation exposure?

4. ***Use the Internet to look for some information on personal annual radiation dose per year. Pay attention to the following common sources of radiation:***

- Cosmic radiation (exposure depends on your elevation)
- Terrestrial (from the ground)
- House construction
- Food/water
- Air (radon)
- Man-made sources (smoke detectors, TV, computers, etc)
- Medical diagnostic procedures
- Others (smoking, travelling by plane etc)

5. Make a short report on how much radiation you are exposed to. Compare your results with your group-mates.

UNIT 10

HISTORY OF ATOMIC STRUCTURE

	**Underline every word in the list you don't know and check for the meanings:**
• search (n) • atom (n) • composed of (adj) • propose (v)-proposal (n) • indivisible (adj) • break down (phr. verb) • perform (v) • emerge (v) • indefinitely (adv) • credible (adj) • remain (v) • inquiry for (n) • pursuit (n) • conduct (v) • ratios (n) • compound (n) • subsequently (adv) • evidence (n) • cathode ray • lead to (v) • resemble (v)	• dispersed (adj) • immersed (adj) • foil (n) • densely-packed (adj) • core (n) • surrounded (adj) • nucleus (n) • quantized (adj) • confine to (v) • discrete (adj) • force (v) • precursor (n) • prohibit (v) • restrict (v) • feature (n) • dense (adj) • bound (adj) • electron shells (n) • release (n) • induce (v) • remove from (v)

1. Complete the following sentences with your own words:

An atom is_____

The 3 particles of the atom are: _____

Their respective charges are: _____

Classical atomic theories are: _____

2. Read the text and do the tasks that follow:

The search for the atom began as a philosophical question. It was the natural philosophers of ancient Greece that began the search for the atom by asking such questions as what is stuff composed of? What is the structure of material objects? Is there a basic unit from which all objects are made? As early as 400 B.C., some Greek philosophers proposed that matter is made of indivisible building blocks known as **atomos**. (*Atomos* in Greek means indivisible.) To these early Greeks, matter could not be continuously broken down and divided indefinitely. Rather, there was a basic unit or building block which was indivisible and foundational to its structure. This indivisible building block of which all matter was composed became known as the atom.

The early Greeks were simply philosophers. They did not perform experiments to test their theories. In fact, science as an experimental discipline did not emerge as a credible and popular practice until sometime during the 1600s. So the search for the atom remained a philosophical inquiry for a couple of millennia. From the 1600s to the present century, the search for the atom became an experimental pursuit. Several scientists are notable; among them are Robert Boyle, John Dalton, J.J. Thomson, Ernest Rutherford, and Neils Bohr.

Boyle's studies (middle to late 1600s) of gaseous substances promoted the idea that there were different types of atoms known as elements. Dalton (early 1800s) conducted a variety of experiments to show that different elements can combine in fixed ratios of masses to form compounds. Dalton subsequently proposed one of the first theories of atomic behavior which was supported by actual experimental evidence.

English scientist J.J. Thomson's cathode ray experiments (end of the 19th century) led to the discovery of the negatively-charged electron and the first ideas of the structure of these indivisible atoms. Thomson proposed the *Plum Pudding Model*, suggesting that an atom's structure resembles the favorite English dessert - plum pudding. The raisins dispersed amidst the plum pudding are analogous to negatively charged electrons immersed in a sea of positive charge.

Nearly a decade after Thomson, Ernest Rutherford's famous gold foil experiments led to the nuclear model of atomic structure. Rutherford's model suggested that the atom consisted of a densely-packed core of positive charge known as the **nucleus** surrounded by negatively-charged electrons. While the nucleus was unique to the Rutherford atom, even more surprising was the proposal that an atom consisted mostly of empty space. Most the mass was packed into the nucleus that was abnormally small compared to the actual size of the atom.

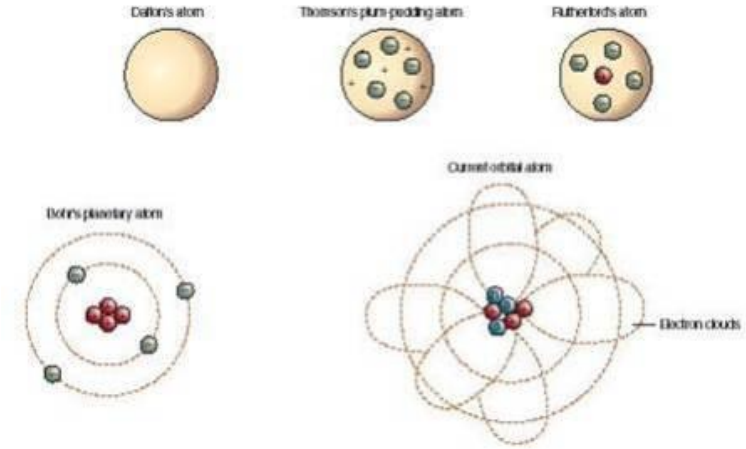
Neils Bohr (1913) improved upon Rutherford's nuclear model by explaining that the electrons present were present in orbits outside the nucleus. The electrons were confined to specific orbits of fixed radius, each characterized by their own discrete levels of energy. While electrons could be forced from one orbit to another orbit, it could never occupy the space between orbits.

Bohr's view of quantized energy levels was the precursor to modern quantum mechanical views of the atoms. The mathematical nature of quantum mechanics prohibits a discussion of its details and restricts us to a brief conceptual description of its features. Quantum mechanics suggests that an atom is composed of a variety of subatomic particles. The three main subatomic particles are the proton, electron and neutron. The proton and neutron are the more massive of the three subatomic particles; they are located in the nucleus of the atom, forming the dense core of the atom. The proton is charged positively. The neutron does not possess a charge and is said to be neutral. The protons and neutrons are bound tightly together within the nucleus of the atom. Outside the nucleus are concentric spherical regions of space known as **electron shells**. The shells are the home of the negatively charged electrons. Each shell is characterized by a distinct energy level. Outer shells have

higher energy levels and are characterized as being lower in stability. Electrons in higher energy shells can move *down* to lower energy shells; this movement is accompanied by the release of energy. Similarly, electrons in lower energy shells can be induced to move to the higher energy outer shells by the addition of energy to the atom. If provided sufficient energy, an electron can be removed from an atom and be freed from its attraction to the nucleus.

(Available at:https://www.mwit.ac.th/~physicslab/applet_04/physics_classroom/Class/estatics/ u8l1a.html)

3. Complete the table with the information from the text:

Atoms are building blocks of matter		Positive charge is located within a central nucleus		
				
Early Greek philosophers 400BC				Quantum mechanics Modern model

4. Answer the following questions:

1. Who was the first to propose the concept of the atom?
2. What does the word "atom" mean?
3. Are the ancient Greeks' theories about the atom still relevant today? Why?/Why not?

4. What other scientists contributed to the study of the atom?

5. Can you name three main subatomic particles? What are their characteristics?

FOCUS ON VOCABULARY

5. Form the adverbs from the following adjectives and translate them into Russian: continuous, indefinite, subsequent, negative, abnormal, dense, tight.

6. Fill in the sentences with the appropriate adverbs from ex. 5. There are two adverbs are not needed:

a. We already learned that J. J. Thomson discovered a _____ charged particle, called the electron.
b. A _____ traveling wave can be thought of as a series of wave pulses.
c. Most solids are crystalline, where the molecules are _____ bound to each other
d. Röntgen's discovery of a new form of energy would be _____ named after him.
e. He found _____ high emission temperatures in the reaction zone.

7. *Guess the words from the definition*:

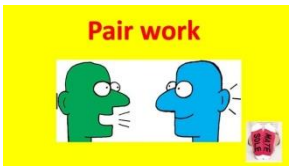
a. toam - the smallest unit of any chemical element, consisting of a positive nucleus surrounded by negative electrons.
b. vsniidilibe - not able to be divided into parts.
c. lofi- a very thin sheet of metal.
d. lcusenu- the central part of an atom.
e. hlsle - the hard outer covering of something.
f. snede - containing a lot of matter in a small space.

8. *Find English equivalents the following words and word combinations:*

Состоять из, выдвигать (теорию), неделимый, положительно/отрицательно заряженный, экспериментальные данные (доказательства), рассредоточенный, атомное ядро, формировать соединения, описание характеристик, субатомная частица, плотно ядро, тесно связанный.

9. *Translate the following sentences into English:*

a. Еще с давних времен мыслители, философы и первые ученые предполагали, что все сущее состоит из неких мельчайших частиц — атомов.
b. В переводе с древнегреческого ἄτομος означает «неделимый».
c. Первая модель атома была предложена английским физиком Дж. Дж. Томсоном, открывшим электрон.
d. Эрнест Резерфорд подвергал бомбардировке альфа-частицами различные элементарные газы.
e. Ученые физики Нильс Бор и Эрнест Резерфорд предложили так званую планетарную модель атома, сравнив его с планетной системой.
f. Помимо модели Бора/Резерфорда были и другие, например, модель Томпсона, полагавшего, что атом является положительно заряженным телом, внутри которого располагаются электроны.
g. Наши знания о внутреннем устройстве атомов основаны на огромном количестве экспериментальных данных.
h. Ядро – центральная часть атома, состоящая из положительно заряженных протонов и нейтральных нейтронов.
i. Электрон является отрицательно заряженной частицей.
j. Мы знаем что протоны, из которых состоит атомное ядро, сами в свою очередь состоят из еще более мелких элементарных частиц – кварков.

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

EXTENSION WORKSHEET

1. Check how much you know about the Large Hadron Collider:

The Large Hadron Collider is used for……

The Large Hadron Collider is located……..

The Large Hadron Collider is important because…….

2. Match the words with the definitions.

1. tunnel 2. powerful 3. counterparts 4. collide 5. the Higgs Boson 6. accelerator ***7.*** pillar	a. an apparatus for imparting high velocities to charged particles (such as electrons) b. a fundamental precept c. something that is the equivalent to, or has the same features, functions and/or characteristics d. having a lot of strength or force e. the elementary particle that is thought to be responsible for the a existence of mass. f. covered passageway

Read the text about the Large Hadron Collider. Complete the text with the proper word from ex. 2.

CERN has published its ideas for a £20bn successor to the Large Hadron Collider, given the working name of Future Circular Collider (FCC). The Geneva based particle physics research centre is proposing an _____that is almost four times longer and ten times more _____. The aim is to have the FCC hunting for new subatomic particles by 2050.

The proposal involves digging a new _____ under CERN and then installing a ring that would initially _____electrons with their positively charged _____, positrons. Stage two would involve colliding protons with electrons. Stages one and two would lay the ground for the final step of colliding protons together nearly ten times harder than they have been by the LHC.

Physicists hope that such collisions at these unprecedented high energies will reveal a new realm of particles that really make the Universe tick, rather than the sub-atomic pretenders we know of, which play only a part in mediating the forces of nature. Uncovering them would provide physicists with their much sought after

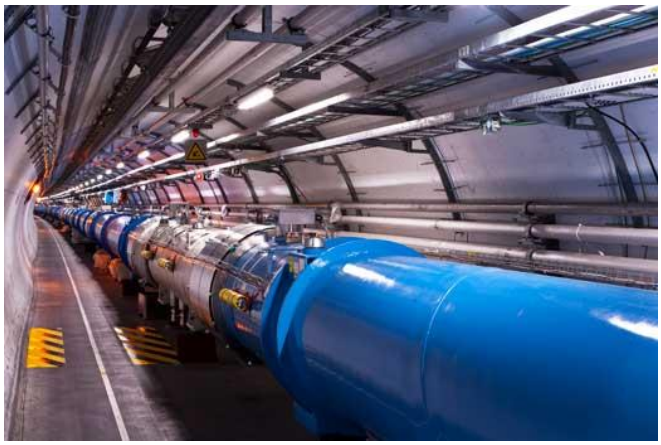
theory of everything, one that would tie together all the forces of nature and unify the twin _____ on which modern physics rests: general relativity and quantum mechanics.

The current theory of sub-atomic physics, called the Standard Model, has been one of the great triumphs of the 20th century. It neatly explains the behaviour of matter and forces through the interaction of a family of 17 particles. The last of these, _____, was discovered by the Large Hadron Collider in 2012. But observations by astronomers indicated that there was more to the Universe than could be explained by the Standard Model. On top of that, the Standard Model cannot explain gravity.

The difficulty with Cern's proposals for a larger Large Hadron Collider is that no one knows what energies will be needed to crash hadrons together to discover the enigmatic, super particles that hold the keys to the new realm of particles.

3. Answer the following questions to the text:

1. What stands for FCC?
2. What are main stages for building up FCC?
3. How does the LHC benefit?
4. What is a possible difficulty?



UNIT 11

THE BIG BANG THEORY

	**Underline every word in the list you don't know and check for the meanings:**
• evidence (n) • Big Bang theory • universe (n) • spread apart (adj) • distant (adj) • expand (v) • misjudge (v) • overwhelming (adj) • origin (n) • spiral nebulae • wavelength (n) • Milky Way • variable star • energy output • brightness (n) • abundance (n) • compressed (adj) • volume (n)	• pressure (n) • fuse (v) • nucleosynthesis (n) • ratio (n) • trace element (n) • background emisson (n) • tremendous (adj) • shift (v) • large-scale (adj) • density (n) • pillar (n) • fluctuation (n) • dark matter • supernovae (n) • gravity (n) • relativity (n) • refine (v)

1. Discuss the following questions with your classmates:

a. How old is the Universe?

b. How did the Universe begin?

c. What do you know about the Big Bang theory?

2. Read the text and do the tasks that follow:

What is the evidence for the Big Bang? Almost all astronomers agree on the theory of the Big Bang that the entire Universe is spreading apart, with distant galaxies speeding away from us in all directions. Run the clock backwards to 13.8 billion years ago, and everything in the Cosmos started out as a single point in space. In an instant, everything expanded outward from that location, forming the energy, atoms and eventually the stars and galaxies we see today. But to call this concept merely a theory is to misjudge the overwhelming amount of evidence.

There are separate lines of evidence, each of which independently points towards this as the origin story for our Universe. The first came with the amazing discovery that almost all galaxies are moving away from us.

In 1912, Vesto Slipher calculated the speed and direction of "spiral nebulae" by measuring the change in the wavelengths of light coming from them. He realized that most of them were moving away from us. We now know these objects are galaxies, but a century ago astronomers thought these vast collections of stars might actually be within the Milky Way.

In 1924, Edwin Hubble figured out that these galaxies are actually outside the Milky Way. He observed a special type of variable star that has a direct relationship between its energy output and the time it takes to pulse in brightness. By finding these variable stars in other galaxies, he was able to calculate how far away they were. Hubble discovered that all these galaxies are outside our own Milky Way, millions of light-years away.

So, if these galaxies are far, far away, and moving quickly away from us, this suggests that the entire Universe must have been located in a single point billions of years ago. The second line of evidence came from the abundance of elements we see around us.

In the earliest moments after the Big Bang, there was nothing more than hydrogen compressed into a tiny volume, with crazy high heat and pressure. The

entire Universe was acting like the core of a star, fusing hydrogen into helium and other elements.

This is known as Big Bang Nucleosynthesis. As astronomers look out into the Universe and measure the ratios of hydrogen, helium and other trace elements, they exactly match what you would expect to find if the entire Universe was once a really big star.

Line of evidence number 3: cosmic microwave background radiation. In the 1960s, Arno Penzias and Robert Wilson were experimenting with a 6-meter radio telescope, and discovered a background radio emission that was coming from every direction in the sky –day or night. From what they could tell, the entire sky measured a few degrees above absolute zero.

Theories predicted that after a Big Bang, there would have been a tremendous release of radiation. And now, billions of years later, this radiation would be moving so fast away from us that the wavelength of this radiation would have been shifted from visible light to the microwave background radiation we see today.

The final line of evidence is the formation of galaxies and the large-scale structure of the cosmos. About 10,000 years after the Big Bang, the Universe cooled to the point that the gravitational attraction of matter was the dominant form of energy density in the Universe. This mass was able to collect together into the first stars, galaxies and eventually the large-scale structures we see across the Universe today.

These are known as the 4 pillars of the Big Bang Theory, the four independent lines of evidence that build up one of the most influential and well-supported theories in all of cosmology. But there are more lines of evidence. There are fluctuations in the cosmic microwave background radiation, we don't see any stars older than 13.8 billion years, the discoveries of dark matter and dark energy, along with how the light curves from distant supernovae.

So, even though it's a theory, we should regard it the same way that we regard gravity, evolution and general relativity. We have a pretty good idea of what's going on, and we've come up with a good way to understand and explain it. As time

progresses we'll come up with more inventive experiments to throw at. We'll refine our understanding and the theory that goes along with it.

Most importantly, we can have confidence when talking about what we know about the early stages of our magnificent Universe and why we understand it to be true.

(Available at: https://www.universetoday.com/106498/what-is-the-evidence-for-the-big-bang/#ixzz2peOWj8xV)

3. *Underline the evidence to support the Big Bang theory presented in the passage:*

a. _____

b. _____

c. _____

d. _____

4. Answer the following questions to the text:

a. What does the Big Bang theory suggest?

b. Does everything have a single point beginning?

c. What was Vesto Slipher's contribution to astronomy?

d. What is Edwin Hubble most famous for?

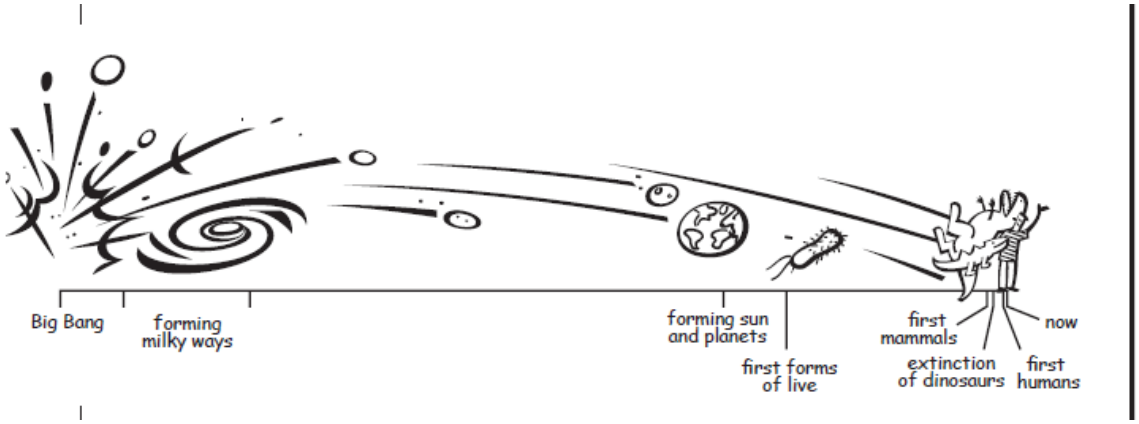
e. What happened in the earliest moments after the Big Bang?

f. What were the original two elements in our universe?

g. Who discovered cosmic microwave radiation? What does cosmic microwave radiation indicate?

h. How did the large-scale structures of the universe come about?

i. What other evidences are there that the Universe began in a big bang?



5. Do the Internet research and find out about:

- ✓ other theories of our universe's origin
- ✓ existing controversies
- ✓ other Names for the Big Bang

6. Describe two possibilities of what will happen to the universe in the future using the expressions from the box below:

Adjectives of prediction	Adverbs of prediction
✓ It is probable that… ✓ It is likely that… ✓ It is possible that… ✓ It is unlikely that… ✓ It is doubtful that…	✓ This will undoubtedly lead to… ✓ This will certainly lead to… ✓ This will definitely lead to… ✓ This will probably lead to… ✓ This will possibly lead to… ✓ This might lead to…

FOCUS ON VOCABULARY:

7. Find and circle the words that mean:

a. the cause of something, or where something begins or comes from
b. that which tends to prove or disprove something; ground for belief; proof.
c. a cloud of interstellar gas and dust.
d. the relationship between two things expressed in numbers to show how much bigger one is than the other
e. extraordinarily great in size, amount, or intensity:
f. continual change from one point or condition to another.

relativityspiralevidenceshiftnebulaewavelengthoriginтheorycurveratiofluctuationpredicttremendousuniversevolume

8. Complete the sentences with the appropriate form of the words:

origin	Milky Way	expand
supernovae	dark matter	nucleosynthesis
spiral nebulae	distant	

a. A ……. —the kind of exploding star that has been so important in discoveries about the *Big Bang*.
b. The universe has continued to ……. since the *Big Bang*, albeit at a slower rate since the period of inflation.
c. Though some of the constituents of the ……. have been around for a long time, the disk and bulge themselves didn't form until about 10-12 billion years ago.
d. The best-supported theory of our *universe's* ……. centers on an event known as the big bang.
e. ……. is the process of creating new atomic nuclei from preexisting nucleons (protons and neutrons).
f. Vesto Slipher had investigated the ……. before Hubble's Andromeda discovery.
g. Its advanced spectroscope will enable astronomers to study ……., galaxies in much finer detail, giving more insight into early star and galaxy formation.

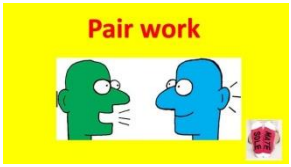
9. Find English equivalents to the following words and word combinations:

Теория большого взрыва, далекие галактики, расширяться, спиральная туманность, переменная звезда, выход энергии, сжатый в крошечном объеме, давление, следовой элемент, фоновое радиоизлучение, смещаться, крупномасштабная структура космоса, плотность, колебания, темная материя, относительность.

10. Translate the sentences into English:

a. Сегодня большинство астрономов и космологов пришли к общему мнению, что Вселенная, которую мы знаем, появилась в результате гигантского взрыва.
b. Ученые предполагают, что все должно было начаться с единственной точки с бесконечной плотностью и конечным временем, которые начали расширяться.

c. После первоначального расширения, Вселенная прошла фазу охлаждения, которая позволила появиться субатомным частицам и позже простым атомам.
d. Гигантские облака этих древних элементов позже, благодаря гравитации, начали образовывать звезды и галактики.
e. По предположению группы ученых, в число которых входит С.Хокинг, все сущее могло возникнуть из абсолютного вакуума («ничего») из-за колебаний системы.
f. Большой взрыв не единственная теория о происхождении и эволюции Вселенной. Основными из них являются: Теория струн и Теория стационарной Вселенной.
g. Почти во всех случаях наблюдения показали, что спиральные галактики отдаляются от нашего млечного пути.
h. Теория «Большого Взрыва» казалось бы подразумевает, что время и пространство существовали прежде, чем возникла наша Вселенная.

	Suggest 10 keywords/phrases from the text that will help you remember the text. Type the words and create the cloud (https://worditout.com/word-cloud/create). Exchange your word clouds with your partner and retell the text in as much detail as possible with the help of key words included in the cloud.

PART II

ENGLISH GRAMMAR SUPPORT

WORD FORMATION RULES:

Prefixes and their meanings	***Examples***
un- , dis- , in- , non- , il- , im- , ir- : указывают на отрицание, делают слово противоположным по значению	indefinite, uncontrolled, illogical, impossible…..
sub- : придает значение «под»	subatomic
over- : «сверх», «чрезмерно»	overload
under- : «недостаточный»	underload
en- : «делать», используется для образования глаголов от существительных и прилагательных	enlarge…..
pre- : указывает на значение «до», «перед	pre-historic….
post- : «после	post-war
mis- : меняет смысл слова на «неверный», «ложный	misunderstand, mislead…..
re- : «снова», «вновь»; сделать что-либо повторно	reconstruct…..
co-: аналог приставки в русском языке «со»	co-worker…..
Suffixes and their meanings	***Examples***
Образование существительного	
-er, -or, -ar: (от глаголов) указывают на профессию/занятие, а также предмет с помощью которых выполняется действие	inventor, container …..

-ment: (от глаголов) имеют значения действия, состояния или результата действия	measurement, development …..
-ion -tion, -sion: (от глаголов)имеют в основном значения действия, процесса или состояния	conclusion, acceleration etc…..
hood, -ship: образуют существительные от других существительных	relationship …..
-ist: (от существительных) используется для указания принадлежности к профессии или политическому званию	physicist, scientist….
-ian: (от существительных и прилагательных) указывают на национальность, реже профессию	mathematician ……
-ness: (от прилагательных) преобразовывает прилагательное в существительное	brightness….
-ty –ity (от прилагательных)	density….
Образование прилагательного	
-ful: (от существительных) означает наличие качества	powerful…..
-able, -ible: (от глаголов) выражают возможность подвергнуться действию, выраженному соответствующим глаголом	observable, reproducible…..
-ic –ical (от существительных)	magnetic…..

less: (от существительных) означает отсутствие качества	brushless, countless
-ive: (от существительных) означает обладающий качеством, которое выражено существительным	massive….
-ous (от существительных) означает обладающий качеством, которое выражено существительным	famous, dangerous……
Образование глагола	
-en: образует глаголы от прилагательных и существительных	lengthen…..
fy, -ify: обычно образует глаголы от прилагательных	liquify…..
-ise, -ize: обычно образует глаголы от существительных	magnitize

TENSES (ACTIVE VOICE):

Tense	Signal words	Use	Form
Present Simple	every day often always sometimes never etc.	✓ repeated actions ✓ things in general ✓ scheduled events	S+ V_1(Vs) S+ do not/does not+V_1 Do/does +S+ V_1?
Present Continuous	now at the moment Look! Listen! etc.	✓ actions at the moment of speaking ✓ temporary actions ✓ fixed plans	S+ am/is/are+Ving S+ am/is/are NOT+Ving Am/Is/Are +S+ Ving?

Tense	Signal words	Use	Form
Present Perfect	just yet never already ever since for etc.	✓ result of actions ✓ recently completed actions ✓ actions beginning in the past and still continuing (focus on the result)	S+ have/has+V_3 S+ have/has NOT+V_3 Have/has +S+ V_3?
Present Perfect Continuous	all day the whole day since for	✓ actions beginning in the past and still continuing (focus is on the action)	S+ have/has been+V_{ing} S+ have/has NOT been+V_{ing} Have/has +S+ been V_{ing}?
Past Simple	yesterday last week a month ago in 2010 etc.	✓ actions finished in the past	S+ V_2 S+ did NOT+V_1 Did +S+ V_1?
Past Continuous	at 3 o'clock yesterday while etc.	✓ actions were in progress at a special time in the past	S+ was/were+Ving S+ was/were NOT+Ving Was/Were +S+ Ving?
Past Perfect	by 3 o'clock yesterday before after since for etc.	✓ the action happened before another action in the past	S+ had+V_3 S+ had NOT+V_3 Had +S+ V_3?
Past Perfect Continuous	since for Questions with how long	✓ how long something had been happening before something else happened	S+ had been+V_{ing} S+ had NOT been+V_{ing} Had +S+ been V_{ing}?

Tense	Signal words	Use	Form
Future Simple	every day often always sometimes never etc.	✓ repeated actions ✓ things in general ✓ scheduled events	S will + V_1 S + do not/does not+V_1 Do/does +S+ V_1?
Future Continuous	now at the moment Look! Listen! etc.	✓ actions happening at the moment of speaking ✓ temporary actions ✓ trends ✓ fixed plans in the near future	S+ am/is/are+V<u>ing</u> S+ am/is/are NOT+V<u>ing</u> Am/Is/Are +S+ V<u>ing</u>?
Future Perfect	just yet never already ever since for etc	✓ sth. will already have happened before a certain time in the future	S+ will have+$V_{\underline{3}}$ S+ won't have +$V_{\underline{3}}$ Will +S+have+ $V_{\underline{3}}$?
Future Perfect Continuous	all day the whole day since for Questions with how long	✓ actions beginning in the past and still continuing (focus is on the action)	S+ will have been+$V_{\underline{ing}}$ S+ won't have been +$V_{\underline{ing}}$ Have/has +S+ been $V_{\underline{ing}}$?

GRAMMAR REVISION EXERCISES:

<u>PRESENT TENSES</u>

1. ***Choose the correct form of the verb. Explain your choice:***

a. Most physicists _____ (specialize) in either theoretical or experimental research.

b. There are likely billions of Earth-like planets that we_____ (not discover) yet.
c. Currently, many physicists _____ (develop) ambitious concepts often called theories of everything.
d. At standard atmospheric pressure, water _____(boil) at approximately 100 degrees Celsius.
e. What _____(be) it like to be a physicist?
f. They offer proof of a radical theory of the universe he _____ (develop) for 50 years.
g. Magnetic levitation (maglev) _____(be) a relatively new transportation technology in which non-contacting vehicles _____(travel) safely at speeds of 250 to 300 miles-per-hour or higher.
h. EM waves_____ (not need) a medium to travel through.

PAST TENSES

1. Choose the correct form of the verb. Explain your choice:

a. In the 19th century, James Clerk Maxwell _____ (offer) a second great unification by demonstrating that electricity and magnetism _____(be) different manifestations of a single underlying electromagnetic force.
b. Einstein _____(be) a true genius.
c. Right from the Big Bang theory to big data, there is virtually nothing that Stephen Hawking _____(not contribute) to.
d. Nikola Tesla _____ (walk) with a friend through a park when the concept of the rotating magnetic field _____(flash) through his mind.
e. I really _____(enjoy) studying physics at the beginning. But then it _____(get) difficult and I _____(not can) understand the formulae.
f. In 1896 Henri Becquerel _____(use) naturally fluorescent minerals to study the properties of x-rays, which Wilhelm Roentgen _____(discover) in 1895.

g. Curie _____(study) uranium rays, when she _____(make) the claim the rays _____(not be) dependent on the uranium's form, but on its atomic structure.
h. How _____ the universe _____(begin)?

FUTURE TENSES

3. Choose the correct form of the verb. Explain your choice:

a. I think that Current forms of transportation and energy production _____ (become) obsolete.
b. By 2030, the Vogtle power plant in Georgia, the only nuclear power station currently under construction in the US, _____(run) for a few years.
c. Tomorrow at this time we _____(do) some experiments in the laboratory.
d. By 2024, 5G mobile network technology _____ (reach) more than 40 percent of the global population.
e. _____ maglev ever _____(become) mainstream?
f. He _____ (draw) diagrams all the afternoon tomorrow.
g. We _____(not wite) a report before he comes.

MIXED TENSES

4. Put the verbs in the correct form. Explain your choice:

a. Archimedes _____(be) the greatest scientist of ancient times. He _____(push) mathematics, physics and engineering to new heights.
b. Newton _____(make) his great discovery while he _____(sit) under an apple tree.
c. At the moment our scientists _____(work) on laser technologies.
d. I think that solar physicists _____(not take) their research to the next level in early 2030.
e. John _____(study) theoretical physics and may never see the inside of a laboratory.

f. By the end of 2025, China will have completed the final design of this colossal machine.

g. In the 17th century Johannes Kepler _____ (discover) that heavenly bodies follow elliptical paths.

h. Physicists _____(play) a role in computer technology since its earliest days.

i. Carbon dioxide is called dry because it _____(not exist) as a liquid.

j. _____you ever_____(do) experiments with concave mirror?

k. -Have you analyzed data? – No, but _____(do) by the end of the day.

l. At the moment scientists _____(make) studies to predict earthquakes.

m. The solar eclipse _____ (begin) tomorrow.

n. Franklin _____(fly) a kite when he _____(discover) the principle of the lightning conductor.

5. Answer the following questions. Mind the tenses:

a. What do you like most/least about physics?

b. Who was the greatest physicist ever?

c. What has science done for humankind?

d. What will the next big discovery be in physics?

e. Is technology developing faster than it used to?

f. What research/experiments have you carried out?

g. How likely is that we will have people on Mars by 2040?

h. What physical phenomena are you studying now?

TENSES (PASSIVE VOICE)

	SIMPLE	**CONTINUOUS**	**PERFECT**
PRESENT	(+) S + am/is/are + V_3 (-)S + am/is/are not+ V_3 (?) Am/Is/Are + S + V_3?	(+) S + am/is/are being + V_3 (-)S + am/is/are not being + V_3 (?) Am/Is/Are + S + being + V_3?	(+) S + have/has been + V_3 (-)S + have/has not been + V_3 (?) Have/has + S + been + V_3?

PAST	(+) S + was/were + V_3 (-)S + was/were not+ V_3 (?) Was/Were + S + V_3?	(+) S + was/were being + V_3 (-)S + was/were not being + V_3 (?) Was/Were + S + being + V_3?	(+) S + had been + V_3 (-)S + had not been + V_3 (?) Had + S + been + V_3?
FUTURE	(+) S + will be + V_3 (-) S + will not be + V_3 (?)Will + S + be + V_3?	Вместо Future Continuous используется Future Simple Passive	(+) S + will + have been + V_3 (-)S + will not + have been + V_3 (?)Will + S + have been + V_3?

1. Change from the active to the passive voice:

a. Albert Einstein proposed the concept of relativity in 1905.
b. Will we study particle physics next term?
c. We do not use the English system of measurement for scientific purposes.
d. The company will have launched roughly 720 satellites this summer.
e. As of early 1905, however, Einstein had still not finished his doctorate, and he had only published a few papers in scientific journals
f. We have not developed innovative technology which serves the national security yet.
g. Scientists are still testing new equipment in the laboratory.
h. Perm State University was holding a scientific conference last week.

2. Put the verbs in brackets into the correct passive form:

a. Their papers always _____ (discuss) at the seminars.
b. The experimental technique _____ (apply) tomorrow.
c. They _____ (prove) the scientific theory to be false by the end of the day yesterday.
d. The data _____ (process) now.
e. The changes _____ (detect) by X-ray analyses last week.
f. An interesting research _____ (do) this year.
g. Your scientific paper _____ (publish) by next month.

h. Discussions _____ (hold) after the plenary meeting from 3 to 5 p. m. yesterday.

i. Computers widely _____ (use) in our experiment at the moment.

3. Speak for one minute about:

a. A conference that was held

b. The subjects that are taught at your faculty

c. The research that have been carried out

d. A scientist who was awarded a Nobel Prize

e. Something important that has been discovered recently

f. Interesting inventions that will be launched

COMPARATIVE DEGREE

	Adjective	***Comparative***	***Superlative***
one syllable	short	shorter	the shortest
one syllable consonant+short vowel+consonant	big	bigger	the biggest
Two syllables ending in -Y	heavy	heavier	the heaviest
Two or more syllables	important	more important	the most important
Irregular adjectives	little much/many far good bad	less more farther/further better worse	the least the most the farthest/furthest the best the worst

1. *Put the correct form of the adjective into gaps*:

a. Alpha particles are the _____ (large) and _____ (heavy) of the particulate radiation.

b. If the liquid is heated, the particles move_____ (fast).

c. The SI system of units _____ (easy) to use than the British system.

d. His scientific career was not so _____ (successful) as his practice.

e. The sun is _____ (important) source of light.

f. The Large Hadron Collider (LHC) is _____ (powerful) particle collider in the world.
g. Sound waves travel a million times _____ (slow) than light waves.
h. Thinner lenses are _____ *(*accurate) than thicker ones when it comes to producing an image
i. These machines are _____ (reliable) as all lab equipment.

2. Answer the following questions. Mind comparatives:

a. Which subatomic particle is the heaviest?
b. What is the most interesting branch of physics? Why?
c. Why do molecules in gases move faster than molecules in liquid?
d. Which would cause a more serious burn: 30g of steam or 30 g of liquid water, both at 100C and why is this so?
e. Do you think solar power offers the best source of renewable energy?
f. Where is the magnetic field around a magnet strongest?
g. Why does white color reflect more light than a dark colour?

CONDITIONALS

Conditional	Tense	Use
Zero	If/When Present Simple+Present Simple	Used for present, real situations
First	If/When Present Simple+Future Simple	Used for future, real situations
Second	If/When Past Simple+Future-in-the-Past	Used for future, unreal/imaginary situations

1. Make the zero, first or second conditional:

a. If you _____ a ball and throw another one straight out, they will both _____ the ground at the same time (drop, hit).
b. If we _____ X-rays, today's world _____ different (not have, be).
c. We _____ the distance travelled if we _____ speed and time (calculate, know).

d. I _____ a lot of money if I _____ multiple projects that I work on (earn, have).

e. If we _____other planets, we would probably _____ (colonize, survive).

f. If you _____ a job of "physicist" with your degree, you likely _____obtain a higher degree, like a PhD in the field (want, have to).

2. Complete the sentences with your own ideas. Then compare your answers with a* partner*:

a. If I were a famous scientist, _____.

b. If you cool a gas, _____.

c. I will pass my physics exams _____.

d. You have to take precautions _____.

e. If I could invent something new, _____.

f. If a laboratory is well-equipped, _____.

g. If fossil fuels disappear tomorrow, _____.

h. The magnets will push away _____.

MODAL VERBS AND THEIR EQUIVALENTS

verb	***use***	***present***	***past***	***future***
can	ability/ permission	can	could (general ability)	will be able to
	possibility	can	could have done	can
be able to	=can	am/is/are able to	was/were able to (specific achievement)	will be able to
may/might	possibility	may/might	may/might have done	may/might
	permission		was/were to allowed	will be to allowed

be allowed to	**= may**	am/is/are allowed to	was/were to allowed	will be to allowed
must	certainty strong recommendation /obligation necessity prohibition (negative)	must	had to	will have to
have to	obligation lack of necessity (negative)	has/have to	had to	will have to
need	requirement, permission not to do (negative)	need		
should	recommendation/ advice	should	should have done	should

1. Complete the sentences with modals given in the box.

mustn't	*have to*	*were allowed*	*don't have to*
*may (*2)*	*should*	*will be able*	*had to*

a. Everyone _____ignore safety rules in a laboratory that uses hazardous materials or processes.
b. We _____to complete the experiment in two months.
c. It's possible that the conditions to support life _____exist underground on Mars.
d. You _____use a new device. An old one works properly.
e. Astronauts _____wear spacesuits whenever they leave a spacecraft and are exposed to the environment of space.
f. _____ I ask you some questions?

g. You _____ pay more attention to the results of your first experimental work.

h. We _____ work hard to submit our paper to a scientific journal.

i. Students _____ continue the experiment.

2. Speak for one minute about. Make sentences using the modals given in brackets:

- Mind-bending discoveries in physics (possibility)
- General laboratory rules (obligation and prohibition)
- Preparation of future students for physics learning (recommendation/advice)

PARTICIPLE (ПРИЧАСТИЕ)

это неличная форма глагола, в которой сочетаются признаки имени прилагательного или наречия с признаком глагола и которая соответствует в русском языке причастию и деепричастию.

	Active	**Passive**
Participle I	V_{ing}	being V_3
Perfect Participle I	having + V_3	having been V_3
Participle II	V_3	-

Функции причастия I в предложении и способы их перевода

The beta particles are electrons *moving* with very high velocity.	определение	…….*двигающиеся*…….
Making the experiment we followed their procedure.	обстоятельство	*Когда мы проводили*……..
Putting it mildly, the experiment was not conducted properly.	вводный член предложения	*Мягко говоря*, …….

Основные функции причастия II в предложении и способы их перевода

The instrument *used* is very reliable.	определение	…….*используемый*…….
When *completed*, reduce the heater voltage to zero and shut down the system.	обстоятельство	*После завершения*……..
All things considered, the experiment is a great success.	вводный член предложения	*Учитывая все*…….

1. Translate into English the following word combinations:

Отрицательно заряженные частицы, данный пример, сформулированный закон, обнаруженное свойство, действующие силы, работающий прибор, широко-применяемый метод, ученый, проводящий эксперимент, частицы, называемые электронами, полученные данные, изменяя температуру - изменив температуру, помещая тело в жидкость, поместив тело в жидкость, обсуждая проблему - обсудив проблему, слушая лекцию – прослушав лекцию.

2. Choose the correct form of the participle:

a. Light is made up of many small particles (moved/moving) at high speed.
b. (Having made/having been made) a lot of experiments, he derived a law.
c. A group of such particles (travelled/travelling) parallel paths is called a beam of light.
d. Bodies (being rubbed/rubbing) together produce heat.
e. The experiments (carried/carrying) out at our laboratory are rather interesting.
f. Franklin carried out the experiment for himself, (using/having used) a kite (attached/attaching) to a long string.
g. The metal (used/using) in that experiment was titanium.
h. The results (received/receiving) changed with the material used.
i. (Having finished/Finishing) the research the scientists made the analysis of the data obtained.

3. Make your own sentences with phrases given in ex. 1 using participle forms:

_____
_____
_____
_____
_____
_____
_____

INFINITIVE (ИНФИНИТИВ)

неличная форма глагола, которая только называет действие в процессе его совершения, не указывая ни лица, ни числа, ни наклонения. Инфинитив соответствует в русском языке неопределенной форме глагола (инфинитиву), которая отвечает на вопросы что делать? что сделать?

ACTIVE			
SIMPLE	**CONTINUOUS**	**PERFECT**	**PERFECT CONTINUOUS**
to V	to be V_{ing}	to have V_3	to have been V_{ing}
PASSIVE			
to be asked	-	to have been asked	-

Основные функции инфинитива в предложении и способы их перевода

<u>*To heat*</u> the body is to raise its temperature.	подлежащее	*Нагреть/Нагревание…….*
The most difficult thing is <u>*to give*</u> the definition Scientists tried <u>*to explain*</u> how electricity passes through space.	часть именного сказуемого часть составного сказуемого	*……дать……..* *……объяснить……*
<u>*To understand*</u> the properties of electrons it is necessary to know about the atomic structure.	обстоятельство	*Для того чтобы понять/Для понимания……..*

It is a very useful instrument <u>*to be used*</u> in industry.	определение	*…….который используется……..*
To sum up, all solutions to problems are conditional.	вводный член предложения	*Подводя итог,……..*

1. Give all the possible forms of the following infinitives:

Supply, break, charge, reflect, prevent, give, derive, to absorb, to transmit, apply, magnify, to use, to keep, to develop, to calculate.

2. Translate into Russian paying special attention to the functions of the infinitive:

a. To find the distance traveled by the object over a certain amount of time, we need an equation for its position.
b. We are working on standards to be applied internationally.
c. To solve the problem would justify all the costs.
d. The first person to invent a fully functional television was Philo Taylor Farnsworth.
e. Canadian scientists want to plant a billion new trees by 2028 using a network of drones.
f. The law can be derived after a lot of experiments.
g. Steam was passed through the tube to heat it.
h. To observe the air current is easy.

3. Make your own sentences with phrases given in ex. 1 using infinitive forms.

_____

_____

_____

_____

_____

GERUND (ГЕРУНДИЙ)

неличная форма глагола, обозначающая действие и сочетающая в себе свойства глагола и существительного. По форме герундий совпадает с причастием I и перфектным причастием.

	VOICE	
	Active	***Passive***
Indefinite	V_{ing}	being + V_3
Perfect	having + V_3	having been V_3

Основные функции герундия в предложении и способы их перевода

Solving physical problems is a difficult task.	подлежащее	*Решение* физических проблем – трудная задача.
They suggested *analyzing* the data tomorrow	дополнение (прямое или косвенное)	Они предложили *проанализировать* данные завтра.
There are numerous ways of *transforming* mechanical energy into heat.	определения	Существуют многочисленные способы *преобразования* механической энергии в тепло.
By *comparing* the data they received interesting results.	Обстоятельство (в сочетании с предлогами before, after, in, on, by, without etc)	*Путем сравнения/Сравнивая* данные, они получили интересные результаты

1. Translate into Russian paying special attention to the functions of the Gerund:

a. In studying the theory of semiconductors Joffe had in mind the direct conversion of solar energy into electricity for the experiment.
b. We have finished programming the computer.

c. Finding unknown quantities is the task of algebra.
d. Radioisotops' decaying occurs in half-lives over a long period of time.
e. Upon heating the crystallites melt.
f. Marconi made his successful radio tests by raising the receiving aerial on a kite.
g. Dendrochronology is a valuable method of measuring time.

2. Complete the sentences with your own ideas. Then compare your answers with a partner:

a. Being a scientist means _____.
b. Russian scientists succeeded in _____.
c. I am fond of_____
d. After having analyzed everything thoroughly_____.
e. What is considered important is understanding_____.
f. Becoming a physicist starts with _____.
g. The present project aims at_____.

GERUND VS INFINITIVE

(ИСПОЛЬЗОВАНИЕ ГЕРУНДИЯ И ИНФИНИТИВА)

Глаголы, которые используются с инфинитивом (с частицей to)

afford	expect	offer	want
agree	fail	plan	wish
appear	hesitate	prepare	would like
arrange	hope	pretend	would love
beg	learn	promise	would prefer
choose	manage	refuse	
decide	mean	tend	

! Глаголы, которые используются с инфинитивом (без частицы to): модальные глаголы (can, must, should and etc), let, make, help.

Глаголы, которые используются с герундием

admit	can't stand	finish	practise
advise	deny	keep	suggest
allow	dislike	mind	imagine
avoid	enjoy	miss	
can't help	fancy	permit	

Глаголы с предлогами, после которых используется герундий

accuse of	blame for	dream about/of	look forward to
agree with	care for	feel like	object to
apologize for	carry on	forgive for	think of
ask about	complain about	give up	succeed in
believe in	concentrate on	insist on	use for
be used to	depend on	keep on	

Глаголы, после которых используется герундий или инфинитив (без изменения значения)

attempt	cannot bear	hate	prefer
begin	cease	intend	start
bother	continue	love	

Глаголы, после которых используется герундий или инфинитив (с изменением значения)

	Infinitive meaning	**Gerund meaning**
forget	with regard to the future	with regard to the past
remember	with regard to the future	with regard to the past
go on	start something new	continue with the same action
regret	with regard to the future	with regard to the past
stop	interrupt another action	terminate
try	do something complicated	do it and see what happens

1. Choose the correct gerund or infinitive from:

a. Metals tend _____(lose) valence electrons to form positive ions.
b. We expected _____ (hear) thunder after we saw the lightening.
c. We carried on _____(work) on the project in spite of late hours.
d. Scientists looked at how different levels of dark energy might _____(affect) the development of life.
e. Physics seems _____(explain) everything about our world and our universe.
f. We are looking forward _____ (obtain) research results.
g. I suggested _____(carry) out the experiment again.
h. According to quantum mechanics a molecule can never stop _____(vibrate).

2. Discuss the following topics using infinitives and gerunds:

a. an invention you would like to be surprised with
b. subjects you enjoy studying
c. an event you are excited about having participated
d. a job you would like to do in the future
e. a famous person in history you would like to have met
f. physical phenomena you liked being told about

PART III

STUDY SUPPORT

Рекомендации по переводу текстов профессиональной направленности

Цель всякого перевода с иностранного языка на родной – познакомить читателя с каким-либо текстом или содержанием устного текста. Перевод должен в полной мере соответствовать нормам того языка, на котором он сделан.

Приступая к переводу текста, следует прочитать его полностью и постараться понять его общее содержание. Важную роль при первичном ознакомлении с текстом играет правильный перевод названия текста, либо оно, как правило, определяет тему текста, а часто и его общее содержание. Итак, после общего ознакомления с содержанием текста следует читать его по предложениям и производить грамматический анализ:

1. Установить тип предложения, т.е. определить, является ли анализируемое предложение простым или сложным;
2. Если предложение сложное, то выделить по знакам препинания, союзам и по порядку слов все самостоятельные предложения, определив главное предложение;
3. Грамматический анализ каждого предложения следует начинать с определения главных членов предложения, т.е. подлежащего и сказуемого.
4. При переводе подлежащего следует обратить внимание на то, какой частью речи оно выражено, на род и число, а при переводе сказуемого – на лицо, число, время, залог.
5. После определения главных членов предложения нужно определить группы подлежащего (само подлежащее и поясняющее его определения) и группу сказуемого (сказуемое и относящиеся к нему дополнения и обстоятельства).
6. Установите связи между всеми остальными членами предложения.

Перевод сначала следует делать дословным, а потом, когда мысль предложения становится полностью понятна, следует осуществлять последовательно, т.е. одно предложение за другим. Когда текст переведен полностью, его читают целиком и вносят стилистические поправки.

Для правильного понимания исходного английского текста необходимо:

1. Иметь определенный запас слов английского языка (в том числе специальной терминологии в определенной области знаний)
2. Знать грамматику ИЯ. В обратном случае, неправильная передача значения грамматических конструкций ведет к искажению текста при переводе
3. Уметь эффективно пользоваться словарями
4. Иметь представление об области знания, к которой относится переводимый текст
5. Уметь определять знание слов по контексту
6. Помнить о различиях в языках и соблюдать все требования языка, на который переводишь без ущерба для смысла оригинала.

PHRASES FOR PRESENTATIONS

Introductions and welcome.

I would like to thank you for inviting me here today to talk about... ...

I would like to thank you all for attending this presentation. I plan to be brief. ...

I shall only take about fifteen minutes of your time. ...

If you have any questions, I'd be very happy to answer them at the end. ...

Explaining the purpose of your presentation.

I'd like to give you a brief presentation about... ...

The subject of my talk is... ...

I'm going to talk about... ...

My topic today is... ...

My talk is concerned with... ...

Giving an overview of the presentation.

I'm going to divide this talk into four parts. ...

There are a number of points I'd like to make. ...

I'd like to begin by... ...

Let's begin by... ...

First of all, I'll discuss... ...

and then I'll go on to talk about ...

Then... / Next,... ...

Secondly,... / Thirdly,... ...

Finally,... / Lastly,... ...

Finishing a section.

That's all I have to say about... ...

So, in this section, we've looked at... ...

Well, I think I've said enough about... ...

Starting a new section.

Turning now to... ...

Let's turn now to ...

The next area I'd like to focus on next is ...

I'd now like to discuss... ...

Let's now look at... ...

Giving examples.

For example,... ...

A good example of this is... ...

As an illustration, I'd like to mention... ...

To give you an example,... ...

To illustrate this point,... ...

Referring to photos, graphs or tables.

If you'd like to look at this graph, you'll see... ...

Take a look at this table. Here, we can see quite clearly that... ...

This chart illustrates... ...

Let me show you a pie-chart that will make everything much clearer. ...

Paraphrasing and clarifying.

Simply put,... ...

In other words,... ...
So what I'm saying is,.... ...

To put it more simply,... ...

Summarising the content of your presentation.

To sum up,... ...

To summarise,... ...

In short,... ...

Let's summarise briefly what we've looked at... ...

If I can just sum up the main points,... ...

So, to remind you of what I've covered in this talk,... ...

Closing the presentation.

To conclude,... ...

In conclusion,... ...

Well, that covers all I wanted to say today. ...

Before I finish let me say just one last thing. ...

That brings me to the end of my presentation. ...

It just remains for me to say, thank you very much for coming and I hope you have found this presentation useful. ...

Invitation to ask questions.

Does anyone have any questions or comments? ...

Please feel free to ask questions. ...

If you would like me to elaborate on any point I've made today, please ask. ...

Would you like to ask any questions? ...

PHRASES FOR DISCUSSIONS AND DEBATES:

Asking for opinion

- What's your opinion about ...?
- How do you feel about ....?
- Do you share my point of view?
- What do you think about/of….?

Expressing opinion

- In my opinion....
- To my mind…
- From my point of view,…
  It seems to me that ..
- I think/feel/reckon/believe ....
- The way/As I see it

Stating something as a fact

- As everyone knows….
- It is generally accepted that…..
- It is a fact that….

Asking for clarification

What do you mean by saying that…..?

I'm sorry, I don't understand what you mean by….?

What are you trying to say…..?

Can you clarify that for me?

Giving clarification

I mean that…

What I am trying to say is that…

What I wanted to say was that…

In other words,….

Expressing agreement

I strongly agree with you.

I couldn't agree more.

I share your point of view.

You're absolutely right

Agreeing in part

Yes, I agree up to a point, however ….....

Well, you have a point there, but ...

I guess you could be right, but ...

Yes, I suppose so, however…..

Expressing disagreement

I'm afraid I disagree.

I totally disagree.

I'm afraid you're wrong.

On the contrary!

I'm of a different opinion.

Interruptions

Can I add something here?

Sorry to interrupt, but...

Excuse me for interrupting you, but

Expressing doubt

I'm not sure if….

I doubt that…

I'm not convinced that….

It is not very likely

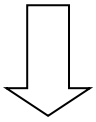
Phrases to keep a discussion going

Let's get back to ...

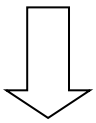
As we just heard ...

Useful Phrases for Summary Writing

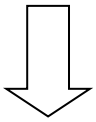
The text (article) under the title «__». It consists of/is divided into……



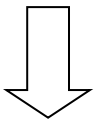
At the beginning of the text the author describes/ explains/ points out/characterizes/ stresses/underlines… . /The article begins with the description of/the analysis of/ the review of/the characterization of/ the author's opinion of … .



Then (after that, next) the author passes on to/goes on to say about/gives a detailed analysis (description) of … .



In addition (besides, moreover, further) … .



In conclusion (at the end of the article) the author underlines/criticizes/draws the conclusion that … ./The article ends with the analysis of … / In short/to sum it up …

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