ПЕРЕДМОВА

Методичні вказівки для СРС та навчальний матеріал з англійської мови призначені для студентів ***III курсу*** денної форми навчання зі спеціальності «Науки про Землю».

Мета запропонованих методичних вказівок — розвинути навички читання, аналізу, перекладу текстів, а також їх переказу на матеріалі наукової літератури за фахом.

Методичні вказівки складаються з 6 уроків, де подано відповідний граматичний матеріал за програмою, а також тексти, що відібрані з оригінальної науково-популярної та наукової літератури.

Тексти А та В призначені для аудиторній роботи студентів: для читання, усного перекладу, аналізу елементів тексту, анотування та переказу; ***тексти С*** тематично пов'язані з текстами А та В, призначені для СРС та тематично-письмового перекладу з подальшою перевіркою на занятті, уточненням значень окремих лексичних одиниць та переказу.

Лексичні вправи призначені для вивчення та закріплення лексичного матеріалу кожного уроку та охоплюють лексику основних текстів. Вони можуть бути використані також для контролю (самоконтролю) засвоєння лексичного матеріалу уроку. Під час виконання лексичних вправ рекомендується не тільки підбирати українські або англійські еквіваленти наведених слів та словосполучень, але й знаходити у тексті або складати самостійні речення з зазначеними словами, звертаючи увагу на багатозначність слів.

Граматичні вправи спрямовані на аналіз найскладніших граматичних явищ англійської мови, розвиток навичок орієнтування у граматичній структурі англійського речення, що сприяє вірній інтерпретації текстів, української мови та матеріалів наукової літератури.

Після вивчення даного курсу студенти повинні знати і вміти:

читати та перекладати науково-технічну англомовну літературу за фахом для отримання необхідної інформації;

розуміти зміст прочитаного та лексико-граматичний матеріал, наданий у методичних вказівках;

розуміти і володіти відповідними граматичними конструкціями та матеріалом;

брати участь в усному спілкуванні англійською мовою в обсязі матеріалу, передбаченого програмою.

Introduction to the subject

Answer the questions:

1. What is the importance of Earth science education?
2. Why do we study Earth sciences?
3. Why is teaching Earth science important?
4. Why should I study Earth science?
5. Is Earth science more important than other branches of science?
6. What are some important functions of Earth science?
7. What is the importance of Earth science and life science to humanity?
8. How are Earth and life science related?
9. How does Earth science affect your life?
10. Why was the "Earth" named Earth. Who named it? How have the planets been named?

LESSON 1

Text A

Earth sciences, the fields of study concerned with the solid Earth, its waters, and the air that envelops it. Included are the geologic, hydrologic, and atmospheric sciences.

Volcanology

The broad aim of the Earth sciences is to understand the present features and the past evolution of the Earth and to use this knowledge, where appropriate, for the benefit of humankind. Thus the basic concerns of the Earth scientist are to observe, describe, and classify all the features of the Earth, whether characteristic or not, to generate hypotheses with which to explain their presence and their development, and to devise means of checking opposing ideas for their relative validity. In this way the most plausible, acceptable, and long-lasting ideas are developed.

The physical environment in which humans live includes not only the immediate surface of the solid Earth, but also the ground beneath it and the water and air above it. Early man was more involved with the practicalities of life than with theories, and thus his survival depended on his ability to obtain metals from the ground to produce, for example, alloys, such as bronze from copper and tin, for tools and armour, to find adequate water supplies for establishing dwelling sites, and to forecast the weather, which had a far greater bearing on human life in earlier times than it has today. Such situations represent the foundations of the three principal component disciplines of the modern Earth sciences.

The rapid development of science as a whole over the past century and a half has given rise to an immense number of specializations and subdisciplines, with the result that the modern Earth scientist, perhaps unfortunately, tends to know a great deal about a very small area of study but only a little about most other aspects of the entire field. It is therefore very important for the layperson and the researcher alike to be aware of the complex interlinking network of disciplines that make up the Earth sciences today, and that is the purpose of this article. Only when one is aware of the marvelous complexity of the Earth sciences and yet can understand the breakdown of the component disciplines is one in a position to select those parts of the subject that are of greatest personal interest.

It is worth emphasizing two important features that the three divisions of the Earth sciences have in common. First is the inaccessibility of many of the objects of study. Many rocks, as well as water and oil reservoirs, are at great depths in the Earth, while air masses circulate at vast heights above it. Thus the Earth scientist has to have a good three-dimensional perspective. Second, there is the fourth dimension: time. The Earth scientist is responsible for working out how the Earth evolved over millions of years. For example, what were the physical and chemical conditions operating on the Earth and the Moon 3.5 billion years ago? How did the oceans form, and how did their chemical composition change with time? How has the atmosphere developed? And finally, how did life on Earth begin, and from what did man evolve?

Today the Earth sciences are divided into many disciplines, which are themselves divisible into six groups:

Those subjects that deal with the water and air at or above the solid surface of the Earth. These include the study of the water on and within the ground (hydrology), the glaciers and ice caps (glaciology), the oceans (oceanography), the atmosphere and its phenomena (meteorology), and the world's climates (climatology). In this article such fields of study are grouped under the hydrologic and atmospheric sciences and are treated separately from the geologic sciences, which focus on the solid Earth.

Disciplines concerned with the physical-chemical makeup of the solid Earth, which include the study of minerals (mineralogy), the three main groups of rocks (igneous, sedimentary, and metamorphic petrology), the chemistry of rocks (geochemistry), the structures in rocks (structural geology), and the physical properties of rocks at the Earth's surface and in its interior (geophysics).

The study of landforms (geomorphology), which is concerned with the description of the features of the present terrestrial surface and an analysis of the processes that gave rise to them.

Disciplines concerned with the geologic history of the Earth, including the study of fossils and the fossil record (paleontology), the development of sedimentary strata deposited typically over millions of years (stratigraphy), and the isotopic chemistry and age dating of rocks (geochronology).

Applied Earth sciences dealing with current practical applications beneficial to society. These include the study of fossil fuels (oil, natural gas, and coal); oil reservoirs; mineral deposits; geothermal energy for electricity and heating; the structure and composition of bedrock for the location of bridges, nuclear reactors, roads, dams, and skyscrapers and other buildings; hazards involving rock and mud avalanches, volcanic eruptions, earthquakes, and the collapse of tunnels; and coastal, cliff, and soil erosion.

The study of the rock record on the Moon and the planets and their satellites (astrogeology). This field includes the investigation of relevant terrestrial features—namely, tektites (glassy objects resulting from meteorite impacts) and astroblemes (meteorite craters).

With such intergradation boundaries between the divisions of the Earth sciences (which, on a broader scale, also intergrade with physics, chemistry, biology, mathematics, and certain branches of engineering), researchers today must be versatile in their approach to problems. Hence, an important aspect of training within the Earth sciences is an appreciation of their multidisciplinary nature.

Evaporation from the sea

The question remained as to whether the amount of water evaporated from the sea is sufficient to account for the precipitation that feeds the streams. The English astronomer-mathematician Edmond Halley measured the rate of evaporation from pans of water exposed to the air during hot summer days. Assuming that this same rate would obtain for the Mediterranean, Halley calculated that some 5.28 billion tons of water are evaporated from this sea during a summer day. Assuming further that each of the nine major rivers flowing into the Mediterranean has a daily discharge 10 times that of the Thames, he calculated that a daily inflow of fresh water back into that sea would be 1.827 billion tons, only slightly more than a third of the amount lost by evaporation. Halley went on to explain what happens to the remainder. A part falls back into the sea as rain before it reaches land. Another part is taken up by plants.

In the course of the hydrologic cycle, Halley reasoned, the rivers constantly bring salt into the sea in solution, but the salt is left behind when seawater evaporates to replenish the streams with rainwater. Thus the sea must be growing steadily saltier.

Atmospheric sciences

Water vapour in the atmosphere

After 1760 the analytical chemists at last demonstrated that water and air are not the same substance in different guises. Long before this development, however, investigators had begun to draw a distinction between water vapour and air. Otto von Guericke, a German physicist and engineer, produced artificial clouds by releasing air from one flask into another one from which the air had been evacuated. A fog then formed in the unevacuated flask. Guericke concluded that air cannot be turned into water, though moisture can enter the air and later be condensed into water. Guericke's experiments, however, did not answer the question as to how water enters the atmosphere as vapour. In "Les Météores"("Meteorology," an essay published in the book Discours de la methodein 1637), Descartes envisioned water as composed of minute particles that were elongate, smooth, and separated by a highly rarified "subtle matter."

The same uncertainty as to how water gets into the air surrounded the question as to how it remains suspended as clouds. A popular view in the 18th century was that clouds are made of countless tiny bubbles that float in air. Guericke had suggested that the fine particles in his artificial clouds were bubbles. Other observers professed to have seen bubble-shaped particles of water vapour rising from warm water or hot coffee.

Pressure, temperature, and atmospheric circulation

If clouds are essentially multicompartmented balloons, their motions could be explained by the movements of winds blowing on them. Descartes suggested that the winds might blow upward as well as laterally, causing the clouds to rise or at least preventing them from descending. In 1749 Benjamin Franklin explained updrafts of air as due to local heating of the atmosphere by the Sun. Sixteen years later the Swiss-German mathematical physicist Johann Heinrich Lambert described the conditions necessary for the initiation of convection currents in the atmosphere. He reasoned that rising warm air flows into bordering areas of cooler air, increasing their downward pressure and causing their lower layers to flow into ascending currents, thus producing circulation.

The fact that Lambert could appeal to changes in air pressure to explain circulation reflects an important change from the view still current in the late 16th century that air is weightless. This misconception was corrected after 1643 with the invention of the mercury barometer. It was soon discovered that the height of the barometer varied with the weather, usually standing at its highest during clear weather and falling to the lowest on rainy days.

Toward the end of the 18th century it was beginning to be understood that variations in the barometer must be related to the general motion and circulation of the atmosphere. That these variations could not be due solely to changes in humidity was the conclusion of the Swiss scientist Horace Bénédict de Saussure in his Essais sur l'hygrométrie (1783; "Essay on Hygrometry"). From experiments with changes of water vapour and pressure in air enclosed in a glass globe, Saussure concluded that changes in temperature must be immediately responsible for variations of the barometer and that these in turn must be related to the movement of air from one place to another.

I. Answer the questions:

1. What is the first aim of the Earth sciences?
2. What does the physical environment, where the people live, include?
3. What is very important for the layperson and the researcher?
4. What do three divisions of the Earth sciences have in common?
5. What are the Earth sciences divided into?
6. What are the applied Earth sciences?
7. What do you learn about the evaporation from the sea?
8. What did a German physicist first produce?
9. How did water get into the air? (as to a popular view in the 18^{th} century)
10. What facts were discovered about pressure and atmosphere circulation?

II. What new factors have you learnt from Text A? Give your own thoughts on that.

III. Make up your own vocabulary of unknown words. Not less than 50 words.

Text B

The 19th Century

Geologic sciences

Crystallography and the classification of minerals and rocks

The French scientist René-Just Häuy, whose treatises on mineralogy and crystallography appeared in 1801 and 1822, respectively, has been credited with advancing mineralogy to the status of a science and with establishing the science of crystallography. From his studies of the geometric relationships between planes of cleavage, he concluded that the ultimate particles forming a given species of mineral have the same shape and that variations in crystal habit reflect differences in the ways identical molecules are put together. In 1814 Jöns Jacob Berzelius of Sweden published a system of mineralogy offering a comprehensive classification of minerals based on their chemistry. Berzelius recognized silica as an acid and introduced into mineralogy the group known as silicates. At mid-century the American geologist James Dwight Dana's System of Mineralogy, in its third edition, was reorganized around a chemical classification, which thereafter became standard for handbooks.

The development of the polarizing microscope and the technique for grinding sections of rocks so thin as to be virtually transparent came in 1827 from studies of fossilized wood by William Nicol. In 1849 Clifton Sorby showed that minerals viewed in thin section could be identified by their optical properties, and soon afterward improved classifications of rocks were made on the basis of their mineralogic composition. The German geologist Ferdinand Zirkel's Mikroscopische Beschaffenheit der Mineralien und Gesteine (1873; "The Microscopic Nature of Minerals and Rocks") contains one of the first mineralogic classifications of rocks and marks the emergence of microscopic petrography as an established branch of science.

Geologic time and the age of the Earth

By mid-century the fossiliferous strata of Europe had been grouped into systems arrayed in chronological order. The stratigraphic column, a composite of these systems, was pieced together from exposures in different regions by application of the principles of superposition and faunal sequence. Time elapsed during the formation of a system became known as a period, and the periods were grouped into eras: the Paleozoic

(Cambrian through Permian periods), Mesozoic (Triassic, Jurassic, and Cretaceous periods), and Cenozoic (Paleogene, Neogene, and Quaternary periods).

Charles Darwin's Origin of Species (1859) offered a theoretical explanation for the empirical principle of faunal sequence. The fossils of the successive systems are different not only because parts of the stratigraphic record are missing but also because most species have lost in their struggles for survival and also because those that do survive evolve into new forms over time. Darwin borrowed two ideas from Lyell and the uniformitarians: the idea that geologic time is virtually without limit and the idea that a sequence of minute changes integrated over long periods of time produce remarkable changes in natural entities.

The evolutionists and the historical geologists were embarrassed when, beginning in 1864, William Thomson (later Lord Kelvin) attacked the steady-state theory of the Earth and placed numerical strictures on the length of geologic time. The Earth might function as a heat machine, but it could not also be a perpetual motion machine. Assuming that the Earth was originally molten, Thomson calculated that not less than 20 million and not more than 400 million years could have passed since the Earth first became a solid body. Other physicists of note put even narrower limits on the Earth's age ranging down to 15 million or 20 million years. All these calculations, however, were based on the common assumption, not always explicitly stated, that the Earth's substance is inert and hence incapable of generating new heat. Shortly before the end of the century this assumption was negated by the discovery of radioactive elements that disintegrate spontaneously and release heat to the Earth in the process.

Concepts of landform evolution

The scientific exploration of the American West following the end of the Civil War yielded much new information on the sculpture of the landscape by streams. John Wesley Powellin his reports on the Colorado River and Uinta Mountains (1875, 1876) explained how streams may come to flow across mountain ranges rather than detour around them. The Green River does not follow some structural crack in its gorge across the Uinta Mountains; instead it has cut its canyon as the mountain range was slowly bowed up. Given enough time, streams will erode their drainage basins to plains approaching sea level as a base. Grove Karl Gilbert's Report on the Geology of the Henry Mountains (1877) offered a detailed analysis of fluvial processes. According to Gilbert all streams work toward a graded condition, a state of dynamic equilibrium that is attained when the net effect of the flowing water is neither erosion of the bed nor deposition of sediment, when the landscape reflects a balance between the resistance of the rocks to erosion and the processes that are operative upon them. After 1884 William Morris Davis developed the concept of the geographical cycle, during which elevated regions pass through successive stages of dissection and denudation characterized as youthful, mature, and old. Youthful landscapes have broad divides and narrow valleys. With further denudation the original surface on which the streams began their work is reduced to ridgetops. Finally in the stage of old age, the region is reduced to a nearly featureless plain near sea level or its inland projection. Uplift of the region in any stage of this evolution will activate a new cycle. Davis's views dominated geomorphic thought until well into the 20th century, when quantitative approaches resulted in the rediscovery of Gilbert's ideas.

Gravity, isostasy, and the Earth's figure

Discoveries of regional anomalies in the Earth's gravity led to the realization that high mountain ranges have underlying deficiencies in mass about equal to the apparent surface loads represented by the mountains themselves. In the 18th century the French scientist Pierre Bouguer had observed that the deflections of the pendulum in Peru are much less than they should be if the Andes represent a load perched on top of the Earth's crust. Similar anomalies were later found to obtain along the Himalayan front. To explain these anomalies it was necessary to assume that beneath some depth within the Earth pressures are hydrostatic (equal on all sides). If excess loads are placed upon the crust, as by addition of a continental ice cap, the crust will sink to compensate for the additional mass and will rise again when the load is removed. The tendency toward general equilibrium maintained through vertical movements of the Earth's outer layers was called isostasy in 1899 by Clarence Edward Dutton of the United States.

Evidence for substantial vertical movements of the crust was supplied by studies of regional stratigraphy. In 1883 another American geologist, James Hall, had demonstrated that Paleozoic rocks of the folded Appalachians were several times as thick as sequences of the same age in the plateaus and plains to the west. It was his conclusion that the folded strata in the mountains must have accumulated in a linear submarine trough that filled with sediment as it subsided. Downward crustal flexures of this magnitude came to be called geosynclines.

I. Answer the questions:

1. What scientific discoveries did the French and Swedish scientists make?
2. How could the minerals be identified?
3. Name the periods of Earth existence.
4. What were the principles of Ch. Darwin's Origin of Species?
5. What was W. Thompson's theory on the origin of the Earth?
6. What were the concepts of landform evolution?
7. What can you say about gravity and the Earth's figure?

II. Give a summary of Text B in your own words. Not less than 10-15 sentences.

III. Make up your own vocabulary of unknown words to you. Not less than 50 words.

Text C

Outline of Earth Science

Introduction

The Universe has existed for about 15 billion years.

In it, the speed of light is always faster than speed of sound.

Therefore the first event generated a large flash of light outwards in all directions long before it would have made a big, or any sort of bang.

Stars are suns. Billions and billions of suns (thank you, Carl Sagan).

Galaxies are collections of suns. Our sun is in a galaxy which we see edge on as the Milky Way.

The sun's average temperature is about 5480 degrees Celsius, or 548 times boiling water.

Our sun has a Solar System which includes Mercury, Venus, Earth, Mars, the asteroid belt, Jupiter, Saturn, Neptune, Uranus, Pluto/Charon and the Oort Cloud of comets. There is a regular spacing to the planets. Using the Sun-Mercury distance as one unit, the spacing is 1:1:2:3:5:8 and so on, more or less and excluding Pluto/Charon. The age of the Earth and Moon are about the same; about 3.9 billion years.

Earth is about 25,000 miles around. This was first calculated by Eratosthenes, a teacher at the Alexandria Museum about 239 BC. He assumed that the sun's rays were parallel and that the sun was a great distance away. An ancient well is said to have reflected the light directly upward to light a monument and was quite a tourist attraction for several thousand years. So everyone knew that the sun stood overhead in Aswan on Summer Solstice. Eratosthenes measured the angle of the sun at noon in Alexandria and found it was about 7.5 degrees out of a total of 360. Since 7.5 divided by 360 degrees in a circle works out to about 1/50 of a circle, he now knew the angle of the Sun's rays between Alexandria and Aswan. The Egyptian post office is said to have provided the ground distance between the two points as the equivalent of 500 miles. So if 500 miles is 1/50th of a circle, the whole circle is 25,000 miles around. Almost spot on, as it turns out. From this, he calculated that it is about 8,000 miles to the center of the Earth.

But his accomplishment is dwarfed by Mesopotamian astronomers who described the following systems almost exactly, but in ancient Sumerican terms as early as 2,500 BC and copied and recopied as "religious texts" for centuries afterward along with the construction mathematics to build observatories and instruments.

It has been known since ancient times that:

The North Pole appears to point to a north star. Right now it's a star called Polaris. Stars rotate around Polaris; some are always visible at night, others appear to rise and set. Stars which rotate closest to Polaris cannot be seen from the Southern Hemisphere.

In the Southern Hemisphere, the Southern Cross points toward the pole, but there is no star exactly there right now. Starts rotate around the southern pole; some are always visible at night, others appear to rise and set. Starts which rotate closest to the southern pole cannot be seen from the Northern Hemisphere.

The stars which rise and set can be seen from both hemispheres.

The plane in which most of the planets in our Solar System rotates is called the plane of the ecliptic. The zodiac constellations mark the plane of the ecliptic and the planets, the moon and the sun all appear to rise and set in this plane.

The moon revolves around the Earth once ~ every 28 days and rotates on its axis once in the same time; keeping its face always towards the Earth.

The Earth's axis tilts about 23.5 degrees now. It wobbles over about 26,000 years in a full circle so that while Polaris is the North Star at the present time, the north polar star changes slowly over time and will return to being Polaris again in about another 26,000 years.

We know that our axis points at Polaris - on a human life span and that the Sun is in the middle of the Solar System.

We know that there is a solid core in the middle of the Earth which rotates within a liquid outer core very rapidly and generates the Earth's magnetic field. The axis of the solid core is not the same as the axis of the Earth; it moves, but returns to about the same point on Earth's surface once every 400 years. This is why the magnetic pole and the axial pole are not the same.

The Earth's orbit is an ellipse, not a circle. It is closest to the sun around January 3 (perihelion) and farthest from the sun around July 3 (aphelion). The difference is minimal. The distance is about 93 million miles.

Our seasons are a function of the axial tilt. In Northern Hemisphere summer, the north pole receives 24 hours a day of sunlight for 6 weeks, warming the whole hemisphere. At that time, the Southern Hemisphere is having winter and the south pole is having 24 hours a day of darkness for the same 6 weeks. In Spring and Fall - around the equinoxes, the Earth is evenly heated and every where on Earth has 12 hours of day and 12 hours of night that day. Hence the name, Equinox. The winter effects on each Hemisphere are the opposite of the summer effects.

The tilt of the Earth is also responsible for the length of the day changing throughout the year. In the northern hemisphere, the longest day in the is Summer Solstice, about June 21 and the shortest day is Winter Solstice about December 21 with the Equinoxes at March and September 21 or so every year.

The tilt is also responsible for the apparent change in where the sun appears to rise. In Northern Hemisphere summer, the sun rises far to the northeast and sets far to the northwest; in winter it appears to rise southeast and set southwest. At the equinoxes, it appears to rise due east and set due west.

The moon orbits the Earth between five degrees north and south of the equator, crossing that line twice a year. That is why in Northern Hemisphere summer, the moon appears to ride low in the sky (it is in the southern hemisphere itself) and in Northern winter, the moon appears high in the sky. It is the opposite of the sun which rides high in summer and low in winter.

Here are some other factoids about our planet:

Earth rotates on its axis about once every 24 hours and revolves around the sun about once every 365 days. The speed at the equator is about 1040 miles per hour.

Northern Hemisphere is 50 percent of the land -- the Southern is 75 percent ocean.

Average land height is 0.8 kilometers

Average ocean depth 3.8 kilometers (3800 meters)

Lowest point - Marianas Trench 11,000 meters

Highest point - Mt. Everest 8936 meters

Molten magma, hot rock in Hawaii'an volcanos can reach 3000 C or 300 times boiling water.

Before artificial lighting, it was possible to see sun shadow, moon shadow and the shadow of Venus and bows on both the sun (rainbows) and moon under certain atmospheric conditions.

The direction of Earth's spin controls the directions of winds and waves.

At the Equator to 30 degrees N or S, the winds run away from the spin (easterlies).

In the mid-latitudes from 30 to 60 degrees N or S, the winds run toward the spin (westerlies).

In the polar latitudes, the winds again run away from the spin (easterlies).

The direction of the prevailing winds influences currents which flow away from the spin at the Equator and are deflected by continents towards the respective poles and back around to their place of origin.

Water is amazing stuff.

Unlike just about every other solid, the solid form of water (ice) floats which means it has a density less than that of its liquid phase.

Fresh water freezes at O Celsius (32 F) and boils at 100 C (212 F) at sea level. In both cases, its density becomes less than one.

Sea water is more dense than freshwater. The average density of seawater 1.026 g/cm3 while the average density of water 1.0 g/cm3.

Most water on Earth is salty (97 percent) leaving just 3 percent in glaciers and the other 1 percent in streams, lakes, groundwater and water vapor.

Pressure can do some unbelievable things.

Changing the pressure of a substance can change its temperature. Compression raises temperature, expansion lowers temperature.

The pressure of air at sea level is called 1 atm (about 100 g/cc or 14.7 lb/sq.in or 29.92 inches of mercury) . The instrument to measure barometric pressure gave rise to the terms "low pressure" and "high pressure." The air at sea level, being the most compressed, is usually the warmest and air gets colder as you go up. Half the air is in the bottom five miles of the 150 mile thick atmosphere.

At the surface of the earth, water boils at 100 degrees Celsius (212F) and freezes at 0 C (32F).

At higher elevations, water actually boils at a lower temperature, but takes longer to do it due to lower air pressures.

Confining pressure in the ocean rises 1 atm per 10 meters of depth + the 1 atm of air at the surface, so the pressure of air at the average ocean depth of 3800 meters is 381 atmospheres. Temperature at the bottom is variable and can be quite high near underseas volcanos.

Confining pressure in rock results in rock pressure increases of about 250-300 bars/kilometer and increases of around 30 degrees C/kilometer. Temperature, however, can vary based on nearness to volcanic activity.

Fluids tend to follow faults or cracks in rocks, upward towards areas of lesser pressure.

Minerals form in places with abrupt changes in pressure/temperature such as the air/water interface.

The effects of organisms can and has affected Earth's atmosphere. In the earliest days of Earth's history, the atmosphere did not have much free oxygen. The Earth's oxygen was emitted as waste by colonial bacteria while they built huge colonial masses now called "stromatolites." Alternating layers of fine-grained silica with iron oxides in several phases suggests winter clay or fine quartz runoff being recolonized every year by new iron-fixing bacteria. Their huge and deep deposits are mined for much industrial iron. Areas such as Iron Mountain, Michigan and areas in Western Australia have huge underground and open pit operations.

The organisms, however, changed the atmosphere and most were driven far underwater and underground where their descendants are in some places, still the dominant force on their changed Earth.

I. What new information have you learnt from text C? Discuss it pairs.

Grammar Exercises

Exercise I. Identify the tenses in the left column, then match them with the correct description.

1. Do bats live in caves?	a. repeated or habitual action
2. The rate of unemployment is decreasing slowly.	b. expressing annoyance about a frequently repeated action
3. She often goes to the gym on Fridays.	c. sports commentary, review or narration
4. The black car stops in front of the bank and three suspicious looking men get out of it.	d. fixed arrangement in the near future
5. Sam and Tom are repairing the cottage roof at the moment.	e. action happening at or around the moment of speaking
6. The evening performance starts at nine o'clock.	f. timetable or programme
7. Carl is always interrupting me.	g. changing or developing situation
8. I am helping Helen choose her wedding dress on Saturday.	h. general truth or law of nature

Exercise II. Choose the correct item.

1. The plane ________ off at seven o'clock, so we must be on time.
   A) takes B) is taking C) took D) has taken
2. We _______ you should tell her truth.
   A) was thinking B) are thinking C) have thought D) think
3. Ann is my best friend. We _______ each other for years.
   A) know B) knew C) knows D) have known
4. Nicky _________ to San Francisco when the accident happened.
   A) flies B) has flown C) was flying D) has been flying
5. Tim _______ in a cafe at present, but he has already applied for a new job.
   A) work B) have worked C) is working D) worked
6. I spoke to two people, neither of ________ were Spanish.
   A) whom B) which C) who D) where
7. We _______ some friends for dinner tonight. Would you like to join us?

A) saw B) are seeing C) have seen D) see

Exercise III. Complete the e-mail. Use the Present Perfect or the Past Simple of the verbs in brackets.

Dear Javier,

I'm sorry I (1) ________ (not be) in touch recently but I (2) _________ (be) really busy. I (3) ________ (go) to my third job interview this morning but unfortunately, no one (4) _________ (offer) me a job yet. I (5) _____ (look) everywhere and I (6) ______ (fill in) dozens of application forms. Still, I'm not discouraged. Some things take time.

In fact, I'm really enjoying myself here. I (7) ________ (already/see) Cats and I (8) ________ (just/buy) tickets for the next Madonna concert — I (9) __________ (stand) in line for an hour this afternoon but it was worth it. Also, I like the family

I'm staying with — they (10) _______ (give) me lots of advice about finding work and last night they even (11) _______ (take) me out for a meal. I We talk all the time and as a result, my English (12) _________ (already/improve) a lot. Anyway, someone (13) ________ (just/come) to the door. I hope it's the pizza I (14) _________ (order) an hour ago. I'll write more often in future — I promise.

Frida.

Exercise IV. Put the verbs in brackets in the Present Perfect Simple or the Perfect Continuous Tense.

2. It _________ (not/rain) for three hours! Only about one hour.
3. How long __________ (you/live) in London?
4. How long __________ (you/wait) for the bus?
5. He _________ (never/be) abroad.
6. ___________ (they/arrive) already?
7. ____________ (you / finish) your homework yet?
8. Julie ________ (not/eat) anything today.
9. How long __________ (you/have) your car?
10. She __________ (drink) ten glasses of water!
11. I _________ (wait) for three hours already!
12. How long ___________ (you/be) a lawyer?
13. It __________ (not/rain) all summer, so the garden is dead.
14. How long _________ (you/know) Luke?
15. She ________ (have) parties every week for ten years.
16. I __________ (have) my dog for sixteen years.
17. How long ____________ (Julie/have) problems at school?
18. I __________ (read) your book all day, it's very interesting.
19. It____________ (snow) since last night.
20. How long __________ (you/think) about changing your job?

21. She ______________ (eat) chocolate all morning so she feels sick.

Exercise V. Complete the article. Use the Past Simple, the Past Continuous, the Past Perfect Simple or the Past Perfect Continuous of the verbs in brackets.

A Japanese businessman recently made medical history by surviving without food and water in rear-freezing weather for about three weeks.
Mr Mitsutaka Uchikoshi, 35, climbed up Mount Rokko in western Japan for a barbecue party with friends but (1) _________ (decide) to come back down on his own. While he (2) _______ (walk) down the mountain, he (3) ________ (slip) in a stream and (4) ________ (break) his pelvis. Until he (5) ________ (become) unconscious, he survived by sipping the remains of a bottle of barbecue sauce that he (6) ___________ (carry) with him at the time of the accident. When searchers (7) _________ (rescue) him, he (8) _________ (appear) to be in a coma. His pulse was almost undetectable and his body temperature (9) _______ (drop) to 32 degrees. He (10) _________ (also/lose) a lot of weight. Doctors (11) _________ (treat) Mr Uchikoshi for hypothermia, multiple organ failure and blood loss. By the time he was rescued, he (12) ________ (miss) for twenty-five days. Remarkably, he (13) ________ recover fully. One of his doctors said, “He was frozen alive and survived. If we can understand why. It opens up all sorts of possibilities for the future.”

Exercise VI. Circle the correct answer.

Wind power

If the British government gets its way, the “fuel” of the future (1) *will/is about to* be the air we breathe. The government (2) *is on the point of using/plans to use* electricity from wind farms to help meet its targets for renewable energy. With government approval, private firms (3) *will have built/are to build* offshore wind farms in the southeast of England. One of these, the London Array wind farm, (4) *will be/will have been* the largest in the world when it (5) *is/will have been* completed. Together, the London Array and Thanet wind farms (6) *will produce / are producing* enough electricity to power a million homes.

London Array have not yet announced when they (7) *begin/will begin* construction of the wind farm. However, they expect that they (8) *will be completing/will have completed* it by 2010 or 2011. The smaller wind farm in Thanet (9) *is going to supply/will be supplying* electricity to about 240,000 homes by 2008.

However, the farms are controversial. Developers (10) *were hoping/would hope* to build a third farm in the Lake District but the government rejected their plans because they are concerned about the effect of the farm on the countryside and on tourism.

Environmentalists say we (11) *will have to/are having to* do much more than build wind farms in the future. Otherwise, climate change (12) *will have/will be having* a devastating effect on the environment.

VII. Read the sentences and explain the usage of the Present Simple or the Present Continuous Tense.

1) This TV programme starts at 5.30 p.m. 2) The Sharons are looking for a babysitter. 3) Dick seldom visit« his aunt. 4) Susan's elder brother runs a small café. 5) Tom is always chewing a gum! 6) She sings perfectly in this opera. 7) My parents are celebrating their wedding anniversary next Saturday. 8) Money doesn't buy health. 9) Dean is getting better after his illness. 10) They are having tea in the dining room.

VIII. Circle the correct item.

1) Mary usually *takes/is taking* a bath in the evening. 2) The bus *arrives/is arriving* in Odessa at eight o'clock in the evening. 3) The Harrods *stay/are staying* in a luxurious hotel at present. 4) Helen usually *cooks/is cooking* breakfast at 7 o'clock. 5) Pam *moves/is moving* to a new flat in three days. 6) In a new film «Alice in Wonderland» Alice *wins/is winning* the final battle and *saves/is saving* the inhabitants of the country from the power of the Red Queen. 7) Henry *picks/is picking* me up at eight o'clock tomorrow. 8) Skill *comes/is coming* with practice. 8) Monica *always argues/is always arguing* with me! 10) Today we *go/are going* to the Museum of Fine Arts. 11) My friend *lives/is living* in a private house. 12) At the end of the book the main character *explains/is explaining* everything to his girlfriend and they *go/are going* on a journey together. 13) This plant *produces/is producing* office furniture. 14) The Johnsons *visit/are visiting* us next Sunday. 15) You *always wear/are always wearing* dirty shoes!

IX. Put the verbs in brackets into the Present Simple or the Present Continuous Tense.

1) John often ... *(to send)* e-mail letters to his friends abroad. 2) Paul ... *(to write)* an e-mail letter to his friend in Canada now. 3) Margaret ... *(to look)* for a better job at the moment. 4) We ... *(to attend)* language courses three times a week. 5) The secretary ... *(to be)* busy now. She ... *(to prepare)* the documents for the conference. 6) My elder brother ... *(always to make fun)* of me! 7) The professor ... *(not to examine)* patients now. He ... *(to give)* a lecture to the students at the moment. He usually ... *(to examine)* the patients in the morning. 8) The article ...*(to contain)* the results of important researches in medicine. 9) You never ... *(to tell)* me about your problems at school. I'm a bit surprised that you ... *(to ask)* me for a piece of advice now. 10) Most oils ... *(to boil)* at 200—300°C. 11) ... the musicians ... *(to have)* lunch now? — No, they ... . They ... *(to rehearse)* in the assembly hall. They ... *(to perform)* some new songs at the concert tomorrow. 12) ... doctors ... *(to use)* antibiotic drugs to fight viruses? — No, antibiotic drugs ... *(not to work)* against viruses. Doctors usually ... *(to prescribe)* antibiotics against bacterial infections. 13) Max ... *(always to play)* pranks on his

classmates! 14) ... you ... *(to wait)* for a ferry? — Yes, we ... . The ferry ... *(to arrive)* at four o'clock. 15)... Peter and Tim ... (to go) fishing next Thursday? — Yes, ... They often ... *(to go)* fishing together. And they always ... *(to invite)* me to join them.

LESSON II

Text A

Hydrologic sciences

Darcy's law

Quantitative studies of the movement of water in streams and aquifers led to the formulation of mathematical statements relating discharge to other factors. Henri-Philibert-Gaspard Darcy, a French hydraulic engineer, was the first to state clearly a law describing the flow of groundwater. Darcy's experiments, reported in 1856, were based on the ideas that an aquifer is analogous to a main line connecting two reservoirs at different levels and that an artesian well is like a pipe drawing water from a main line under pressure. His investigations of flow through stratified beds of sand led him to conclude that the rate of flow is directly proportional to the energy loss and inversely proportional to the length of the path of flow. Another French engineer, Arsène-Jules-Étienne-Juvénal Dupuit, extended Darcy's work and developed equations for underground flow toward a well, for the recharge of aquifers, and for the discharge of artesian wells. Philip Forchheimer, an Austrian hydrologist, introduced the theory of functions of a complex variable to analyze the flow by gravity of underground water toward wells and developed equations for determining the critical distance between a river and a well beyond which water from the river will not move into the well.

Surface water discharge

A complicated empirical formula for the discharge of streams resulted from the studies of Andrew Atkinson Humphreys and Henry Larcom Abbot in the course of the Mississippi Delta Survey of 1851–60. Their formula contained no term for roughness of channel and on this and other grounds was later found to be inapplicable to the rapidly flowing streams of mountainous regions. In 1869 Emile-Oscar Ganguillet and Rudolph Kutter developed a more generally applicable discharge equation following their studies of flow in Swiss mountain streams. Toward the end of the century, systematic studies of the discharge of streams had become common. In the United States the Geological Survey, following its establishment in 1879, became the principal agency for collecting and publishing data on discharge, and by 1906 stream gauging had become nationwide.

Foundations of oceanography

In 1807 Thomas Jefferson ordered the establishment of the U.S. Coast Survey (later Coast and Geodetic Survey and now the National Ocean Survey). Modeled after British and French agencies that had grown up in the 1700s, the agency was charged with the responsibilities of hydrographic and geodetic surveying, studies of tides, and preparation of charts. Beginning in 1842, the U.S. Navy undertook expansive oceanographic operations through its office of charts and instruments. Lieut. Matthew Fontaine Maury promoted international cooperation in gathering meteorologic and hydrologic data at sea. In 1847 Maury compiled the first wind and current charts for the North Atlantic and in 1854 issued the first depth map to 4,000 fathoms (7,300 metres). His Physical Geography of the Sea (1855) is generally considered the first oceanographic textbook.

The voyage of the Beagle (1831–36) is remembered for Darwin's biological and geologic contributions. From his observations in the South Pacific, Darwin formulated a theory for the origin of coral reefs, which with minor changes has stood the test of time. He viewed the fringing reefs, barrier reefs, and atolls as successive stages in a developmental sequence. The volcanic islands around which the reef-building organisms are attached slowly sink, but at the same time the shallow-water organisms that form the reefs build their colonies upward so as to remain in the sunlit layers of water. With submergence of the island, what began as a fringing reef girdling a landmass at last becomes an atoll enclosing a lagoon.

Laying telegraphic cables across the Atlantic called for investigations of the configuration of the ocean floor, of the currents that sweep the bottom, and of the benthonic animals that might damage the cables. The explorations of the British ships Lightning and Porcupine in 1868 and 1869 turned up surprising oceanographic information. Following closely upon these voyages, the Challenger was authorized to determine "the conditions of the Deep Sea throughout the Great Ocean Basins."

The Challenger left port in December of 1872 and returned in May 1876, after logging 127,600 kilometres (68,890 nautical miles). Under the direction of Wyville Thomson, Scottish professor of natural history, it occupied 350 stations scattered over all oceans except the Arctic. The work involved in analyzing the information gathered during the expedition was completed by Thomson's shipmate Sir John Murray, and the results filled 50 large volumes. Hundreds of new species of marine organisms were described, including new forms of life from deep waters. The temperature of water at the bottom of the oceans was found to be nearly constant below the 2,000-fathom level, averaging about 2.5 °C (36.5 °F) in the North Atlantic and 2 °C (35 °F) in the North Pacific. Soundings showed wide variations in depths of water, and from the dredgings of the bottom came new types of sediment—red clay as well as oozes made predominantly of the minute skeletons of foraminifera, radiolarians, or diatoms. Improved charts of the principal surface currents were produced, and the precise location of many oceanic islands was determined for the first time. Seventy-seven samples of seawater were taken at different stations from depths ranging downward to about 1.5 kilometres. The German-born chemist Wilhelm Dittmar conducted quantitative determinations of the seven major constituents (other than the hydrogen and oxygen of the water itself)—namely, sodium, calcium, magnesium, potassium, chloride, bromide, and sulfate. Surprisingly, the percentages of these components turned out to be nearly the same in all samples.

Efforts to analyze the rise and fall of the tides in mathematical terms reflecting the relative and constantly changing positions of Earth, Moon, and Sun, and thus to predict the tides at particular localities, has never been entirely successful because of local variations in configuration of shore and seafloor. Nevertheless, harmonic tidal analysis gives essential first approximations that are essential to tidal prediction. In 1884 a mechanical analog tidal prediction device was invented by William Ferrel of the U.S. Coast and Geodetic Survey, and improved models were used until 1965, when the work of the analog machines was taken over by electronic computers.

I. Answer the questions:

1. What were Darcy's experiments based on?
2. What did a French engineer Dupuit extend Darcy's work to?
3. What theory did Ph. Forchheimer introduce?
4. What are the main steps of foundations of oceanography? (from the period of 1807 to 1876)
5. What were the results of voyages of the Challenger?
6. The prediction of the tides at particular localities has never been successful, has it?
7. What new information was taken from the deep waters of the oceans?
8. What are the results of the constantly moving planets?

II. Put 20 questions to Text A.

III. Make up your own vocabulary of unknown words to you. Not less than 50.

Text B

Atmospheric sciences

Composition of the atmosphere

Studies of barometric pressure by the British chemist and physicist John Dalton led him to conclude that evaporation and condensation of vapour do not involve chemical transformations. The introduction of vapour into the air by evaporation must change the average specific gravity of the air column and, without altering the height of that column, will change the reading of the barometer. In 1857 Rudolf Clausius, a German physicist, clarified the mechanics of evaporation in his kinetic theory of gases. Evaporation occurs when more molecules of a liquid are leaving its surface than returning to it, and the higher the temperature the more of these escaped molecules will be in space at any one time.

Following the invention of the hot-air balloon by the Montgolfier brothers in 1783, balloonists produced some useful information on the composition and movements of the atmosphere. In 1804 the celebrated French chemist Joseph-Louis Gay-Lussac ascended to about 7,000 metres, took samples of air, and later determined that the rarefied air at that altitude contained the same percentage of oxygen (21.49 percent) as the air on the ground. Austrian meteorologist Julius von Hann, working with data from balloon ascents and climbing in the Alps and Himalayas, concluded in 1874 that about 90 percent of all the water vapour in the atmosphere is concentrated below 6,000 metres—from which it follows that high mountains can be barriers against the transport of water vapour.

Understanding of clouds, fog, and dew

Most of the names given to clouds (cirrus, cumulus, stratus, nimbus, and their combinations) were coined in 1803 by the English meteorologist Luke Howard. Howard's effort was not simply taxonomic; he recognized that clouds reflect in their shapes and changing forms "the general causes which effect all the variations of the atmosphere."

After Guericke's experiments it was widely believed that water vapour condenses into cloud as soon as the air containing it cools to the dew point. That this is not necessarily so was proved by Paul-Jean Coulier of France from experiments reported in 1875. Coulier found that the sudden expansion of air in glass flasks failed to produce an artificial cloud if the air in the system was filtered through cotton wool. He concluded that dust in the air was essential to the formation of cloud in the flask.

From about the mid-1820s, efforts were made to classify precipitation in terms of the causes behind the lowering of temperature. In 1841 the American astronomer-meteorologist Elias Loomis recognized the following causes: warm air coming into contact with cold earth or water, responsible for fog; mixing of warm and cold currents, which commonly results in light rains; and sudden transport of air into high regions, as by flow up a mountain slope or by warm currents riding over an opposing current of cold air, which may produce heavy rains.

Observation and study of storms

Storms, particularly tropical revolving storms, were subjects of much interest. As early as 1697 some of the more spectacular features of revolving storms were recorded in William Dampier's New Voyage Round the World. On July 4, 1687, Dampier's ship survived the passage of what he called a "tuffoon" off the coast of China. The captain's vivid account of this experience clearly describes the calm central eye of the storm and the passage of winds from opposite directions as the storm moved past. In 1828 Heinrich Wilhelm Dove, a Prussian meteorologist, recognized that tropical revolving storms are traveling systems with strong winds moving counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. The whirlwind character of these storms was independently established by the American meteorologist William C. Redfield in the case of the September hurricane that struck New England in

1821. He noted that in central Connecticut the trees had been toppled toward the northwest, whereas some 80 kilometres westward they had fallen in the opposite direction. Redfield identified the belt between the Equator and the tropics as the region in which hurricanes are generated, and he recognized how the tracks of these storms tend to veer eastward when they enter the belt of westerly winds at about latitude 30° N. In 1849 Sir William Reid, a British meteorologist and military engineer, studied the revolving storms that occur south of the Equator in the Indian Ocean and confirmed that they have reversed rotations and curvatures of path compared with those of the Northern Hemisphere. Capt. Henry Piddington subsequently investigated revolving storms affecting the Bay of Bengal and Arabian Sea, and in 1855 he named these cyclones in his Sailor's Horn-book for the Laws of Storms in all Parts of the World.

Beginning in 1835, James Pollard Espy, an American meteorologist, began extensive studies of storms from which he developed a theory to explain their sources of energy. Radially convergent winds, he believed, cause the air to rise in their area of collision. Upward movement of moist air is attended by condensation and precipitation. Latent heat released through the change of vapour to cloud or water causes further expansion and rising of the air. The higher the moist air rises the more the equilibrium of the system is disturbed, and this equilibrium cannot be restored until moist air at the surface ceases to flow toward the ascending column.

That radially convergent winds are not necessary to the rising of large air masses was demonstrated by Loomis in the case of a great storm that passed across the northeastern United States in December 1836. From his studies of wind patterns, changes of temperature, and changes in barometric pressure, he concluded that a cold northwest wind had displaced a wind blowing from the southeast by flowing under it. The southeast wind made its escape by ascending from the Earth's surface. Loomis had recognized what today would be called a frontal surface.

Weather and climate

Modern meteorology began when the daily weather map was developed as a device for analysis and forecasting, and the instrument that made this kind of map possible was the electromagnetic telegraph. In the United States the first telegraph line was strung in 1844 between Washington, D.C., and Baltimore. Concurrently with the expansion of telegraphic networks, the physicist Joseph Henry arranged for telegraph companies to have meteorological instruments in exchange for current data on weather telegraphed to the Smithsonian Institution. Some 500 stations had joined this cooperative effort by 1860. The Civil War temporarily prevented further expansion, but, meanwhile, a disaster of a different order had accelerated development of synoptic meteorology in Europe. On Nov. 14, 1854, an unexpected storm wrecked British and French warships off Balaklava on the Crimean Peninsula. Had word of the approaching storm been telegraphed to this port in the Black Sea, the ships might have been saved. This mischance led in 1856 to the establishment of a national storm-warning service in

France. In 1863 the Paris Observatory began publishing the first weather maps in modern format.

The first national weather service in the United States began operations in 1871 as an agency of the Department of War. The initial objective was to provide storm warnings for the Gulf and Atlantic coasts and the Great Lakes. In 1877 forecasts of temperature changes and precipitation averaged 74 percent in accuracy, as compared with 79 percent for cold-wave warnings. After 1878 daily weather maps were published.

Synoptic meteorology made possible the tracking of storm systems over wide areas. In 1868 the British meteorologist Alexander Buchan published a map showing the travels of a cyclonic depression across North America, the Atlantic, and into northern Europe. In the judgment of Sir Napier Shaw, Buchan’s study marks the entry of modern meteorology, with “the weather map as its main feature and forecasting its avowed object.”

In addition to weather maps, a variety of other kinds of maps showing regional variations in the components of weather and climate were produced. In 1817 Alexander von Humboldt published a map showing the distribution of mean annual temperatures over the greater part of the Northern Hemisphere. Humboldt was the first to use isothermal lines in mapping temperature. Buchan drew the first maps of mean monthly and annual pressure for the entire world. Published in 1869, these maps added much to knowledge of the general circulation of the atmosphere. In 1886 Léon-Philippe Teisserenc de Bort of France published maps showing mean annual cloudiness over the Earth for each month and the year. The first world map of precipitation showing mean annual precipitation by isohyets was the work of Loomis in 1882. This work was further refined in 1899 by the maps of the British cartographer Andrew John Herbertson, which showed precipitation for each month of the year.

Although the 19th century was still in the age of meteorologic and climatological exploration, broad syntheses of old information thus kept pace with acquisition of the new fairly well. For example, Julius Hann’s massive Handbuch der Klimatologie (“Handbook of Climatology”), first issued in 1883, is mainly a compendium of works published in the Meteorologische Zeitschrift (“Journal of Meteorology”). The Handbuch was kept current in revised editions until 1911, and this work is still sometimes called the most skillfully written account of world climate.

I. Answer the questions:

1. What conclusion did J. Dalton make in his studies on barometric pressure?
2. What experiments with the balloons were very important?
3. When does water vapour condense into cloud?
4. What did E. Loomis recognize in 1841?
5. Why were the tropical storms of much interest?

6. What caused the air to rise as to the theory of J. Espy?
7. Why do you think the modern meteorology began with the weather map?
8. What other maps were produced in addition to weather maps?

II. Retell Text B as to your own plan. Use the words from the text as far as possible.

III. Make up your own vocabulary of unknown words. Not less than, 50.

Text C

Why the sky is blue?

It turns out very' few people know the answer to this seemingly "always hi question in the air." Often children are asked about it, but adults are not re give an explanation. Many believe that this question is from a series of the we can not answer at all, such as "where the end of the universe". There are] who believe that this is the color of a mixture of nitrogen and oxygen, wher gases are many and they are illuminated by the Sun. There are those that c< the color of the sky with the refraction of light in the layers c atmosphere. Those who were excellent students at school will say that t disperses the blue color more intensely than all other colors of the spt according to Rayleigh's law, often not understanding the essence o scattering. By the way, the question of the color of the sky was solv physicists only in the twentieth century. Therefore, we should not be partic ashamed.

And although this issue is not directly related to temperature, let's try to fi; out. We will not dig very deeply into physics, but let us recall the basic pro\ on light and air.

Sunlight is a mixture of radiations of all colors of the rainbow, i.e. Electroma waves with vibration frequencies such that they can affect the human retin violet color corresponds to the emission wavelength of 380 nm, the red corresponds to a wavelength of 720 nm. In the retina there are cones respc for the perception of color. The cones are of three types: blue (responsible high frequency range), green (responsible for medium frequencies) and re low frequencies). Sensitivity ranges of cones overlap, but the maximum is a < color.

The air molecules in the normal state have no charge, they are neutral. Ho they consist of charged particles - electrons and nuclei. Under the influence electric field, the nuclei are shifted in one direction, the electrons in the otht a dipole with its own electromagnetic field is produced. If the dipole falls i alternating electromagnetic field, then it begins to oscillate, i.e. the positn negative charges are shifted back and forth and the dipole itself begins to e electromagnetic wave. In our case, the electromagnetic wave of sunlight cau: air molecules to turn into emitting electromagnetic waves of dipoles. AJ directions of studying dipoles can be all kinds. According to the 1; conservation of energy, the light wave loses intensity in the original directioi is ihe main mechanism of light scattering in the air. Rather, it is not even i about scattering, but about the glow of air molecules under the action of lig look through the atmosphere and actually see the light from the sun and th emitted by the molecules of our atmosphere. Why is it not white, but blue? The point is that the intensity of the dipole radiation is proportional to the power of the radiation frequency. The waves with the maximum frequem the atmosphere, there is, as it were, filtering the white color alon spectrum. Air molecules radiate mainly blue, i.e. light, which excites the bli green cones of the retina much more than the red cones.

The first to take a step toward correct explanation of the color of the sky was Tyndal in 1865. He discovered that when light rays pass through an environrr which suspended particles of small particles of impurities are present, the color dissipates more intensively than red. As a result, we see the coloring transmitted light in a blue hue. This can be seen from the side of a beam o passing through the water, slightly clouded by milk. If you look not from th< but in the direction of the beam, then the light acquires a reddish tint, becauj blue component dissipated.

A few years later, British scientist Lord Relay studied this effect in more det£ showed that the intensity of light scattering on particles of very small dimensi inversely proportional to the fourth power of the radiation wavelength. It fol that the blue light is scattered 10 times more intense than red light.

Tyndall and Rayleigh thought that the blue of the sky was due to the presei fine particles of dust and water vapor in the atmosphere. Later, scientists re that if this were indeed so, we would observe much more variations in the cc the sky when the humidity, nebula and air pollution change, than we ol now. The problem was solved by Einstein, who in 1911 derived a fc describing the scattering of light by molecules. The formula confirmed all pr< experiments. It was proved that not dust and vapor, namely air molecules s light, because (as mentioned above) the electromagnetic field of light in electric dipole moments in molecules.

Why is the sky not purple, but blue? After all, the purple waves are shorter th blue ones. The first reason is that the spectrum of solar radiation i uniform. There is less purple. In addition, the purple rays are scattered even uppermost layers of the atmosphere. The second reason is that the sensitivity cones to the violet color is lower than to blue. The third reason is that th< color irritates not only the blue cones in the retina, but also the slightly re green ones. Therefore, the color of the sky is not pale, but saturated especially when the air is transparent.

Scattering of light on air molecules explains the color of sunset. Passing frc Sun along the tangent to the Earth a long way, the ray loses all the shades. Only yellow and red tones reach the eye. Near the sea, the sunset cai be orange, due to the particles of salt in the air that are responsible fi scattering of Tyndall.

Note that the composition of the atmosphere, i.e. Availability of nitroge oxygen, the color of the sky is almost independent. If the planet has a trans atmosphere of sufficient thickness and density, illuminated by a light spectrum is as white as the Sun, then the sky will be blue there.

How, then, can we explain that the images from the spacecraft that landed or indicate that the sky is pink and red? This is because the atmosphere of Mars is very thin and polluted with dust. Scattering of sunlight does not occur on molecules, but mainly on suspended impurities of dust. Many dust particles are larger than the wavelengths of light and consist of iron oxide, which has a red color. Now you know that to answer the question "why the sky is blue" is not very simple. We understand something, but what can we say to the children? Probably, our beautiful atmosphere consists of air, which shines with blue light when the Sun warms it. Because the blue color i s the strongest of all the colors of the rainbow.

I. So, why is the sky blue? Answer in your own words.

Grammar Exercises

Exercise I. Rewrite these sentences in the passive.

1. They publish a lot of books on information technology.
2. The people at the garage are repairing our car.
3. They will have completed the new motorway by Christmas.
4. The Government is now building a lot of new schools in the provinces.
5. The police have just arrested him on suspicion of murder.
6. The company cut the water off because Mr and Mrs Dixon hadn't paid their bill.
7. The fire fighters put out the fire before it did much damage.
8. The pressures of work were affecting her health.
9. Will they publish her new book next month?
10. They are going to open the new supermarket next week.

Exercise II. Open the brackets and use the verb in the appropriate form of the Passive Voice.

1. The first draft resolution___________ (not discuss) yesterday; it _____________ (withdraw) long before the beginning of the meeting.
2. He is not in town; he __________ (send) on a special mission.
3. Don't come into the compartment; the bed _________ (fix) now.
4. A new underground line __________n (construct) now. They say one of its stations __________ (build) in my street.

5. He wants to know when the final decision _______ (take). The activities of the committee and their delays already much _______ (speak) about.
6. It was three o'clock. We ___ (tell) to hurry up because we ______ (wait).
7. Do you believe that such a problem can ________ (solve)?
8. It must __________ (do) without delays.
9. On September 9, 1850, California ________ (admit) to the Union as the thirty-first state.
10. Don't speak in a loud voice: we ________ (listen) to.
11. The plan __________ (approve)? — No, it (discuss) now. — How long it ____________ (discuss)?
12. By the time he arrives everything _________ (settle).

Exercise III. Paraphrase the following sentences.

1. People say that the company is having problems.
   The company ***is said to be having problems.*** ___________________
2. Journalists report that the war is over.
   The war ____
3. Everyone expects that it will rain this weekend.
   It ____
4. People believe he is the richest man in the world.
   He ____
5. Everyone thought that he was lying.
   It ____
6. People expect that she will win an Oscar.
   It____
7. They sold the car factory to a German company.
   The car factory____________________________________
8. People believe that a spy revealed the secret.
   A spy ____
9. They will execute the prisoner tomorrow.
   The prisoner________________________________
10. Someone should clean up this mess.
    This mess_______________________________________
11. The crew had not checked the plane before we boarded.
    The plane______________________________________

Exercise IV. Turn the following sentences into passive in two ways.

Example: They gave him a watch when he retired. —
He was given a watch when he retired.

A watch was given to him when he retired.

1. They give the students extra lessons. —
   The students_______________________________
   Extra lessons________________________________
2. Someone gave her a book. —
   She_______________________________________
   A book_______________________________________
3. She will send you a fax. —
   You____
   A fax____
4. They have offered him the job. —
   He____
   The job_______________________________________
5. They have shown her the plans for the house. —
   She____
   The plans for the house___________________________________
6. They are going to show me a new technique. —
   I____
   A new technique_______________________________________
7. They should have sent you a receipt. —
   You____
   A receipt____

Exercise V. Choose the variant that can't be used in the following sentences.

1. He ______ in the battle.
   a) won’t have been hurt
   b) may have been hurt
   c) can’t have been hurt

2. She ______ the best actress of the year.
   a) will be chosen as
   b) will choose
   c) will be being chosen as

3. These plants _______ three times a week.
   a) you should water
   b) can be watered
   c) should be watered

4. He ________ at.
   a) is often laughed
   b) is usual laughed
   c) is never laughed

5. She ______ with the housework.
   a) is being helped
   b) has been helped
   c) won't been helped
6. The fence ________.
   a) had be painted
   b) could be painted
   c) might have been painted
7. You ______ many questions.
   a) won't be asked
   b) didn't be asked
   c) weren't asked
8. As he behaves badly, he ______.
   a) must be punished
   b) will be punished
   c) was punished
9. The logs _______ too long for our fireplace.
   a) were cut
   b) have to be cut
   c) have been cut
10. The book _____ everywhere.
   a) is looked for
   b) must be looked
   c) has been looked for

Exercise VI. Rewrite the sentences in two ways. Put the underlined parts in the passive.

1. They say that <u>a fire has completely destroyed the Royal Hotel</u>.
   It ***is said that the Royal Hotel has been completely destroyed by afire.***
   The Royal Hotel ***is said to have been completely destroyed by a fire.***
2. They expect that <u>the police will investigate the cause of the blaze</u>.
   It ____
   The cause of the blaze_______________________________________
3. They report that <u>seven people are in a serious condition</u>
   It ____
   Seven people _______________________________________
4. They say that <u>the fire is still burning</u>.
   It ____
   The fire ____

5. They believe that <u>ambulances have taken fifteen people to hospital</u>
   It ____
   Fifteen people ____
6. They believe that <u>a cigarette started the fire</u>
   It ____
   The fire ____

VII. Put the verbs in brackets into the Present Simple or the Present Continuous Tense.

- ... *(to be)* everything ready for the party, Jessica?
- Almost everything. Dolly and Alice ... *(to set)* the tables right now.
- I ... *(to believe)* they ... *(to remember)* to put the flowers on the tables.
- Of course, they ....
- And what... Mike ... *(to do*)?
- He ... *(to choose)* the music. He ... *(to want)* everybody to feel relaxed at the party.
- Good. ... Rosemary ... *(still to cook)!*
- Yes, she... *(to cook)* something very delicious and ... *(to hope)* to surprise all the guests.
- Oh, her dishes ... *(to smell)* very tasty! By the way, ... you ... *(to know)* Molly's phone number? I... *(to need)* to remind her our address. I ... *(to be)* afraid she ... *(not to remember)* it.
- It... *(to be)* OK. I have just spoken to her. She ... *(to go)* to our place right now.
- Jessica, dear, tell Mike to muffle the music. It … (to seem) to me it ... *(to play)* too loudly. ... you ... *(not to think)* so?
- Oh, I ... *(to agree)* with you. I ... *(not to hear)* what you ... *(to tell)* me.
- Listen! Somebody ... *(to ring)* the doorbell! The guests ... *(to come)!* Let's meet them!

VIII. Choose the correct form to complete the sentences.

What Is the Solar System?

The Solar System is made up of all the planets that orbit the Sun. In addition to the planets, the Solar System also 1) ... of moons, comets, asteroids, minor planets, dust and gas.

Everything in the Solar System 2)... around the Sun. The Sun 3) ... around 98% of all the material in the Solar System. The larger the object is, the more gravity it has. Because the Sun is so large, its powerful gravity 4) ... all the objects in the Solar System towards it. At the same time, these objects, which 5) ... very rapidly, try to fly away from the Sun into the emptiness of outer space and the Sun 6) ... to pull them inward.

So the objects 7) ... trapped half-way in between. Scientists 8) ... about the number of planets in the Solar System. Some of them 9)... that there are nine planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. Others 10)... that Pluto can't be considered as a planet, it is just the largest member of a distinct population called the Kuiper belt. There are a lot of other points the scientists 11) ... about nowadays. Perhaps you'll find the answers to these questions?

1)	a) consist;	b) consists;	c) is consisting.
2)	a) revolve;	b) revolves;	c) are revolving.
3)	ai contain;	b) contains;	c) is containing.
4)	a) attracts;	b) is attracting;	c) are attracting.
5)	a) moves;	b) is moving;	c) are moving.
6)	a) try;	b) is trying;	c) are trying.
7)	a) become;	b) becomes;	c) are becoming.
8)	a) still argue;	b) still argues;	c) are still
9)	a)think;	b)thinks;	c) are thinking.
10	a) believe;	b) is believing;	c) are believing.
11	a) debate;	b) is debating;	c) are debating.

IX. Complete the sentences with the verbs in brackets in the Present Simple or the Present Continuous Tense as in the example.

Example: Eddy ... a new coffee-making machine. He ... coffee with his friends in the dining room now.
(to have) — Eddy has a new coffee-makinq machine. He is having coffee with his friends in the dining room now.

1) Why ... you ... the milk? — Because it... sour, *(to smell) 2)* I... nobody near the theatre. Bob can't meet you, he ... his chief at the moment, *(to see)* 3) We ... every episode of this film, it's so funny! Sally ... watching comedies, *(to love)* 4) The customs officer ... his suitcase now. The suitcase ... six kilos, *(to weigh)* 5) Why ... she ... these shoes? — She is afraid they're wet. This scarf ... silky, *(to feel)* 6) Chris ... a driving lesson now. We ... lessons five days a week, *(to have)* 7) What ... he ...? — The chicken ... delicious! *(to taste)* 8) It ... as if it's going to snow! What ... Pam ... at now? *(to look)* 9) Pierre is French, he ... from Marcel. Monica has been on a business trip. She ... from Warsaw now. *(to come)* 10) Little Ben ... too naughty today! Little children ... usually naughty, *(to be)* 11) My parents ... about spending winter holidays in the mountains. Personally I ... it's a wonderful idea. *(to think)* 12) ... you ... your stay at this hotel? — Oh, yes. I ... staying at comfortable hotels, *(to enjoy)*

LESSON III

Text A

The 20th Century: Modern Trends And Developments

Geologic sciences

The development of the geologic sciences in the 20th century has been influenced by two major "revolutions." The first involves dramatic technological advances that have resulted in vastly improved instrumentation, the prime examples being the many types of highly sophisticated computerized devices. The second is centred on the development of the plate tectonics theory, which is the most profound and influential conceptual advance the Earth sciences have ever known.

Modern technological developments have affected all the different geologic disciplines. Their impact has been particularly notable in such activities as radiometric dating, experimental petrology, crystallography, chemical analysis of rocks and minerals, micropaleontology, and seismological exploration of the Earth's deep interior.

Radiometric dating

In 1905, shortly after the discovery of radioactivity, the American chemist Bertram Boltwood suggested that lead is one of the disintegration products of uranium, in which case the older a uranium-bearing mineral the greater should be its proportional part of lead. Analyzing specimens whose relative geologic ages were known, Boltwood found that the ratio of lead to uranium did indeed increase with age. After estimating the rate of this radioactive change, he calculated that the absolute ages of his specimens ranged from 410 million to 2.2 billion years. Though his figures were too high by about 20 percent, their order of magnitude was enough to dispose of the short scale of geologic time proposed by Lord Kelvin.

Versions of the modern mass spectrometer were invented in the early 1920s and 1930s, and during World War II the device was improved substantially to help in the development of the atomic bomb. Soon after the war, Harold C. Urey and G.J. Wasserburg applied the mass spectrometer to the study of geochronology. This device separates the different isotopes of the same element and can measure the variations in these isotopic abundances to within one part in 10,000. By determining the amount of the parent and daughter isotopes present in a sample and by knowing their rate of radioactive decay (each radioisotope has its own decay constant), the isotopic age of the sample can be calculated. For dating minerals and rocks, investigators commonly use the following couplets of parent and daughter isotopes: thorium-232–lead-208, uranium-235–lead-207, samarium-147–neodymium-143, rubidium-87–strontium-87, potassium-40–argon-40, and argon-40–argon-39. The SHRIMP (Sensitive High Resolution Ion Microprobe) enables the accurate determination of the uranium-lead age of the mineral zircon, and this has revolutionized the understanding of the isotopic age of formation of zircon-bearing igneous granitic rocks. Another technological development is the ICP-MS (Inductively Coupled Plasma Mass Spectrometer), which is able to provide the isotopic age of the minerals zircon, titanite, rutile, and monazite. These minerals are common to many igneous and metamorphic rocks.

Such techniques have had an enormous impact on scientific knowledge of Earth history because precise dates can now be obtained on rocks in all orogenic (mountain) belts ranging in age from the early Archean (about 4 billion years old) to the early Neogene (roughly 20 million years old). The oldest known rocks on Earth, estimated at 4.28 billion years old, are the faux amphibolite volcanic deposits of the Nuvvuagittuq greenstone belt in Quebec, Canada. A radiometric dating technique that measures the ratio of the rare earth elements neodymium and samarium present in a rock sample was used to produce the estimate. Also, by extrapolating backward in time to a situation when there was no lead that had been produced by radiogenic processes, a figure of about 4.6 billion years is obtained for the minimum age of the Earth. This figure is of the same order as ages obtained for certain meteorites and lunar rocks.

Experimental study of rocks

Experimental petrology began with the work of Jacobus Henricus van ’t Hoff, one of the founders of physical chemistry. Between 1896 and 1908 he elucidated the complex sequence of chemical reactions attending the precipitation of salts (evaporites) from the evaporation of seawater. Van ’t Hoff’s aim was to explain the succession of mineral salts present in Permian rocks of Germany. His success at producing from aqueous solutions artificial minerals and rocks like those found in natural salt deposits stimulated studies of minerals crystallizing from silicate melts simulating the magmas from which igneous rocks have formed. Working at the Geophysical Laboratory of the Carnegie Institution of Washington, D.C., Norman L. Bowen conducted extensive phase-equilibrium studies of silicate systems, brought together in his Evolution of the Igneous Rocks (1928). Experimental petrology, both at the low-temperature range explored by van ’t Hoff and in the high ranges of temperature investigated by Bowen, continues to provide laboratory evidence for interpreting the chemical history of sedimentary and igneous rocks. Experimental petrology also provides valuable data on the stability limits of individual metamorphic minerals and of the reactions between different minerals in a wide variety of chemical systems. These experiments are carried out at elevated temperatures and pressures that simulate those operating in different levels of the Earth’s crust. Thus the metamorphic petrologist today can compare the minerals and mineral assemblages found in natural rocks with comparable examples produced in the laboratory, the pressure–temperature limits of which have been well defined by experimental petrology.

Another branch of experimental science relates to the deformation of rocks. In 1906 the American physicist P.W. Bridgman developed a technique for subjecting rock samples to high pressures similar to those deep in the Earth. Studies of the behaviour of rocks in the laboratory have shown that their strength increases with confining pressure but decreases with rise in temperature. Down to depths of a few kilometres the strength of rocks would be expected to increase. At greater depths the temperature effect should become dominant, and response to stress should result in flow rather than fracture of rocks. In 1959 two American geologists, Marion King Hubbertand William W. Rubey, demonstrated that fluids in the pores of rock may reduce internal friction and permit gliding over nearly horizontal planes of the large overthrust blocks associated with folded mountains. More recently the Norwegian petrologist Hans Ramberg performed many experiments with a large centrifuge that produced a negative gravity effect and thus was able to create structures simulating salt domes, which rise because of the relatively low density of the salt in comparison with that of surrounding rocks. With all these deformation experiments, it is necessary to scale down as precisely as possible variables such as the time and velocity of the experiment and the viscosity and temperature of the material from the natural to the laboratory conditions.

Crystallography

In the 19th century crystallographers were able to study only the external form of minerals, and it was not until 1895 when the German physicist Wilhelm Conrad Röntgen discovered X-rays that it became possible to consider their internal structure. In 1912 another German physicist, Max von Laue, realized that X-rays were scattered and deflected at regular angles when they passed through a copper sulfate crystal, and so he produced the first X-ray diffraction pattern on a photographic film. A year later William Bragg of Britain and his son Lawrence perceived that such a pattern reflects the layers of atoms in the crystal structure, and they succeeded in determining for the first time the atomic crystal structure of the mineral halite (sodium chloride). These discoveries had a long-lasting influence on crystallography because they led to the development of the X-ray powder diffractometer, which is now widely used to identify minerals and to ascertain their crystal structure.

The chemical analysis of rocks and minerals

Advanced analytic chemical equipment has revolutionized the understanding of the composition of rocks and minerals. For example, the XRF (X-Ray Fluorescence) spectrometer can quantify the major and trace element abundances of many chemical elements in a rock sample down to parts-per-million concentrations. This geochemical method has been used to differentiate successive stages of igneous rocks in the plate-tectonic cycle. The metamorphic petrologist can use the bulk composition of a recrystallized rock to define the structure of the original rock, assuming that no structural change has occurred during the metamorphic process. Next, the electron microprobe bombards a thin microscopic slice of a mineral in a sample with a beam of electrons, which can determine the chemical composition of the mineral almost instantly. This method has wide applications in, for example, the fields of industrial mineralogy, materials science, igneous geochemistry, and metamorphic petrology.

I. **Answer the questions:**

1. What were the two major “revolutions” of geologic sciences?
2. What are the main ideas of the abstract of Radiometric dating?
3. What does experimental petrology provide?
4. What did P. Bridgman develop in 1906?
5. What is the history of X-rays?
6. What is the method of the chemical analysis of racks and minerals?

II. **Make up a summary of Text A in a written form.**

III. **Make up your own vocabulary of unknown words. Not less than 50.**

Text B

Micropaleontology

Microscopic fossils, such as ostracods, foraminifera, and pollen grains, are common in sediments of the Mesozoic and Cenozoic eras (from about 251 million years ago to the present). Because the rock chips brought up in oil wells are so small, a high-resolution instrument known as a scanning electron microscope had to be developed to study the microfossils. The classification of microfossils of organisms that lived within relatively short time spans has enabled Mesozoic-Cenozoic sediments to be subdivided in remarkable detail. This technique also has had a major impact on the study of Precambrian life (i.e., organisms that existed more than 542 million years ago). Carbonaceous spheroids and filaments about 7–10 millimetres (0.3–0.4 inch) long are recorded in 3.5 billion-year-old sediments in the Pilbara region of northwestern Western Australia and in the lower Onverwacht Series of the Barberton belt in South Africa; these are the oldest reliable records of life on Earth.

Seismology and the structure of the Earth

Earthquake study was institutionalized in 1880 with the formation of the Seismological Society of Japan under the leadership of the English geologist John Milne. Milne and his associates invented the first accurate seismographs, including the instrument later known as the Milne seismograph. Seismology has revealed much about the structure of the Earth’s core, mantle, and crust. The English seismologist Richard Dixon Oldham’s studies of earthquake records in 1906 led to the discovery of the Earth’s core. From studies of the Croatian quake of Oct. 8, 1909, the geophysicist Andrija Mohorovičić discovered the discontinuity (often called the Moho) that separates the crust from the underlying mantle.

Today there are more than 1,000 seismograph stations around the world, and their data are used to compile seismicity maps. These maps show that earthquake epicentres are aligned in narrow, continuous belts along the boundaries of lithospheric plates (see below). The earthquake foci outline the mid-oceanic ridges in the Atlantic, Pacific, and Indian oceans where the plates separate, while around the margins of the Pacific where the plates converge, they lie in a dipping plane, or Benioff zone, that defines the position of the subducting plate boundary to depths of about 700 kilometres.

Since 1950, additional information on the crust has been obtained from the analysis of artificial tremors produced by chemical explosions. These studies have shown that the Moho is present under all continents at an average depth of 35 kilometres and that the crust above it thickens under young mountain ranges to depths of 70 kilometres in the Andes and the Himalayas. In such investigations the reflections of the seismic waves generated from a series of "shot" points are also recorded, and this makes it possible to construct a profile of the subsurface structure. This is seismic reflection profiling, the main method of exploration used by the petroleum industry. During the late 1970s a new technique for generating seismic waves was invented: thumping and vibrating the surface of the ground with a gas-propelled piston from a large truck.

The theory of plate tectonics

Plate tectonics has revolutionized virtually every discipline of the Earth sciences since the late 1960s and early 1970s. It has served as a unifying model or paradigm for explaining geologic phenomena that were formerly considered in unrelated fashion. Plate tectonics describes seismic activity, volcanism, mountain building, and various other Earth processes in terms of the structure and mechanical behaviour of a small number of enormous rigid plates thought to constitute the outer part of the planet (i.e., the lithosphere). This all-encompassing theory grew out of observations and ideas about continental drift and seafloor spreading.

In 1912 the German meteorologist Alfred Wegener proposed that throughout most of geologic time there was only one continental mass, which he named Pangea. At some time during the Mesozoic Era, Pangaea fragmented and the parts began to drift apart. Westward drift of the Americas opened the Atlantic Ocean, and the Indian block drifted across the Equator to join with Asia. In 1937 the South African Alexander Du Toit modified Wegener's hypothesis by suggesting the existence of two primordial continents: Laurasia in the north and Gondwanaland in the south. Aside from the congruency of continental shelf margins across the Atlantic, proponents of continental drift have amassed impressive geologic evidence to support their views. Similarities in fossil terrestrial organisms in pre-Cretaceous (older than about 146 million years) strata of Africa and South America and in pre-Jurassic rocks (older than about 200 million years) of Australia, India, Madagascar, and Africa are explained if these continents were formerly connected but difficult to account for otherwise. Fitting the Americas with the continents across the Atlantic brings together similar kinds of rocks and structures. Evidence of widespread glaciation during the late Paleozoic is found in

Antarctica, southern South America, southern Africa, India, and Australia. If these continents were formerly united around the South Polar region, this glaciation becomes explicable as a unified sequence of events in time and space.

Interest in continental drift heightened during the 1950s as knowledge of the Earth's magnetic field during the geologic past developed from the studies of Stanley K. Runcorn, Patrick M.S. Blackett, and others. Ferromagnetic minerals such as magnetite acquire a permanent magnetization when they crystallize as components of igneous rock. The direction of their magnetization is the same as the direction of the Earth's magnetic field at the place and time of crystallization. Particles of magnetized minerals released from their parent igneous rocks by weathering may later realign themselves with the existing magnetic field at the time these particles are incorporated into sedimentary deposits. Studies of the remanent magnetism in suitable rocks of different ages from over the world indicate that the magnetic poles were in different places at different times. The polar wandering curves are different for the several continents, but in important instances these differences are reconciled on the assumption that continents now separated were formerly joined. The curves for Europe and North America, for example, are reconciled by the assumption that America has drifted about 30° westward relative to Europe since the Triassic Period (approximately 251 million to 200 million years ago).

In the early 1960s a major breakthrough in understanding the way the modern Earth works came from two studies of the ocean floor. First, the American geophysicists Harry H. Hess and Robert S. Dietz suggested that new ocean crust was formed along mid-oceanic ridges between separating continents; and second, Drummond H. Matthews and Frederick J. Vine of Britain proposed that the new oceanic crust acted like a magnetic tape recorder insofar as magnetic anomaly strips parallel to the ridge had been magnetized alternately in normal and reversed order, reflecting the changes in polarity of the Earth's magnetic field. This theory of seafloor spreading then needed testing, and the opportunity arose from major advances in deepwater drilling technology. The Joint Oceanographic Institutions Deep Earth Sampling (JOIDES) project began in 1969, continued with the Deep Sea Drilling Project (DSDP), and, since 1976, with the International Phase of Ocean Drilling (IPOD) project. These projects have produced more than 500 boreholes in the floor of the world's oceans, and the results have been as outstanding as the plate-tectonic theory itself. They confirm that the oceanic crust is everywhere younger than about 200 million years and that the stratigraphic age determined by micropaleontology of the overlying oceanic sediments is close to the age of the oceanic crust calculated from the magnetic anomalies.

The plate-tectonic theory, which embraces both continental drift and seafloor spreading, was formulated in the mid-1960s by the Canadian geologist J. Tuzo Wilson, who described the network of mid-oceanic ridges, transform faults, and subduction zones as boundaries separating an evolving mosaic of enormous plates, and who proposed the idea of the opening and closing of oceans and eventual production of an orogenic belt by the collision of two continents.

Up to this point, no one had considered in any detail the implications of the plate-tectonic theory for the evolution of continental orogenic belts; most thought had been devoted to the oceans. In 1969 John Dewey of the University of Cambridge outlined an analysis of the Caledonian-Appalachian orogenic belts in terms of a complete plate-tectonic cycle of events, and this provided a model for the interpretation of other pre-Mesozoic (Paleozoic and Precambrian) belts. Even the oldest volcano-sedimentary rocks on Earth, in the 3.8 billion-year-old Isua belt in West Greenland, have been shown by geologists from the Tokyo Institute of Technology to have formed in a plate-tectonic setting—i.e., in a trench or mouth of a subduction zone. For a detailed discussion of plate-tectonic theory and its far-reaching effects, see plate tectonics.

I. Answer the questions:

1. When and where was the earthquake study institutionalized?
2. What was the result of the Earth's study?
3. What do the seismicity maps show?
4. What information has been obtained since 1950?
5. What does the theory of plate tectonics describe?
6. What happened with Pangaea during the Mesozoic Era?
7. Why did the interests in continental drift heighten?
8. What is the essence of the plate –tectonic theory?

II. Retell text B using the words from the text as far as possible.

III. Discuss the main ideals of plate tectonic theory.
What does it explain to us?

Text C

From Heaven to Earth (how to protect the satellite from combustion in the atmosphere)

This year the whole world celebrates the fiftieth anniversary of the first manned flight into space. The beginning of the space age has become a victory of human thought in many areas of science and technology. One of the most important and intractable tasks was to protect the spacecraft from overheating when returning to Earth.

Everyone knows that small-sized space bodies that fall to Earth from space completely or almost completely bum out in dense layers of the atmosphere. High speeds entering into the atmosphere of spacecrafts lead to the fact that in the incoming air stream at the front edge of their temperature temperatures reaching 7000-8000 ^{0} C develop. There is no material in nature capable of withstanding such a temperature. But you can save the surface of the ship.

The first factor that helps to save the space descent vehicle is a limited time of descent. The heat streams that enter this or that body, destroying it, nevertheless, may not have time to finish this "work" before the descent stops. It is this effect that is used: with thermal protection of space vehicles. To this end, a special coating is **applied** to the body from the outside, which, **when aerodynamically heated, is destroyed** , absorbing some heat. Since the amount of heat flow coming from the descent of the device per unit area is quite definite, it is possible to choose the thickness of the heat-shielding coating in such a way that, if it is destroyed, this stream will be completely absorbed and the main body of the apparatus remains intact. The method of thermal protection, based on the pre-determined process of destruction of material absorbing the heat flux, is called **ablation cooling.** The possibility of its use is mainly determined by the existence of materials capable of absorbing a significant amount of heat, while at the same time having a relatively small specific density and satisfactory strength.

Beginning in the mid-1950s, when rocket technicians came up with the question of heat-shielding the returned missile head parts, special plastics based on phenol-formaldehyde resins with good heat absorbing properties were developed. In the early sixties, new materials based on epoxy resins were developed, which, although they did not show good ablative properties, had good mechanical and technological characteristics. In addition to fiberglass, at present, asbestos, coal, quartz, graphite and some other types of fibers are used.

For the production of heat shields of returned space vehicles, reinforced plastics are widely used. Despite the low specific density of plastics, the mass of these screens loads. For this purpose, the hemisphere is quite suitable, which is often used in practice.

For example, the descent device (probe) of stations of the Venus type has a spherical shape and is provided with several layers of heat-shielding coating, part of which is destroyed by aerodynamic braking, and the remaining part protects the probe equipment from high temperatures of Venus reaching 280 ° C on its surface. From the thermal point of view, it is much more difficult to ensure the safety of the material part of the apparatus descending on the surface of other planets than when descending from a near-earth orbit. This is due to the fact that "alien" devices enter the atmosphere of planets with a higher, second cosmic speed.

To solve the problem of thermal protection of spacecraft when they descend into the atmosphere of planets, we must also take into account some of the ballistic features of flight. For example, a probe for descent in the atmosphere of Jupiter should be directed along a shallow trajectory, so that the entry point lies near the equator of the planet, and the probe moves in the direction of its rotation. This will reduce the speed of the vehicle relative to the atmosphere of the planet, and therefore reduce the heating of its structure. The configuration of the probe is chosen such that it begins to be braked as much as possible at high altitudes, where the atmosphere still has a significant negative pressure. Ballistic features associated with heating spacecraft when they descend, a lot, and the **choice of the optimal flight path** can **rightfully be considered** one of the methods of thermal **protection .**

Particularly difficult is the problem of heat protection for space vehicles of reusable use. Their developed surfaces lead to a very large mass of ablative heat-shielding coating. In addition, the requirement of reusable use, generally speaking, poses the task of developing materials capable of withstanding the arising thermal loads without destroying. For example, the maximum temperatures on the surface of the shell of the US space shuttle multi-use are 1260-1454 ° C. The working temperature of the aluminum alloy, from which the housing is made, should not be maintained above 180 ° C. But such a value is unsatisfactory for the crew and instruments of the device. Further its reduction requires the application of additional measures: increasing the internal thermal insulation of the cabin, the heat dissipation by means of a thermal control system, etc. In fact, the whole surface of the apparatus is divided into four zones by the temperature level, each of which uses its own coating. On the nose cone and wing tips of the apparatus, where the temperatures exceed 1260 ° C, a carbon-fiber reinforced carbon material is used. In the process of returning the device to Earth, this material is destroyed, and it must be replaced with a new one before each subsequent flight. Where the temperature does not exceed 371 ° C, a flexible heat- shield coating is used for multiple applications. In areas where the surface temperature is 371-649 ° C, it is applied; Also a reusable coating consisting of an

is significant, therefore, to reduce it, it is desirable to choose the shape of the descent compartment with a smaller surface area exposed to strong thermal amorphous quartz fiber of 99.7% purity, to which is added a binder - colloidal silicon dioxide. Thermal protection of the housing part with a temperature of 649- 1260 ° C is also carried out with the help of reusable insulation. The difference is in the size of the tile (152x152 mm with a thickness in the range of 19-64 mm). It should be noted that the requirements for the heat-shielding coatings of the reusable ship are quite diverse and very complex. So, for example, these coatings should have quite certain **optical properties,** which is necessary to maintain their temperature regime in orbital flight and in the descent section. They must withstand large dynamic loads at the entrance of the apparatus into the dense layers of the atmosphere. To solve this problem, the material becomes porous - the voids occupy 90% of the volume of the tile. As a result, the pressure in the tiles is always equal to the pressure of the environment, so all aerodynamic loads are transferred to the skin of the ship's main structure.

In this article, we only touched on the problems of thermal protection of spacecraft, trying to show what the main solutions to the problem were proposed in the design of the first descent vehicles. Science does not stand still, new solutions and new materials will help to make the most bold dreams of mankind about space exploration possible.

I. Put 20 questions to Text C (general, alternative, reflexive, special question)
II. Discuss the text in group.

Grammar Exercises

Exercise I. Choose the correct answer.

1. Alice went on *to act/acting* until she was forced to retire because of her health.
2. Although Alice started out in television, she went on *to act/acting* on the stage.
3. *I'd like to go/1 like going on holiday to a different place every summer.*
4. *I'd like to go/ I like going* somewhere different this summer. Any ideas?
5. He remembered *to close/closing* the windows so the rain didn't get in.
6. He remembered *to close /closing* the windows so he was surprised to find them open when he got home.
7. He stopped *to have/having* coffee because it kept him awake at night.
8. He stopped *to have/having* a coffee and then he went back to work.
9. I regret *to tell/telling* you that your contract will not be renewed.
10. I regret *to tell/telling* you about it because it upset you.
11. I know you're tired but please try *to concentrate/concentrating* for a few more minutes.
12. I'm going to try *to drink/drinking* warm milk before I go to bed; it might help me sleep better.

Exercise II. Complete the e-mail. Use the correct form of the words in brackets.

Hi, Nigel!
Just to say I've moved into my new university accommodation. I (1) ______ (spend/a few days/pack) everything into boxes but I paid someone to move the stuff. In the end, I decided it (2) ________ (be / worth / pay) professionals to do the job — I've got a lot of expensive electronic equipment and I (3) _______ (can't face/the thought of it/get) damaged. Right now I (4) ______ (be / busy / take) everything out of boxes and putting it away. They say that (5) _______ (move) house is really stressful — and they're right!

Now I'm here, though, I think I'll like my new place. It's right next to the fitness centre so I'm able to (6) _______ (go/swim) every day — they have an Olympic-size pool there. Unfortunately, some nights I have (7) ________ (trouble / study) because of the people next door. They're so noisy! It's probably (8) _______ (a waste of time/ask) them to be quieter but I might go and speak to them. Anyway, it (9) ________ (be/always/great/hear) from you so keep in touch.
Alistair.

Exercise III. Choose the correct answer.

Text A

I always wanted (1) *to be/being/to have been* a photographer. When I was a child, my father (2) *allowed to use/allowed me use/allowed me to use* his camera and I'll never forget (3) *to take/taking/being taken* hundreds of pictures. I studied photography at college and went on (4) *to get /getting/having got* a job as a crime photographer with the police. I don't work regular hours and it can be difficult (5) *to get/get/to getting* out of bed to photograph a crime scene in the middle of the night. Fortunately, I love (6) *do/doing/being done* my job and (7) *to work/working/to be working* with people who feel the same way.

Text B

I didn't intend (1) *me to become/me becoming/to become* a private investigator- it just happened! Fortunately, you don't need (2) *to have/having/to be having* any special qualifications. Many people come into the profession from a police or military background but now it's possible (3) *to do/doing/to be doing* a work placement course. In fact, (4) *to train/training/having trained* on the job is essential. I love my work but the hours are not sociable. I often find myself (5) *to sit/sitting/ to be sitting* on my own in a car for ten to fifteen hours when I'm on a case.

Exercise IV. Complete the second sentence so that it is as similar in meaning as possible to the first sentence, using the word given. Do not change this word.

1. I want them to offer me the job. **(offered)**
   I want ________________ the job.
2. I don't like it when people ask me to do things like that, (being)
   I hate ___________ things like that.
3. It seems that Leo has left the party**, (to)**
   Leo seems _________ the party.
4. I think Myra is studying for her exams, **(be)**
   Myra seems _________ for her exams.
5. I'm sorry but we have decided not to accept your application, **(regret)**
   I _______ we have decided to reject your application.

6. They think he lied in order to get the job. **(having)**
   He is suspected of _______ in order to get the job.
7. When I heard they had got married, I was surprised, **(hear)**
   I was _________ that they had got married.
8. She has tried twice to sail round the world, **(attempts)**
   She has made two ____________ round the world.
9. Let’s find a place where we can have breakfast, **(somewhere)**
   Let’s find __________ breakfast.
10. Funnily enough I’d prefer a pizza for a change, **(rather)**
    Funnily enough ____________.
11. We were not allowed to drink too much Coke when we were children, **(let)**
    Our parents __________.
12. I think it would be a good idea to take the train, **(suggest)**
    I ___________.
13. She succeeded in persuading her parents to let her go. **(managed)**
    She _______________.
14. It looks as if this door’s locked after all. **(appears)**
    This __________.
15. One of the things I hate is people eating popcorn in the cinema, **(stand)**
    One of the things I ______________.

Exercise V. Put the verbs in brackets into the correct infinitive form or the -ing form.

1. Colin went on _________ (study) for two more hours after his friends left the library.
2. I hate __________ (listen) to loud music when I’m reading.
3. She stopped ___________ (watch) horror films because she couldn’t sleep.
4. We regret ________ (inform) you that your credit card hasn’t been accepted by our computer.
5. “Did you remember ______ (call) the babysitter about next Saturday night?”
6. Sorry, I didn’t mean __________ (interrupt) your meeting, Mr Jackson.
7. “Don’t forget _________ (take) the dog for a walk before you leave for school.”
8. You should try ___________ (walk) more. It’s a great form of exercise.
9. I’ll never forget __________ (win) my first award.
10. I really regret __________ (buy) these expensive shoes. They hurt my feet!
11. I tried _________ (lift) the boxes but they were full of books so they were too heavy.
12. If the mixture doesn’t stick together well, try ________ (add) a little water.
13. She told us her theory and went on __________ (explain) the details.
14. I don’t remember __________ (leave) the lights on in the house!

Exercise VI. Choose the correct item.

1. Try __________ more water if you want healthier skin.
   A) drink B) to drink C) drinking
2. Now that Anne has been promoted she's got a lot of work ______ with.
   A) to deal B) dealing C) deal
3. You should stop ________ your nails if you want them to grow.
   A) to bite B) bite C) biting
4. I'll never forget ___________ my first book.
   A) to publish B) publish C) publishing
5. A: What was Helen doing when you arrived?
   B: Well, I saw her _____ her suitcase.
   A) packing B) to pack C) pack
6. Do you think this sauce will be too spicy for the baby ___________ ?
   A) to eat B) eat C) eating
7. I've always dreamt of ___________ my own boutique.
   A) to open B) opening C) open
8. We arrived home from our holidays only _________ that we had been burgled.
9. A) to discover B) discover C) discovering
10. Marco Polo will be remembered for __________ trade between Asia and Europe.
    1. A) establish B) establishing C) to establish
11. The inspector wanted to know who the last person the room was.
    A) leave B) leaving C) to leave
12. He tried ___________ but realised he was trapped under debris.
    A) to move B) move C) moving
13. Do you fancy ___________ a pizza tonight?
    A) to order B) ordering C) order
14. They were reluctant __________ us the money.
    A) to lend B) lending C) lend

VII. Circle the correct item.

1) The secretary usually *comes/is coming* to the office at 9 a.m. 2) Dave *works/is working* for an advertising company. 3) Jim and Nelly *fly/are flying* to Prague in two days. 4) Roger *always leaves/is always leaving* dirty plates on the table! 5) The seminar *starts/is starting* at ten o'clock. 6) The number of taxes *increases/is increasing* nowadays. 7) The article *contains/ is containing* a lot of useful information. 8) Isabel *works/is working* at a department store at present. 9) Trees

produce/are producing oxygen. 10) Stuart *seems/is seeming* to be a reliable person. 11) This café *belongs/is belonging* to Tina's parents. 12) She *knows/is knowing* where the children are. 13) Mr Boyle *takes part/is taking part* at the congress these days. 14) Sarah *has/is having* an interview right now. 15) I *think/am thinking* this is a perfect job for you. 16) Miss Lane *has/is having* a small flat in the suburbs. 17) You *look/are looking* very pale. 18) Gordon *thinks/is thinking* of spending a week in Thailand. 19) Our chief *is/is being* very annoyed today. 20) These flowers *smell/are smelling* sweet.

VIII. Put the verbs in brackets into the Present Simple or the Present Continuous Tense.

1) Where ... you ... *(to drive)* now? — I ... *(to drive)* to Donetsk. My friend ... *(to live)* there. He ... *(to get)* married tomorrow and I... *(to want)* to congratulate him and his bride. 2)... you ... *(to know)* that man over there? — ... he (to *be)* the man who ... *(to talk)* to a group of people? — Yes. He ... *(to be)* a famous director and he ... *(to make)* a new film in our town these days. By the way, he ... *(to look)* for people to act in this film. He mostly ... *(to need)* young people. — As for me, I ... *(to prefer)* to watch films in the cinema. It ... *(to seem)* to me acting in a film ... *(not to be)* much fun, but hard work. 3) What... Simon ... *(to do)* for a living? — He ... *(to run)* an advertising agency. He ... *(to enjoy)* his work and the agency ... *(to bring)* him a lot of money. By the way, his agency ... *(to expand)* rapidly and Simon ... *(to think)* of engaging new employees. 4) Why ... you … (*to weigh*) yourself? – I … *(to want)* to know how much I … (to weigh). You … *(to see)*, I … *(to eat)* too little these days. — No wonder you ... *(to eat)* so little these days. It ... *(to be)* too hot and nobody ... *(to want)* to eat in such weather.

IX. Find mistakes and correct them.

1) This professor gives a lecture tomorrow. 2) What time is the bus arriving in Manchester? 3) This salad is tasting delicious. 3) His cousin is having a cottage in the mountains. 5) Linda thinks of going to Germany to study. 6) This idea is sounding good. 7) Why do you smell the sausages? 8) Alice is being a very shy girl. 9) Their route is depending on the weather. 10) Ann has dinner with her business partner tonight. 11) I'm feeling relaxed and full of energy after the weekend. 12) Why do you feel your pockets? 13) The apple trees are blooming in spring. 14) She is always spend too much money! 15) The Moors visit us tonight.

LESSON IV

Text A

Hydrologic sciences

Water resources and seawater chemistry

Quantitative studies of the distribution of water have revealed that an astonishingly small part of the Earth's water is contained in lakes and rivers. Ninety-seven percent of all the water is in the oceans, and, of the fresh water constituting the remainder, three-fourths is locked up in glacial ice and most of the rest is in the ground. Approximate figures are also now available for the amounts of water involved in the different stages of the hydrologic cycle. Of the 859 millimetres of annual global precipitation, 23 percent falls on the lands; but only about a third of the precipitation on the lands runs directly back to the sea, the remainder being recycled through the atmosphere by evaporation and transpiration. Subsurface groundwater accumulates by infiltration of rainwater into soil and bedrock. Some may run off into rivers and lakes, and some may reemerge as springs or aquifers. Advanced techniques are used extensively in groundwater studies nowadays. The rate of groundwater flow, for example, can be calculated from the breakdown of radioactive carbon-14 by measuring the time it takes for rainwater to pass through the ground, while numerical modeling is used to study heat and mass transfer in groundwater. High-precision equipment is used for measuring down-hole temperature, pressure, flow rate, and water level. Groundwater hydrology is important in studies of fractured reservoirs, subsidence resulting from fluid withdrawal, geothermal resource exploration, radioactive waste disposal, and aquifer thermal-energy storage.

Chemical analyses of trace elements and isotopes of seawater are conducted as part of the Geochemical Ocean Sections (Geosecs) program. Of the 92 naturally occurring elements, nearly 80 have been detected in seawater or in the organisms that inhabit it, and it is thought to be only a matter of time until traces of the others are detected. Contrary to the idea widely circulated in the older literature of oceanography, that the relative proportions of the oceans' dissolved constituents are constant, investigations since 1962 have revealed statistically significant variations in the ratios of calcium and strontium to chlorinity. The role of organisms as influences on the composition of seawater has become better understood with advances in marine biology. It is now known that plants and animals may collect certain elements to concentrations as much as 100,000 times their normal amounts in seawater. Abnormally high concentrations of beryllium, scandium, chromium, and iodine have been found in algae; of copper and arsenic in both the soft and skeletal parts of invertebrate animals; and of zirconium and cerium in plankton.

Desalinization, tidal power, and minerals from the sea

For ages a source of food and common salt, the sea is increasingly becoming a source of water, chemicals, and energy. In 1967 Key West, Fla., became the first U.S. city to be supplied solely by water from the sea, drawing its supplies from a plant that produces more than 2 million gallons of refined water daily. Magnesia was extracted from the Mediterranean in the late 19th century; at present nearly all the magnesium metal used in the United States is mined from the sea at Freeport, Texas. Many ambitious schemes for using tidal power have been devised, but the first major hydrographic project of this kind was not completed until 1967, when a dam and electrical generating equipment were installed across the Rance River in Brittany. The seafloor and the strata below the continental shelves are also sources of mineral wealth. Concretions of manganese oxide, evidently formed in the process of subaqueous weathering of volcanic rocks, have been found in dense concentrations with a total abundance of 1011 tons. In addition to the manganese, these concretions contain copper, nickel, cobalt, zinc, and molybdenum. To date, oil and gas have been the most valuable products to be produced from beneath the sea.

Ocean bathymetry

Modern bathymetric charts show that about 20 percent of the surfaces of the continents are submerged to form continental shelves. Altogether the shelves form an area about the size of Africa. Continental slopes, which slant down from the outer edges of the shelves to the abyssal plains of the seafloor, are nearly everywhere furrowed by submarine canyons. The depths to which these canyons have been cut below sea level seem to rule out the possibility that they are drowned valleys cut by ordinary streams. More likely, the canyons were eroded by turbidity currents, dense mixtures of mud and water that originate as mudslides in the heads of the canyons and pour down their bottoms.

Profiling of the Pacific basin prior to and during World War II resulted in the discovery of hundreds of isolated eminences rising 1,000 or more metres above the floor. Of particular interest were seamounts in the shape of truncated cones, whose flat tops rise to between 1.6 kilometres and a few hundred metres below the surface. Harry H. Hess interpreted the flat-topped seamounts (guyots) as volcanic mountains planed off by action of waves before they subsided to their present depths. Subsequent drilling in guyots west of Hawaii confirmed this view; samples of rocks from the tops contained fossils of Cretaceous age representing reef-building organisms of the kind that inhabit shallow water.

Ocean circulation, currents, and waves

Early in the 20th century Vilhelm Bjerknes, a Norwegian meteorologist, and V. Walfrid Ekman, a Swedish physical oceanographer, investigated the dynamics of ocean circulation and developed theoretical principles that influenced subsequent studies of currents in the sea. Bjerknes showed that very small forces resulting from pressure differences caused by nonuniform density of seawater can initiate and maintain fluid motion. Ekman analyzed the influence of winds and the Earth’s rotation on currents.

He theorized that in a homogeneous medium the frictional effects of winds blowing across the surface would cause movement of successively lower layers of water, the deeper the currents so produced the less their velocity and the greater their deflection by the Coriolis effect (an apparent force due to the Earth's rotation that causes deflection of a moving body to the right in the Northern Hemisphere and to the left in the Southern Hemisphere), until at some critical depth an induced current would move in a direction opposite to that of the wind.

Results of many investigations suggest that the forces that drive the ocean currents originate at the interface between water and air. The direct transfer of momentum from the atmosphere to the sea is doubtless the most important driving force for currents in the upper parts of the ocean. Next in importance are differential heating, evaporation, and precipitation across the air-sea boundary, altering the density of seawater and thus initiating movement of water masses with different densities. Studies of the properties and motion of water at depth have shown that strong currents also exist in the deep sea and that distinct types of water travel far from their geographic sources. For example, the highly saline water of the Mediterranean that flows through the Strait of Gibraltar has been traced over a large part of the Atlantic, where it forms a deepwater stratum that is circulated far beyond that ocean in currents around Antarctica.

Improvements in devices for determining the motion of seawater in three dimensions have led to the discovery of new currents and to the disclosure of unexpected complexities in the circulation of the oceans generally. In 1951 a huge countercurrent moving eastward across the Pacific was found below depths as shallow as 20 metres, and in the following year an analogous equatorial undercurrent was discovered in the Atlantic. In 1957 a deep countercurrent was detected beneath the Gulf Stream with the aid of subsurface floats emitting acoustic signals.

Since the 1970s Earth-orbiting satellites have yielded much information on the temperature distribution and thermal energy of ocean currents such as the Gulf Stream. Chemical analyses from Geosecs makes possible the determination of circulation paths, speeds, and mixing rates of ocean currents.

Surface waves of the ocean are also exceedingly complex, at most places and times reflecting the coexistence and interferences of several independent wave systems. During World War II, interest in forecasting wave characteristics was stimulated by the need for this critical information in the planning of amphibious operations. The oceanographers H.U. Sverdrup and Walter Heinrich Munk combined theory and empirical relationships in developing a method of forecasting "significant wave height"—the average height of the highest third of the waves in a wave train. Subsequently this method was improved to permit wave forecasters to predict optimal routes for mariners. Forecasting of the most destructive of all waves, tsunamis, or "tidal waves," caused by submarine quakes and volcanic eruptions, is another recent development. Soon after 159 persons were killed in Hawaii by the tsunami of 1946, the U.S. Coast and Geodetic Survey established a seismic sea-wave warning system. Using a seismic network to locate epicentres of submarine quakes, the installation predicts the arrival of tsunamis at points around the Pacific basin often hours before the arrival of the waves.

I. Group activity. Hold a discussion in the group to broach the topics:

a) water resources and seawater chemistry;
b) desalinization, minerals from the sea;
c) ocean circulation, currents and waves;
d) results of investigations of ocean currents.

Text B

Glacier motion and the high-latitude ice sheets

Beginning around 1948, principles and techniques in metallurgy and solid-state physics were brought to bear on the mechanics of glacial movements. Laboratory studies showed that glacial ice deforms like other crystalline solids (such as metals) at temperatures near the melting point. Continued stress produces permanent deformation. In addition to plastic deformation within a moving glacier, the glacier itself may slide over its bed by mechanisms involving pressure melting and refreezing and accelerated plastic flow around obstacles. The causes underlying changes in rate of glacial movement, in particular spectacular accelerations called surges, require further study. Surges involve massive transfer of ice from the upper to the lower parts of glaciers at rates of as much as 20 metres a day, in comparison with normal advances of a few metres a year.

As a result of numerous scientific expeditions into Greenland and Antarctica, the dimensions of the remaining great ice sheets are fairly well known from gravimetric and seismic surveys. In parts of both continents it has been determined that the base of the ice is below sea level, probably due at least in part to subsidence of the crust under the weight of the caps. In 1966 a borehole was drilled 1,390 metres to bedrock on the North Greenlandice sheet, and two years later a similar boring of 2,162 metres was cut through the Antarctic ice at Byrd Station. From the study of annual incremental layers and analyses of oxygen isotopes, the bottom layers of ice cored in Greenland were estimated to be more than 150,000 years old, compared with 100,000 years for the Antarctic core. With the advent of geochemical dating of rocks it has become evident that the Ice Age, which in the earlier part of the century was considered to have transpired during the Quaternary Period, actually began much earlier. In Antarctica, for example, potassium-argon age determinations of lava overlying glaciated surfaces and sedimentary deposits of glacial origin show that glaciers existed on this continent at least 10 million years ago.

The study of ice sheets has benefited much from data produced by advanced instruments, computers, and orbiting satellites. The shape of ice sheets can be determined by numerical modeling, their heat budget from thermodynamic calculations, and their thickness with radar techniques. Colour images from satellites show the temperature distribution across the polar regions, which can be compared with the distribution of land and sea ice.

Atmospheric sciences

Probes, satellites, and data transmission

Kites equipped with meteorgraphs were used as atmospheric probes in the late 1890s, and in 1907 the U.S. Weather Bureau recorded the ascent of a kite to 7,044 metres above Mount Weather, Virginia.

In the 1920s the radio replaced the telegraph and telephone as the principal instrument for transmitting weather data. By 1936 the radio meteorgraph (radiosonde) was developed, with capabilities of sending signals on relative humidity, temperature, and barometric pressure from unmanned balloons. Experimentation with balloons up to altitudes of about 31 kilometres showed that columns of warm air may rise more than 1.6 kilometres above the Earth's surface and that the lower atmosphere is often stratified, with winds in the different layers blowing in different directions. During the 1930s airplanes began to be used for observations of the weather, and the years since 1945 have seen the development of rockets and weather satellites. TIROS (Television Infra-Red Observation Satellite), the world's first all-weather satellite, was launched in 1960, and in 1964 the Nimbus Satellite of the United States National Aeronautics and Space Administration (NASA) was rocketed into near-polar orbit.

There are two types of weather satellites: polar and geostationary. Polar satellites, like Nimbus, orbit the Earth at low altitudes of a few hundred kilometres, and, because of their progressive drift, they produce a photographic coverage of the entire Earth every 24 hours. Geostationary satellites, first sent up in 1966, are situated over the Equator at altitudes of about 35,000 kilometres and transmit data at regular intervals. Much information can be derived from the data collected by satellites. For example, wind speed and direction are measured from cloud trajectories, while temperature and moisture profiles of the atmosphere are calculated from infrared data.

Weather forecasting

Efforts at incorporating numerical data on weather into mathematical formulas that could then be used for forecasting were initiated early in the century at the Norwegian Geophysical Institute. Vilhelm Bjerknes and his associates at Bergen succeeded in devising equations relating the measurable components of weather, but their complexity precluded the rapid solutions needed for forecasting. Out of their efforts, however, came the polar front theory for the origin of cyclones and the now-familiar names of cold front, warm front, and stationary front for the leading edges of air masses (see climate: Atmospheric pressure and wind).

In 1922 the British mathematician Lewis Fry Richardson demonstrated that the complex equations of the Norwegian school could be reduced to long series of simple arithmetic operations. With no more than the desk calculators and slide rules then available, however, the solution of a problem in procedure only raised a new one in manpower. In 1946 the mathematician John von Neumann and his fellow workers at the Institute for Advanced Study, in Princeton, N.J., began work on an electronic device to do the computation faster than the weather developed. Four years later the von Neumann group could claim that, given adequate data, their computer could forecast the weather as well as a weatherman. Present-day numerical weather forecasting is achieved with the help of advanced computer analysis (see weather forecasting).

Cloud physics

Studies of cloud physics have shown that the nuclei around which water condenses vary widely in their degree of concentration and areal distribution, ranging from six per cubic centimetre over the oceans to more than 4 million per cubic centimetre in the polluted air of some cities. The droplets that condense on these foreign particles may be as small as 0.001 centimetre in diameter. Raindrops apparently may form directly from the coalescence of these droplets, as in the case of tropical rains, or in the temperate zones through the intermediary of ice crystals. According to the theory of Tor Bergsonand Walter Findeisen, vapour freezing on ice crystals in the clouds enlarges the crystals until they fall. What finally hits the ground depends on the temperature of air below the cloud—if below freezing, snow; if above, rain.

Properties and structure of the atmosphere

Less than a year after the space age began with the launching of the Soviet Sputnik I in 1957, the U.S. satellite Explorer I was sent into orbit with a Geiger counter for measuring the intensity of cosmic radiation at different levels above the ground. At altitudes around 1,000 kilometres this instrument ceased to function due to saturation by charged particles. This and subsequent investigations showed that a zone of radiation encircles the world between about latitude 75° N and 75° S, with maximum intensities at 5,000 and 16,000 kilometres. Named after the American physicist James Van Allen, a leading investigator of this portion of the Earth's magnetosphere, these zones are responsive to events taking place on the Sun. The solar wind, a stream of atomic particles emanating from the Sun in all directions, seems to be responsible for the electrons entrapped in the Van Allen region as well as for the teardrop shape of the magnetosphere as a whole, with its tail pointing always away from the Sun.

In 1898 Teisserenc de Bort, studying variations of temperature at high altitudes with the aid of balloons, discovered that at elevations of about 11 kilometres the figure for average decrease of temperature with height (about 5.5 °C per 1,000 metres of ascent) dropped and the value remained nearly constant at around −55 °C. He named the atmospheric zones below and above this temperature boundary the troposphere and the stratosphere.

Toward the end of World War II the B-29 Superfortress came into use as the first large aircraft to cruise regularly at 10,000 metres. Heading westward from bases in the Pacific, these planes sometimes encountered unexpected head winds that slowed their flight by as much as 300 kilometres per hour. The jet streams, as these high-altitude winds were named, have been found to encircle the Earth following wavy courses and moving from west to east at velocities ranging upward to 500 kilometres per hour. Aircraft have also proved useful in studies of the structure and dynamics of tropical hurricanes. Following the destruction wrought to the Atlantic Coast of the United States in 1955 by hurricanes Connie and Diane, a national centre was established in Florida with the missions of locating and tracking and, it is hoped, of learning how to predict the paths of hurricanes and to dissipate their energy.

Weather modification

As late as the 1890s experiments were conducted in the United States in the hope of producing rain by setting off charges of dynamite lofted by balloons or kites. No positive results were reported, however. More promising were the cloud-seeding experiments of the 1940s, in which silver iodide was released into clouds as smoke or solid carbon dioxide broadcast into clouds from airplanes. The results are still uncertain for increasing precipitation. The lessons learned from cloud seeding, however, have had other successful applications, such as the dispersal of low-level supercooled fog at airports (the first system designed for this purpose, the Turboclair fog-dissipation system, was set up in 1970 at Orly airport in Paris).

The inadvertent weather modification that has followed industrialization and the building of large cities has, however, already produced measurable changes in local climate and may someday produce effects more widespread. The introduction of some 12 billion tons of carbon dioxide into the atmosphere each year from the burning of fuels may in time raise the Earth’s average temperature. Cities affect the flow of wind, warm the atmosphere over them, and send pollutants into the sky. Updrafts and an abundance of condensation nuclei may increase rainfall and winter fog and reduce sunshine and daylight.

I. Make up 20 questions to text B. Use all types of questions.

II. What new information have you learnt from this text.

III. Summarize the text in four paragraphs singling out the main problems.

Text C

For nearly the entire 4.5 billion year history of our Solar System, the Earth hasn't been alone while we revolve around the Sun. Our giant lunar companion is larger and more massive than any other moon when compared to the planet it orbits. When it's in its full phase, it brightly illuminates the night, and the Moon has been linked throughout history to phenomena such as insanity (or lunacy), animal behavior (howling at the moon), farming (a harvest moon). While those links don't stand up to scientific scrutiny, there are many ways the Moon actually does affect the Earth. Destroying it would be a catastrophe, but would also change our world forever in some incredibly interesting ways.

Destroying the Moon would send debris to Earth, but it might not be life exterminating. Imagine a weapon so deadly it could gravitationally unbind the Moon, blowing it apart. It would take a medium-sized asteroid's worth of antimatter to do it (about a kilometer in diameter), and the debris would spread out in all directions. If the blast were weak enough, the debris would re-form into one or more new moons; if it were too strong, there would be nothing left; of just the right magnitude, and it would create a ringed system around Earth. Over time, those lunar fragments would de--orbit thanks to Earth's atmosphere, creating a series of impacts.

But these impacts wouldn't be as destructive as the asteroids or comets we're so afraid of today! Even though chunks of Moon would be massive, dense and even potentially larger than the asteroid that wiped out the dinosaurs, they would have a lot less energy. Asteroids or comets striking Earth move at twenty, fifty or even over a hundred kilometers-per-second, but lunar debris would be moving at a mere 8 km/s, and would strike only a glancing blow with our atmosphere. The debris striking Earth would still be destructive, but would impact our world with less than 1 % the total energy of a comparably sized asteroid. If the chunks hitting us were small enough, humanity could easily survive.

The night sky would be naturally much brighter. Once the Moon and all its remnants were gone, the second-brightest object from Earth's sky would be completely gone. While the Sun is naturally 400,000 times brighter than even the full, perigee Moon, the full Moon is again 14,000 times brighter than the next- brightest object in the sky: Venus. When you look at the Bortle Dark-Sky Scale, a full Moon can take you from a "1" — the most pristine, naturally dark sky possible - - all the way up to a 7 or 8, washing out even bright stars. Without a Moon, there would be no natural impediments to pristine, dark skies every night of the year.

An illustration of the Sun-Moon-Earth configuration setting up a total solar eclipse. The Earth's non-flatness means that the Moon's shadow gets elongated when

An illustration of the Sun-Moon-Earth configuration setting up a total solar eclipse. The Earth's non-flatness means that the Moon's shadow gets elongated when it's close to the edge of the Earth.

Eclipses would be no more. Whether you're talking solar eclipses — partial, total or annular — or lunar eclipses, where Earth's natural satellite passes into our shadow, we would no longer have eclipses of any type. Eclipses require three objects to be aligned: the Sun, a planet and a planet's moon. When the moon passes between the Sun and a planet, a shadow can be cast on the planet's surface (total eclipse), the moon can transit across the Sun's surface (annular eclipse), or it can obscure just a fraction of the Sun's light (partial eclipse). But without a moon at all, none of these could occur. Our only natural satellite would never pass into Earth's shadow if it didn't exist, putting an end to eclipses. The Moon exerts a tidal force on the Earth, which not only causes our tides, but causes braking of the Earth's rotation, and a subsequent lengthening of the day.

I. Make up a summary of text C (1-3 parts) in a written form.

Grammar Exercises

Exercise I. Fill in *if* or *unless.*

1. __________there is a delay, her train will arrive at 6.
2. __________we finish the project before Friday, the boss will be very pleased.
3. __________you forget your keys, you can use my spare ones.
4. __________there is a lot of traffic, I'll be home early.
5. __________they call while I'm out, tell them I'll be back later.
6. __________she studies hard, she'll pass the exams.
7. __________he passes his driving test, he can't buy a car.
8. __________they invite him to the party, he wont go.
9. __________you find any clues, call me.
10. __________you decide to come to the party, give us a call.
11. __________they start saving money now, they won't be able to go on holiday next summer.
12. __________you give up junk food, you won't lose any weight.

Fill in *if* or *when,* then complete the sentences with your own ideas.

1. ___________Dad comes home early, ________________________________
2. ___________it stops raining soon,___________________________________
3. ____________I finish school,_______________________________________
4. ____________I grow up,____
5. ____________the train arrives,______________________________________
6. ____________I win the gold medal,__________________________________
7. ____________you see a burglary,____________________________________
8. ____________the sun sets,____
9. ____________I get up tomorrow morning,_____________________________
10. __________the weather is nice on Saturday,__________________________

Exercise II. Put the verbs in brackets into the correct tense.

1. A: Will you come to the cinema with me?
   B: I'm sorry but I'm busy. If I _____; (not/have) so many things to do at home, I________ (come) with you.
2. A: Dad, why didn't you let me play with Dana yesterday?
   B: If you_________ (finish) your homework, you_______ (play) with her.
3. A: Do you live in Paris?
   B: No, but if I_______ (live) in Paris, I_______ (learn) to speak French fluently.
4. A: If you_______ (go) to the supermarket, _________ (you/buy) some milk, please?
   B: Of course.
5. A: I haven't been feeling well lately.
   B: If I________ (be) you, I _______(call) the doctor's for an appointment.
6. A: Mum, I didn't pass the Physics test.
   B: If you________ (study) for it, you_______ (pass) it.
7. A: What time should I expect you?
   B: If the bus ________ (come) on time, I_________ (arrive) around 3.00.
   A: I can't believe that people still drop litter!
   B: I know! If everyone________(stop) dropping litter, our neighbourhood ________ (be) a nicer place to live in.
8. A: If you________ (see) Bill, can you tell him to call me?
   B: Of course.

Exercise III. Choose the correct item.

1. If I were you, I ________ to the dentist.
   A) will go B) would go
   C) would have gone D) would going
2. If I hadn't overslept today, I__________ late for my lessons.
   A) wouldn't be B) would have been
   C) won't have been D) wouldn't have been
3. If Suzie____________ a healthy diet, she wouldn't be fit.
   A) didn't follow B) hadn't followed
   C) followed D) doesn't follow
4. If Dan ___________ gold, he'll become rich.
   A) found B) will find
   C) finds D) would find.
5. If he_________ a car, he would get to work faster.
   A) had B) has
   C) would have D) had had
6. If he _________his homework, he could have played with his friends.
   A) has done B) had done

C) did D) would do

7. I won't go to the dance unless you __________me a new outfit.

A) won't buy B) don't buy

C) bought D) buy

8. If he _________late, he wouldn't have missed the professor's lecture.

A) hadn't arrived B) didn't arrived

C) had arrived D) arrived

9. If I_________ you, I'd think twice before asking her.

A) am B) was

C) were D) been

10. If you to the party, you will see Andrea there.

A) will go B) go

C) would go D) went

Exercise IV. Make 3rd type Conditional sentences for each of the following situations. Begin with the words given.

Example: I was tired. I went to bed early.

If I hadn't felt tired, I wouldn't have gone to bed early, **or**

If I hadn't felt tired, I would have gone to bed later.

1. I didn't have enough money. I didn't take a taxi.
   If____
2. I wasn't interested in the film. I didn't go to the cinema.
   If____
3. We took the wrong turning. We arrived late.
   If____
4. Romeo thought Juliet was dead. He committed suicide.
   Romeo wouldn't________________________________
5. Oliver was punished. He asked for more food.
   If Oliver ______________________________________
6. The building had weak foundations. It fell down.
   The building wouldn't have_______________________
7. I didn't go downstairs. I was afraid of the dark.
   I might____
8. You didn't run fast. You didn't come first.
   You could______________________________________
9. I didn't know she was the examiner. I made a silly joke.
   Had____

10. She didn't have a car. She couldn't have driven there.
If she ____

Exercise V. Underline the correct answer.

1. If you *told/<u>had told</u>* me about the problem earlier, everything *would be/would have been* all right now.
2. If she *didn't die/hadn't died* so young, she *would be/would have been* a famous musician now.
3. You should relax. If you *didn't work/hadn't worked* so hard all the time, you *wouldn't be/wouldn't have been* ill last year.
4. If he *didn't waste/hadn't wasted* so much money in his youth, he *could be/could have been* a wealthy man now.
5. If I *have been/were* a more sensitive person, I *wouldn't upset/ wouldn't have upset* her in the way that I did.
6. If they really *want/wanted* to emigrate, they *would move /would have moved* to another country by now.
7. If he *worked/had worked* harder last month, he *wouldn't be/wouldn't have been* so busy now.
8. I *wouldn't be doing/ wouldn't have been doing* this job today if I *knew/had known* how boring it would be.
9. If the train *wasn't delayed/hadn't been delayed,* we *will be /would be* there now.
10. If the passenger *didn't forget/hadn't forgotten* her passport, she *would be boarding/ would have been boarding* the plane now.
11. If you *followed / had followed* the diet your doctor gave you, you *might not be/might not have been* ill now.

Exercise VI. Choose the correct item.

1. If you hadn't eaten all those sweets, you __________stomach ache.
   A) won't have B) don't have C) wouldn't have
2. If we _____________now, we'll catch the last bus.
   A) had left B) leave C) left
3. __________ she been more careful, she wouldn't have broken her arm.
   A) Were B) Had C) Should
4. If I got lost in the forest, I__________ a compass to help me find my way.
   A) would have used B) would use C) will use
5. I wish Sandra _________let me use her computer.
   A) would B) could C) might
6. When you _____________an onion, your eyes water.

A) could peel B) had peeled C) peel

7. If you ___________more experienced, you would have got the job.

A) would have been B) could be C) had been

8. I don't know if Carol____________ to sell the house.

A) will agree B) agrees C) should agree

9. _______________ you need any help moving, give me a call.

A) Would B) Will C) Should

10..______________ you hang up your clothes, they'll get creased.

A) If B) Unless C) Providing

11.If the museum is open tomorrow, we ___________to the exhibition.

A) will go B) have gone C) would go

12.Were he more sensitive, he ____________have said such a horrible thing.

A) wouldn't B) couldn't C) mustn't

13.If he hadn't fought with his boss, he ______________his job.

A) wouldn't have lost B) don't lose C) will lose

14.If I __________now, I won't be late for work.

A) will get up B) had got up C) get up

15.. __________you need any more information, ask John.

A) Will B) Should C) Would

16.. ___________ you have already made plans, we can go to the supermarket this afternoon.

A) Would B) Should C) Unless

Exercise VII. Find mistakes and correct them.

1) Carol has been done the ironing since 11 o'clock in the morning. 2) Jack has still waited for a message from you. 3) Have she been swimming for an hour now? 4) Phil work at the advertising agency in the city centre. 5) We have been having this car for about five years. 6) The train is departing at 6 o'clock in the evening. 7) They have been decorating the hall since three hours. 8) You have flying to Detroit tomorrow morning. 9) How long have you translated this article? 10) How many messages have you been receiving since yesterday?

Exercise VIII. Put the verbs in brackets into the correct form of the Present Perfect Continuous Tense.

1) It ... *(to snow)* for three days now. 2) We ... *(to row)* towards the island for two hours. 3) ... Paula ... *(to watch)* the DVD since 4 o'clock? — No, she ... *(to watch)* it for an hour now. 4) The children ... *(to prepare)* for the New Year party since the beginning of December. 5) What ... you ... *(to discuss)* with Mark since 3 o'clock? — We ... *(to discuss)* the list of the guests for our wedding party. 6) Why do you look so tired? — I

... *(to clean*) the swimming pool since 9 o'clock in the morning. 7) Who ... *(to cry)* since 6 o'clock in the morning? — I think it's Fiona's baby. 8) How long ... Brian ... *(to study)* management? — He ... *(to study)* it for four years now. 9) ... Sue ... *(to sleep)* long? — No, she ... . She ... *(to sleep)* just for two hours. 10) How long ... your brother ... *(to wear)* glasses? — He ... *(to wear)* glasses since he was 5 years old.

LESSON V

Text A

Climate change and agriculture

Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level.

Climate change is already affecting agriculture, with effects unevenly distributed across the world. Future climate change will likely negatively affect crop production in low latitude countries, while effects in northern latitudes may be positive or negative.[121] Climate change will probably increase the risk of food insecurity for some vulnerable groups, such as the poor.

Agriculture contributes to climate change by anthropogenic emissions of greenhouse gases (GHGs), and by the conversion of non-agricultural land (e.g., forests) into agricultural land. Agriculture, forestry and land-use change contributed around 20 to 25% to global annual emissions in 2010.

There are a range of policies that can reduce the risk of negative climate change impacts on agriculture,[1^1] and to reduce GHG emissions from the agriculture sector.

Impact of climate change on agriculture

Despite technological advances, such as improved varieties, genetically modified organisms, and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities. The effect of climate on agriculture is related to variability’s in local climates rather than in global climate patterns. The Earth's average surface temperature has increased by 1.5 °F (0.83 °C) since 1880. Consequently, agronomists consider any assessment has to be individually consider each local area.

On the other hand, agricultural trade has grown in recent years, and now provides significant amounts of food, on a national level to major importing countries, as well as comfortable income to exporting ones. The international aspect of trade and security in terms of food implies the need to also consider the effects of climate change on a global scale.

A 2008 study published in Science suggested that, due to climate change, "southern Africa could lose more than 30% of its main crop, maize, by 2030. In South Asia losses of many regional staples, such as rice, millet and maize could top 10%".

The Intergovernmental Panel on Climate Change (IPCC) has produced several reports that have assessed the scientific literature on climate change. The IPCC Third Assessment Report, published in 2001, concluded that the poorest countries would be hardest hit, with reductions in crop yields in most tropical and sub-tropical regions due to decreased water availability, and new or changed insect pest incidence. In Africa and Latin America many rainfed crops are near their maximum temperature tolerance, so that yields are likely to fall sharply for even small climate changes; falls in agricultural productivity of up to 30% over the 21st century are projected. Marine life and the fishing industry will also be severely affected in some places.

Climate change induced by increasing greenhouse gases is likely to affect crops differently from region to region. For example, average crop yield is expected to drop down to 50% in Pakistan according to the UKMO scenario whereas corn production in Europe is expected to grow up to 25% in optimum hydrologic conditions.

More favourable effects on yield tend to depend to a large extent on realization of the potentially beneficial effects of carbon dioxide on crop growth and increase of efficiency in water use. Decrease in potential yields is likely to be caused by shortening of the growing period, decrease in water availability and poor vernalization.

In the long run, the climatic change could affect agriculture in several ways:

- productivity, in terms of quantity and quality of crops
- agricultural practices, through changes of water use (irrigation) and agricultural inputs such as herbicides, insecticides and fertilizers
- environmental effects, in particular in relation of frequency and intensity of soil drainage (leading to nitrogen leaching), soil erosion, reduction of crop diversity
- rural space, through the loss and gain of cultivated lands, land speculation, land renunciation, and hydraulic amenities.
- adaptation, organisms may become more or less competitive, as well as humans may develop urgency to develop more competitive organisms, such as flood resistant or salt resistant varieties of rice.

They are large uncertainties to uncover, particularly because there is lack of information on many specific local regions, and include the uncertainties on magnitude of climate change, the effects of technological changes on productivity, global food demands, and the numerous possibilities of adaptation.

Most agronomists believe that agricultural production will be mostly affected by the severity and pace of climate change, not so much by gradual trends in climate. If change is gradual, there may be enough time for biota adjustment. Rapid climate change, however, could harm agriculture in many countries, especially those that are already suffering from rather poor soil and climate conditions, because there is less time for optimum natural selection and adaption.

But much remains unknown about exactly how climate change may affect farming and food security, in part because the role of farmer behaviour is poorly captured by crop-climate models. For instance, Evan Fraser, a geographer at the University of Guelph in Ontario Canada, has conducted a number of studies that show that the socio-economic context of farming may play a huge role in determining whether a drought has a major, or an insignificant impact on crop production. In some cases, it seems that even minor droughts have big impacts on food security (such as what happened in Ethiopia in the early 1980s where a minor drought triggered a massive famine), versus cases where even relatively large weather-related problems were adapted to without much hardship.[11161] Evan Fraser combines socio-economic models along with climatic models to identify “vulnerability hotspots. One such study has identified US maize (com) production as particularly vulnerable to climate change because it is expected to be exposed to worse droughts, but it does not have the socio-economic conditions that suggest farmers will adapt to these changing conditions.

Other studies rely instead on projections of key agro-meteorological or agro-climate indices, such as growing season length, plant heat stress, or start of field operations, identified by land management stakeholders and that provide useful information on mechanisms driving climate change impact on agriculture.

Pest Insects and Climate Change

Global warming could lead to an increase in pest insect populations, harming yields of staple crops like wheat, soybeans, and com. While wanner temperatures create longer growing seasons, and faster growth rates for plants, it also increases the metabolic rate and number of breeding cycles of insect populations.[1201] Insects that previously had only two breeding cycles per year could gain an additional cycle if warm growing seasons extend, causing a population boom. Temperate places and higher latitudes are more likely to experience a dramatic change in insect populations.[1211]

The University of Illinois conducted studies to measure the effect of warmer temperatures on soybean plant growth and Japanese beetle populations.[1221] Warmer temperatures and elevated CO_2 levels were simulated for one field of soybeans, while the other was left as a control. These studies found that the soybeans with elevated CO_2 levels grew much faster and had higher yields, but attracted Japanese beetles at a significantly higher rate than the control field.[1221] The beetles in the field with increased CO_2 also laid more eggs on the soybean plants and had longer lifespans, indicating the possibility of a rapidly expanding population. DeLucia projected that if the project were to continue, the field with elevated CO: levels would eventually show lower yields than that of the control field.[1221]

The increased CO_2 levels deactivated three genes within the soybean plant that normally create chemical defenses against pest insects. One of these defenses is a protein that blocks digestion of the soy leaves in insects. Since this gene was deactivated, the beetles were able to digest a much higher amount of plant matter than the beetles in the control field. This led to the observed longer lifespans and higher egg-laying rates in the experimental field.[1221]

There are a few proposed solutions to the issue of expanding pest populations. One proposed solution is to increase the number of pesticides used on future crops. This has the benefit of being relatively cost effective and simple, but may be ineffective. Many pest insects have been building up an immunity to these pesticides. Another proposed solution is to utilize biological control agents. This includes things like planting rows of native vegetation in between rows of crops. This solution is beneficial in its overall environmental impact. Not only are more native plants getting planted, but pest insects are no longer building up an immunity to pesticides. However, planting additional native plants requires more room, which destroys additional acres of public land. The cost is also much higher than simply using pesticides.

I. **Group activity. Hold a discussion in the group to broach the topic**

II. **Write the essay of Text A as to your own plan.**

III. **Review the climate change: its affection on agriculture.**

Text B

Plant Diseases and Climate Change

Although research is limited, research has shown that climate change may alter the developmental stages of pathogens that can affect crops. The biggest consequence of climate change on the dispersal of pathogens is that the geographical distribution of hosts and pathogens could shift, which would result in more crop losses. This could affect competition and recovery from disturbances of plants. It has been predicted that the effect of climate change will add a level of complexity to figuring out how to maintain sustainable agriculture.

Observed impacts

Effects of regional climate change on agriculture have been limited. Changes in crop phenology provide important evidence of the response to recent regional climate change. Phenology is the study of natural phenomena that recur periodically, and how these phenomena relate to climate and seasonal changes. A significant advance in phenology has been observed for agriculture and forestry in large parts of the Northern Hemisphere. Droughts have been occurring more frequently because of global warming and they are expected to become more frequent and intense in Africa, southern Europe, the Middle East, most of the Americas, Australia, and Southeast Asia. Their impacts are aggravated because of increased water demand, population growth, urban expansion, and environmental protection efforts in many areas. Droughts result in crop failures and the loss of pasture grazing land for livestock.

Examples

As of the decade starting in 2010, many hot countries have thriving agricultural sectors. Jalgaon district, India, has an average temperature which ranges from 20.2C in December to 29.8C in May, and an average precipitation of 750mm/year.[1321] It produces bananas at a rate that would make it the world's seventh-largest banana producer if it were a country.[1331]

During the period 1990-2012, Nigeria had an average temperature which ranged from a low of 24.9C in January to a high of 30.4C in April.[1341] According to the Food and Agriculture Organization of the United Nations (FAO), Nigeria is by far the world's largest producer of yams, producing over 38 million tonnes in 2012. The second through 8th largest yam producers were all nearby African countries, with the largest non-African producer. Papua New Guinea, producing less than 1% of Nigerian production.[1351]

In 2013, according to the FAO, Brazil and India were by far the world's leading producers of Sugarcane, with a combined production of over 1 billion tonnes, or over half of worldwide production.[1361]

Projections

As part of the IPCC's Fourth Assessment Report, Schneider et al. (2007) projected the potential future effects of climate change on agriculture. With low to medium confidence, they concluded that for about a l to 3 °C global mean temperature increase (by 2100, relative to the 1990-2000 average level) there would be productivity decreases for some cereals in low latitudes, and productivity increases in high latitudes. In the 1PCC Fourth Assessment Report, "low confidence" means that a particular finding has about a 2 out of 10 chance of being correct, based on expert judgement. "Medium confidence" has about a 5 out of 10 chance of being correct. Over the same time period, with medium confidence, global production potential was projected to: increase up to around 3 °C, very likely decrease above about 3 °C.

Most of the studies on global agriculture assessed by Schneider et al. (2007) had not incorporated a number of critical factors, including changes in extreme events, or the spread of pests and diseases. Studies had also not considered the development of specific practices or technologies to aid adaptation to climate change.

The US National Research Council (US NRC, 201 1) assessed the literature on the effects of climate change on crop yields. US NRC (2011) stressed the uncertainties in their projections of changes in crop yields.

Their central estimates of changes in crop yields are shown above. Actual changes in yields may be above or below these central estimates. US NRC (2011)[1401] also provided an estimated the "likely" range of changes in yields. "Likely" means a greater than 67% chance of being correct, based on expert judgement. The likely ranges are summarized in the image descriptions of the two graphs.

Food security

The IPCC Fourth Assessment Report also describes the impact of climate change on food security. Projections suggested that there could be large decreases in hunger globally by 2080, compared to the (then-current) 2006 level.[1431] Reductions in hunger were driven by projected social and economic development. For reference, the Food and Agriculture Organization has estimated that in 2006, the number of people undernourished globally was 820 million.[1441] Three scenarios without climate change (SRESA1, Bl, B2) projected 100-130 million undernourished by the year 2080, while another scenario without climate change (SRES A2) projected 770 million undernourished. Based on an expert assessment of all of the evidence, these projections were thought to have about a 5-in-10 chance of being correct.

The same set of greenhouse gas and socio-economic scenarios were also used in projections that included the effects of climate change. Including climate change, three scenarios projected 100-380 million undernourished by the year 2080, while another scenario with climate change "projected 740-1,300 million undernourished. These projections were thought to have between a 2-in-10 and 5-in-10 chance of being correct.

Projections also suggested regional changes in the global distribution of hunger. By 2080, sub- Saharan Africa may overtake Asia as the world's most food-insecure region. This is mainly due to projected social and economic changes, rather than climate change.

I. Put 20 questions to the text B
II. Make up a plan of text B and retell it in accordance to it.

Text C

The length of a day would remain constant. You might not think about it much, but the Moon exerts a tiny frictional force on the spinning Earth, causing our rotation rate lo slow down over time. We might only lose a second here or there over many centuries, but it adds up over time. Our 24 hour day was only 22 hours back when dinosaurs roamed the Earth, and was under 10 hours a few billion years ago. In another four million years, we won't need leap days any longer in our calendar, as the rotation rate slows and the length of a day continues to get longer. But without a Moon, all that would cease. It would be 24 hour days every single day to come, until the Sun itself ran out of fuel and died. Gorey Harbour at low tide, illustrating the extreme difference between high and low tide found in bays, inlets and other shallow, coastal regions here on Earth.

Our tides would be tiny. High tide and low tide presents an interesting, vast difference for those of us who live near the coast, particularly if we're in a bay, sound, inlet, or other area where water pools. Our tides on Earth are primarily due to the Moon, with the Sun contributing only a small fraction of the tides we see today. During full moons and new moons, when the Sun, Earth and Moon are aligned, w'e have spring tides: the largest differences between high and low tide possible. When they're at right angles, during a half Moon, we have neap tides: the smallest such differences. Spring tides are twice as large as neap tides, but without our Moon, the tides would always be the same paltry size, and only a quarter as big as today's spring tides.

The obliquity of Earth's axial tilt, currently 23.4 degrees, actually varies between 22.1 and 24.5 degrees. This is a very small variation compared to, say, Mars. The obliquity of Earth's axial tilt, currently 23.4 degrees, actually varies between 22.1 and 24.5 degrees. This is a very small variation compared to, say, Mars.

Our axial tilt would be unstable. This is an unfortunate one. Earth spins on its axis, tilted at 23.4° with respect to our orbital plane around the Sun. (This is known as our obliquity.) You might not think the Moon has much to do with that, but over tens of thousands of years, that tilt changes: from as little as 22.1° to as much as 24.5°. The Moon is a stabilizing force, as worlds without big moons - like Mars — see their axial tilt change by ten times as much over time. On Earth, without. a Moon, its estimated that our tilt would possibly even exceed 45° at times, making us a world that spun on our sides. Poles wouldn't always be cold; the equator might not always be warm. Without our Moon to stabilize us, ice ages would preferentially hit different parts of our world every few thousand years.

And finally...

The Apollo mission trajectories, made possible by the Moon's close proximity to us. Image credit: NASA’s Office of Manned Space Flight, Apollo missions.

We would no longer have our stepping stone to the rest of the Universe. As far as we can tell, humanity is the only species ever to willfully put ourselves on the surface of another world. Part of why we were able to do that, from 1969 to 1972, is because of how close the Moon is to Earth. At only 380,000 km away, a conventional rocket can make the journey in approximately 3 days, and a round-trip signal at the speed of light takes only 2.5 seconds. The next closest options — Mars or Venus — take months to get there via rocket, over a year for a round trip, and many minutes for a round-trip communication.

The Moon is the easiest, most useful "practice run" we could have asked the Universe for if our goal was to explore the rest of the Solar System. Perhaps we'll take advantage of it again — and all that it brings to Earth — someday soon.

I. Make up a summary of Text C (4-7 parts) in a written form.

Grammar Exercises

Exercise I. Decide which word is correct.

1. We all tried to push the van, but it move.
   A) can't B) couldn't
   C) won't D) wouldn't
2. _________ you like to go for a ride with us?
   A) Do B) Should
   C) Will D) Would
3. I wonder if this is the right way. It ______ not be.
   A) can B) could
   C) might D) must
4. I don't think I want to see this film. — Oh, I think you _______ enjoy it.
   A) can B) shall
   C) will D) would
5. I'm quite happy to walk. You ________ drive me home.
   A) don't B) haven't
   C) mustn't D) needn't
6. _______ I show you the way? — Oh, thank you.
   A) Do B) Shall
   C) Will D) Would
7. It's late. I think we _________ better go.
   A) had B) have
   C) should D) would
8. Everyone's asleep. We ________ make a noise.
   A) couldn't B) mustn't
   C) needn't D) wouldn't

Exercise II. Complete the sentences using *must, have to, may, might, could* or *can't,* as in the example.

1. Perhaps Tom will work late tonight.
   Tom *may/might work late tonight.*___________________________
2. It's possible that Mary is trying to call us.
   Mary____
3. The students are obliged to finish the test in one hour.
   The students____
4. It's possible that Mum is working in the garden.
   Mum____
5. I'm sure Rachel is hungry.
   Rachel____

6. Perhaps Dad will take us out to dinner.
Dad____

7. I'm sure Lucy hasn't reached the station yet.
Lucy____

8. It is necessary for Grandma to take her medication every morning.
Grandma____

9. It's likely that they have gone to the supermarket.
They____

10. I'm certain Bob didn't leave the-party early.
Bob____

Exercise III. Choose the correct item.

1. You write and thank everyone for the birthday presents they gave you.
A) shouldn't B) need C) ought to
2. It's very late. The children be sleeping.
A) must B) can't C) shouldn't
3. We finish the project by Friday or else we'll lose the client.
A) might B) needn't C) have to
4. You made anything for the party. I have plenty of food.
A) needn't have B) needn't C) mustn't
5. The north of England get very cold during the winter.
A) may B) can C) could
6. Kevin is very rude. He have talked to Sarah that way.
A) could B) shouldn't C) mustn't
7. Dan isn't at home. He be at the gym.
A) might B) couldn't C) can't
8. Susan has a broken leg. She gone skiing.
A) can't have B) couldn't C) may
9. It's your own fault you crashed the car. You been driving so fast.
A) might not have B) may not have C) shouldn't have
10. A: I call David now?
B: Yes, he said it was an emergency.
A) Need B) Needn't C) Could
11. That be Mary on the phone. She doesn't know our new number.
A) mustn't B) needn't C) can't
12. Eve must the stage props all night. She looks extremely tired.
A) be preparing B) have been preparing C) have prepared
13. You bring your tent with you. We can both sleep in mine.
A) need B) don't need to C) needn't have
14. You have brought so many jumpers. I could have lent you some of mine.
A) needn't B) couldn't C) didn't need to

15. A: Why are Bob and Moira late?
B: Well, they missed the 5 o'clock bus.
A) could have been B) might have C) should

Exercise IV. Complete the sentences. Use the correct form of must or have to and the verbs in brackets.

Example: She ***<u>had to leave</u>*** at eleven o'clock because the last bus left at twenty past. **(leave)**

1. Fiona _______ for a new car because her parents gave her one for her birthday. **(save)**
2. Mike _______ to the station because he was late. **(run)**
3. Attention, please! All accidents ______ reported to the safety officer. **(be)**
4. I don't like ____ everything my boss tells me. **(do)**
5. They ______ late tonight. They can finish the job tomorrow**. (work)**
6. I _______ my parents. I'm really worried about them. **(ring)**
7. _______ a uniform when you were at school? **(you/wear)**
8. You ______ late for English classes. Otherwise, the teacher will lock you out. **(be)**
9. Why_____ so suddenly? Was anything wrong? **(they/leave)**
10. Sam gets ill all the time. He ________ a doctor three times so far this year. **(see)**
11. You ________ to switch off all electric appliances before you leave the building. **(forget)**
12. You _____ in a hostel. You can stay with us**. (stay)**

Exercise V. Complete the sentences. Use the correct form of *must* or *should* and the verbs in brackets.

Example: It's your own fault you're tired. You ***<u>shouldn't have gone</u>*** to bed late last night. **(go)**

1. You ________ and see us one evening. We'd love to see you. **(come)**
2. She _______ a bath right now. We've got to leave in ten minutes! **(have)**
3. They ________ him what happened. Now he'll never get over it. **(tell)**
4. Billy and Ann ___________that new Chinese place. It's the best restaurant in town**. (try)**
5. You ________ when I came into the room, not talking**. (work)**
6. I ___________that suit. It was a waste of money. **(buy)**
7. You ________ to your mother in that tone of voice ever again. **(speak)**
8. Do you think I _______ my hair or ______ it as it is? **(dye, leave)**
9. You really _________ us soon, Albert. We'd love to see you. **(visit)**
10. Why aren't they at the gym? They________ hard for the championship. **(train)**

Exercise VI. Complete the conversations. Use one word in each blank.

A: (1) __________ don't we watch a film at my place this evening?
B: Good idea. I've got a new DVD. (2) __________ I bring it?

A: I'm sorry, but you (3) ___________ only have one piece of hand luggage.
B: But the last time I flew I **(4)** ______allowed to bring two bags onto the plane.
A: I'm afraid the regulations have changed.

A: I don't feel well. I've got a headache.
B: You'd (5) ________ not go to work today then.
A: Would you (6) ___________ ringing the office for me?

A: How's your new job?
B: It's good. I don't like (7) __________ to travel to London three days a week but I do like (8) ______________ able to work from home the rest of the time.

Exercise VII. Circle the correct item.

1) Tina *sunbathed/ was sunbathing* while her children *swam/were swimming* in the sea. 2) Mr White *phoned/had phoned* us after the conference *was beginning/had begun.* 3) They *were sailing/ had been sailing* for two weeks before they reached the continent. 4) My brother *bought/had bought* this computer a year ago. 5) We *had/were having* breakfast when our neighbour *knocked/ had knocked* at the door. 6) Tom's eyes were red because he *had worked/had been working* at the computer all day. 7) Dolly *took/was taking* a letter, *opened/was opening* it and *started/ had started* reading. 8) After we *cleaned/had cleaned* the house we *decided/had decided* to go to the cinema. 9) The boys *were playing/had been playing* tennis at 3 o'clock yesterday. 10) Mrs Davis was upset because she *was losing/had lost* her purse.

Exercise VIII. Put the verbs in brackets into the Past Simple or the Past Perfect Continuous Tense.

1) Mike ... *(to cycle)* for two hours before he ... *(to stop)* for a rest. 2) We ... *(to walk)* about for half a day before we ... *(to find)* your house. 3) They ... *(to wait)* for an hour already when the taxi ... *(to arrive).* 4) Victor ... *(to feel)* tired because he ... *(to dig)* out the bushes in the garden all day. 5) Before Alice ... *(to prepare)* all the dishes, she ... *(to cook)* for four hours. 6) It... *(to snow)* for two days before the weather ... *(to change).* 7) Simon ... *(to surf)* the Internet for six hours before he ... *(to find)* the necessary information. 8) The scientists of our institute ... *(to conduct)* the research for many years

before they ... *(to discover)* a new source of energy. 9) Jack ... *(to wonder)* how long he ... *(to wait)* for Sandra. 10) Betty ... *(to stare)* at me for a few minutes before she ... *(to understand)* the meaning of my words.

LESSON VI

Text A

The GFCS is a global partnership of governments and organizations that produce and use climate information and services. It seeks to enable researchers and the producers and users of information to join forces to improve the quality and quantity of climate services worldwide, particularly in developing countries.

The GFCS seeks to build on continued improvements in climate forecasts and climate change scenarios to expand access to the best available climate data and information. Policymakers, planners, investors and vulnerable communities need climate information in user-friendly formats so that they can prepare for expected trends and changes. They need good-quality data from national and international databases on temperature, rainfall, wind, soil moisture and ocean conditions. They also need long-term historical averages of these parameters as well as maps, risk and vulnerability analyses, assessments, and long-term projections and scenarios.

Depending on the user's needs, these data and information products may be combined with non-climate data, such as agricultural production, health trends, population distributions in high-risk areas, road and infrastructure maps for the delivery of goods, and other socioeconomic variables. The aim is to support efforts to prepare for new climate conditions and adapt to their impact on water supplies, health risks, extreme events, farm productivity, infrastructure placement, and so forth.

Expanding the production, distribution and use of relevant and up-to-date climate information can best be achieved by pooling expertise and resources through international cooperation. UN agencies, regional institutions, national governments and researchers will work together through the GFCS to disseminate data, information, services and best practices. This collaboration will build greater capacity in countries for managing the risks and opportunities of climate variability and change and for adapting to climate change.

The GFCS implementation plan, to be considered by the First Session of the Intergovernmental Board on Climate Services (IBCS-1) will guide development of the information resources that are so urgently needed for building climate resilience and preparing adaptation plans. According to the draft plan, over the next two years GFCS will carry out a series of priority projects that will create partnerships and build trust with users. It will identify the demand for climate services and ensure that this demand is met through access to scientific information. It will start with the four priority sectors of health, water, food security and agriculture, and disaster risk reduction. Within six years, GFCS aims to have facilitated access to improved climate services around the world; within 10 years, services will have been provided to all climate-sensitive sectors.

The results will be an effective global partnership for identifying and meeting user needs for climate information; the effective application of climate observations, socio-economic data, models and predictions to solving national, regional and global problems; a system for transforming data into information products and services to inform decision making; and increased capacity around the world for producing and using climate services.

Who is driving the development of the GFCS?

Because climate services are a global public good, the development of the GFCS is being driven by the world's governments. For decades governments have been working together to establish scientific programmes, operational agencies and international conventions to address the diverse challenges of climate. GFCS marks a critical next step in this process. In 2009, Heads of State and Government, Ministers, and Heads of Delegations of over 150 countries and 70 organizations unanimously decided at the World Climate Conference - 3 to establish the GFCS in order to better serve society's needs for accurate and timely information on climate variability and change.

The central forum now for governments to discuss GFCS is the Intergovernmental Board on Climate Services and its subsidiary bodies. A number of United Nations agencies are fully engaged in the GFCS under the banner of "The UN System Delivering as One on Climate Knowledge."

Given the experience and expertise that many national agencies and organizations have developed in providing information, forecasts and services that are relevant to climate adaptation and response, these institutions clearly have a key role to play in guiding the GFCS.

Which nations and entities stand to benefit most from the GFCS?

Every country is vulnerable to climate variability and change, so all countries will benefit from high-quality climate information that is prepared and delivered to meet users' needs. Of course, some countries are more vulnerable than others due to their limited national capacities, their markedly volatile or difficult climate, or both. African countries, lesser developed countries, small island developing states and land-locked countries will draw particular benefit from GFCS and its associated capacity development activities.

Developing countries that experience dramatic climate variability urgently need to improve their capacity to respond to extreme events such as storms and floods as well as to longer term trends such as drought and heat waves. Through GFCS they will gain improved access to targeted and relevant data, information, best practices, and capacity building.

Countries that already struggle with climate variability tend to be particularly vulnerable to climate change. The adaptation strategies and emergency response services required for climate variability will often be essential for climate change. This is equally true for the types of data and information systems that will be required. GFCS will facilitate national efforts to address climate variability and climate change simultaneously and to integrate climate adaptation activities into sustainable development strategies.

At the same time, GFCS will benefit developed countries that already have a strong national response capacity. It will provide them with a forum for sharing data and best practices. Climate patterns do not respect political boundaries, and GFCS will facilitate cross-border and regional collaboration on adaptation activities. GFCS could also provide useful insights for ensuring that climate adaptation is incorporated into development assistance programmes. Many government agencies and organizations will find their institutional mandates and capabilities strengthened through their engagement with GFCS. They will benefit from new partnerships, improved access to data and resources, and expanded opportunities to contribute to critical national issues that are cross-cutting and linked to sustainable development.

I. Group activity. Hold a discussion in the group to broach the topics:
a) the Global Framework for climate services.
b) the development of the GPCS.
c) the countries which will benefit from the GPCS.

Text B

Which national entities should be informed or involved?

To launch the development of GFCS at the international level, the World Climate Conference - 3 succeeded in obtaining buy-in at the highest possible political level by engaging Heads of State and Government and Ministers. Expanding and maintaining this high- level political commitment is essential at the national level for building the necessary collaboration across government ministries.

This collaboration can be orchestrated through a Framework for Climate Service at the National Level. To help build and facilitate this Framework, government agencies with a potential to contribute to climate services should consider informing and involving all relevant ministries, such as those responsible for agriculture, water, environment, health, and foreign affairs. Contacts at both the leadership and working levels, through personal visits and workshops, should be initiated as soon as possible. Many contributors to and users of GFCS will be non-governmental entities, including universities, NGOs, and the media. These various contributors will have an important role both in providing information and in ensuring that services are appropriate for, and delivered to, the user communities with which they already work.

As this list of potential partners reveals, there is almost no limit to the number and kinds of national entities that could be engaged in GFCS. Setting priorities on which ones to focus on first is clearly essential. The choices could, if appropriate, be driven by the four GFCS priority areas of water management, disaster reduction, agriculture and health, taking due account of national priorities and policies, especially those for sustainable development and climate adaptation and mitigation.

What specific benefits can countries capture from participation in GFCS?

GFCS will produce a wide range of social, economic and environmental benefits. It will build on existing investments in climate observation systems and scientific research in order to produce practical information for decision making. During the first several years, GFCS will generate most of its benefits in the priority sectors of disaster risk, food security, health and water. Just a few examples of the specific benefits that could be realized include:

- Major infrastructure projects, such as water reservoirs, bridges, towns and factories, are normally expected to last for decades or longer. By anticipating future climate conditions, developers can ensure that their projects remain well suited to changes in water supplies, extreme events, and other variables shaped by climate.
- Climate information can assist water resource managers to improve their operational planning, including the allocation of supplies in the short term and the development of infrastructure needed over the long term.
- A better understanding of likely changes in the intensity and frequency of droughts or floods can guide investments in maintaining irrigation canals, building water storage towers, afforesting or reforesting hydrological basins, and so forth.
- As the climate evolves and the timing of the seasons changes, the calendar for planting and harvesting crops will change. Better climate information will make it possible to time interventions and investments more precisely, thus boosting agricultural productivity. It can also be used to monitor and predict year-to-year variations in productivity and thus serve as an early warning system for potential food shortages.
- The spread of infectious diseases such as diarrhea and malaria and of many waterborne diseases can be strongly influenced by climate. By combining climate and weather information with socio-economic data, health providers can more effectively organize vaccination campaigns and other interventions.
- As the pattern of extreme events changes, good forecasts can provide early warning of potential hazards. They can also be used to minimize vulnerability by improving land-use planning, for example to reduce exposure to land slides or to sea-level rise.
- More accurate evaluations of how climate risks and impacts will evolve could also help insurance markets to correctly price the risks posed by extreme events, sea-level rise, and wildfires, thus supporting disaster risk management and helping to ensure that insurance continues to be available.

- Looking beyond the four priority sectors, climate has a significant impact on energy demand. More accurate estimates of energy supply and demand will make it possible to anticipate future energy use and ensure that there is sufficient supply, including from renewable sources, as climate services can also be used for evaluating the longer term potential of wind and solar energy.

What might be expected of my country?

All countries are encouraged to promote climate services actively, both domestically and internationally, and to help shape the development of GFCS to ensure that GFCS meets their needs and those of the international community.

Developed countries with good capacity in climate services can share and disseminate data, expertise, and best practices. They can provide advice and assistance to other countries that are committed to establishing and sustaining their own national climate services. They are invited to strengthen their bilateral partnerships and, where feasible, to contribute in-kind and financial support.

Developing countries are encouraged to leverage their internal capacities and to build partnerships between government agencies and other institutions. It is recommended that they integrate GFCS activities into their sustainable development strategies and projects as well as their National Adaptation Programme of Action (NAPAs).

Where feasible, countries are also encouraged to report to the World Meteorological Congress and other UN forums on their GFCS-related activities, to provide experts and expertise to GFCS projects and activities, to serve on the GFCS Intergovernmental Board, and to contribute staff to the GFCS secretariat.

How should the providers and users of climate services seek to influence GFCS?

To be successful, GFCS needs to be fully country driven. Governments can influence GFCS by commenting on the draft Implementation Plan and then participating actively in the debate at the First Session of the Intergovernmental Board on Climate Service. In this way, they will not only ensure that GFCS meets their own particular national needs, but they will help to make GFCS more relevant and effective for all countries.

Just as Heads of State and Government and Ministers played a key role at WCC - 3 in launching work on GFCS, their engagement in the IBCS-1 would make an enormous difference in advancing its implementation. The decisions at IBCS-1 are of political importance because they will shape the national commitments and benefits that GFCS will generate. Coming just few months before the launches of the IPCC's Fifth Assessment Report begin, the IBCS-1 coincides with an important period on the international climate calendar.

I. **Discuss each example of the specific benefits of the Global Framework for Climate Services.**

II. **Give your own opinion of the subject.**

Text C

WHY IS CLIMATE CHANGING?

World Wide Fund for Nature (WWF) data show that our planet has lost a half of its biodiversity in he past 40 years due to anthropogenic interference and climate change.

Climate changes have been caused by human-induced carbon dioxide emissions into the atmosphere. About 2,000 researchers have been addressing this problem for about 20 years within the framework of the Intergovernmental Panel on Climate Change. This organization was awarded the Nobel Peace Prize in 2007 for research in the sphere of climate change.

These researchers also include Ukrainian experts. Academics analyze all the achievements in the field of climate change and publish a comprehensive report once in five or six years, which includes assessments and climate forecasts. The latest one was published in 2015.

The latest research shows that the level of oceans will rise owing to the melting of glaciers and small islands will soon go under water. Among other consequences are a large number of extreme weather phenomena. Droughts, tornadoes, floods, and tsunamis are in store for us.

WHAT CLIMATE CHANGES ARE AFFECTING UKRAINE?

Svitlana Krakovska, senior research associate at the Ukrainian Hydro-Meteorological Institute affiliated with the State Service for Emergencies and the National Academy of Sciences, representative of Ukraine on the IPCC, says that Ukrainians could have particularly felt climate changes in the past few 'ears.

First of all, extreme weather phenomena are on the rise. Early frosts may come after relatively high temperatures, and the plants that have already grown and even blossomed will be destroyed.

The pattern of precipitations is changing. The Ukrainians can also see a paradoxical phenomenon: droughts and extremely heavy rainfalls are on the rise at the same time. To avoid negative consequences, it s necessary, in particular, to modernize urban sewerages which are incapable now of receiving a month's ate of rainfall in a day.

The latest research in Europe shows that summer heat waves mostly affect urban dwellers, specially those who live on the uppermost stories of high-rises. And the majority of Ukraine’s population reside in the cities.

According to the Ukrainian Hydro-Meteorological Center, the average yearly temperature has risen by 0.8 degrees Celsius and the average winter temperature by almost 2 degrees Celsius in the past 20 years. These changes have already disrupted the rhythm of seasonal phenomena, such as snowfalls, springtime floods, blossoming, and duration of the vegetation period as a whole. Experts forecast further increases in yearly maximum and minimum temperatures - in other words, winters will be milder and shorter and summers longer and hotter.

This will reduce the productivity of agriculture, one of Ukraine’s most important economic sectors, and the amount of potable water, as well as increase the number of forest fires.

WILL UKRAINE BE ABLE TO SWITCH TO THE RENEWABLE SOURCES OF ENERGY?

The power-generation sector accounts for about 70 percent of carbon dioxide emissions. Nuclear and coal-fired power plants are the main pollutants of Ukraine. If this country gives them up, it will not only reduce its contribution to global pollution, but also gain energy independence.

In fact, this is the only option for us, taking into account the events in the east.

As of 2015, renewable sources accounted for a mere 4 percent of the gross final consumption of energy resources in Ukraine. This indicator was at a level of 20 percent in the world and almost the same i the European Union.

The Heinrich Boell Foundation Ukraine requested the Ukrainian Institute of Economics and Forecasting to do the necessary calculations on the basis of the information of governmental organizations and the related associations, as well as all the available research materials in Ukraine on this matter.

We can already see a steep drop in the cost of the technologies to gain solar energy. Forecasts show that the technologies of solar, wind, and geothermal energy will be dramatically falling in cost. At the same time, the cost of coal will be on the rise. All this will encourage the development of alternative power generation.

Experts concluded after longtime research that Ukraine could give up fossil fuels before 2050 and bring the share of “green energy” to meet its energy needs up to 91 percent. The details of this report were lade public in Bonn as part of the presentation of the study “Ukraine’s Transition to Renewable Power Generation before 2050.”

This transition will be made above all at the expense of solar, wind, and biomass energy. The scenario calls for investments worth 220 billion euros until 2050, which is almost twice the investments that will be made if there are no changes in the country’s energy sector. But, in reality, it is not so large an mount. For example, it will cost the state 7 billion euros to build a new nuclear power station, so this should not be done. Instead, a part of investments in renewable power generation can be made at the expense if fossil fuel purchase savings.

I. Discuss the topic:

1. **What can you say about the climate changes in Ukraine?**
2. **What are the main problems in the country?**
3. **What new technologies can save Ukraine?**

Exercise I. Rewrite the sentences in Reported Speech.

1. "Don't ever act like that again!" he said to Mike.
   ____
2. "Take off your shoes," Mother said to us.
   ____
3. "Fasten your seat belt, please," the air steward said to the passenger.
   ____
4. "Open the door at once!" the policeman said to him.
   ____
5. "Don't talk to strangers," her father said to her.
   ____
6. "Call the fire brigade immediately!" he said.
   ____
7. "Don't throw litter out of the window!" Mum said to me.
   ____
8. "Turn off the TV, Tom," his Mother said.
   ____
9. "Please, help me," the woman said to Peter.
   ____

Exercise II. Rewrite the questions in Reported Speech.

1. "Do you know how to use the Internet?" our teacher asked us.
   ____
2. "Can I go to the cinema this weekend?" she asked her mother.
   ____
3. "Why is he so late for our appointment?" Sara wondered.
   ____
4. "Has she finally decided to sail from Spain to Aus alone?" he asked.
   ____
5. "Where were you last night at the time of the burglary?" the police inspector asked me.
   ____

6. “Will you tell Harry he’s the worst detective you’ve met?” Fred asked Tim.
   ____
7. “Was he using the computer to find the secret code?” the manager asked his secretary.
   ____
8. “How did the Prince wake Sleeping Beauty up? asked Grandma.
   ____
9. “Did you go to Bill’s party last night?” asked Mark.
   ____
10. Have you ever been to Italy?” she asked me.
   ____

Exercise III. Rewrite the sentences in Reported Speech.

1. She said “I will always trust you.”
   ____
2. He said “I can’t go.”
   ____
3. He said “I can’t come to help next week.”
   ____
4. She said “I may be late tonight.”
   ____
5. She asked “Shall I tell her Tom quit?”
   ____
6. “You must hand in your homework tomorrow morning,” our teacher said to us.
   ____
7. “You must pay the bills on Monday,” Clare said to Alan.
   ____
8. She asked “What time shall we be back?”
   ____
9. She said “You must do your homework.”
   ____
10. He said “She must have forgotten.”
   ____

Exercise IV. Choose a reporting verb and turn the following from Direct into Reported Speech.

Suggest; explain; advise; warn; beg; order; refuse; promise; offer; ask.

1. “Do you know where I’ve put my hat?” he said to her.
   ____
2. “What have you bought me for Christmas?” the little boy said to his parents.
   ____
3. “Go to your room now and do your homework,” the mother said to her son.
   ____
4. “Don’t go near the fire because it’s dangerous,” she said to Ben.
   ____
5. “Let’s have steak for dinner,” June said.
   ____
6. “I promise I’ll write to you as soon as I arrive, Mary,” John said.
   ____
7. “Please, don’t shoot me!” he said to the robber.
   ____
8. “You will be paid twice a month,” her boss said.
   ____
9. “I think you should take more exercise,” the doctor said to me.
   ____
10. “I will not answer your questions,” the actor said to him.
   ____

Exercise V. Match the first part (1-10) with an appropriate reporting verb (A-J).

1. “Please give me another chance,”	A. he asked.
2. “I’m innocent of all the charges,”	B. she begged.
3. “Our team will easily beat yours,"	C. she shouted.
4. “Careful! The water’s deep!”	D. she whispered.
5. “First of all, you press the button,”	E. she threatened.
6. “If you do that again, I’ll leave,”	F. he explained.
7. “I’m now going to read out the results,”	G. he answered.
8. “Could you bring me the wine list?”	H. he boasted.
9. “Of course, I’ll bring it right away,”	I. she announced.
10. “Shhh! The baby’s sleeping,”	J. he claimed.

Exercise VI. Report the statements and questions.

1. “Did you pay the electricity bill?” he said to he wife.
   He asked his wife ____

2. "Shall I ask Sandra out for a meal?"
   Lewis wondered ____
3. "Do we have to stay here all evening?"
   Morgan asked____
4. "I was watching television when they arrived."
   Nicolas said that ____
5. "I'll be there in an hour."
   Emily says that ____
6. "Niels hadn't left when I rang an hour ago.
   Eugene said that ____
7. "Are you going out this evening?"
   Michael asked Susan____
8. "I'll love you forever."
   Peter told Greta that____
9. "Where have you been?" my brother asked me.
   My brother asked me where__________________________________
10. "Where have you left the newspaper?"
   Flora asked me____
11. "Please don't say anything to Helen."
   Catherine asked me____
12. "I've been living in Cardiff for ten years."
   Douglas says that ____

Exercise VII. Find mistakes and correct them.

1) They had arrived at the airport on time yesterday. 2) Colin was finishing his work before he went to bed. 3) Jessica had cut her finger when she was slicing the bread. 4) Sally was taking a bath for ten minutes before the water was cut off. 5) The secretary had been making copies when the photocopier broke down.
6) She washed the dishes and had poured herself a cup of tea. 7) Nick went to the swimming pool after he was watching the news. 8) While we were gathering vegetables in the garden, our mother had made an apple pie for dessert. 9) Gordon felt sleepy because he worked all night. 10) Wendy was studying management for three years before she got her diploma.

Exercise VIII. Make up sentences using the Present Continuous Passive or the Past Continuous Passive.

1) A new sports club/to build/in our town/now. 2) This bridge/to build/for two years. 3) A new song/to record/at the studio/at the moment. 4) The press conference/to hold/from 2 to 3 p.m./ yesterday. 5) The letters/to type/at the moment? 6) This project/

to discuss/at the meeting/for an hour/yesterday? 7) What film/ to show/at 6 o'clock yesterday? 8) What/to cook/for supper/ now? 9) Who/to interview/at the moment? 10) What time/the competition/to hold/yesterday?

Exercise IX. Put the verbs in brackets into the Present Continuous Passive or the Past Continuous Passive.

1) — Why didn't you phone me after the presentation yesterday? — Sorry, the phone ... *(to repair)* at that time. 2) Your shirt is dirty! Why don't you wash it? — It's impossible right now. The washing machine ... (*to fix).* 3) This church is three hundred years old. How long ... this church ... *(to build)?* — It ... *(to build)* for thirty-five years. 4) Where is the injured man? — He ... *(to examine)* by the doctor at the moment. 5) ... the windows in my room ... *(to wash)* now? — Yes, they ... . 6) She didn't know where she ... *(to take).* 7) Have they caught the thief yet? — No, the thief ... *(to chase)* at the moment. 8) Can you give me a lift? — Sorry, my car ... *(to service)* now. 9) A new assembly hall... *(to decorate)* for the party now. 10) A famous actor visited our town yesterday. He ... *(to interview)* by local journalists for more than an hour and the interview ... *(to film).*

Translate the social and political articles from the English language media (5000 p.s.)

Список літератури

1. English усі вправи з грамматики англійської мови, - Торсінг плюс, Харків, 2013, 320 с.
2. Murphy English Grammar in use. - Cambridge: “Cambridge University Press”, 1991.-325 p.
3. Oxford English-Russian Dictionary. - Cambridge: “Cambridge University Press”, 199.- 623 p.
4. Качалова К.Н., Израилевич Е.Е. Практическая грамматика английского языка с упражнениями ЮНВЕС.- М.: Русский язык, 2007.- 718с.
5. Dixson English Series. Robert V. - Dixson: “Press”, 1986. - 527 p
6. Спеціальна та наукова література сучасних газет та журналів вітчизняних та зарубіжних видань.