**Unit Two: SPACE AND TIME**

## Part I “The Solar System”

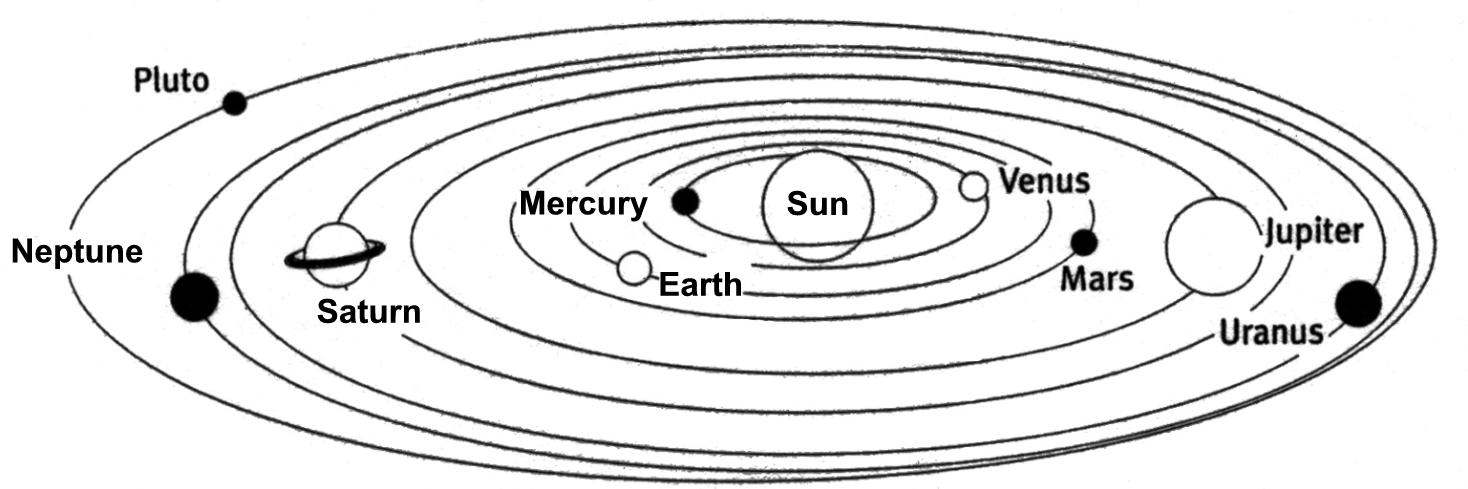
*“The sun, with all those planets revolving around it and dependent on it, can still ripen a bunch of grapes as if it had nothing else in the universe to do.”*

Galileo Galilei

Before we set off on a journey through space and time, take a few minutes and do the quiz!

## Cosmology quiz

1. How long does it take light from the sun to reach the earth?
2. 1 minute and 8 seconds;
3. 8 minutes and 18 seconds;
4. 18 minutes and 8 seconds;
5. How old is the sun?
6. 4.6 billion years;
7. 15 billion years;
8. 1 million years.
9. Which planet is the hottest?
10. Mars;
11. Mercury;
12. Venus.
13. Which of the planets, other than Earth, has an atmosphere and seasons?
14. Uranus;
15. Venus;
16. Mars.

LEAD-IN

**1. Read the introduction.**

The **Solar System** includes the Sun, eight planets, the Asteroid belt, comets, and meteors. All bodies of the Solar System are separated by enormous distances and are **visible** because they **reflect** the **sunlight**. The study of the Solar System has been developing actively since the invention of the telescope in the 17th century. In the telescope planets seem to be larger than the stars as they are closer. Almost all planets **rotate** and **revolve** in the same direction, which is **counterclockwise**, and lie in the same **plane**.

2. Try to explain each word below in pairs (use cards).

the Solar System

the Sun

the inner Solar System

the outer Solar System

the Kuiper belt

the interstellar space

a planet

an asteroid

a comet

a meteorite/meteor

the Heliosphere

the Milky Way galaxy

a collision

a spacecraft

**3. Try to match each term with its definition.**

|  |  |
| --- | --- |
| 1. solar system | 1. a very large hot ball of gas that appears as a small bright light in the sky at night |
| 1. the Sun | 1. a mass of rock that moves around in space |
| 1. a star | 1. the [planet](http://www.macmillandictionary.com/dictionary/british/planet) on which we [live](http://www.macmillandictionary.com/dictionary/british/live_1) |
| 1. a planet | 1. a star and the planets that go round it, especially the Sun and the group of planets that includes the Earth |
| 1. the Earth | 1. a very large round object that moves around the Sun or another star |
| 1. an asteroid | 1. the star in the sky that provides light and warmth to the Earth |
| 1. the asteroid belt | 1. a large piece of rock from space that passes into the Earth’s atmosphere and appears as a bright light in the sky |
| 1. a comet | 1. a bright object in space that has a tail of gas and dust |
| 1. a meteor | 1. an extremely large group of stars and planets |
| 1. a meteorite | 1. a region of space between the planets Jupiter and Mars where most asteroids are found |
| 1. a galaxy 2. a spacecraft | 1. space between the stars 2. an extended shell of icy objects that exist in the outermost reaches of the solar system; it is roughly spherical, and is the origin of most of the long-period comets |
| 1. the interstellar space | 1. a piece of rock that has fallen from space and landed on the ground |
| 1. the Kuiper belt | 1. a very small star that does not shine brightly |
| 1. The Oort Cloud | 1. a region of the Solar System beyond the planets, extending from the orbit of Neptune (at 30 AU) (Astronomical units) to approximately 50 AU from the Sun; it contains small solar system bodies made mostly of ices |
| 1. a dwarf (planet) | 1. a vehicle that can travel in space |
| 1. the Milky Way | 1. the group of planets and stars that the Earth belongs to and that you can see at night as a band of pale light across the sky |
| 1. a collision | 1. an accident in which a thing that is moving crashes into something |

LISTENING AND READING

4. Before the listening, make sure you understand the following verbs:

to grow out of

to collide

to float

to reach

to earn the name

to maintain

to establish

to fail

to demote

to stretch

to clear away

to traverse

5. Listen to or watch a video about the Solar System done by Space School project. What information was new for you?

**6. Put the abstracts from the lisening in the correct order. Listen again and check yourself.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **j** |  |  |  |  |  |  |  |  |  |

THE SOLAR SYSTEM

a) After almost 80 years Pluto lost its status as the ninth planet. The international astronomical union couldn’t ignore findings that similar, even larger bodies than Pluto, traverse the outer Solar System.

b) Finally, after millions of **collisions**, the body must have cleared away other objects from its own orbital **neighborhood**. This last point is where Pluto fails. So it’s been demoted to a **dwarf** planet and joined two other dwarves: Eris and Ceres. Astronomers believe there may be as many as 42 dwarf planets in our solar system.

c) Forced to define the word for the first time, astronomers established 3 distinct criteria to earn the name “planet”. First, the object must **orbit** the sun. Second, it must have sufficient gravity to maintain a planet’s spherical shape.

d) Pluto and beyond is not simply the beginning of endless open space but the **inner** edge of a gigantic region filled with asteroids, comets, and meteorites. Billions of miles beyond our sun stretches the Kuiper belt – an area larger than our entire planetary system. It’s home to most of our Solar System’s comets, icy flying rocks.

e) Still, despite overwhelming odds, we humans have set out on a journey of exploration. We’re sending one spacecraft after another into the **farthest** regions of the solar system all in the quest to understand our place in the Universe and the mystery of the great beyond.

f) The four planets of the outer Solar system make up 99% of the known mass orbiting the sun. It was in that distant region of the **outer** Solar system that in the year 2006 astronomy was shaken to its very core.

g) The sun’s gravity then locked them in the orbit. The Solar system is divided into two distinct regions: Mercury, Venus, Earth, and Mars make up the inner solar system, while Jupiter, Saturn, Uranus, and Neptune make up the outer Solar system.

h) There’re more than 3, 350 known comets in our Solar system. Further out, still, is the **scattered** disk, a belt of strangely orbiting objects, often small and icy minor planets. Finally, we reach the Heliosphere, an immense magnetic bubble, which forms the very outer edge of the Solar system.

i) This area is thought to be the boundary between **solar** and **interstellar** winds – the boundary between our own neighborhood and the great expanse of the interstellar space. For us the Solar system seems enormous. Its distances are almost beyond our comprehension. But incredibly it’s just a tiny corner of the giant Milky Way galaxy.

j) Today’s topic, at 4.6 bln years old, is the solar system. Its planets, including our own earth, formed out of what was left over after the birth of the sun. Amazingly, these 8 **massive** celestial bodies grew out of tiny specks of dust orbiting the new star. Time and again\*, the young planets collided while floating debris\*\* eventually reaching their current size.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\* time and again = frequently, often, many times

\*\* debris /’deibri/ or /’debri/ – fragments or remnants

**7. What was the purpose of these statements in the text? Choose one which explains each of them better.**

1. “The international astronomical union couldn't ignore findings that similar bodies traverse the outer Solar system.”
2. There are a lot of dwarf planets like Pluto.
3. Pluto was never regarded as a planet.
4. All dwarf planets are larger than Pluto.
5. All dwarf planets are outside our Solar system.
6. “Forced to define the word for the first time, astronomers established 3 distinct criteria to earn the name planet.”
7. Astronomers always wanted to find distinct criteria.
8. The status of Pluto made astronomers define distinct criteria.
9. Other bodies like Pluto forced the astronomers to define 3 criteria.
10. There used to be only 2 distinct criteria.
11. “Its planets including our own earth formed out of what was left over after the birth of the sun.”
12. All planets initially were quite big in size.
13. All planets were born from the Sun.
14. The birth of the Sun gave material for future planets.
15. All planets were formed out of pieces of rocks.

**8. Choose three statements which better summarize the content of the article.**

* The Solar system is divided into the inner and outer.
* Pluto is not a planet.
* There are more than 3350 known comets in the Solar system.
* There are some reasons why Pluto has been demoted to a dwarf planet.
* The Solar system is very old.
* The distances in space are huge.

**9. Answer the questions.**

1. Draw in your copy book (or on the blackboard) and explain the general structure of the Solar System and beyond it.
2. What are the criteria for an object to be called a planet?
3. Why Pluto is not a planet anymore?

VOCABULARY

**10. Match an adjective with its Russian translation.**

|  |  |
| --- | --- |
| gigantic | огромный |
| immense | гигантский |
| enormous | необъятный, огромный, бескрайний |
| giant | массивный |
| tiny | ошеломительный, потрясающий |
| massive | гигантский |
| overwhelming | крошечный |

**11. In cosmology there are a few adjectives of Latin and Greek origin denoting "having to do with". Complete the list of adjectives:**

Mars *Martian*

Sun \_\_\_\_\_\_\_\_\_\_\_\_

Moon \_\_\_\_\_\_\_\_\_\_\_\_

Sky \_\_\_\_\_\_\_\_\_\_\_\_

Earth \_\_\_\_\_\_\_\_\_\_\_\_

Star \_\_\_\_\_\_\_\_\_\_\_\_

**12. For each set find one word mentioned in the text The Solar System that will fit all sentences (it must be one word but may be different forms and parts of speech)**

**A.**

1. It is set in the world of the traditional fairy tale, with a cast of elves, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, trolls and goblins as well as hobbits and humans.
2. The stellar wind from the red \_\_\_\_\_\_\_\_\_\_\_\_\_\_ star removes the dust in the debris disk by causing the dust to slowly spiral into the star.
3. Jack was abnormally small because of a medical condition and everybody called him a \_\_\_\_\_\_\_\_.

**B.**

1. This is because Venus and the \_\_\_\_\_\_\_\_ orbit the Sun at a slight angle to each other.
2. They felt the \_\_\_\_\_\_\_\_ shaking beneath their feet.
3. Older electrical systems in council flats don't have \_\_\_\_\_\_\_\_wires.

**C.**

1. How many \_\_\_\_\_\_\_\_[does](http://www.macmillandictionary.com/dictionary/british/does) the [hotel](http://www.macmillandictionary.com/dictionary/british/hotel) have?
2. All the [big](http://www.macmillandictionary.com/dictionary/british/big_1) \_\_\_\_\_\_\_\_were at the [party](http://www.macmillandictionary.com/dictionary/british/party_1).
3. Have you read your \_\_\_\_\_\_\_\_[today](http://www.macmillandictionary.com/dictionary/british/today_1)? (British Informal a [horoscope](http://www.macmillandictionary.com/dictionary/british/horoscope))
4. Later, astronomers further scrutinized this \_\_\_\_\_\_\_\_with the Hubble Space Telescope.

**13. Find a synonym to the first word.**

to float: to swim slowly / to run fast / to move freely / to fly high

to maintain: to keep at the same level or condition / to become important / to be strong and stiff

to demote: to demotivate / to lose status / to deny / to make less popular

to establish: to build / to estimate / to create / to discuss

**14. Choose the most suitable words (not all!) to fill in the gaps.**

PART **A**

*plane circular giant terrestrial consists orbits outer metal gas massive ice planets*

The Solar System 1\_\_\_\_\_\_\_\_\_ of the Sun and its planetary system of eight 2\_\_\_\_\_\_\_\_, their moons, and other non-stellar objects. It formed 4.6 billion years ago from the collapse of a 3\_\_\_\_\_\_\_\_\_ molecular cloud. The vast majority of the system's mass is in the Sun, with most of the remaining mass contained in Jupiter. All planets have almost 4\_\_\_\_\_\_\_\_\_\_ 5\_\_\_\_\_\_\_\_\_ that lie within a nearly flat disc called the ecliptic 6\_\_\_\_\_\_\_\_\_\_.

PART **B**

*plane circular giant terrestrial consists orbits outer metal gas massive ice planets*

The four smaller inner planets, Mercury, Venus, Earth and Mars, also called the 1\_\_\_\_\_\_\_\_\_\_ planets, are primarily composed of rock and 2\_\_\_\_\_\_\_\_\_\_ . The four 3\_\_\_\_\_\_\_\_\_\_ planets, called the 4\_\_\_\_\_\_\_ giants, are substantially more 5\_\_\_\_\_\_\_\_\_\_\_ than the terrestrials. The two largest, Jupiter and Saturn, are composed mainly of hydrogen and helium; the two outermost planets, Uranus and Neptune, are composed largely of ices, such as water, ammonia and methane, and are often referred to separately as "6\_\_\_\_\_\_\_\_ giants".

**15. Use all the words to fill in the gaps. Do not change the form of the words.**

PART **A**: *further interstellar approximately bubble flow scattered*

The solar wind, a 1\_\_\_\_\_\_\_\_\_ of plasma from the Sun, creates a 2\_\_\_\_\_\_\_\_ in the 3\_\_\_\_\_\_\_\_ medium known as the heliosphere, which extends out to the edge of the 4\_\_\_\_\_\_\_\_ disc. The Oort cloud, which is believed to be the source for long-period comets, may also exist at a distance 5\_\_\_\_\_\_\_\_\_ a thousand times 6\_\_\_\_\_\_\_\_\_ than the Heliosphere.

PART **B**: *rotating plane counterclockwise close orbit dominates*

The principal component of the Solar System is the Sun, a G2 main-sequence star that contains 99.86 percent of the system's known mass and 1\_\_\_\_\_\_\_\_\_\_\_ it gravitationally. The Sun's four largest orbiting bodies, the gas giants, account for 99 percent of the remaining mass, with Jupiter and Saturn together comprising more than 90 percent.

Most large objects in orbit around the Sun lie near the 2\_\_\_\_\_\_\_\_\_ of Earth's orbit, known as the ecliptic. The planets are very 3\_\_\_\_\_\_\_\_ to the ecliptic while comets and Kuiper belt objects are frequently at significantly greater angles to it. All the planets and most other objects 4\_\_\_\_\_\_\_\_\_\_ the Sun in the same direction that the Sun is 5\_\_\_\_\_\_\_\_\_ (6\_\_\_\_\_\_\_\_\_\_\_\_).

**16. Use the words given in bold to form a word that fits in the space in the same line.**

|  |  |
| --- | --- |
| The Moon (or Luna) is the Earth’s only \_\_\_\_\_\_\_\_\_\_\_\_\_ satellite and was \_\_\_\_\_\_\_\_\_\_\_\_\_ 4.6 billion years ago around some 30–50 million years after the formation of the \_\_\_\_\_\_\_\_\_\_\_ system. The Moon is in synchronous \_\_\_\_\_\_\_\_\_\_\_\_\_ with Earth, meaning the same side is always \_\_\_\_\_\_\_\_\_\_\_\_\_ the Earth. The first unmanned mission to the Moon was in 1959 by the Soviet \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Program but the first \_\_\_\_\_\_\_\_\_\_\_\_\_ landing was Apollo 11 in 1969. | 1. **nature** 2. **form** 3. **sun** 4. **rotate** 5. **face** 6. **moon** 7. **man** |

WRITING

**17. Find the following phrases back in the text above. Translate them into Russian as if you were a professional translator.**

*astronomy was shaken to its very core* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*beyond our comprehension* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*set out on a journey of exploration* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*in the quest to understand our place* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*despite overwhelming odds* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**18. Translate the text into Russian.**

**The Sun**

The Sun is the star at the centre of our solar system. It lies about 150 million km (or 8.3 light minutes) away from Earth and has a diameter of 1,391,000 km (864,300 miles). The Sun's composition is almost three-quarters hydrogen, roughly one-quarter helium (by mass), while heavier elements make up less than 2 per cent.

The Sun generates energy by nuclear fusion of hydrogen in its core. Heat moves out to the ‘photosphere' where the sunlight we see originates. Beyond that a thin 'corona' expands outwards to form the solar wind, a stream of particles that constantly blows out into space. Sunspots are temporary, relatively cool patches on the Sun where magnetic fields have suppressed heat transfer to the surface.

The Sun formed from a collapsing gas cloud about 4.57 billion years ago. Around 5 billion years from now, it will expand into a red giant star, its outer layers engulfing the planets Mercury, and Venus, and possibly the Earth. Eventually, it will shrink into a hot and dense white dwarf.

**Task 19. Translate the text into English.**

**Heliosphere**

Гелиосфера — область околосолнечного пространства, в которой [плазма солнечного ветра](https://ru.wikipedia.org/wiki/%D0%A1%D0%BE%D0%BB%D0%BD%D0%B5%D1%87%D0%BD%D1%8B%D0%B9_%D0%B2%D0%B5%D1%82%D0%B5%D1%80) движется относительно [Солнца](https://ru.wikipedia.org/wiki/%D0%A1%D0%BE%D0%BB%D0%BD%D1%86%D0%B5) со [сверхзвуковой скоростью](https://ru.wikipedia.org/wiki/%D0%A1%D0%B2%D0%B5%D1%80%D1%85%D0%B7%D0%B2%D1%83%D0%BA%D0%BE%D0%B2%D0%B0%D1%8F_%D1%81%D0%BA%D0%BE%D1%80%D0%BE%D1%81%D1%82%D1%8C). Извне гелиосфера ограничена [бесстолкновительной ударной волной](https://ru.wikipedia.org/w/index.php?title=%D0%91%D0%B5%D1%81%D1%81%D1%82%D0%BE%D0%BB%D0%BA%D0%BD%D0%BE%D0%B2%D0%B8%D1%82%D0%B5%D0%BB%D1%8C%D0%BD%D0%B0%D1%8F_%D1%83%D0%B4%D0%B0%D1%80%D0%BD%D0%B0%D1%8F_%D0%B2%D0%BE%D0%BB%D0%BD%D0%B0&action=edit&redlink=1), возникающей в солнечном ветре из-за его взаимодействия с[межзвёздной плазмой](https://ru.wikipedia.org/w/index.php?title=%D0%9C%D0%B5%D0%B6%D0%B7%D0%B2%D1%91%D0%B7%D0%B4%D0%BD%D0%B0%D1%8F_%D0%BF%D0%BB%D0%B0%D0%B7%D0%BC%D0%B0&action=edit&redlink=1) и [межзвёздным магнитным полем](https://ru.wikipedia.org/w/index.php?title=%D0%9C%D0%B5%D0%B6%D0%B7%D0%B2%D1%91%D0%B7%D0%B4%D0%BD%D0%BE%D0%B5_%D0%BC%D0%B0%D0%B3%D0%BD%D0%B8%D1%82%D0%BD%D0%BE%D0%B5_%D0%BF%D0%BE%D0%BB%D0%B5&action=edit&redlink=1).

Первые 10 миллиардов километров скорость [солнечного ветра](https://ru.wikipedia.org/wiki/%D0%A1%D0%BE%D0%BB%D0%BD%D0%B5%D1%87%D0%BD%D1%8B%D0%B9_%D0%B2%D0%B5%D1%82%D0%B5%D1%80) составляет около миллиона километров в час. По мере того, как он сталкивается с [межзвёздной средой](https://ru.wikipedia.org/wiki/%D0%9C%D0%B5%D0%B6%D0%B7%D0%B2%D1%91%D0%B7%D0%B4%D0%BD%D0%B0%D1%8F_%D1%81%D1%80%D0%B5%D0%B4%D0%B0), происходит его торможение и смешение с ней. Граница, на которой происходит замедление солнечного ветра, носит название границы ударной волны; граница, вдоль которой уравновешивается давление солнечного ветра и межзвёздной среды, носит название гелиопаузы; граница, на которой происходит столкновение межзвёздной среды с набегающим солнечным ветром — [головная ударная волна](https://ru.wikipedia.org/wiki/%D0%93%D0%BE%D0%BB%D0%BE%D0%B2%D0%BD%D0%B0%D1%8F_%D1%83%D0%B4%D0%B0%D1%80%D0%BD%D0%B0%D1%8F_%D0%B2%D0%BE%D0%BB%D0%BD%D0%B0).

### PRESENTATION: PLANETS

**20.** Choose one object of the Solar System and give a short presentation about it touching upon the following characteristics (see the table below). Your time limit is 4 minutes + 1 min for questions.

**21.** Copy the table into your copy book. Listen to every presentation and fill in the blocks where possible. Afterwards you will be given a short test on this material.

|  |  |  |  |
| --- | --- | --- | --- |
| **Mercury**  **Neptune**  **Mars** | **Uranus**  **Saturn**  **Jupiter** | **Earth**  **Venus**  **Sun** | **Pluto \***  **Moon \*** |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Distance/  Order from  the Sun | When was  discovered,  by who | Size | Weight | Composition,  color | Atmosphere | Satellites | Orbit,  rotation, revolution | Interesting fact |
| Mercury |  |  |  |  |  |  |  |  |  |
| Neptune |  |  |  |  |  |  |  |  |  |
| Mars |  |  |  |  |  |  |  |  |  |
| Uranus |  |  |  |  |  |  |  |  |  |
| Saturn |  |  |  |  |  |  |  |  |  |
| Jupiter |  |  |  |  |  |  |  |  |  |
| Earth |  |  |  |  |  |  |  |  |  |
| Venus |  |  |  |  |  |  |  |  |  |
| Pluto |  |  |  |  |  |  |  |  |  |
| Moon |  |  |  |  |  |  |  |  |  |
| Sun |  |  |  |  |  |  |  |  |  |

MINI-GRAMMAR: ARTICLES

**22. Explain the use of articles (the, a/an, zero) in the following extract.**

(1) The heliosphere is (2) the immense magnetic bubble containing our (3) solar system, (4) solar wind, and (5) the entire solar magnetic field. It extends well beyond (6) the orbit of Pluto. While (7) the density of (8) particles in the heliosphere is very low (it's (9) a much better vacuum than is created in (10) a laboratory), it is full of particles of (11) interest to (12) heliospheric scientists. Check out (13) the image below for (14) a diagram of the heliosphere.

**23. Use articles (the, a/an, zero) where necessary.**

When (1) \_\_\_ solar winds hit (2) \_\_\_ local interstellar medium, (3) \_\_\_ kind of (4) \_\_\_ bubble forms that prevents (5) \_\_\_ certain material from getting in. Thus, (6) \_\_\_ heliosphere acts as (7) \_\_\_ kind of (8) \_\_\_ shield that protects (9) \_\_\_ our solar system from (10) \_\_\_ cosmic rays, which are (11) \_\_\_ dangerous interstellar particles. (12) \_\_\_ interaction between interstellar gas and (13) \_\_\_ solar winds depends on (14) \_\_\_ pressure of (15) \_\_\_ solar winds and properties of interstellar space, such as (16) \_\_\_ pressure, (17) \_\_\_ density, and qualities of (18) \_\_\_ magnetic field. (19) \_\_\_ astronomers believe that (20) \_\_\_ other solar systems have (21) \_\_\_ their own heliospheres caused by (22) \_\_\_ different stars.

**24. Test yourself.**

1. What is the solar system? How did the solar system form?
2. How old is the solar system? How big is the solar system?
3. How many planets are there in our solar system? Can you see any planets with the "naked eye?"
4. Which planets are called the "rocky" or "terrestrial" planets? Which planets are called the "gaseous" planets?
5. What is the hottest planet in our solar system? What planet is famous for its big red spot on it?
6. Which planets have rings? How thick are these rings?
7. Ganymede is a moon of which planet?
8. What is the name of Saturn’s largest moon?
9. Olympus Mons is a large volcanic mountain on which planet?
10. Is the planet Neptune bigger than Earth?
11. What is a comet? How did comets form? Why do comets have tails? Where do comets come from? What path do comets follow through the solar system?
12. What is the difference between a meteor, a meteoroid, a meteorite, an asteroid and a comet? What is the asteroid belt?

## Part II “The Universe”

*"The universe is wider than our views of it."*

Henry David Thoreau

LEAD-IN

**Cosmology** (from the Greek *kosmos* "world" and -*logia* "study of") isthe branch of astronomy that deals with the evolution and structure of the Universe. Physical cosmology is the scientific study of the origin, evolution, large-scale structures and dynamics, and ultimate fate of the universe, as well as the scientific laws that govern these realities.

READING

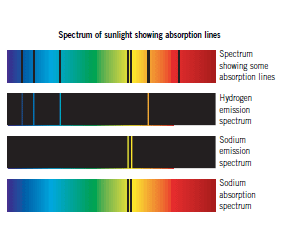
**1. Read the text. In Para 7 all sentences are mixed. Put them in the right order.**

THE BIG BANG

**Red-shift**

For visible light, red has the longest wavelength and violet the shortest. If the wavelength is longer than expected this is called a **red-shift**.

If a source of waves is moving away the wavelength appears longer. A red-shift in the light from a star shows that the distance between us and the star is increasing. The bigger the red-shift, the faster the star is moving away.



[1] **Cosmology** is the search for origins. The origin of the universe remains one of the greatest questions in science.

[2] According to **the Big Bang** theory, our **Universe** came into being as an infinitesimally small, infinitely hot, infinitely dense, something – a "singularity" around 13.7 billion years ago. Singularities are zones of infinite density that are thought to exist at the core of black holes, which are areas of intense gravitational pressure. In the first second after the Universe began, the surrounding temperature was about 5.5 billion Celsius. After its initial appearance, it apparently inflated (the "Big Bang"), expanded and cooled, going from very, very small and very, very hot, to the size and temperature of our current universe. It continues to expand and cool to this day and we are inside of it.

[3] The Big Bang theory is the result of several important observations.  In 1927, Edwin Hubble first observed that:

* The light from all the distant galaxies is red-shifted.
* The further away the galaxy the bigger the red-shift.

This means:

* All the distant galaxies are moving away from us.
* The further away the galaxy, the faster it is moving away.

[4] We would not see these patterns in the red-shifts just because we, or the galaxies, are moving through space, but it is what we would see if space was expanding.  
This is why scientists think we live in an expanding Universe. The Universe is everything that exists. There is nothing outside the Universe – not even empty space.

[5] If the Universe is expanding, then one can assume that the galaxies that compose our Universe were once much closer together than they are now.  By simply measuring how far apart galaxies are and how fast they are moving, we determine the [Hubble Constant](http://btc.montana.edu/ceres/html/Universe/hnought.htm) (estimates range from 50 to 100 km/s per kiloparsec\*). The Hubble Law states that the recessional velocity\*\* of a distant galaxy is proportional to its distance from us. It is very easy to determine the recessional velocity of galaxies; on the other hand, their current positions are difficult to measure.  The distance to the galaxy is quite hard to measure, but can be estimated from its apparent angular size or by the brightness of objects in it such as supernovae.

[6] If we run the expansion process backward, we get two results.

* The first is that it probably took approximately 15 billion years for the Universe to grow to its present size.
* Second, the Universe must have begun its expansion in an awesome event that astronomers call the Big Bang.

[7] 1\_\_The Big Bang Theory started as a hypothesis – a suggested explanation created to account for the data. 2\_\_It was the CMBR. 3\_\_The Big Bang Theory was the only theory that could account for it, so this evidence led to the theory being accepted by most scientists. 4\_\_Scientists then used it to make a prediction. 5\_\_It would come from all parts of the Universe. 6\_\_Scientists called this the **cosmic microwave background radiation** (CMBR). 7\_\_They said that the Big Bang would have produced radiation that, by now, would be found in the microwave region\*\*\* of the spectrum. 8\_\_They were using a radio telescope and could not account for an annoying microwave signal that seemed to come equally from all directions. 9\_\_Scientists began searching for the CMBR and in 1965 two scientists, Arno Penzias and Robert Wilson, discovered it accidently.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\* A distance of 1000 parsecs (3262 light-years) is commonly denoted by the kiloparsec (kpc). Distances expressed in parsecs (pc) include distances between nearby [stars](http://en.wikipedia.org/wiki/Star).

\*\* Recessional velocity can be calculated according to the formula:

v = H_0 D\ 

where H_0 is the [Hubble constant](http://en.wikipedia.org/wiki/Hubble_constant), D is the distance, and v is the recessional velocity, generally measured in km/s.

\*\*\* Microwave region - микроволновый диапазон, диапазон сверхвысоких частот

**2. Try to match each term with its definition.**

|  |  |
| --- | --- |
| Recessional velocity | 1. an exploding star that produces an extremely bright light |
| The Hubble constant | 1. a belief that there was an explosion 15 billion years ago which caused the universe to begin to exist |
| parsec | 1. the study of the origin and nature of the universe |
| Supernova | 1. the speed of [receding](http://www.oxforddictionaries.com/definition/english/recede#recede__2) or moving away from an [observer](http://www.oxforddictionaries.com/definition/english/observer#observer__2). |
| Cosmology | 1. A unit of distance used in astronomy, equal to about 3.26 light years (3.086 × 1013 kilometres) |
| a radio telescope | 1. a very large piece of equipment that receives and records the radio waves that come from stars and other objects in space |
| The Big Bang theory | 1. The ratio of the speed of recession of a galaxy (due to the expansion of the universe) to its distance from the observer. |
| Singularity | 1. the [force](http://www.macmillandictionary.com/dictionary/british/force_1) that [causes](http://www.macmillandictionary.com/dictionary/british/cause_1) [objects](http://www.macmillandictionary.com/dictionary/british/object_1) to move towards each other |
| Gravitation | 1. the process of increasing in size and filling more space |
| Expansion | 1. the [quality](http://www.macmillandictionary.com/dictionary/british/quality_1) of being [unusual](http://www.macmillandictionary.com/dictionary/british/unusual) |
| Black hole | 1. an area in outer space where the force of gravity is so strong that light and everything else around it is pulled into it |

**3. Identify the reason.**

1. Why does the author say that the origin of the universe is one of the greatest questions in science? (Para 1)
2. The Big Bang theory is still unclear.
3. There are many other theories explaining the origin of the universe.
4. Even Edwin Hubble could not resolve this problem.
5. The name of Edwin Hubble is mentioned in Para 3 because:
6. He had the most powerful telescope at that time.
7. He used his knowledge about the physics of visible light.
8. He created the Hubble constant.
9. According to Para 7, the Big Bang theory was accepted by most scientists because:
10. Everybody respected the opinion of Penzias and Wilson.
11. Scientists predicted long time ago that the Big Bang theory was the only right theory.
12. Penzias and Wilson discovered some evidence to prove the theory.

**4. Decide if these statements are true or false.**

1. If a source of waves is moving away, the wavelength appears shorter.
2. The only thing that exists outside the Universe is empty space.
3. The further away the galaxy, the slower it is moving away.
4. It is believed that the galaxies composing the Universe used to be much closer together than they are now.
5. Cosmic microwave background radiation didn’t prove the Big Bang theory.

**5. Choose three statements which better summarize the content of the article.**

* The Big Bang theory is one the most reliable theories explaing the origin of the universe.
* The Hubble Law is very complicated.
* The theory was developed not at once.
* Stephen Hawking have made a great contribution to the development of the Big Bang theory.
* The Big Crunch must follow the Big Bang at some point of time in the future.
* The theory was based not only on theoretical knowledge, but also on practical observations.

**6. Answer the questions.**

1. What is a red-shift?
2. What relationship exists between the speed of the galaxies moving apart and their initial distance from one another? Name this Law.
3. What is harder for the astronomer to measure: a galaxy's red-shift (indicating recessional velocity) or its distance from Earth?
4. How long ago was the Big Bang?
5. What did the Big Bang Theory predict that scientists started to search for?
6. Why is it believed that we live in an expanding Universe?

VOCABULARY

**7. Match the words with their explanations.**

|  |  |
| --- | --- |
| 1. to account for (something) | 1. the rate or speed at which an object is moving away, typically from Earth |
| 1. to expand | 1. to the same degree |
| 1. a pattern | 1. clear to understanding, open to view |
| 1. recessional velocity | 1. to give reasons for, to explain |
| 1. current | 1. to make or become greater in extent, volume, size, or scope; increase |
| 1. equally | 1. a star that explodes catastrophically due to instabilities of its nuclear fuel or gravitational collapse |
| 1. apparent | 1. a form or model proposed for imitation |
| 1. supernova (pl -*ae*) | 1. most recent; up-to-date |

**8. Complete the sentences using correct forms of the following words:**

*to account for (something), to expand, pattern, recessional velocity, current, equally, apparent, supernovae.*

1. What is your opinion of the \_\_\_\_\_\_\_\_\_\_\_ state of modern art, in this country and internationally?
2. \_\_\_\_\_\_\_\_\_ is measured by distance from the Earth multiplied by the [Hubble constant](http://en.wikipedia.org/wiki/Hubble_constant).
3. A great proportion of primary cosmic rays comes from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. From the beginning, it was \_\_\_\_\_\_\_\_\_\_ that she was not an ordinary child.
5. Both features allow you to specify a \_\_\_\_\_\_\_\_ that controls the form of data.
6. It is \_\_\_\_\_\_\_\_ important to install these updates, especially for web applications.
7. The liquid \_\_\_\_\_\_\_\_\_\_ and contracts with changes in temperature.
8. How do you \_\_\_\_\_\_\_\_\_\_\_ the fact that the amount of particles is still rising?

**9. For each set find one word mentioned in the text that will fit all sentences (it must be one word but may be different forms and parts of speech)**

**A.**

1. The time of the annihilation process is much less than the period of one \_\_\_\_\_\_\_\_\_\_\_.
2. It’s a spacious, clean, kitchen outfitted with every appliance from \_\_\_\_\_\_\_\_\_\_\_to dish washer
3. Such a signal has harmonics at 1-MHz intervals throughout the \_\_\_\_\_\_\_\_\_\_\_region, all of which have the same phase at the reference intervals.

**B.**

1. It is fun to see a pirate tavern where the bar fights are just the \_\_\_\_\_\_\_\_\_\_\_background noise.
2. Her best friend and \_\_\_\_\_\_\_\_\_\_\_companion is Brent.
3. Since its differences are the same as the Fibonacci series differences, we can add or subtract a \_\_\_\_\_\_\_\_\_\_\_to the Fibonacci series.
4. The diffraction \_\_\_\_\_\_\_\_\_\_\_for the diffractometer was calculated using a grating with 0.1 turn spacings.

**C.**

1. There was only £50 in his [bank](http://www.macmillandictionary.com/dictionary/british/bank_1) \_\_\_\_\_\_\_\_\_\_\_.
2. [Electronic](http://www.macmillandictionary.com/dictionary/british/electronic) [goods](http://www.macmillandictionary.com/dictionary/british/goods) \_\_\_\_\_\_\_\_\_\_\_for over 30% of our [exports](http://www.macmillandictionary.com/dictionary/british/export_1).
3. I have two \_\_\_\_\_\_\_\_\_\_\_on Facebook: my personal one and for business.
4. The [increase](http://www.macmillandictionary.com/dictionary/british/increase_1) in [carbon](http://www.macmillandictionary.com/dictionary/british/carbon) dioxide [emissions](http://www.macmillandictionary.com/dictionary/british/emission) may \_\_\_\_\_\_\_\_\_\_\_for [changes](http://www.macmillandictionary.com/dictionary/british/change_1) in the [climate](http://www.macmillandictionary.com/dictionary/british/climate).
5. The [study](http://www.macmillandictionary.com/dictionary/british/study_1) [aims](http://www.macmillandictionary.com/dictionary/british/aim_1) to give an \_\_\_\_\_\_\_\_\_\_\_of [modern](http://www.macmillandictionary.com/dictionary/british/modern) [attitudes](http://www.macmillandictionary.com/dictionary/british/attitude) towards [democracy](http://www.macmillandictionary.com/dictionary/british/democracy).

**D.**

1. Rudolfo [works](http://www.macmillandictionary.com/dictionary/british/work_1) the [day](http://www.macmillandictionary.com/dictionary/british/day) \_\_\_\_\_\_\_\_\_\_\_.
2. The [government](http://www.macmillandictionary.com/dictionary/british/government) has \_\_\_\_\_\_\_\_\_\_\_its [attention](http://www.macmillandictionary.com/dictionary/british/attention) [away](http://www.macmillandictionary.com/dictionary/british/away_1) from the [fight](http://www.macmillandictionary.com/dictionary/british/fight_1) against [crime](http://www.macmillandictionary.com/dictionary/british/crime_1).
3. The [wall](http://www.macmillandictionary.com/dictionary/british/wall_1) is \_\_\_\_\_\_\_\_\_\_\_a [couple](http://www.macmillandictionary.com/dictionary/british/couple_1) of [centimeters](http://www.macmillandictionary.com/dictionary/british/inch_1) every [year](http://www.macmillandictionary.com/dictionary/british/year).
4. [Just press](http://www.macmillandictionary.com/dictionary/british/press_1) a \_\_\_\_\_\_\_\_\_\_\_key on a computer [keyboard](http://www.macmillandictionary.com/dictionary/british/keyboard_1) when you [want](http://www.macmillandictionary.com/dictionary/british/want_1) to [write](http://www.macmillandictionary.com/dictionary/british/write) a [capital](http://www.macmillandictionary.com/dictionary/british/capital_1) [letter](http://www.macmillandictionary.com/dictionary/british/letter).

**10. Find a synonym to the first word.**

Infinitely: continuously / very much / always / with no limit

Current: electrical / high-quality / present-time / fast

To account for: to count money / to be the reason for / to prove smth / to detect

**11. Use the words given in bold to form a word that fits in the space in the same line.**

|  |  |
| --- | --- |
| The 20th century was a boon for cosmology. \_\_\_\_\_\_\_\_\_\_ with Einstein, scientists now believed in an \_\_\_\_\_\_\_\_\_\_ expanding universe based on the rules of \_\_\_\_\_\_\_\_\_\_. Edwin Hubble then \_\_\_\_\_\_\_\_\_\_ the scale of the universe by proving that “spiral nebulae” observed in the night sky \_\_\_\_\_actually other galaxies. By showing how they were red \_\_\_\_\_\_\_\_, he also demonstrated that they were moving away, proving that the \_\_\_\_\_\_\_\_ really was \_\_\_\_\_\_\_\_\_\_. This in turn, led to the Big Bang theory which put a starting point to the universe and a \_\_\_\_\_\_\_\_\_\_ end. | 1. **begin** 2. **finite** 3. **relative** 4. **demonstration** 5. **be** 6. **shift** 7. **unity** 8. **expansion** 9. **possibility** |

**12. Translate the text into English.**

**Dark Energy**

In 1996, observations of very distant supernovae required a dramatic change in the picture. It had always been assumed that the matter of the Universe would slow its rate of expansion. Mass creates gravity, gravity creates pull, the pulling must slow the expansion. But supernovae observations showed that the expansion of the Universe, rather than slowing, is accelerating. Something, not like matter and not like ordinary energy, is pushing the galaxies apart. This "stuff" has been dubbed [dark energy](http://science.nasa.gov/astrophysics/what-is-dark-energy), but to give it a name is not to understand it. Whether dark energy is a type of dynamical fluid, heretofore unknown to physics, or whether it is a property of the vacuum of empty space, or whether it is some modification to general relativity is not yet known.

LISTENING: DARK MATTER

**13. Read the introduction.**

All the stars in a spiral galaxy rotate around a center – but to astronomers, the speed that each star travels wasn't making sense. Why didn't stars slow down toward the edges as expected? Don Lincoln explains how a mysterious force called dark matter is (possibly) the answer – and why the search for an answer matters.

**14. Make sure you understand these phrases:**

* this observation was devastating
* to move leisurely
* galaxies should have torn themselves apart
* other options have been ruled out

**15. Listen to or watch the video and answer the questions. Only one answer is correct. Read the questions first.**

*1) The fact that we can see so many spiral galaxies using our telescopes tells us that they are both:*

A spontaneous and short-lived

B common and stable

C hot and dangerous

D magnetic and bright

*2) Stars at which distance from the center of the galaxy move the fastest according to predictions?*

A Those closest to the center

B Those in the middle

C Those on the outer edge

D All the stars move at the same speed

*3) The observation that the stars located far away from the center of a galaxy move too quickly was devastating because scientists began to doubt:*

A Newton’s Theory of Gravity

B Theory of Motion

C mathematical calculations of mass of galaxies

D all mentioned above

*4) What's the best description of dark matter?*

A A watery substance that surrounds most galaxies that is unaffected by gravity and visible to visible light and all other form of electromagnetic radiation

B A vacuum that surrounds some galaxies that is affected by gravity and invisible to ultraviolet light and most other form of electromagnetic radiation

C A cloud that surrounds most galaxies that is affected by gravity and invisible by visible light and all other form of electromagnetic radiation

D A weighty dust that surrounds most galaxies that is affected by gravity and visible to visible light and most other form of electromagnetic radiation

*5) Which is not true about dark matter?*

A Its name comes from its inability to emit or absorb light

B It adds to the mass of the galaxy it surrounds

C It has not yet been directly observed

D The dark matter hypothesis has been proved beyond all reasonable doubt

**16. Test yourself.**

1. How old is the universe? How big is the universe? In what sense is the universe expanding?
2. What is a galaxy? Where is the Earth in the Milky Way galaxy?
3. What is the closest galaxy like our own, and how far away is it?
4. Galaxy names are identified by a group of letters and numbers. What do they stand for?
5. Why do astronomers study galaxies in ultraviolet light?
6. How do astronomers measure the distances to galaxies?
7. Who is Edwin P. Hubble and what has he to do with galaxies?
8. What are constellations?
9. Has Hubble found planets around other stars?
10. How is the color of a star cluster linked to its age?
11. What is a supernova, and what can it tell us about the universe?

MINI-GRAMMAR

PASSIVE AND ACTIVE VOICE

**Forms of passive**

The passive voice is not a tense itself. But for transitive verbs each tense, as well as other verb forms such as infinitives and participles, can be produced in the passive voice. Some of the more complicated tenses (mostly perfect continuous) are rarely used in the passive, but they are possible.

The universal formula of the passive is:

|  |
| --- |
| **(TO BE) + V3** |

Here are some examples of the passive voice with many of the possible forms using the verb *break*:

|  |  |
| --- | --- |
| infinitive | *to be broken* |
| perfect infinitive | *to have been broken* |
| participle | *broken* |
| perfect participle | *having been broken* |
| gerund | *being broken* |

INFINITIVE FORMS

|  |  |  |
| --- | --- | --- |
| **Tense** | **Active** | **Passive** |
| Present Simple  Present Continuous  Present Perfect  Present Perfect Continuous\* | (to) give  (to) be giving  (to) have given  (to) have been giving | (**to) be given**  **(to) be being given**  **(to) have been given**  **(to) have been being given** |

**The Passive Voice is used:**

1. when the agent is unknown or unimportant (деятель неизвестен, неважен)

*A big company will build an experimental solar power plant in the Australian desert. → An experimental solar power plant* ***will be built*** *in the Australian desert.*

1. when the agent is obvious from the context or from general knowledge (деятель очевиден)

*The professor delivers lectures on physics on Friday mornings. → The lectures on physics are delivered on Friday mornings.*

1. when the speaker does not want to mention the agent to be more polite in a formal situation (из вежливости в формальной ситуации деятель не упоминается)

*Will you grant our application for a new stage of experiments? →* ***Will*** *our application for a new stage of experiments* ***be granted****?*

1. to be vague about who is responsible, or not to blame a specific person (не обвинять конкретного человека, расплывчато говорить о деятеле)

*John has made mistakes on this project. → Mistakes* ***have been made*** *on this project.*

1. to report impersonal or general feelings, opinions, beliefs, decisions (выражать общие ощущения, мнения, решения)

*They report that she came back. → She* ***is reported to*** *have come back.*

*People think that Newton was a great scientist. → Newton* ***is thought to*** *be a great scientist.*

*We expect you to complete the project. → You****are expected to*** *complete the project. → We expect the project* ***to be completed****. → The project****is expected to be completed****. (double passive)*

1. to focus on the topic more, not the agent (делать упор не на деятеля, а больше на действие)

*Researchers at the University of Toronto first discovered insulin in 1921. → Insulin****was first discovered*** *in 1921 by researchers at the University of Toronto.*

1. to describe rules, processes, methods and procedures (при описании правил, процессов, методов, процедур)

*The sodium hydroxide* ***was dissolved*** *in water. This solution* ***was*** *then* ***titrated*** *with hydrochloric acid.*

***Note!***

*Over the past several years, there has been a movement within many science disciplines away from passive voice. Scientists often now prefer active voice in most parts of their published reports, even occasionally using the subject "we" in the scientific research papers.*

**The Passive Voice is NOT used:**

1. with intransitive verbs, that is the verbs that do not take an object (с непереходными глаголами)

*We****arrived****to the conference very late. ~~We were arrived to the conference very late.~~****Did****you****sleep****well? ~~Were you slept well?~~  
The plane* ***has landed****. ~~The plane has been landed.~~*

1. with certain state verbs even if they are transitive (с некоторыми переходными глаголами выражающими состояние)

*belong принадлежать, have* иметь (own, possess)*, lack не иметь достаточно, be быть, pretend притворяться, seem казаться, resemble напоминать, suit подходить, appear казаться)*.

*Joanne****has****two major articles. ~~Joanne is had two major articles.~~****Does****this theory****belong to****you?**~~Is this theory belonged to you?~~  
The test* ***seems*** *to be quite difficult. ~~The test is seemed to be quite difficult.~~*

1. with active verbs with a passive meaning (с активными глаголами в пассивном значении)

*The company's new phone****doesn't sell****as well as the last one. (телефон не продаётся)  
The sign on the door****read****"No entry". (знак читается как, говорит нам)  
The trousers have been mended, and now the hole****doesn't show****. (дырка не заметна, не видна)*

1. with certain verbs followed by (object) + infinitive/bare infinitive, such as *want (him to leave), refuse (to leave), let (him leave)* etc. (некоторые глаголы в составе инфинитивной конструкции)

*The teacher* ***let*** *us do the experiment. ~~The teacher was let us do the experiment.~~*

*I* ***refuse*** *to answer your question. ~~Your question is refused to answer.~~*

1. with *have + noun* to describe an action, e.g*. have a shower, have lunch, have a good time etc.* (глагол have выражающий действие, а не состояние)

*John* ***is having*** *lunch. ~~Lunch is being had by John.~~*

**17. Identify the passive form of the verb and translate into Russian.**

1. Methods employed in solving a problem are strongly influenced by the research objective.
2. As data are changed, how are outputs affected?
3. This paper was shortly followed by another by the same author.
4. Any statement which must be referred to by any other statement in the program must be identified by a "statement number".
5. The inward component is not affected by any of these treatments.
6. These rules were arrived at independently.
7. Often objects can be defined and dealt with independent of their parameters.
8. A printer gets assigned temporally to a user as his own whilst he uses it.
9. Mercury becomes contaminated and cannot be reused.
10. The output gets subtracted from the input signal.

## Part III “Space Exploration”

*“God not only plays dice, but also sometimes throws them where they cannot be seen.”*

Stephen Hawking, 1977

LEAD-IN: DISCUSSION

1. What is your opinion of science fiction series and films like ET, Alien, Star Trek, Star Wars?
2. Have you ever taken an astronomy course? If so, tell about something you learned. Have you ever used a telescope? What did you look at?
3. Would you like to be an astronaut? Why or why not?
4. When do you think people will visit Mars? What do you think they will find there?
5. Methods of finding out about the Solar System and what is beyond it are: to use telescopes both ground-based and in orbit, to send unmanned space probes, to send manned spacecrafts. In your opinion, which method is the most dangerous? the cheapest? the most effective?



LISTENING: THE INTERVIEW WITH STEPHEN HAWKING

**1. Answer the questions.**

Do you know who Stephen Hawking is?

Do you think people will destroy the Earth one day? How will that happen?

Do you believe that people may die out just like dinosaurs?

Is it now possible for people to move to another planet?

**2. Listen to or watch a video of an interview with Stephen Hawking\* recorded on March 7, 2008 and answer the following questions.**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\* Stephen Hawking is a British theoretical physicist, cosmologist, and author. Despite being almost completely paralyzed and communicating through a speech generating device, Hawking remains one of the world's foremost theoretical physicists and has contributed greatly to our understanding of the universe.

**Questions:**

1. What is going to be the greatest achievement of scientists since the Theory of Relativity?

2. What does Stephen Hawking worry about?

1. about the future of the Universe because it can explode one day
2. about the life on Earth because people can destroy themselves
3. about the future of the Universe because it will continue to grow forever
4. about the life of the human race because there wouldn’t be enough resources on Earth

3. What does human survival depend on?

4. What should people do by the end of this century?

1. invent the Theory of Everything and it will make life easier
2. find another place to live beside Earth

5. What is the problem that people are not solving efficiently nowadays?

1. inventing the Theory of Everything
2. climate change
3. finding life on Mars
4. researching the Dark matter and energy

6. Does Stephen Hawking believe that people are going to survive?

READING: SPACE EXPLORATION

#### 3. Discuss in pairs

Would you like to travel in space?

Do you believe that people can inhabit other planets in the future?

Can you imagine leaving Earth forever to live on another planet?

#### 4. Before reading, match the words with their definitions.

|  |  |
| --- | --- |
| a crew | occurring before or in preparation |
| preliminary | the owner or manager of a business |
| feasible | a vehicle used for exploring the surface of a moon, planet, etc. |
| a rover | the amount of goods or material that is carried by a vehicle |
| an entrepreneur | being good, appropriate or relevant for a specific purpose |
| to expose | to leave (something) without covering or protection |
| payload | to consist of |
| applicable | a group of people assigned to a particular job or type of work |
| to be comprised of | possible, probable |

**5. Read the text. In Para 2 all sentences are mixed. Put them in the right order.**

# A BRIEF HISTORY OF SPACE EXPLORATION

[1] Humans have dreamed about spaceflight since antiquity. As often happens in science, the earliest practical work on rocket engines designed for spaceflight occurred simultaneously during the early 20th century in three countries by three key scientists: in Russia, by Konstantin Tsiolkovski; in the United States, by Robert Goddard; and in Germany, by Hermann Oberth.

[2] 1\_\_ Four years later on April 12, 1961, Russian Lt. Yuri Gagarin became the first human to orbit Earth in Vostok 1. 2\_\_ His flight lasted 108 minutes. 3\_\_ After World War II, the United States and the Soviet Union created their own missile programs. 4\_\_ In the 1930s and 1940s Nazi Germany saw the possibilities of using long-distance rockets as weapons. 5\_\_ On October 4, 1957, the Soviets launched the first artificial satellite, Sputnik 1, into space.

[3] Landing a man on the moon was a national goal set by American president John Kennedy in 1961. He said: "We choose to go to the Moon, not because it is easy, but because it is hard”. On July 20, 1969, Amerian astronaut Neil Armstrong took “a giant step for mankind” as he stepped onto the moon.

# MISSION TO MARS

[4] Many people have been thinking of a manned mission to Mars as the next logical step after lunar exploration. Mars has always been a source of inspiration for explorers and scientists. Robotic missions have found evidence of water, but if life exists beyond Earth still remains a mystery. Scientific robotic missions have shown that Mars has characteristics and a history similar to Earth's, but we know that there are striking differences that we have yet to begin to understand. Humans can build upon this knowledge and look for signs of life and investigate Mars' geological evolution, resulting in research and methods that could be applied here on Earth.

[5] **Preliminary** work for missions to the red planet has been undertaken since the 1950s, and over the last century a number of mission concepts for such an expedition have been proposed. For example, in 2011 Russian and European space agencies successfully completed the ground-based MARS-500, the biomedical experiment simulating manned flight to Mars.

[6] In 2012, a Dutch **entrepreneur** group revealed plans of a fund-raising campaign for a human Mars base to begin in 2023. In other words, Mars One's goal is to establish a human settlement on Mars for exploring, working and living there. However, it would be a "one-way" mission, i.e.\*, there will be no return trip to Earth. Astronaut applications were invited from the ordinary people all over the world. The search for astronauts began in April 2013. More than 200,000 registered for the first selection program. Mars One is now selecting and training the human **crew** for settlement.

[7] The mission **is comprised of** the following primary hardware components.

Launcher. Several rocket launches will be needed to take **payloads** into Earth orbit and then onto Mars. Payload may be satellites, rovers, cargo or humans.

Mars Transit Vehicle. Human crew will travel through space for around seven months. On reaching Mars the crew in their Marssuits will descend to the surface in the landing module.

Rovers. Two Rovers will be sent to Mars to set up the outpost before the humans arrive. One of them will explore the surface of Mars in search of the most suitable location for the settlement.

Mars Suit. All astronauts must wear their Marssuits when **exposed** to the Mars atmosphere. Marssuits protect astronauts from extreme temperatures, the very thin, non-breathable atmosphere, and otherwise harmful radiation.

Communications System. The communications system will consist of two communications satellites and Earth ground stations. It will transmit data from Mars to Earth and back.

Mars Landing capsule. Mars One Landers will be equipped to perform different functions as carrying Life Support Units (that generate energy, water and breathable air for the settlement), Supply Unit (with food, solar panels, spare parts and other components), Living Units, Humans to the surface of Mars, Rovers to the surface of Mars.

[8] While being complex, the Mars One Mission is **feasible**. The science and technology required to place humans on Mars exists today. Much of what was learned from Skylab, Mir and the International Space Station has resulted in vital data, experiences with systems and related know-how – all of which are **applicable** to living on Mars.

[9] Mars is the stepping stone of the human race on its voyage into the universe. Human settlement on Mars will increase our understanding of the origins of the solar system, the origins of life and our place in the universe. As with the Apollo Moon landings, a human mission to Mars will inspire generations to believe that all things are possible, anything can be achieved.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\* i.e. /ai i:/ = abbreviation for id est (Latin for that is; in other words)

**6. Read the text and decide if these statements are true or false.**

#### MARS-500 mission has already sent a few people to Mars.

#### Mars One Mission is a non-profit organization.

#### More than 200,000 people will take part in the mission.

#### Traveling to Mars will take less than a year.

#### Mars One Mission is too complex and almost impossible to implement.

#### 7. Complete the table with the name of the hardware component or its description.

|  |  |
| --- | --- |
| **Name** | **Description** |
| Rover |  |
|  | protecting astronauts from extreme temperatures, non-breathable atmosphere |
|  | taking payloads into Earth orbit and then onto Mars |
| Mars Transit Vehicle |  |
|  | transmitting data from Mars to Earth and back |
| Mars Landing capsule |  |

#### 8. Identify the purpose.

1. By saying "We choose to go to the Moon, not because it is easy, but because it is hard”, Kennedy meant that:
2. going to the Moon was a real challenge and they tried to deal with it
3. the USA must be the first in Moon exploration
4. it was impossible to go the Moon
5. the USA was the only country which could do that
6. A fund-raising campaign for a human Mars base means that:
7. candidates for the flight will receive a salary
8. investors donate money to the project
9. the CEO of the Mars One project will receive a salary
10. “Mars is the stepping stone of the human race on its voyage into the universe” means:
11. Exploring Mars is a very hard, difficult task.
12. Nations all over the world are trying to compete and win the space race.
13. The exploration of Mars will help us to move forward.

**9. Identify the reason.**

1. In Para 9 the author calls Mars a “stepping stone” because:
2. it will help us to learn more about space
3. it will make people more interested in space
4. it will make people dream more about incredible things
5. all of the above
6. In Para 7 the author described the hardware parts of the mission:
7. to show that there are only a small amount of things needed
8. to prove that their theoretical plan is very well thought-out
9. for the reader to know that the mission is not as simple as it may seem
10. In Para 2 the main idea was:
11. Russia set a record in space exploration
12. scientists all over the world shared their knowledge with each other at those times
13. world conflicts have initiated the development of space programs
14. the USA set a record in space exploration

**10. Choose three statements which better summarize the content of the article.**

* A lot of people are interested in manned missions to other planets.
* It will take scientists a lot of time and efforts to create all necessary technologies for the project.
* Only Dutch people have produced an interesting idea connected with Mars exploration.
* The Soviet Union sent the first man into space.
* For the mission to succeed, they must have a certain set of equipment.
* Mars One seems to be possible at this stage of development.

#### 11. Answer the questions.

1. What are the main events in the history of space exploration?

#### Why do many people support the idea of a manned mission to Mars?

#### What is so special about Mars One Mission?

#### Who can take part in the mission?

#### What functions does Landing Capsule have?

#### Why are Mars Suits necessary?

#### Why is Mars One Mission feasible?

VOCABULARY

**12. Find a synonym to the first word.**

an entrepreneur: an entrance / a leader / a businessman / a financial consultant

to apply: to fly / to manage / to use / to buy

to launch: to be in a lounge / to start / to create/ to have lunch

**13. For each set find one word mentioned in the text that will fit all sentences (it must be one word but may be different forms and parts of speech)**

**A.**

1. She left home in 1993 and hasn’t been seen \_\_\_\_\_\_\_\_ .
2. \_\_\_\_\_\_\_\_ there’s no more business, we can all go home.
3. He had been composing music \_\_\_\_\_\_\_\_ he was ten years old.

**B.**

1. [People](http://www.macmillandictionary.com/dictionary/british/people_1) were [sitting](http://www.macmillandictionary.com/dictionary/british/sitting) on the \_\_\_\_\_\_\_\_ in [small](http://www.macmillandictionary.com/dictionary/british/small_1) [groups](http://www.macmillandictionary.com/dictionary/british/group_1).
2. He [believes](http://www.macmillandictionary.com/dictionary/british/believe) he has [reasonable](http://www.macmillandictionary.com/dictionary/british/reasonable) \_\_\_\_\_\_\_\_ for [making](http://www.macmillandictionary.com/dictionary/british/making) the [demand](http://www.macmillandictionary.com/dictionary/british/demand_1).
3. He has \_\_\_\_\_\_\_\_ the washing machine with a special wire.
4. I love the [smell](http://www.macmillandictionary.com/dictionary/british/smell_1) of \_\_\_\_\_\_\_\_ [coffee](http://www.macmillandictionary.com/dictionary/british/coffee).

**C.**

1. Clubs, [diamonds](http://www.macmillandictionary.com/dictionary/british/diamond), [hearts](http://www.macmillandictionary.com/dictionary/british/heart_1), and [spades](http://www.macmillandictionary.com/dictionary/british/spade) are the four \_\_\_\_\_\_\_\_.
2. The [after-school](http://www.macmillandictionary.com/dictionary/british/after-school) [programme](http://www.macmillandictionary.com/dictionary/british/programme_1) \_\_\_\_\_\_\_\_ the [needs](http://www.macmillandictionary.com/dictionary/british/need_1) of most of the [children](http://www.macmillandictionary.com/dictionary/british/children).
3. The [family](http://www.macmillandictionary.com/dictionary/british/family_1) [filed](http://www.macmillandictionary.com/dictionary/british/file_2) a \_\_\_\_\_\_\_\_ against the [hospital](http://www.macmillandictionary.com/dictionary/british/hospital) for [a](http://www.macmillandictionary.com/dictionary/british/negligence) doctor’s mistake.
4. Mitchell [wears](http://www.macmillandictionary.com/dictionary/british/wore) a \_\_\_\_\_\_\_\_ and [tie](http://www.macmillandictionary.com/dictionary/british/tie_1) in the office all the time.

**14. Use the words given in bold to form a word that fits in the space in the same line.**

|  |  |
| --- | --- |
| Human spaceflight (also referred to as \_\_\_\_\_\_\_\_\_ spaceflight) is space travel with a crew \_\_\_\_\_\_\_\_\_ the spacecraft. When a spacecraft is crewed, it can be operated \_\_\_\_\_\_\_\_\_\_\_\_, as opposed to being remotely operated or \_\_\_\_\_\_\_\_\_\_\_\_\_.  The first \_\_\_\_\_\_\_\_\_ spaceflight was launched by the Soviet Union on 12 April 1961 as a part of the Vostok program, with \_\_\_\_\_\_\_\_\_ Yuri Gagarin aboard. Humans have been \_\_\_\_\_\_\_\_\_ present in space for 14 years and 292 days on the \_\_\_\_\_\_\_\_\_ Space Station. | 1. **man** 2. **board** 3. **direct** 4. **auto** 5. **man** 6. **cosmos** 7. **continue** 8. **nation** |

RESEARCH PAPER WRITING: AIMS AND RESULTS

**A. Expressing aims**

|  |  |  |
| --- | --- | --- |
| **Key word** | **Useful phrases** | **Comment** |
| **goal** | *to accomplish, achieve a goal; to have smth as a goal* |  |
| **intention** | *with the intention of Ving; have no intention of Ving/to V* | verb: *to intend to do smth* |
| **motive** | *motive for Ving* | general noun: *motivation* |
| **objective** | *to meet, achieve objectives; main/primary objective* | what you plan to do |
| **priority** | *top priority; to set/establish/identify priorities* | a list of important things |
| **purpose** | ***for the purpose of Ving*** | *on purpose* = deliberately |
| **strategy** | *to develop, follow, plan a strategy* | detailed plan for success |
| **target** | *to achieve, reach a target* | level or situation you want to achieve |
| **aim** | *to achieve /fulfill your aims* | the thing that you hope to achieve by doing something |

**B. Developing ideas**

|  |  |  |
| --- | --- | --- |
| **Key word** | **Useful phrases** | **Comment** |
| **hypothesis** | *to be based on a hypothesis; to formulate, to confirm a hypothesis* | plural form: *hypotheses* |
| **research** | *to do, conduct, carry out research; research on/into* | uncountable (no “a” article, no plural form: *Her latest work confirms the findings of earlier* *~~researches~~.)* |
| **definition** | *a clear definition; to broaden/widen a definition* | verb: *to define* |
| **method** | *an effective /efficient method; to apply, develop, provide, use a method* |  |
| **criteria** | *to meet, fulfill criteria* | the plural form of  *criterion*  is  *criteria* |
| **application** | *practical application* |  |
| **contribution** | *to make a contribution to smth; a great, important, significant, useful contribution* | verb: *to contribute* |
| **problem** | *to solve a problem* |  |
| **issue** | *to raise an issue; a big, controversial issue about/around* |  |
| **challenge** | *to face a challenge* | adjective: *challenging*;  verb: to challenge |

**C. Analyzing results**

Academic texts often include sections which deal with the analysis of data. In analyzing a controversial issue, the writer may need to **come to / reach a conclusion** about the **advantages** and **disadvantages** of a particular **course of action**. The writer may, for instance, conclude that the **benefits outweigh** the **drawbacks** or vice versa. An analysis may be a matter of **weighing up** both **sides of an argument, taking into account** all the **relevant aspects** of the issue and discussing all the **points** **raised** by the research. When analyzing the results of a scientific experiment, the writer is likely to need to **take into consideration** a range of **variables**. In their analysis scientists try to **deduce** as much as they can from their data, **drawing conclusions** that are **soundly** **based** on their results.

**15. Match a key phrase from the text above with its explanation.**

|  |  |
| --- | --- |
| **Key words** | **Explanation** |
| course of action (1) | 1. are of more importance than |
| to outweigh (2) | 1. completely, firmly |
| drawbacks (3) | 1. consider |
| to weigh up (4) | 1. disadvantages |
| relevant aspects (5) | 1. idea, opinion or piece of information that has been presented in relation to the topic |
| points (6) | 1. important parts, features (of a problem or situation) |
| variables (7) | 1. number, amount or aspect of a situation which can change |
| to deduce (8) | 1. reach an answer by thinking carefully about the known facts |
| soundly (9) | 1. think carefully about |
| to take into account (10) | 1. way of doing something |

**16. Here are some other sentences relating to analyses. Translate them into Russian using explanations in brackets.**

1. The survey provided some useful **insights into** the problem. [points that help us to understand more clearly]
2. The results **point to** an interesting trend. [show, indicate]
3. **On the basis of** the application data we would **predict** continuing interest of perspective students in astrophysics. [say something will happen in the future]
4. We found that women **constitute** 70% of the workforce in the university. [account for]
5. We began with a **critical** review of the scientific literature in the field. [giving opinions]
6. We are reaching a **critical** period in terms of global climate change. [very important]
7. The astronaut is in a **critical** condition. [serious]

**17. Complete the expressions with a word which can combine with all the words given.**

1. \_\_\_\_\_\_\_\_\_\_ moment / review / comments
2. come to / draw / reach a \_\_\_\_\_\_\_\_\_\_
3. come down on one / be in favor of one / see both \_\_\_\_\_\_\_\_\_\_ (s) of an argument

**18. Introduce your current research paper. Write in short about its aim and main ideas using phrases from sections A and B.**

WRITING: FOR AND AGAINST ESSAY

**19. Write an essay concerning the topic.**

*No human has landed on Mars to this day. Why should Mars One succeed? Is it best to send unmanned space probes or a manned mission to find out about Mars?*

**Use the plan:**

Paragraph 1: introduce the question and express your point of view

to accomplish, achieve a goal

to have smth as a goal

to meet /achieve objectives

the main/primary objective

to set/establish/identify priorities

to develop a strategy

to achieve/ reach a target

to achieve /fulfill your aims

Paragraph 2: mention that the problem is controversial and present a few ideas that you do not support/disadvantages (see useful phrases below)

Paragraph 3 (+/- 4): present ideas that you support/advantages, provide a few examples if possible

to be based on a hypothesis

to formulate, to confirm a hypothesis

to do/ conduct/ carry out research on

to apply, develop an effective method

to meet/ fulfill criteria

practical application

to make a contribution to smth

to solve a problem

to raise an issue

a big, controversial issue

to face a challenge

Paragraph 5: analyze the results and write a conclusion (see useful phrases below)

to come to / reach a conclusion

advantages and disadvantages

benefits outweigh the drawbacks

to weigh up both sides of an argument

to take into account the points raised

to take into consideration a range of variables

to draw conclusions

Look through some ideas to help you build your own opinion. **Do not plagiarize them!**

|  |  |
| --- | --- |
| **For a manned mission** | **Against** |
| * humans would easily be able to outperform robotic explorers in precision and accuracy * humans are intelligent creatures – less time to analyze data * unmanned mission must be planned and programmed thoroughly a long time ahead – no possible changes on the way * unmanned missions do not inspire people * people want to gain popularity and fame | * cost less money * a manned mission could contaminate Mars by introducing earthly microbes * we have a lot of information about Mars without human travelling there * harmful conditions would kill humans * limitation of food, water and other supplies * low gravity of Mars would affect humans’ organism * instant cosmic rays and radiation * instabilities of psychological state of isolated humans |

## Part IV “Future Transportation”

*“It is said that there's no such thing as a free lunch. But the universe is the ultimate free lunch.”*

Alan Guth, 1947

#### LEAD-IN

#### 1. Discuss the questions:

What do you think is a space elevator and how could it be used?

How do you think a space elevator would work?

What technical challenges would it face?

How seriously do you think the concept of space elevators is being taken at present?

#### READING

Photo courtesy LiftPort Group: satellite at GEO

#### http://static.ddmcdn.com/gif/space-elevator-2.jpgSpace Elevators

[1] When the Space Shuttle Columbia lifted off on April 12, 1981, from Kennedy Space Center, to begin the first **space shuttle** mission, the dream of a **reusable** spacecraft was realized. Since then, NASA has launched more than 100 missions, but the price of space missions has not changed. Whether it is the space shuttle or the non-reusable Russian spacecraft, the cost of a **launch** is approximately $22,000 per kg.

[2] But many years prior to these events, in his 1979 novel, *The Fountains of Paradise*, Arthur C Clarke had written about an elevator **connecting** the earth's surface to space. Three decades later, this science-fiction concept is preparing to take off in the real world. NASA has launched the Space Elevator Challenge, a competition with a generous prize, and several teams and companies are working on serious research projects aimed at winning it.

[3] As its name suggests, a space elevator is designed to **raise** things into space. **Satellites**, components for space ships, supplies for astronauts in space stations, and even astronauts themselves are examples of payloads that could be **transported** into orbit without the need for explosive and environmentally unfriendly rockets. A new space transportation system like this could make travel to geostationary Earth orbit (GEO) a daily event and transform the global economy. As researchers predict, **space elevator** would be able to carry cargo and humans into space at a price of only about $220-$880 per kg.

[4] However, the altitude of orbital space – a colossal 35,790 km above the earth – is a measure of the challenge facing engineers. How could such a height be reached? The answer is by using an incredibly strong and lightweight **cable**, strong enough to **support** its own weight and a heavy load. It would be **attached** to a **base station** on earth at one end and a satellite in geostationary orbit (fixed above a point on the equator) at the other. Lift vehicles would **ascend** and **descend** the cable, **powered** by electromagnetic force and **controlled** remotely. The design of such a cable is still largely theoretical but current material that could be used for this purpose is **carbon nanotubes**.

[5] Carbon nanotubes have the potential to be 100 times strongerthan **steel** and are as **flexible** asplastic. The strength of carbon nanotubes comes from their unique structure. Once scientists are able to make **fibers** from carbon nanotubes, it will be possible to create **threads** that will form the **ribbon** for the space elevator.

[6] A ribbon could be built in two ways. First, long carbon nanotubes -- several meters long or longer -- would be braided into a structure resembling a rope. As of 2005, the longest nanotubes are still only a few centimeters long. The second way is to place shorter nanotubes in a polymer matrix. Current polymers do not bind well to carbon nanotubes, which results in the matrix being pulled away from the nanotubes when placed under tension. The ribbon would serve as the tracks of a sort of railroad into space. Mechanical lifters would then be used to climb the ribbon to space.

[7] The space elevator could replace the space shuttle as the main space vehicle, and be used for [satellite](http://science.howstuffworks.com/satellite.htm) deployment, defense, [tourism](http://science.howstuffworks.com/space-tourism.htm) and further exploration. To the latter point, a spacecraft would climb the ribbon of the elevator and then would launch toward its main target once in space. This type of launch would require less fuel than would normally be needed to break out of Earth's atmosphere. Some designers also believe that space elevators could be built on other planets, including Mars.

**2. Try to give a definition for each term. You may use the text or a dictionary.**

* space elevator
* cable
* base station
* satellite
* geostationary orbit
* lift vehicles
* carbon nanotubes

**3. Choose three statements which better summarize the content of the article.**

* Geostationary orbit is the place for most earth’s artificial satellites.
* Shuttles are reusable but still very expensive.
* Space elevators would be much more efficient than space shuttles.
* The concept of a space elevator in not as new as it may seem.
* The only technological challenge is to create a long ribbon made of carbon nanotubes.
* There are two ways to build a ribbon.

**4. Answer the questions.**

1. Why space shuttles are not very effective?
2. How did the idea of a space elevator appear?
3. What is a space elevator? Tell about its components.
4. How will the system work?
5. What materials must be used?
6. How could a ribbon be built?
7. How could a space elevator be used in the future?

VOCABULARY

**5. Match the verbs from the text to its synonym.**

|  |  |
| --- | --- |
| 1. connecting 2. raise 3. transported 4. support 5. attached 6. ascend 7. descend 8. powered 9. controlled 10. ribbon | a) carried (objects, over a distance)  b) hold something firmly / bear its weight  c) climb down  d) provided with energy / moved by a force  e) joining  f) driven / have movement directed  g) flat cable  h) climb up  i) lift / make something go up  j) fixed |

**6. For each set find one word mentioned in the text that will fit all sentences (it must be one word but may be different forms and parts of speech)**

**A.**

1. Find out why METRO Cash & \_\_\_\_\_\_\_\_\_\_\_ is the world wholesale leader.
2. British [police](http://www.macmillandictionary.com/dictionary/british/police_1) [officers](http://www.macmillandictionary.com/dictionary/british/officer) don’t [normally](http://www.macmillandictionary.com/dictionary/british/normally) \_\_\_\_\_\_\_\_\_\_\_[guns](http://www.macmillandictionary.com/dictionary/british/guns).
3. It is a [cable](http://www.macmillandictionary.com/dictionary/british/cable) \_\_\_\_\_\_\_\_\_\_\_[electricity](http://www.macmillandictionary.com/dictionary/british/electricity) to [nearby](http://www.macmillandictionary.com/dictionary/british/nearby_1) [homes](http://www.macmillandictionary.com/dictionary/british/home_1).

**B.**

1. He has [amazing](http://www.macmillandictionary.com/dictionary/british/amazing) \_\_\_\_\_\_\_\_\_\_\_of [concentration](http://www.macmillandictionary.com/dictionary/british/concentration).
2. [China](http://www.macmillandictionary.com/dictionary/british/china) has become a [major](http://www.macmillandictionary.com/dictionary/british/major_1) [economic](http://www.macmillandictionary.com/dictionary/british/economic) \_\_\_\_\_\_\_\_\_\_\_in Asia.
3. A [new](http://www.macmillandictionary.com/dictionary/british/new) [vehicle](http://www.macmillandictionary.com/dictionary/british/vehicle) is \_\_\_\_\_\_\_\_\_\_\_by [gas](http://www.macmillandictionary.com/dictionary/british/fuel_1).
4. [Solar](http://www.macmillandictionary.com/dictionary/british/solar) \_\_\_\_\_\_\_\_\_\_\_is an environmentally friendly type of energy.

**C.**

1. Our [head](http://www.macmillandictionary.com/dictionary/british/parent) [company](http://www.macmillandictionary.com/dictionary/british/company) is \_\_\_\_\_\_\_\_\_\_\_in Osaka.
2. A \_\_\_\_\_\_\_is one of the four [places](http://www.macmillandictionary.com/dictionary/british/place_1) on a [baseball](http://www.macmillandictionary.com/dictionary/british/baseball) that a [player](http://www.macmillandictionary.com/dictionary/british/player) must [touch](http://www.macmillandictionary.com/dictionary/british/touch_1) in [order](http://www.macmillandictionary.com/dictionary/british/order_1) to [score](http://www.macmillandictionary.com/dictionary/british/score_1) [points](http://www.macmillandictionary.com/dictionary/british/points).
3. The [statue](http://www.macmillandictionary.com/dictionary/british/statue) [stands](http://www.macmillandictionary.com/dictionary/british/stand_1) on a [large](http://www.macmillandictionary.com/dictionary/british/large) round \_\_\_\_\_\_\_\_\_\_\_.

**7. Use the words given in bold to form a word that fits in the space in the same line.**

|  |  |
| --- | --- |
| Cable section  \_\_\_\_\_\_\_\_\_\_\_\_\_\_ , the main technical problem has been considered the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cable to hold up, with tension, the weight of itself below any given point. The greatest \_\_\_\_\_\_\_\_\_\_\_\_\_\_ on a space elevator cable is at the point of \_\_\_\_\_\_\_\_\_\_\_\_ orbit, 35,786 km (22,236 mi) above the Earth's equator. This means that the cable material must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_ enough to hold up its own \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the surface up to 35,786 km (22,236 mi). A cable which is thicker in cross section at that \_\_\_\_\_\_\_\_\_\_\_\_\_\_ than at the surface could better hold up its own \_\_\_\_\_\_\_\_\_\_\_\_\_\_ over a longer \_\_\_\_\_\_\_\_\_\_\_\_\_\_ . How the cross section area tapers from the maximum at 35,786 km to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the surface is therefore an important design factor for a space \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cable. | 1. **history** 2. **able** 3. **tense** 4. **station** 5. **strength** 6. **weigh** 7. **high** 8. **weigh** 9. **long** 10. **minimize** 11. **elevate** |

**8. James, an engineer, is preparing a talk on space elevators. Look at his short notes and complete them with a missing word.**

**Space Elevators**

Challenge of connecting a 1)\_\_\_\_\_\_\_\_\_\_\_\_\_ to earth by cable is significant.

To support its own weight, and be securely 2)\_\_\_\_\_\_\_\_\_\_\_\_\_ at each end, cable would need phenomenal strength-to-weight ratio.

How could vehicles be 3)\_\_\_\_\_\_\_\_\_\_\_\_\_ into space, up cable?

Self-contained energy source problematic, due to 4)\_\_\_\_\_\_\_\_\_\_\_\_\_ (heavy fuel or batteries required to power vehicle).

Two possible ways round problem:

First. Transmit electricity 5)\_\_\_\_\_\_\_\_\_\_\_\_\_. But technique is only at 6)\_\_\_\_\_\_\_\_\_\_ stage.

Second. Solar power. But would only allow vehicle to 7)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ slowly. Not necessarily a problem, as car could be controlled 8)\_\_\_\_\_\_\_\_\_\_\_\_\_, allowing it to transport 9)\_\_\_\_\_\_\_\_\_\_\_\_\_ unmanned.

LISTENING

**9. Now listen to James’s presentation. Compare your version with his.**

LISTENING AND WRITING: NOTES

**10. Some space elevator designs propose an offshore base station. In pairs discuss how such a system might work using words in this module. What advantages might an offshore base have compared with a land base (onshore)?**

**11. James goes on to discuss offshore base stations. Listen to the talk and answer the following questions.**

\*anchor – якорь

1. How would an offshore base station be supported?
2. What would the function of its anchors be?
3. How would payloads reach the base station?
4. What problem would a mobile base station help to prevent?
5. What would the procedure be if there was an alert?

**12.** You are members of a space elevator research team designing a concept for offshore base stations. In pairs, analyze the notes below, discuss the questions raised in the notes, and think of some suitable solutions for the anchoring system and the propulsion system. At this stage, these should be overall concepts, not detailed designs.

Notes:

*Anchors?*

*Propulsion?*

*Strong winds?*

*How to move the base fast?*

*How to stop the base and fix its position in water?*

*In deep water or near the cost?*

**13. In small groups, take turns to give a short talk using your notes to explain how the systems work, in general terms. Imagine you are speaking to a small group of colleagues, including your manager.**

**14. Write two or three paragraphs to summarize your talk.**

SPEAKING

**15. Express your opinion.**

1. When the first rockets were sent up into space, or the first manned flights started, it was big news. Nowadays, unless associated with a tragedy, space-related news seems to be old hat. Why do you think that is?
2. Nowadays space tourism is just starting up. How would you feel if you won a trip to the international space station?
3. What do you think about the value of space exploration?
4. Can you think of any inventions or benefits which have resulted from space exploration?
5. In what ways would the world be different if there were no satellites in orbit around the earth?
6. What do you think of the idea that we could escape into space if (or when) the earth becomes uninhabitable for whatever reason?

**Unit 2 Vocabulary List**

|  |  |
| --- | --- |
| (inter)stellar  a crew  a fund-raising campaign  a plane (not an airplane)  a rover  a satellite  a stepping stone  an entrepreneur  an outpost  anchor  apparent  applicable  approximately  as a whole  bubble  bulk  celestial  clockwise  considerable  counterclockwise  criterion (pl criteria)  critical  current  drawback  dwarf (pl dwarves)  enormous  far-fa/urther -the fa/urthest  feasible  giant  immense  large/small-scale  lunar  massive  objective  offshore/onshore base station  on the basis of  payload  preliminary (work, results)  reasonable  recessional velocity  ribbon  rope | scattered (disk)  significant  solar  spacecraft  substantial  supernova (pl supernovae)  terrestrial  thread  to accomplish a goal  to account for (something)  to achieve your aims/ a target/a goal  to apply a method  to ascend  to attach  to be comprised of  to come to / draw a conclusion  to descend  to develop a strategy  to do, conduct, carry out research  to expand  to expose  to face a challenge  to float  to formulate a hypothesis  to fulfill your aims  to make a contribution  to meet an objective  to meet criteria  to orbit (smth)  to outweigh  to point to smth  to raise an issue  to reach a target  to revolve  to rise-rose-risen  to rotate  to set/establish priorities  to solve a problem  to stretch  to take into account/consideration  to weigh up both sides of an argument  variables |

**Topics for speaking:**

1. The Solar System
2. The Big Bang
3. The Red-Shift
4. Dark Matter and Energy
5. Mars Exploration
6. Space Elevators