UNIT 4

THE ENDLESS UNIVERSE?

"The Earth is just too small and fragile a basket for the human race to keep all its eggs in it."

Robert Heinlein

Learning Objectives

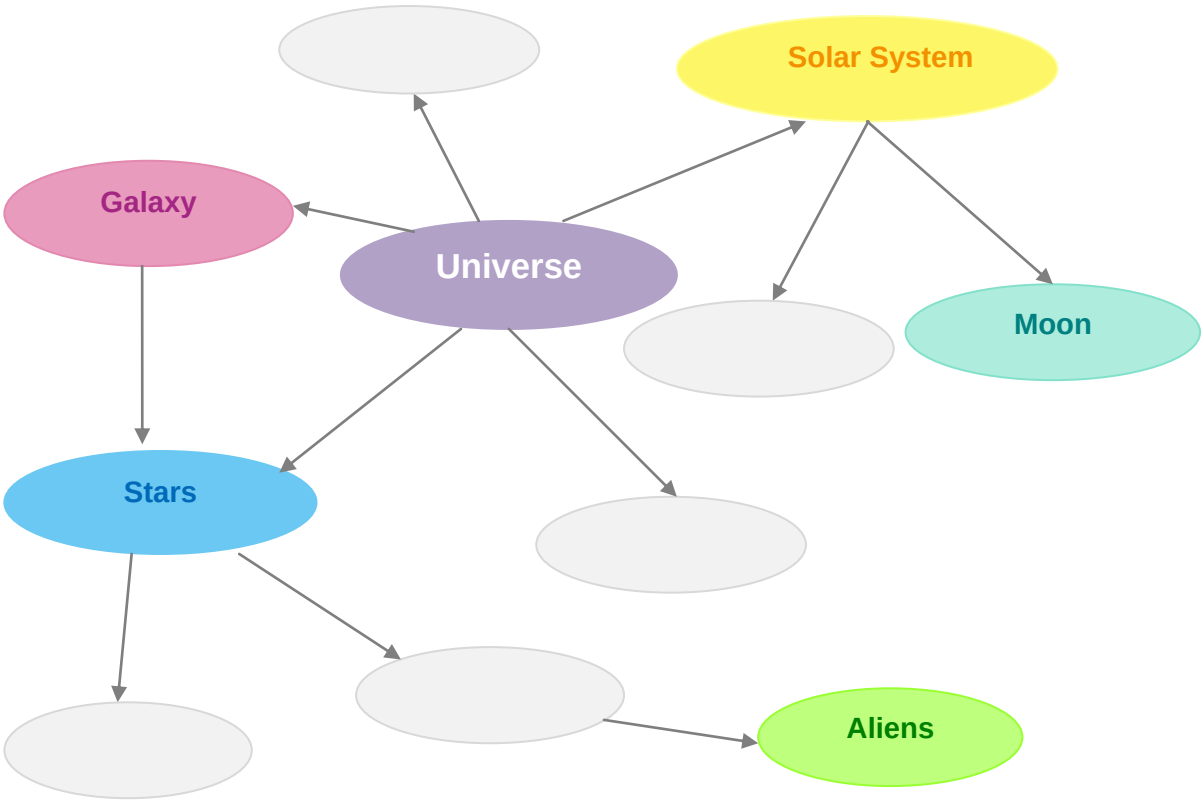
In this unit you will:

- ✓ learn the terms connected with the study of the Universe
- ✓ revisit conditional sentences
- ✓ make use of key words for efficient reading
- ✓ learn how to deliver an oral presentation
- ✓ talk about the exploration of the Universe
- ✓ write a description of the Astrophysics department for a university Prospectus

LEAD IN

1. **Work in groups. Read the definition of the 'Universe' and brainstorm as many ideas associated with this word as you can. Fill in the diagram and comment on how the ideas are connected.**

Universe ['juːnɪvɜːs] n – all space and everything that exists in it; all the stars, planets, their satellites, etc.



2. **What fields of science study the Universe?**
3. **Do you know any outstanding scientists who have studied the Universe?**
4. **What important discoveries in the study of the Universe can you name? In pairs make up a list of discoveries and compare your lists as a class.**

List of discoveries:

- ✓ Halley comet
- ✓ Black holes
- ✓ .....
- ✓ .....

READING

1. **Match the headings (*A-J*) to the texts (1-9). There is one extra heading that you don't need to use.**

A. Something "Dark"

B. "Dark" Side of the Universe Expansion

C. End of Evolution?

D. Dealing with Physical Properties

E. From Primitive to Complex

F. Does Getting Closer Always Mean Friendly?

G. Explosion Leading to Creation

H. It Studies the Universe as a Whole

I. An Endpoint or a Birth?

J. Based on Knowledge from Various Fields

Study help

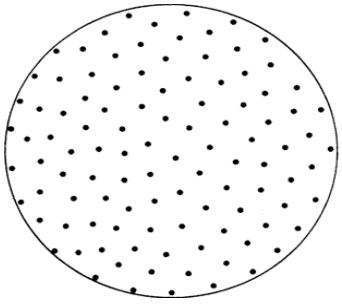
Follow these steps so that you can match the correct heading to each extract:

- read through the list of the headings
- skim all the extracts
- look for topic sentences and key words in each extract
- select the right heading

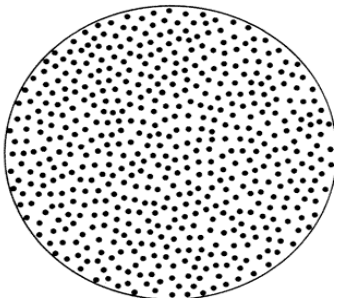
1) Cosmology is the study of the universe as a whole, including theories about its origin, evolution, large-scale structure, and future.

2) Space exploration, or astronautics, is an interdisciplinary area. It draws upon the findings of such fields as physics, astronomy, mathematics, chemistry, biology, medicine, electronics, and meteorology.

3) In 1948 the American physicist of Russian origin George Gamow proposed that the universe was created in a gigantic explosion and that various elements observed today were produced within the first few minutes after the Big Bang, when the extremely high temperature and density of the universe would fuse subatomic particles into the chemical elements.



Model of an early stage of an expanding universe: the universe is homogeneous.



Model of a later stage of an expanding universe: new galaxies emerge continually within the expanding space.

4) In the beginning, soon after the Big Bang, the cosmic gas was distributed extremely uniformly and consisted only of the most primitive chemical elements: hydrogen, helium and lithium. The present-day universe, on the other hand, is full of complexity and structure. Some researchers think that this transition from simplicity to complexity originated in quantum-mechanical processes, whereby tiny perturbations of the vacuum state led to density fluctuations in the very early universe. These fluctuations have been amplified by gravity, and so led to the birth of a hierarchy of gravitationally bound structures from the smallest galaxies to groups, clusters and super clusters of galaxies.

5) The Tunguska event occurred in 1908, when a meteor or comet exploded over the wilderness of Siberia, damaging farmland and trees for miles around.
Because most of the earth is covered by oceans, there may be small impacts that go unnoticed.
When a new asteroid is discovered, astronomers analyze it to determine whether its orbit around the sun could bring it close to the Earth.

6) Observations made by Edwin Hubble revealed that the universe is not static, but is expanding. What's more, recent observations of distant supernovae indicate that something is accelerating that expansion. Cosmologists assume that this expansion is caused by "dark energy" that spreads into every part of the universe, corresponding to a small, positive value for the cosmological constant.

7) Previously, black holes were seen as the endpoints of evolution, the final resting state of most or all of the matter in the universe. Now some scientists believe that black holes also play a critical role in the birth of galaxies. They have got some evidence that galaxies actually did form around the earliest black holes.

8) Astrophysics is the branch of astronomy that deals with the physics of the universe, including the physical properties (luminosity, density, temperature and chemical composition) of astronomical objects such as stars, galaxies, and the interstellar medium, as well as their interactions.

9) Dark energy is the mysterious stuff that is stretching space and speeding the expansion of the universe.
Still, no one can explain precisely what dark energy is. It could be a kind of continual pressure woven into the fabric of space itself, a concept known as a cosmological constant and dreamt up by Einstein. If so, then the amount of dark energy would grow with expanding space so that each cubic centimeter always contains the same constant amount.
Alternatively, dark energy could be some new sort of field, a bit like an electric field, that fills space and grows weaker and more dilute as space expands.

2. Choose the best answer (*a, b,* c or *d*) to answer the questions (1-5).

1) Which science studies the origin, evolution, large-scale structure, and future of the universe?

a) astrophysics
b) cosmology
c) astronomy
d) astronautics

2) Which science studies such properties of the Universe as luminosity, density, temperature, and chemical composition of astronomical objects?

a) cosmology
b) meteorology
c) astronomy
d) astrophysics

3) Which is true? The Big Bang is …

a) a super cluster of galaxies.
b) a gigantic explosion that created the universe.
c) the name of the meteor/asteroid that exploded over Siberia.
d) the hierarchy of gravitationally bound structures in the universe.

4) Which of the statements is false?

a) In the early universe the cosmic gas was composed of the most primitive chemical elements.
b) Observations of Edwin Hubble didn't prove the dynamic nature of the universe.
c) The current universe is complex and structured.
d) The transition from simplicity to complexity was caused by density fluctuations in the universe.

5) Which of the following is not true? Dark energy could be …

a) the final resting state of the matter in the universe.
b) some new kind of field in the space.
c) a cosmological constant that spreads into every part of the universe.
d) a kind of continual pressure that causes the expansion of the universe.

Focus on language

1. Study the words in the box and classify them under the headings (1-3).

1) ***Fields of science***: astrophysics
2) ***General science words***: observation
3) ***Terms connected with the study of the Universe***: dark energy

element	mathematics	astronautics
cosmology	theory	interstellar medium
supernova	property	particle
asteroid	luminosity	perturbation
medicine	black holes	physics
pressure	chemistry	density fluctuation
hydrogen	meteorology	astronomy
evolution	universe	orbit
galaxy	concept	biology

2. **Look back in the texts (1-9) in *Reading* and pick up more words to add to the lists under each heading (1-3) in Task 1. Look them up in a dictionary for pronunciation and meaning.**

Add new vocabulary to your vocabulary notebook. ✍

Get real

Search the Internet and/or popular science magazines to find out more about current studies of the Universe. Choose the one you find most interesting and make a seven-minute PowerPoint presentation about it. Use these questions as the guidelines.

- ✓ **What is being investigated?**
- ✓ **Who is doing the research?**
- ✓ **How long has it been under way?**
- ✓ **What are the purpose and the novelty of the research?**

Study help

PowerPoint is an efficient tool for presentation, if it includes well-crafted slides, useful animations and appropriate graphics.
Avoid slides cluttered with too much information and poor choices of :

- fonts, backgrounds or colours
- graphics and animations
- transition and sound effects

SPEAKING

Make your presentation in class and encourage the rest of the group to ask questions.

Functional language ***Inviting questions***

Please stop me at any time if you have any questions.
If you have any questions or comments, I'll be happy to answer them.
If there are any questions, I'll do my best to answer them.
Are there any more questions?

Focus on language

1st and 2nd type Conditional Sentences

1st type Conditional Sentences are real and about the future.
*If clause (**Present Simple**) + main clause **(Future Simple)***

e.g.

- If we **study** the rock samples from the Moon, we **will learn** more about the early days of the Earth.
- You **won't get** a high score in this subject **if** you **don't do** lab work.

2nd type Conditional Sentences are unreal and about the present.
*If clause (**Past Simple**) + main clause (**would/could +verb1**)*

e.g.

- If I **had** all the necessary data, I **would/could build** the model of the process.
- If I **were** you, I **would specialize** in astrophysics.

1. **Put the verb in the correct form. Translate the sentences into Russian.**

   Example:

   - If I ***knew*** *(know)* Mary's address, I would visit her.
   - If they participate in this conference, they ***will get*** *(get)* a very useful experience.

a) If he _____ *(get)* the promotion, it will be because he does a good job.
b) The teacher will not accept our work if we _____ *(turn)* it in late.
c) If I were you, I _____ (*attend*) definitely the lecture of this visiting professor.
d) If scientists _____ *(build)* the time machine, we could travel to any century of our history.
e) People _____ *(travel)* to other planets if they had more advanced space technologies.
f) If I finish my degree project by April, I _____ *(present)* the results at the conference.
g) You will get more accurate data if you _____ *(use)* this equation.
h) Would you contact an alien if you _____ *(have)* a chance to do so?
i) If you _____ *(not update)* the antivirus software, your computer will be much more vulnerable to malware.
j) If the alternative energy sources _____ *(be)* cheaper and more efficient, they would definitely become mainstream power resources.

LISTENING

1. **Listen to the interview with the astrophysicist Professor Brown about the planet Earth and the possibility of the existence of other intelligent life forms in our universe. Answer the questions.**

   - What makes the Earth suitable for life?
   - How does Professor Brown compare Earth with two other planets closest to it - Venus and Mars?
   - Why are Venus and Mars not able to sustain life?
   - What does SETI stand for?

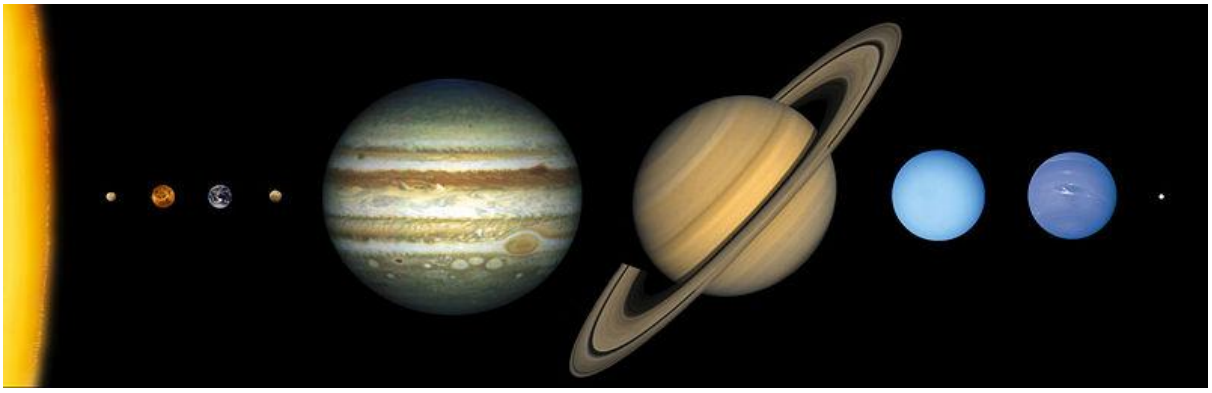
2. **Listen again and fill in the gaps in this interview extract.**

First of all the **1)** _____ of the Earth in relation to the Sun makes it the only planet obviously **2)** _____ of sustaining life right now. If we were any nearer to the Sun, the **3)** _____ would form a thick layer of cloud around us; this in turn would **4)** _____ the heat, further increasing the temperature. Within a comparatively short time, the Earth would turn into a hot and dry **5)** _____ - much like Venus that is unsuitable for life.

On the other hand, if we were any **6)** _____ from the Sun, there would not be enough heat to prevent water from **7)** _____. Before long the Earth would become an **8)** _____ wasteland like the Mars.

3. **Summarize the information you have learned in the listening task and give a detailed answer to the question: "What makes the Earth suitable for life?" Make use of the picture and speak on the following:**

   - **Position of the Earth**
   - **Size of the Earth**



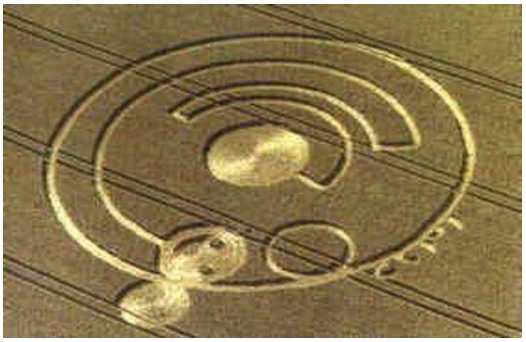
Discuss

- There are many people who claim to have seen unidentified flying objects (UFOs). What do you think of such statements?
- What is usually considered to be the evidence or signs of extraterrestrial activities on the Earth?
- Have you ever seen anything unusual that could be connected with alien activity? What was it like?

READING

1. **Look at the pictures (1-6) and match them with the words (a-f) from the list**.

1) _____



2) _____

3) _____

4) _____

5) _____

6) _____

a) UFO sighting
b) Grey alien
c) Crop circle
d) Flying saucer
e) Giza Pyramid
f) Stonehenge

2. **Match the definitions (1-6) with the words (a-f) in Task 1.**

1) a very large stone structure, which was used as a burial place of pharaohs.
2) off-planet beings with large almond eyes and hairless grey skin.
3) a group of very large, tall stones that are arranged into a large circle with a smaller circle inside it, which stand on Sainsbury Plain in southern England. It is believed they were put there about 4000 years ago and were used for studying the movements of the Sun, Moon, and stars.
4) viewing of an extraterrestrial craft or other unidentified object.
5) any of a variety of patterns that began appearing in the fields of farms in England and some other European countries in the late 1980s and 1990s. Some people think they are the work of beings from outside the Earth.
6) usually a plate-shaped spaceship which is said to be piloted by creatures from another world.

3. **Read the text about some possible evidence of alien activity on our planet. Complete the sentences with the information from the text.**

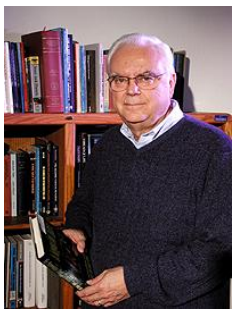
a) The Egyptian pyramids, which date back to around 10500-8000 BC, provide evidence that…
b) Some of the world wonders are believed to have been created by…
c) SETI stands for …
d) "Drake Equation" allows researchers to calculate…
e) Space travel to even the nearest stars is currently absolutely impossible because…
f) Some scientists are quite sceptical about UFO sightings and crop circles because in their opinion they could …

Do They Exist?

The Earth has undergone and still undergoes anomalies which have neither been justified by historical standards nor explained by science. The pyramids and the Sphinx at Giza, Egypt, date back to around 10500-8000 BC, which proves that a highly advanced but unrecorded civilization existed at that time. The exact alignment of the Giza pyramids to the three stars of Orion's Belt reflects the interest of that culture in astronomy. This is also supported by the findings at Stonehenge, where it has been established that wooden totem poles, dated as far back as 8000 BC, are a sort of astronomical marker, a forerunner to the stone observatory built in 2700 BC.

Those who believe in the existence of extraterrestrial life assume that these wonders were built by beings from some other planets that were advanced enough to travel to Earth and make it their station.

The search for extraterrestrial intelligence (SETI) is a scientific investigation into possible communication signals originating from an extraterrestrial civilization.



In the early 1960s Frank Drake came up with an equation (called the "Drake Equation") N = R * f*p* * *ne* * f*l* * f*i* * f*c* * L that calculated the possibility of extraterrestrial life. He determined that there was a possibility of 100,000 to 1,000,000 extraterrestrial civilizations in our galaxy (the Milky Way) alone. With so many complex and huge solar systems across the galaxy, the Earth cannot be the centre of the universe. If it is true, then what is the purpose of the rest of the huge universe?

The most conclusive and most satisfying way of finding life beyond the Earth would be to meet aliens from another planet. But unless they happen to visit us, this is extremely unlikely. Space travel to even the nearest star, Alpha Centauri, is at present totally impossible due to the distances involved; modern spacecraft can only travel at about 36,000 km per hour. At this speed it would take 12,000 years to reach Alpha Centaury; reaching another planet belonging to a sun-like star would take even longer.

Sightings of 'UFOs' - biblical and historic references to ‘flaming chariots’, huge flying 'birds' and odd-looking beings have been reported throughout history. But most scientists pay little attention to UFO sightings, believing them to have either a rational explanation or to be a figment of the imagination. The formation of crop circles in different parts of the world has also been discredited as evidence of alien activity. They are considered either to be a freak natural phenomenon or the work of hoaxers. Even less credence is given to some people’s claims to have been abducted by aliens.

It will probably take some more time and more public participation to determine the truth. If there are extraterrestrials, then we have already lost a lot of time by not accepting their presence. There's truth waiting to be discovered outside the circle of our compact lives.

Summarizing

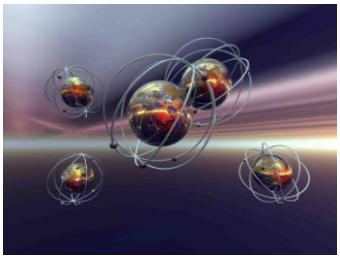
1. **Read the text “Струны в космосе” and highlight the Russian equivalents to the English word combinations (1- 14).**

1) standard cosmological model
2) to be a result of the cosmic explosion (Big Bang)
3) fragments keep scattering
4) to expand/shrink (about the Universe)
5) to result in a powerful cosmic explosion
6) to look at something in a reverse order
7) to vanish in a black hole
8) to shrink into infinitesimal point
9) string theory
10) to explain the origin of the Universe
11) transient stage
12) death and birth cycles
13) tiny string
14) increased density led to the formation of black holes

Струны в космосе

Согласно доминирующей сегодня теории (Стандартной космологической модели), Вселенная образовалась в результате космического взрыва (Большого взрыва). Это произошло около 15 миллиардов лет назад. Но даже сегодня продолжают разлетаться «осколки» этого взрыва, представляющие собой миллиарды галактик. Вселенная расширяется.

Однако ученые не знают, будет ли она расширяться всегда или в какой-то момент она начнет опять сжиматься, что впоследствии вновь приведет к мощному космическому взрыву. Если бы мы смогли просмотреть космическую историю в обратном порядке, то увидели бы, как все галактики проваливались в черную дыру и сжимались в единственную бесконечно малую точку. Физики называют эту точку сингулярностью. В тот момент, когда вся Вселенная сжалась в сингулярность, наша космическая история закончилась бы.



Теория струн по-новому объясняет, как произошла наша Вселенная. «Струнные» физики утверждают, что Большой взрыв был не моментом, когда возникла Вселенная, а просто переходной стадией. Согласно теории струн, Вселенная существовала всегда. В отдаленном прошлом она была почти пуста. К моменту Большого взрыва Вселенная могла пройти несколько циклов гибели и возрождения (расширения и сжатия). До Большого взрыва такие силы, как гравитация, были слабы. Они постепенно росли, и материя начала сжиматься. Но, согласно теории струн, она сжималась не до бесконечно малой точки, а до крохотной длины струны. В некоторых областях Вселенной плотность возросла настолько, что начали формироваться черные дыры. Дыры разрастались, ускоряясь. Они стягивали материю все плотнее и плотнее. Когда материя стала такой плотной, что не могла больше сжиматься, произошел Большой взрыв. Дальнейший сценарий развития нашей Вселенной у «струнных» физиков не отличается от Стандартной космологической модели.

2. **Read the text again and summarize it in English using the word combinations in Task 1and the phrases for summarizing.**

Project Work

1. **Work in groups of four. Collect information about the Cosmology/Astrophysics Department at your faculty/university. Find information about:**

- ✓ the date of its foundation and the leading researchers
- ✓ the major areas of current research
- ✓ facilities of the department (laboratories, equipment, research schools and traditions, etc.)
- ✓ most notable achievements

2. **Report your findings to the class.**

Study help ***Making a group presentation***

When you make your group presentation, follow this procedure:

- one student introduces the group and gives an introduction of the work conducted by the group.
- the next few students present one or two of the points and some interesting comments.
- the last student concludes the presentation by summarizing and interpreting the information.

WRITING

Use the information from the *Project work* and write a short description of the Cosmology or Astrophysics Department for the University Prospectus.

In the Realm of Science

Learn how to say the names of some nebular objects in the Solar System.

Mercury	['mɜːkj(ə)rɪ, 'mɜːkjurɪ]	Saturn	[' sætən]
Venus	['viːnəs]	Titan	['taɪt(ə)n]
Earth	[ɜːθ]	Uranus	['juər(ə)nəs]
Moon	[muːn]	Neptune	['neptjuːn]
Mars	[maːz]	Pluto	['pluːtəʊ]
Jupiter	[' ʤuːpɪtə]		

Progress Monitoring

In this unit you have worked on the vocabulary on the topic: "Universe Exploration".

Tick (*V*) the points you are confident about and cross (*X*) the ones you need to revise.

1. to be created in a gigantic explosion
2. perturbations of the vacuum state
3. density fluctuations in the universe
4. transition from simplicity to complexity
5. hierarchy of structures
6. clusters/super clusters of galaxies
7. to speed/ to accelerate the expansion of the universe
8. to play a critical role in the birth of galaxies
9. to get some evidence of sth
10. to stretch space
11. cosmological constant
12. to sustain life
13. highly advanced civilization
14. to believe in the existence of extraterrestrial life
15. SETI (search for extra-terrestrial intelligence)
16. to have a rational explanation
17. to be discredited as evidence of alien activity
18. to be abducted by aliens
19. to expand/to shrink
20. astronomical/nebular objects

Progress Test

1. **Cross out the odd word. Explain your choices.**
   a) astrophysics, chemistry, cosmology, astronomy
   b) asteroid, supernova, meteor, comet
   c) observation, equation, concept, theory,
   d) hydrogen, matter, helium, lithium
   e) complexity, density, anomaly, luminosity
   f) aliens, UFOs, extraterrestrials, hoaxers

2. Give English equivalents to these Russian word combinations.

a) расширяться/сжиматься
b) приводить к взрыву
c) теория струн
d) происхождение вселенной
e) «провалиться» в черную дыру
f) формирование чёрных дыр
g) переходная стадия

3. Write the word and the Russian equivalent next to each transcription.

e.g. ['orɪʤɪn] – origin - происхождение

a) [ʤaɪ'gæntɪk]
b) [ˌpɜ:t ə'beɪʃən]
c) [ˌflʌktʃu'eɪʃən]
d) ['haɪəra:kɪ]
e) [dɪ'tɜ:mɪn]
f) [ˌɪnfɪnɪ'tesɪm(ə)l]
g) [ˌekstrətə'restrɪəl]

4. Three of these sentences are correct. Write (V) by the correct sentences, and (X) by the incorrect ones. Rewrite the three wrong sentences in correct English.

a) If the Earth is any nearer to the sun, the heat would form a thick layer of cloud around it. ( )
b) A wire carrying a current will rotate if it is placed in a magnetic field. ( )
c) There would not be enough heat to prevent water from freezing if the Earth was any further away from the sun. ( )
d) If I won't pass my exam, I'll be very disappointed. ( )
e) Any object moved toward Earth's centre if it is placed in Earth's gravitational field. ( )
f) If I remembered the formula we could solve this problem now. ( )