**МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ
РОССИЙСКОЙ ФЕДЕРАЦИИ**

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МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ

(национальный исследовательский университет)

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LEARN ABOUT AVIATION AND SPACE FLIGHT IN ENGLISH

АВИАЦИЯ И КОСМОНАВТИКА НА УРОКАХ АНГЛИЙСКОГО ЯЗЫКА

Допущено Учебно-методическим объединением
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LEARN ABOUT AVIATION AND SPACE FLIGHT IN ENGLISH: АВИАЦИЯ И КОСМОНАВТИКА НА УРОКАХ АНГЛИЙСКОГО ЯЗЫКА: Учебное пособие по английскому языку. – М.: Изд-во МАИ, 2013. – 96 с.: ил.

Данное учебное пособие предназначено для студентов 1-го курса всех факультетов авиационных вузов.

Цель пособия – формирование межкультурной коммуникативной профессионально-ориентированной компетенции через развитие различных видов речевой деятельности (перевод, чтение, говорение и письмо). Разнообразные упражнения направлены на закрепление лексического материала авиационно-космической тематики.

Учебное пособие соответствует программе по дисциплине «Иностранный язык» для подготовки бакалавров/специалистов в неязыковых вузах и составлено с учётом основных положений монографии «Общеевропейские компетенции владения иностранным языком: Изучение, обучение, оценка».

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ПРЕДИСЛОВИЕ

Настоящее учебное пособие предназначено для студентов 1-го курса авиационных вузов. Цель учебного пособия – подготовить студентов к самостоятельному чтению и обсуждению технической литературы на английском языке.

Упражнения направлены на развитие различных видов речевой деятельности (перевод, чтение, говорение и письмо). В пособии представлены разнообразные лексические упражнения, упражнения на проверку понимания текстового материала. Достаточное внимание в учебном пособии уделяется подготовке презентаций на темы, связанные с авиаций и космонавтикой.

Пособие представляет собой сборник текстов и упражнений к ним и состоит из десяти разделов:

1. Как возникло воздухоплавание.
2. Братья Райт.
3. Константин Эдуардович Циолковский.
4. Европейские исследователи космоса.
5. Прибытие космонавтов. Юрий Гагарин.
6. Аэропорты.
7. Силы, действующие в полете.
8. Летательные аппараты легче воздуха.
9. Летательные аппараты тяжелее воздуха.
10. Конструкция самолета.

Каждый раздел включает несколько оригинальных (неадаптированных, но сокращенных) текстов на данную тему. При их отборе авторы стремились к тому, чтобы каждый текст носил научно-популярный характер, представлял интерес для обсуждения и был насыщен лексикой, связанной с авиационно-космической тематикой.

В приложении представлены дополнительные тексты для чтения и перевода.

Unit 1 How did aeronautics begin

Aeronautics is typically defined as the art or science of flight, or the science of operating aircraft. This includes a branch of aeronautics called aerodynamics. Aerodynamics deals with the motion of air and the way it interacts with objects in motion, such as an aircraft. Both of these branches are a part of the tree of physical science. Aviation, however, refers to the operation of heavier-than-air craft.

The theoretical basis for these branches stems from the work of Sir Isaac Newton in the 1600s. Newton developed laws that defined the effects of forces acting on objects in motion or at rest. He also developed the concept of viscosity, or fluid friction, which is the resistance of air or any other fluid to flow. Daniel Bernoulli, in the 1700s, developed the principle that the speed of a fluid is directly related to pressure. That is, the faster the flow of a fluid, the lower the pressure that is exerted on the surface it is flowing over. For example, if air is flowing faster over the top of a surface than under a surface, the pressure on the top of the surface will be less than that underneath. Understanding of these concepts was necessary to the development of flight. Without understanding the aerodynamic principles of flight, humans would simply be mimicking the actions of birds. It was demonstrated through many spectacular yet often disastrous attempts that pure imitation would not enable humans to fly.

How did aeronautics evolve past the imitation of birds?

The science of aeronautics really began to evolve in the late 18th and early 19th centuries. Philosophers and early scientists began to look closely at physical phenomena such as gravity and motion. As paths of communication were established between distant cultures, the understanding of flight began to coalesce. With their wealth of understanding of kites, rockets and fireworks, the Asian cultures defined and harnessed propulsion. The Europeans with their penchant for analysis, definition and precision, began to piece together the concept of force. This growth in knowledge and communication continued throughout the 19th century. By the very late 19th and early 20th centuries, this knowledge had evolved to the point where people sought to put it to practical use. As space is the frontier of today, flight was a frontier of that time.

Along with factual knowledge, the method of discovery as well as trial and error evolved into the scientific method. The scientific method became a widely accepted process to question, analyze, test and verify results. Concepts and ideas that were subjected to the scientific method received general acceptance and were used as bases for generating new ideas.

The classification and definition of forces involved with flight were developed. We know them today as lift, drag, weight and thrust. Scientists began to understand how they worked together to enable an object heavier than air to fly. Once these concepts were well understood, it was only a matter of time before humans figured out how to not only fly, but to control their flight. Balloons, which by this time were old news, enabled people to fly but aeronauts remained at the mercy of the wind to determine where they went. With the invention of the airplane people could fly when, how and where they wanted. Another frontier had been conquered. Within a few short years, airplane designers refined the shape of wings and overall construction to improve airplane performance and safety. Further improvements in airplane design allowed flight to become accessible to everyone.

Exercises

Vocabulary

1. You should check the pronunciation of key words. Transcribe the words:

Physical, science, theoretical, laws, fluid, pressure, surface, phenomena, coalesce, frontier, analyze, weight, thrust, figured out, balloons, conquered, designers

2. Match the words from the texts (1-10) with the definitions (A-J):

1	to move	A	one of the large flat parts that stick out from the side of a plane and help to keep it in the air
2	propulsion	B	the way in which wind, air, or water can cause a moving object such as a car, plane, or boat to slow down
3	balloon	C	to change from one place or position to another, or to make something do this
4	resistance	D	the natural force that prevents one surface from sliding easily over another surface
5	friction	E	a large bag of strong light cloth filled with gas or heated air so that it can float in the air. It has a basket hanging below it for people to stand in.
6	shape	F	a light frame covered in coloured paper or plastic that you let fly in the air on the end of one or two long strings
7	wing	G	the form that something has, for example round, square, triangular etc.
8	kite	H	the force that drives a vehicle forward
9	flow	I	the force or weight that is being put on to something
10	pressure	J	a smooth steady movement of liquid, gas, or electricity

3. Match the words from the texts (1-5) with their synonyms (A-E):

1	trial	A	to examine
2	to coalesce	B	test
3	to verify	C	tendency
4	operation	D	to unite
5	penchant	E	work

4. Explain in English and then translate the following words and expressions

Aeronauts remained at the mercy of the wind; to control the flight; invention; improvements; began to piece together the concept of force; the scientific method;

5. Find in the texts the English equivalents for the following expressions:

(1) движение воздуха, (2) силы, действующие на предметы, находящиеся в движении или в покое, (3) сопротивление воздуха, (4) давление на поверхности, (5) аэродинамические принципы полета, (6) подражая действиям птиц, (7) понимание полета, (8) понятие силы, (9) авиаконструкторы, (10) повысить безопасность самолетов, (11) создание новых идей, (12) наука воздухоплавания действительно начала развиваться, (13) физические явления, (14) практическое использование, (15) классификация и определение силы.

6. ***Complete the text with the words from the box***

Early aeronautics

aeronautics	air	wings	machines
scientists	flight	kites	flew
engineering	aerodynamics	fly	mechanism

The first mention of aeronautics in history came in the writings of ancient Egyptians who described the (1) of birds. Aeronautics also finds mention in ancient China where people flew (2) thousands of years ago. The medieval Islamic (3) were not far behind, as they understood the actual (4) of bird flight. Before scientific investigation (5) was started, people started thinking of ways to (6). In a Greek legend, Icarus and his father Daedalus built (7) of feathers and wax and (8) out of prison. When people started to study scientifically how to fly, people began to understand the basics of (9) and (10). Leonardo da Vinci studied the flight of birds in developing (11) schematics for some of the earliest (12) flying in the late fifteenth century.

7. ***Answer the following questions. Begin your answers with such introductory phrases as:*** *as far as I know; as far as I remember; to my mind; certainly; it's hard to tell; probably; of course; if I am not mistaken etc.*

1) How is aeronautics defined?

2) What does aerodynamics deal with?

3) What laws and concepts did Newton develop?

4) What principle did Daniel Bernoulli develop?

5) What contribution to the understanding of flight did the Asian cultures make?

6) What forces are involved in flight?

7) What do airplane designers do to improve airplane performance and safety?

8. Translate the following sentences into English:

1. Наблюдения за летающими птицами дало человеку идею полета человека.
2. Первые научные принципы полета человека появились в 14-м веке.
3. В 1903 году братья Уилбер и Орвилл Райт построили свой самолет.
4. Самолет братьев Райт был самолетом с двигателем внутреннего сгорания.
5. В 1913 году русский конструктор Игорь Сикорский построил первый в мире многомоторный самолет.
6. В начале 20-го века был изобретен дирижабль.
7. Среди пионеров авиации имена авиационных конструкторов Туполева, Поликарпова, Сухого, Архангельского, Ильюшина, Яковлева и др.

Speaking

Give a 5-minute presentation on the following topics. Remember that communication skill is not something you are born with. Effective communication is a skill, which can be acquired.

1. Aerodynamics and Birds
2. The discovery of universal gravitation by Newton.
3. The contribution to the understanding of flight made by the Asian cultures.
4. The classification and definition of forces involved in flight.
5. Why do kites and balloons fly?

Communication

Communication means sharing ideas and information.

The speaker must:

- be very clear about what information he wants to get across;
- remember that communication is not a one-way process and that the feedback from the listener will show how his message was interpreted;
- understand that communication is a dynamic, flexible process.

The Basic Forms of Communication

1. *Public Speaking*

- refers to presentation of a speech to an audience of more than one;
- is characterized by one person's holding central attention.

2. *Group Speaking*

- takes place in committees, boards, task groups;
- is restricted by a particular procedure or agenda; participants take turns in speaking.

3. *Interpersonal Communication*

- refers to face-to-face interaction between two people in public or in private;
- is controlled by generally accepted social rules of behavior.

Unit 2 Wright brothers



American brothers, inventors, and aviation pioneers who achieved the first powered, sustained, and controlled airplane flight (1903). Wilbur Wright (April 16, 1867, near Millville, Indiana, U.S.—May 30, 1912, Dayton, Ohio) and his brother Orville Wright (August 19, 1871, Dayton—January 30, 1948, Dayton) also built and flew the first fully practical airplane (1905).

Wilbur and Orville were the only members of the Wright family who did not attend college or marry. Orville, who had spent several summers learning the printing trade, persuaded Wilbur to join him in establishing a print shop. In addition to normal printing services, the brothers edited and published two local newspapers, and they also developed a local reputation for the quality of the presses that they designed, built, and sold to other printers. These printing presses were one of the first indications of the Wright brothers' extraordinary technical ability and their unique approach to the solution of problems in mechanical design.

In 1892 the brothers opened a bicycle sales and repair shop, and they began to build bicycles on a small scale in 1896. They developed their own self-oiling bicycle wheel hub and installed a number of light machine tools in the shop. Profits from the print shop and the bicycle operation eventually were to fund the Wright brothers' aeronautical experiments from 1899 to 1905. In addition, the experience of designing and building lightweight, precision machines of wood, wire, and metal tubing was ideal preparation for the construction of flying machines.

In later years the Wrights dated their fascination with flight to a small helicopter toy that their father had brought home from his travels when the family was living in Iowa. A decade later, they had read accounts of the work of the

German glider pioneer Otto Lilienthal. By 1899 the brothers had exhausted the resources of the local library and had written to the Smithsonian Institution for suggestions as to further reading in aeronautics. The following year they wrote to introduce themselves to Octave Chanute, a leading civil engineer and an authority on aviation who would remain a confidant of the brothers from 1900 to 1905.

Their first experiments with "wing warping," as the system would be called, were made with a small biplane kite flown in Dayton in the summer of 1899. Discovering that they could cause the kite to climb, dive, and bank to the right or left at will, the brothers began to design their first full-scale glider using Lilienthal's data to calculate the amount of wing surface area required to lift the estimated weight of the machine and pilot in a wind of given velocity.

They selected Kitty Hawk, an isolated village on the Outer Banks of North Carolina, which offered high average winds, tall dunes from which to glide, and soft sand for landings.

Tested in October 1900, the first Wright glider was a biplane featuring 165 square feet (15 square metres) of wing area and a forward elevator for pitch control. The glider developed less lift than expected, however, and very few free flights were made with a pilot on board. The brothers flew the glider as a kite, gathering information on the performance of the machine that would be critically important in the design of future aircraft.

Eager to improve on the disappointing performance of their 1900 glider, the Wrights increased the wing area of their next machine to 290 square feet (26 square metres). Establishing their camp at the foot of the Kill Devil Hills, 4 miles (6.5 km) south of Kitty Hawk, the brothers completed 50 to 100 glides in July and August of 1901. As in 1900, Wilbur made all the glides, the best of which covered nearly 400 feet (120 metres). The 1901 Wright aircraft was an improvement over its predecessor, but it still did not perform as well as their calculations had predicted. Moreover, the experience of 1901 suggested that the problems of control were not fully resolved.

They designed and built a four-cylinder internal-combustion engine with the assistance of Charles Taylor, a machinist whom they employed in the bicycle shop. Recognizing that propeller blades could be understood as rotary wings, the Wrights were able to design twin pusher propellers on the basis of their wind-tunnel data.

The brothers returned to their camp near the Kill Devil Hills in September 1903. They spent the next seven weeks assembling, testing, and repairing their powered machine and conducting new flight tests with the 1902 glider. Then, at about 10:35 on the morning of December 17, 1903, Orville made the first successful flight, covering 120 feet (36 metres) through the air in 12 seconds. Wilbur flew 175 feet (53 metres) in 12 seconds on his first attempt, followed by Orville's second effort of 200 feet (60 metres) in 15 seconds. During the fourth and final flight of the day, Wilbur flew 852 feet (259 metres) over the sand in 59 seconds. The four flights were witnessed by five local citizens. For the first time in history, a heavier-than-air machine had demonstrated powered and sustained flight under the complete control of the pilot.

Determined to move from the success of 1903 to a practical airplane, the Wrights in 1904 and 1905 built and flew two more aircraft from Huffman Prairie, a pasture near Dayton. They continued to improve the design of their machine during these years, gaining skill and confidence in the air. By October 1905 the brothers could remain aloft for up to 39 minutes at a time, performing circles and other maneuvers.

Exercises

Vocabulary

1. You should always check the pronunciation of key words. Transcribe the words:

pioneers, scientific, persuaded, extraordinary, unique, aeronautical, authority, designing, lightweight, machines, featuring, exhausted

2. Match the words from the texts (1-10) with the definitions (A-J):

1	to install	A	the way that something has been planned and made, including its appearance, how it works
2	design	B	to fix something that is damaged, broken, split, or not working properly
3	machine tool	C	a tool for cutting and shaping metal, wood etc. usually one that uses electricity
4	profit	D	a full-scale drawing, model etc. is the same size as the thing it represents
5	full-scale	E	to put all the parts of something together
6	performance	F	a machine, system etc. that existed before another one in a process of development
7	predecessor	G	to travel a particular distance
8	to assemble	H	to put a piece of equipment somewhere and connect it so that it is ready to be used
9	to cover	I	money that you gain by selling things or doing business
10	to repair	J	how well a car or other machine works

3. Match the words from the texts (1-5) with their synonyms (A-E):

1	improve	A	roll
2	fascination	B	agent
3	confidant	C	attraction
4	bank	D	calculated
5	estimated	E	develop

4. Explain in English and then translate the following words and expressions into Russian:

powered, sustained, and controlled airplane flight; on a small scale; a bicycle sales and repair shop; had exhausted the resources of the local library; a biplane featuring 165 square feet.

5. Find in the texts the English equivalents for the following words and expressions:

(1) автоматическая смазка ступицы колеса велосипеда, (2) площадь поверхности крыла, (3) четырех-цилиндровый двигатель внутреннего сгорания, (4) лопасти винта, (5) аэродинамическая труба, (6) проведениие новых летных испытаний, (7) успешный полет, (8) первая попытка, (9) устойчивый полет под полным контролем пилота, (10) приобретать навыки и уверенность в воздухе, (11) улучшить конструкцию своих машин, (12) оставаться в воздухе, (13) выполнять маневры, (14) проблемы управления, (15) машина тяжелее воздуха.

6. ***Complete the text with the words from the box***

The Flyer flew!

control	yaw	move	wing
glider	tilt	roll	elevator
pitch	shape	attach	warping

Orville and Wilbur could use Lilienthal's charts to build their own (1). But the Wrights would not fly until they knew how to (2) their machine. Aircraft (3) in three ways. They turn right or left. That's called (4). They also (5) side to side. That's called (6). Aircraft move up or down too. That's called (7). Pitch was the easiest to solve. They could (8) a small extra (9) to the front of the glider. The wing is called an (10). But how could they change the (11) of a wing while the glider was flying? They could build wings that twisted like the box. Twisting the wings would change their shape. And changing their shape would change lift. If the lift were greater on one end of the glider than the other, the glider would tilt. This idea is called wing (12). The kite tilted just as he had planned. The test was a success!

7. *Answer the following questions. Begin your answers with such introductory phrases as:* *as far as I know; as far as I remember; to my mind; certainly; it's hard to tell; probably; of course; if I am not mistaken, etc.*

1) What were the first indications of the Wright brothers' extraordinary technical ability?

2) What experience did the Wright brothers get at a bicycle sales and repair shop?

3) What inspired the Wright brothers to reading in aeronautics?

4) What did the Wright brothers discover during their first experiments?

5) Why did they select Kitty Hawk for the first flight?

6) Why did the Wrights increase the wing area of their next machine in 1901?

7) How long did the first flight last?

8. Match the questions in list A to their answers in list B.

List A

1. What was aeronautics/air travel like before the invention of the airplane?

2. What lead up to the Wright Brother's invention of the airplane?

3. How has life changed since the Wright's Invention of the airplane?

4. What is the future of airplanes?

5. How has the airplane affected the transportation industry?

6. How has the airplane affected warfare?

7. What happened after the invention of the airplane and before World War I that advanced airplane technology and why did it happen?

8. After the plane was invented, how was it used for transportation?

9. Right after the plane was invented, what did people think it would be used for?

10. I read in an encyclopedia that the Wrights thought the airplane would stop warfare. Why did they think this? (If I am wrong about this fact, please tell me.)

11. How has the airplane shaped our culture?

12. What are the main frontiers that were opened by the airplane?

List B

a) Prior to the invention of the airplane, there was not much air travel going on. There were however, many people were experimenting with gliding and ballooning.

b) The airplane has changed how war is fought. No longer do you have to invade a country or send troops to do battle. Countries were able to fly overhead to keep watch and bomb one another. Planes also allowed for quicker invasions.

c) The Wrights' invention of the airplane change life dramatically. No longer does it take weeks to travel to other parts of the world. Essentially, it has made the world seem like a smaller place.

d) Many people had been studying human flight including DaVinci, Alexander Graham Bell, Otto Lilienthal, and Samuel Langley to name a few. Flying fascinated the Wrights when they were children. As adults, their interest grew and they began studying the work of others working/experimenting in the field of aeronautic. Using the information gathered by others and their own genius, they developed the flyer.

e) Travel by train and boat certainly has diminished. The airplane allows for fast and easy transportation to many parts of the world.

f) Immediately following the invention, the plane was not used for transportation. It was still in a very experimental phase. It was not until after World War II when air travel became commonplace.

g) Many improvements were made in the development of airplanes, such as the automatic stabilizer, hydroplanes, and wing flaps during this time period. As I mentioned earlier, many people had been trying to fly for years. The Wrights proved that human flight was possible. However, the Wrights' first flight was only 12 seconds long. This was not very practical. Therefore, improvements were necessary.

h) Airplanes have come a long way in the past 100 years. It is rather hard to imagine what the next 100 years might bring. I am certain we will see an emphasis on safety with all the recent airplane tragedies. We also will see faster planes for everyday customers. We live in a fast paced world and people desire travel to be even faster than it already is.

i) It was thought that planes would be used mostly for military applications. Some far thinking people believe that flying would be available to everyone in a matter of time.

j) It was a common belief that air flight would inhibit warfare. The idea was that you could no longer surprise attack your enemy. Also, that you would be aware of what they were doing at all times. In fact, the Wrights won the International Peace Award in 1908.

k) The airplane has brought our world closer together. Making us more familiar with far away people, land, and their culture. It gives us the opportunity to live in a world where we have access to worldwide travel in a matter of hours.

l) The main frontiers that were opened were air travel, aeronautics, and expanded business opportunities

Speaking

Give a 5-minute presentation on the following topics. Remember that identifying goals is the starting point for any speaker. What are the goals and objectives of your speech?

1. Early flying machines

2. Aviation Pioneers

3. Wright Flyer

4 The Wrights first experiments

5. The first flight

How to Set Communication Goals

"Communication goal" is the goal of the speech, that determines to a great extent its character, structure, style and effectiveness.

- The speaker should single out a primary objective and secondary objectives. For example:

Lecture	
The primary objective	to teach and to inform
Secondary objectives	to entertain and to explore ideas

- The speaker should remember that a well-formulated statement of objectives will give a clue to the type of presentation which will be the best for implementing the objectives.
- At the final stage of the goal-setting process the speaker should ask himself if it is possible to achieve the goal. Then he has to identify the required result taking into account the objectives of the audience.

Writing

Compose a written report. Read the text aloud using the correct pronunciation. Prepare an outline that will help you present that person to the class. The divisions of the body of the online are up to you. But consider chronological order and/or family background, formal/informal education, contribution to mankind, impact on society, etc.

1) Chaplygin Sergey Alekseevich
2) Zhukovsky Nikolai Egorovich
3) Kamov Nikolai Il'yich
4) Mozhaiskiy Alexander Fedorovich

Unit 3

Konstantin Tsiolkovsky

A hypothetical sputnik, similar to our Moon but nearer to our planet, could orbit at about 300 versts (270 km) free of Earth's gravity.

Konstantin Tsiolkovsky, Dreams of Earth and sky, 1895.

Russia's exploration of space began in a small village called Izhevskoye near the city of Ryazan, 200 km southeast of Moscow. On 17 September 1857 a small boy was born. His father, Eduard Tsiolkovsky, was a forest ranger and he named his son Konstantin.

He was a bright, active child until he was ten, when one disaster followed another. He was struck down by scarlet fever and he became almost totally deaf. For three years his mother nursed him and despite his affliction taught him to read and write and manage at boys' high school. Then, when he had reached thirteen, she died suddenly. Konstantin Tsiolkovsky's life is the story not only of one man's effort to cope with a terrible disablement. For despite it he became a self-taught scientist, a practical person and a theoretician of space flight. He was the one person who inspired the idea of a Russian space programme from the very beginning. Without him, it might never have happened at all.

By the age of 14, Tsiolkovsky was well able to read, and he read books endlessly. It was one thing he was able to do, deprived as he was of the normal channels of human contact and communication. Financially supported by his father, he moved to Moscow when he was 16, rented rooms, and spent day after day in the city's public libraries. By 17 he had begun to master higher mathematics, differential calculus and spherical trigonometry. After three years in

Moscow, Tsiolkovsky took up a teaching post in Kaluga, a town south-west of Moscow. In the Tsar's Russia it was probably the most obvious career for him. His life was hard and he found deafness a terrible torment. He even designed tin funnels as hearing aids so he could try pick up what people were saying.

In 1883, in the course of the long summer school holidays, Tsiolkovsky turned his mind to something which had obsessed him—travel through space. We do not know where the inspiration came from and history gives us no clue. It may have been his deafness which, while depriving him in so many other ways, made him contemplative and all the more imaginative.

"Free space"[1], his book from 1883, took the creative leap from the earth-bound solid practical world to that of fantasy, yet without cutting scientific corners. He described what a human being would see and experience if flying around the Earth in a space ship. He would be weightless; and he would get up there by a 'reactive' interplanetary ship with a rocket engine using spherical projectiles fired by an on-board cannon. Gravity and weightlessness intrigued Tsiolkovsky. He rigged up devices that could create zero-gravity on the ground and a primitive centrifuge to test overloading, which he verified using chicken and mice. They could stand loads of six gravities (6 g) but died at much higher g—just like humans would.

"Free space" was followed by "On the Moon" [2](1887) and "Dreams of Earth and sky" [3](1895). In the last-mentioned he described how a small moon or artificial Earth satellite could be launched and circle the Earth at an altitude of 270 km. It

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[1] «Свободное пространство» (1883). Работа признана первой законченной монографией К.Э.Циолковского по межпланетным сообщениям. Написана в форме дневника. Повествование ведётся от имени наблюдателя, который находится в свободном безвоздушном пространстве и не испытывает действия сил притяжения и сопротивления.

[2] *«На луне».* Фантастическая повесть. Автор описывает приключения юноши, путешествующего во сне по Луне вместе со своим товарищем, картины поверхности Луны и различные явления, наблюдавшиеся путниками.

[3] *«Грезы о Земле и небе и эффекты всемирного тяготения».* Научно-фантастическое произведение, написанное в развитии предыдущих работ по вопросам межпланетных сообщений. (1924)

would be a mistake to regard Tsiolkovsky as simply a Russian equivalent of the French novelist Jules Verne, inspired by him though he was. He was also an inventor. He designed and built a wind tunnel in his home to study air resistance; and he designed a monoplane with a gasoline engine, enclosed cockpit, autopilot and retractable landing gear.

In 1903, Tsiolkovsky, in Kaluga, produced his most important paper ‘Exploring space with reactive devices’[4]. In it he spelt out the advantages of rocket flight and of liquid-fuelled rockets; and he explained how it might be possible to soft-land on other planets. Eventually, he predicted, poetically, ‘people will ascend into the expanse of the heavens and found a settlement there’.

His ideas gained ground and won gradual acceptance. Papers were taken by the Petrograd journal ‘Scientific Review’ (1911). By then his mind had moved on. In the same year he proposed that, due to the possible inefficiency of liquid-fuelled rockets, some kind of atomic power would have to be considered for really distant space journeys!

Tsiolkovsky found some form of financial security when in 1918 the new revolutionary government awarded him a life pension. He continued writing, to produce in 1924 ‘Cosmic rocket trains’[5], advocating multi-stage rockets in which one used the thrust gained by a lower stage to fly to ever greater altitudes. He then

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[4] «Исследование мировых пространств реактивными приборами». Первая в мире научная работа, посвященная теоретическому обоснованию возможности осуществления межпланетных полетов с помощью реактивного летательного аппарата - «ракеты», определяющая научный приоритет Циолковского в этой области. Наиболее ранняя из зарубежных работ по данному вопросу - работа Р. Эсно-Пельтри появилась во Франции в 1913 г. Циолковскому удалось напечатать лишь первую часть работы, так как журнал в 1903 г. был закрыт. Уже в первой своей работе по реактивным аппаратам Циолковский намечает ряд конструктивных элементов ракеты, которые нашли применение в современной ракетной технике. В этом же труде им были высказаны мысли об автоматическом управлении полетом с помощью гироскопического устройства, о возможности использования солнечных лучей для ориентации ракеты и др. (1903)

[5] «Космические ракетные поезда». В работе автор предлагает для достижения космических скоростей «соединение нескольких одинаковых реактивных приборов, двигающихся сначала по дороге, потом в воздухе, потом в пустоте, вне атмосферы, наконец, где-нибудь между планетами или солнцами» (1929)

designed a ‘stellar ship’, complete with closed ecocycle to resupply itself with air, plants and water. His spaceship designs would be considered conventional enough today in any technical journal dealing with future space travel: but liquid-fuelled engines, solar batteries, wheel-shaped space stations, these were all part of his thinking seventy years ago. In the same year the government republished all his old works.

In his later days, his home in Kaluga became a place of pilgrimage. Inventors, designers, journalists, aviators, and scientists beat their path to Tsiolkovsky’s door. The now old, bearded, hollow-chested prophet lived in a two-storey house with a large veranda, where he sat out to reflect the summer. Books, manuscripts, and the odd globe were piled in his study.

Konstantin Tsiolkovsky’s health gave way in August 1935. Newspapers carried accounts of his collapse and his subsequent death in September 1935. His home was at once turned into a national museum and since then it has been a shrine and a tourist attraction. An obelisk has been erected, as has a shining 20 м high silvery rocket against a bronze bust of his figure. In 1954 the Tsiolkovsky Gold Medal was struck, to be awarded every three year to the most outstanding contributor to space flight.

Exercises

Vocabulary

1. Transcribe the words:

hypothetical, exploration, scientist, theoretician, calculus, trigonometry, imaginative, experience, gravity, satellite, resistance, gasoline, atomic

2. Match the words from the texts (1-5) with their synonyms (A-E):

1	spherical	A	faraway
2	obvious	B	ball-shaped
3	imaginative	C	usual
4	distant	D	creative
5	conventional	E	evident

3. Match the words from the texts (1-10) with the definitions (A-J):

1	gravity	A	a device used for storing direct current electricity
2	theoretician	B	the section of an aircraft which contains the pilot, instruments and flight controls
3	landing gear	C	a sudden good idea
4	cockpit	D	the natural force by which objects are attracted to each other, especially that by which a large mass pulls a smaller one to it
5	altitude	E	an aircraft with only one wing on each side
6	inspiration	F	the pushing power of an aircraft engine which makes the plane move forward
7	battery	G	the height of an object or place above sea level
8	monoplane	H	an instrument that guides aircraft, spacecraft, or ships without needing human operation
9	thrust	I	the extendable wheel and leg assembly usually mounted beneath the wings which, together with the nosewheel, enables it to land safely
10	autopilot	J	a person who forms or studies the theory of a subject

4. Explain in English and translate the words and expressions into Russian:

verst, differential calculus, weightless, artificial Earth satellite, free space, zero-gravity, air resistance, heavens, interplanetary ships, liquid-fuelled rockers

5. Find in the texts the English equivalents for the following expressions:

(1) учёный-самоучка, (2) овладеть высшей математикой, (3) слуховой аппарат, 4) история не даёт нам ключа к разгадке, (5) погружённый в размышления, (6) реактивный межпланетный космический корабль, (7) перегрузка, (8) запускать ракету, (9) совершить мягкую посадку, (10)

предсказывать, 11) далёкие космические путешествия, (12) многоступенчатая ракета, (13) замкнутый экологический цикл, (14) пополнить запасы воздуха и воды, (15) конструкция космического корабля

Speaking

Give a 5-minute presentation on the following topics. Organize your material into a definite structure. Remember that the conclusion of any speech is very important. It is the final impression on an audience, so present your remarks assertively, with confidence, and without reading. Do not introduce new points in the conclusion.

1) The life of Konstantin Eduardovitch Tsiolkovsky

2) Scientific achievements of K.E.Tsiolkovsky

3) The works of K.E.Tsiolkovsky *(«Free Space», «On the Moon», «Dreams of Earth and Sky»,* etc.)

Structuring a Speech

The traditional structure of a speech contains the following elements:

- *Introduction*

  In the introduction the speaker grabs the attention of the audience, introduces the subject, his purpose and himself to the audience.

- *The body of the speech*

  The body contains the outline of the major ideas and information that supports and clarifies the ideas

- *Conclusion*

  The conclusion contains a summary or a conclusion from the information presented and helps the speaker to end his speech gracefully. 2. In the actual process of speech writing it is recommended to stick to a different order:

  The body of the speech ➔The conclusion ➔ The introduction should be written.

Unit 4 European spaceflight enthusiasts

Robert H. Goddard (1882-1945)

Robert Goddard began his experiments in rocketry while studying for his doctorate at Clark University in Worcester, Massachusetts. Goddard's doctoral dissertation "On the Conduction of Electricity at Contacts of Dissimilar Solids", 1911, was not related to rocketry, but was rather in the "main stream" physics. Goddard experimentally studied anisotropic changes in the electrical resistance of loosely powdered substances, particularly barium sulphide. The emerging radio technology relied on such materials for receiving the signals. Today we would call this area of research experimental solid-state physics.

His Ph.D. degree attained, Goddard actively embarked on research in rocketry, when he joined the faculty of Clark University in 1914. His basic research and development of new technology would achieve many rocket "firsts" and bring him 214 patents. He would often be called the Father of Modern Rocketry. Goddard concentrated first on the study of solid-propellant gunpowder rockets and improving their efficiency. The term "efficiency," introduced by him, meant "the ratio of the kinetic energy of the expelled gases to the heat energy of the powder."

Robert Goddard presented the results of his early rocket work in the Smithsonian Miscellaneous Collections, 1919, a publication of the respectable Smithsonian Institution. This famous treatise of Goddard, entitled "A Method of Reaching Extreme Altitudes," outlined his ideas on rocketry and included detailed calculations of rocket dynamics and results of his various tests.

In 1935 the first liquid-propellant rocket accelerated to a speed faster than the speed of sound. Two years later, on 26 March 1937, the Goddard's rocket reached an altitude 8000 — 9000 ft (2400 — 2700 m). All of this work was performed by Robert Goddard practically alone, with a few assistants. History would demonstrate, in a few years only, that the time of such individual effort has gone. The development of a modern powerful rocket would require a concerted effort of hundreds and thousands of scientists and engineers backed by the vast resources; the task possible only with the support of a mighty state.

Robert H. Goddard died on 10 August 1945, in Baltimore a few days after World War II ended. The recognition of Goddard's work came only long after his death. In 1959 the U.S. Congress honored Robert H. Goddard, and NASA named after him one of its leading field centers, Goddard Space Flight Center, in Greenbelt, Maryland, on May l.

Hermann Oberth (1894-1989)

Hermann Oberth was born on 25 June 1894, to a German family in Transylvania, a region of Austria — Hungary and now a part of Rumania. When he was 11 years old, Hermann had become fascinated by spaceflight afler reading Jules Verne's From the Earth to the Moon.

Oberth’s book appeared in 1923 under the title “The Rocket into Interplanetary Space”. In his book, Hermann Oberth focused on rocket dynamics. He considered the powered vertical flight through the atmosphere and introduced a concept of the optimal velocity that minimizes propellant consumption. He showed how a rocket could achieve the velocity allowing it to escape Earth's gravity. He described the details of liquid-propellant engines and calculated propellant exhaust velocities. Oberth introduced a number of ideas such as rocket staging, film cooling of the engine walls, and strengthening the structure by pressurizing propellant tanks.

The book presented a detailed design of a two-stage rocket with extensive supporting engineering calculations. The rocket used liquid oxygen as an oxidizer. The fuel was liquid hydrogen for the second (upper) stage engine and the alcoholwater mixture for the first- (lower) stage engine. The latter combination would be used in the famous German A-4 (V-2) ballistic missile in 1940s.

Oberth joined the German Society for Space Travel and became its president in 1929.Hermann Oberth played an important role in practical development of rocketry in Germany in the 1930s and provided inspiration for a generation of.

Exercises

Vocabulary

1. Transcribe the words:

European, spaceflight, enthusiasts, rocketry, experiments, electricity, physics, electrical resistance, research, technology, achieve, solid-propellant, efficiency, powder, calculations, rocket, dynamics, liquid-propellant, accelerate, altitude, development, flight, velocity, propellant, consumption, gravity, missile

2. Explain in English and then translate the following words and expressions into Russian:

spaceflight, experiments, rocketry, solid-propellant gunpowder rockets, rocket dynamics, liquid-propellant rocket, powered vertical flight, optimal velocity, propellant consumption, liquid-propellant engines, exhaust velocities, propellant tanks, two-stage rocket, liquid oxygen

3. Match the words from the texts (1-5) with their synonyms (A-E):

1	word	A	synonym
2	velocity	B	container
3	gravity	C	speed
4	fuel	D	power
5	tank	E	weight

4. *Match the words from the texts (1-10) with the definitions (A-J):*

1	word	A	definition
2	efficiency	B	quickness of motion
3	velocity	C	the ratio of the kinetic energy of the expelled gases to the heat energy of the powder
4	exhaust	D	the act or process of utilization
5	consumption	E	a device used as an incendiary weapon or as a propelling unit
6	rocket	F	to empty by drawing off the contents
7	propellant	G	solid explosive
8	spaceflight	H	fuel plus oxidizer used by a rocket engine
9	powder	I	the rate of change of velocity with respect to time
10	acceleration	J	flight beyond the earth's atmosphere

5. ***Complete the text with the words from the box***

rocketry	rockets	altitude	consumption
efficiency	dynamics	spaceflight	velocity
powder	accelerated	considered	propellant

Robert Goddard began his experiments in (1) while studying for his doctorate at Clark University in Worcester, Massachusetts. Goddard concentrated first on the study of solid-propellant gunpowder (2) and improving their efficiency. The term "(3)," introduced by Goddard, meant "the ratio of the kinetic energy of the expelled gases to the heat energy of the (4)". This famous treatise of Goddard, entitled "A Method of Reaching Extreme Altitudes," outlined his ideas on rocketry and included detailed calculations of rocket (5) and results of his various tests.

In 1935 the first liquid-propellant rocket (6) to a speed faster than the speed of sound. Two years later, on 26 March 1937, the Goddard's rocket reached an (7) 8000 — 9000 ft (2400 — 2700 m). When he was 11 years old, Hermann had become fascinated by (8) after reading Jules Verne's From the Earth to the Moon.

In his book, Hermann Oberth focused on rocket dynamics. He (9) the powered vertical flight through the atmosphere and introduced a concept of the optimal velocity that minimizes propellant (10). He showed how a rocket could achieve the (11) allowing it to escape Earth's gravity. He described the details of liquid-propellant engines and calculated (12) exhaust velocities.

6. Translate the following sentences into English:

1. Роберт Годдард начал проводить эксперименты по ракетостроению, когда обучался в докторантуре Университета Кларка.
2. Годдард сосредоточился в первую очередь на изучении твёрдотопливных пороховых ракет и повышении их эффективности.
3. В 1935 году первая жидкотопливная ракета развила скорость выше скорости звука.
4. В своей книге Герман Оберт сконцентрировался на динамике ракет.
5. Он показал, как ракета могла достичь скороти, позволяющей преодолеть земную гравитацию.
6. Он описал детали жидкотопливных двигателей и вычислил скорости истечения топлива.
7. В книге была представлена подробная конструкция двуступенчатой ракеты в сопровождении подробных вычислений.
8. Ракета использовала жидкий кислород в качестве окислителя.

7. Answer the following questions:

1. Who introduced the term "efficiency," and what does it mean?
2. Who introduced a concept of the optimal velocity, and what does it mean?
3. What did Goddard’s work "A Method of Reaching Extreme Altitudes" outline?
4. What is Hermann Oberth’s book about?

Speaking

Give a 5-minute presentation on the following topics. Organize your material into a definite structure. Use the Manuscript Method of Delivery.

1) Robert Goddard is Father of Modern Rocketry.

2) Hermann Oberth played an important role in practical development of rocketry.

Methods of Delivery

Successful delivery of the speech depends on the method of presentation selected by the speaker. Some memorize the speech word by word. Others prepare a detailed outline and actualize the speech itself at the moment of delivery. There are people who prefer to speak with no apparent preparation. Others read the speech from manuscript.

The Manuscript Method of Delivery

The entire speech is read to the audience. When exact timing and wording are required, the manuscript method is the safest to use.

Advantages: this method is the safest to use when exact timing and wording are required.

Disadvantages: this method is bound to decrease the spontaneity of the performance; there is danger of losing contact with the audience.

Writing

Think of the famous Russian spaceflight enthusiasts. Collect information about him. Write his biography (100-120 words). Follow the plan.

1. Introduction (name, date of birth, place of birth, family).
2. Main body (early years, education, family; later years, achievements.
3. Conclusion (your comments)

Unit 5 Arrival of the cosmonauts

Who would fly the first spaceships? There were no known ground rules and these had to be invented by Korolev and the others. It was decided to recruit an initial group of cosmonauts – the word ‘*cosmonaut*’ was used to differentiate from the existing term of *astronaut*. The cosmonauts had to be brave, reliable, physically fit, not panic, capable of mental endurance. [6]

Air Force Pilots selected for first manned flight into space, March – June 1960	
Pavel Belyayev	**(**Беляев Павел Иванович**)**
Valeri Bykovsky	**(**Быковский Валерий Федорович**)**
Yuri Gagarin	**(**Гагарин Юрий Алексеевич **)**
Viktor Gorbatko	**(**Горбатко Виктор Васильевич**)**
Anatoli Kartashov	**(**Карташов Анатолий Яковлевич**)**
Yevgeni Khrunov	**(**Хрунов Евгений Васильевич**)**
Vladimir Komarov	(Комаров Владимир Михайлович**)**

[6] Начало первого набора можно отнести к 1958 году, когда в Институте авиационной медицины были начаты работы по двум темам (отбор человека для полёта в космос; подготовка человека к 1-му космическому полёту). В мае 1958 года Сергей Павлович Королев рассмотрел предложения проектного отдела, возглавляемого Михаилом Клавдиевичем Тихонравовым, о создании тяжелого спутника для полета человека в космос. В июне С.П.Королев вместе с М.К.Тихонравовым составляет записку в правительство об этих перспективных работах. В ноябре 1959 года на совете главных конструкторов принимается решение начать разработку спутника для человека. В начале 1959 года отбор космонавтов получил организационное оформление. 5 января 1959 года вышло постановление ЦК КПСС и Совета Министров СССР «О медицинском отборе кандидатов в космонавты», а 22 мая 1959 года появилось постановление ЦК КПСС и Совета Министров СССР «О подготовке человека к космическим полётам». Критерии отбора: возраст до 35 лет, рост не более 175 см, вес - до 75 кг, отличное здоровье.

Alexei Leonov	(Леонов Алексей Архипович)
Andrian Nikolayev	(Николаев Андриян Григорьевич)
Pavel Popovich	(Попович Павел Романович)
Georgi Shonin	(Шонин Георгий Степанович)
Boris Volynov	(Волынов Борис Валентинович)
Dmitri Zaikin	(Заикин Дмитрий Алексеевич)
Valentin Bondarenko	(Бондаренко Валентин Васильевич)
Valentin Varlamov	(Варламов Валентин Степанович)
Gherman Titov	(Титов Герман Степанович)
Grigori Nelyubov	(Нелюбов Григорий Григорьевич)
Mars Rafikov	(Рафиков Марс Закирович)
Ivan Anikeyev	(Аникеев Иван Николаевич)
Valentin Filateev	(Филатьев Валентин Игнатьевич)

Yuri Gagarin emerged as the most determined, energetic and ambitious of all the cosmonauts. Yuri Gagarin was born in 1934 near Smolensk, western Russia. In his youth he learned to be a foundryman and went to several industrial schools. He enlisted in the Saratov flying school in his spare time, went to pilot training school, joining the Soviet Air Force as a fighter pilot in 1956.

Because of his short height he always put a cushion on the seat of his MiG fighter. In 1957 he married a nursing student, Valentina, at his base and then transferred for arduous service in the Arctic. In 1959, on his own initiative, he wrote to his superiors, applying to join a group of cosmonauts ‘if such a group exists’. His application was filed. Gagarin was in time called up, put before a medical board and selected as a cosmonaut on his 26th birthday in March 1960.

…So who would fly the first mission? In May the director of the Cosmonaut Training Centre Evgeni Karpov selected six of the 20 as a training group for the first flight (the Americans did something similar, selecting Shepard, Grissom and Glenn from the seven rivals). The six were Kartashov, Varlamov, Gagain, Titov, Nikolayev and Popovich. When Kartashov and Varlamov were invalided out, they were replaced by Nelyubov and Bykovsky. The six were kept waiting even as the final preparations went ahead.

5 April. [Final assembly of the manned spaceship in the huge 20 m high hangar at the cosmodrome.] Korolev and the State Commission were present and all the cosmonauts were at the launch site. They watched the assembly process from Korolev's glass office on the second floor inside the building.

The manned spaceship was carried by crane across the assembly hangar and placed gingerly on the third stage. Fasteners were tightened and connectors joined. The nosecone was put in position. The long grey, white and silver rocket lay on its railcar in the hangar, shining under the arc lamps, pointing towards the pad.

12 April. … It was 90 minutes to blastoff. Yuri Gagarin disappeared into the lift. In minutes he had clambered into the Vostok. The hatch was closed. He was on his own.

… The booster rose, gathering speed every second. Eyes followed intently upwards. Gradually it bent over in its climbing, heading into the north-east. Four bright light diamonds were all that could be seen of the engine chambers as Vostok disappeared from sight.

… Eight minutes. Engine cutoff. The rumble and shaking of the booster subsided abruptly. Silence, total silence, enveloped Vostok. Yuri Gagarin had reached orbit, somewhere over eastern Siberia.

Vostok was 181 km high and its orbit was to reach as high as 327 km. As he gazed through the two portholes of his silent spaceship, Gagarin began to take in the vastness of the planet. Later he described it in his own words. They tell it best:

> *I saw for the first time the spherical shape of the Earth. You can see its curvature when looking to the horizon. It is unique and beautiful. The day side of the Earth was clearly visible. The coasts of continents, islands, big rivers, the surfaces of water were distinguishable. It is possible to see the remarkable colourful change from the light surface of the Earth to the completely black sky in which one can see the stars. The dividing line is very thin, just a belt of film surrounding the Earth's sphere. It is of a*

delicate blue colour and the transition from the blue to the dark is very gradual and lovely. When I emerged from the shadow of the Earth, the horizon looked different. There was a bright orange strip along it which again passed into a blue hue and once again into a dense black colour.

Vostok was travelling at 8 km/s. It headed across the vast blue of the Pacific. Mariners had taken months and months to cross it but Gagarin would transit in 20 minutes. Down below, tossed on the waves of the ocean, Soviet tracking ships turned their antennae skywards to hear the signals and telemetry of Vostok and the voice of its occupant. By now, news of the flight was out. At 9.59 a.m., 6.59 a.m. in Britain and 1.59 a.m. in America, Moscow Radio came on air with the historic announcement:

Today, 12 April 1961, the first cosmic ship named Vostok, with a man on board, was orbited around the Earth from the Soviet Union.

He is an airman, Major Yuri Gagarin....

Exercises

Vocabulary

1. Transcribe the words:

Cosmonaut, fighter, arduous, spherical, curvature, horizon, surfaces, distinguishable, sphere, unique

2. Explain in English and then translate the following words and expressions into Russian:

pilot training school, applying to join a group of cosmonauts, was put before a medical board, cosmodrome, launch site, manned spaceship, launch site

3. Complete the text with the words from the box

system	cabin	floated	horizon	task	stars	sky	space
voice	flight	difficulty	weightlessness	sensation	jets		

Gagarin accustomed himself to (1). He wrote notes on a pad, and when he finished, it (2) free and lodged under the seat. An hour into the (3) and he was over Cape Horn, South America. Night fell:

> *I have never forgotten it. The (4) were so clearly visible—blindingly bright and full-bodied. The (5) was blacker than it ever appears on earth, with the real slate blackness of (6).*

The automatic guidance (7) locked on. Gagarin's next (8) was to test the ability of a man to eat and drink in space. He took away some tubes from their racks, squeezed them and found no (9). Little water droplets floated around the (10). Vostok flashed into daylight and the Sun marched over the eastern (11). Gas (12) hissed in the vacuum. Vostok turned around to prepare for retrofire. All this time Gagarin reported back his every move, his every (13). His (14) came through the mushy crackly short wave.

4. Translate into Russian

manned flight; manned space flight; manned space vehicle; manned spaceship; manned orbiting spacecraft; manned space program = manned man-in-space program; manned satellite; manned artificial satellite; manned space exploration manned program; manned space activities; manned space complex

5. Translate the following text into English:

В декабре 1959 года Юрий Гагарин написал заявление с просьбой зачислить его в группу кандидатов в космонавты. Через неделю его вызвали в Москву для прохождения медицинского обследования. В начале следующего года последовала ещё одна специальная медкомиссия, которая признала Гагарина годным для космических полётов. В марте 1960 года Гагарин был зачислен в группу кандидатов в космонавты. Он вместе с семьёй выехал к новому месту работы. С 25 марта начались регулярные занятия по программе подготовки космонавтов**.**

12 апреля 1961 года с космодрома Байконур впервые в мире стартовал космический корабль «Восток» с пилотом-космонавтом Юрием Алексеевичем Гагариным на борту. За этот полёт ему было присвоено звание Героя Советского Союза и воинское звание майора. Начиная с 12 апреля 1962 года**,** день полёта Гагарина в космос был объявлен праздником — Днём космонавтики**.**

6. Complete each sentence (1-10) with one of the endings (A-J)

1	When a space rocket blasts off,	A	in orbit around a small star.
2	In 1957 the Soviet Union launched	B	has people in it who are operating its controls.
3	The planet is probably	C	a large building in which aircraft are kept.
4	The satellite was called Sputnik,	D	six manned Soviet orbiting spacecraft, the first of which, launched in April 1961, carried the first man in space.
5	A manned vehicle such as a spacecraft	E	between Mercury and the earth at an average distance of 108 million km from the sun.
6	A hangar is	F	the first satellite to orbit the earth.
7	Vostok is a series of	G	and was awarded many medals and titles, including Hero of the Soviet Union, the nation's highest honour.
8	Unmanned vehicles such as spacecraft	H	it leaves the ground at the start of its journey.
9	Venus orbits	I	the Russian word for ‘companion’.
10	Yuri Gagarin became an international celebrity,	J	do not have any people in them and operate automatically or are controlled from a distance.

7. Find proper definitions (second column) for the words and word combinations (first column):

1	reliable	A	showing or involving great activity or vitality
2	capable	B	having made a firm decision and being resolved not to change it
3	energetic	C	an opening of restricted size allowing for passage from one area to another, in particular.
4	ambitious	D	the ability to continue with an unpleasant or difficult situation, experience, or activity over a long period of time.
5	determined	E	having the ability, fitness, or quality necessary to do or achieve a specified thing
6	porthole	F	able to be trusted
7	endurance	G	having or showing a strong desire and determination to succeed
8	blastoff	H	the first stage of a rocket or spacecraft, used to give initial acceleration and then jettisoned.
9	hatch	I	a small window on the outside of a ship or aircraft
10	booster	J	the launching of a rocket or spacecraft

Speaking

Give a 5-minute presentation on one of the following topics. Use the Memorized Method of Delivery.

1) The Idea of Manned Space Flight
2) Russian Cosmonauts
3) American Cosmonauts
4) European Cosmonauts

The Memorized Method of Delivery

It involves:

- Writing out the speech word for word;
- Committing it to memory.

Advantages: if you have a good memory the memorized method of delivery might seem the best way to present your speech.

Disadvantages: when you try to recite from memory, all your energy will be focused on remembering the exact wording and phrasing instead of projecting your message to the audience.

Writing

Do some research and write a 100-200 word history of space flight. Organize your material into a definite structure. Read the text aloud using the correct pronunciation. Look through this list of words and phrases for new ideas on how to begin and end paragraphs in your paper.

	Details	
as follows	especially	in detail
in particular	including	namely
specifically	to enumerate	to explain
	Example and illustration	
an illustration of	as an illustration	as follows
by way of illustration	e.g. (for example)	even
for example	for instance	in other words
in particular	namely	specifically
such as	the following example	thus
	Sequence	
afterward	at first	at the same time
earlier	finally	first of all
first	for now	for the time being
in conclusion	in the first place	in the meantime
in time	in turn	last
later on	later	meanwhile
next	simultaneously	soon
subsequently	the next step	then
to begin with	ultimately	while

Unit 6 Airports

Also known as: Aerodromes, airfields, landing strips

Definition: An area of land that provides for the taking off, landing, and surface maneuvering of aircraft.

Significance: Although airports mark the beginning and ending points of aircraft flights, they are more than mere runways or grass areas for takeoffs and landings. Airports are facilities that provide for the maintenance and servicing of aircraft, serve as exchange points for passengers and cargo, and host the various navigational aids used by pilots to guide an aircraft in flight.

Nature and Use

An airport is defined by the type of aircraft it serves and by where it is located. Airports range in size from large commercial air carrier airports, such as Chicago's O'Hare International Airport, with more than 30 million passengers per year, to small, privately owned grass landing strips in rural areas with landings of only a few small aircraft each year. In the United States, there are about 15,000 airport landing facilities, only 5,000 of which are open to the public. Even fewer, about 3,000, are served by commercial air carrier service. The other airports are small, general aviation airports in private or public ownership.

Types of Airports

Although airports may be classified in a number of different ways, the broadest categories are general aviation and commercial service airports. General aviation airports are those that do not receive regularly scheduled passenger service but rather have a primary purpose of serving the aviation interests and needs of small or outlying communities. General aviation includes such activities as corporate and business transportation, recreational flying, aircraft instruction and rental, aerial observation, skydiving activities, and other special uses.

Landing Facilities

An airport's landing facilities generally consist of a runway or landing strip along with related taxiways and parking areas. A runway is a graded or paved area suitable for the taking off or landing of aircraft. Although most runways in developed nations serving small to large commercial aircraft are paved, there are still many airports that are either grass or dirt strips. These types of landing strips usually serve small piston- or turbine-engine aircraft in rural or undeveloped areas of a country or in developing nations.

Runways

In the early days of aviation, dirt and grass runways were the norm. They tended to be wide open field areas that allowed pilots to take off and land in whichever direction the wind was blowing. This is because aircraft weighed relatively little and needed only a short distance to take off. As aircraft and pavement technology developed and the weight of aircraft increased, the need for longer and stronger runway surfaces emerged. The previously open fields were soon developed into graded areas oriented in the direction of the prevailing winds. These graded areas were then paved. If strong winds occasionally blew from a direction different to that of the paved runway, crosswind runways might also be graded and paved. Aircraft are designed to land into the wind. When winds blow from a different direction than the orientation of the primary runway, some aircraft are unable to handle the side forces of the wind when landing or taking off. A secondary crosswind runway built to accommodate the occasional crosswind is then used instead of the primary runway.

Exercises

Vocabulary

1. Transcribe the words:

Aerodromes, maneuvering, scheduled, aerial, designed, technology, surface although, commercial

2. Match the words from the texts (1-10) with the definitions (A-J):

1	take-off	A	the way something or someone moves, faces, or is aimed:
2	landing	B	the amount of physical power with which something moves or hits another thing
3	runway	C	a wind that blows across the direction that you are moving in
4	cargo	D	the surface which an aircraft drives on to get to and from the runway
5	taxiways	E	the action of bringing an aircraft down to the ground after being in the air
6	crosswind	F	the sport of jumping from a plane and falling through the sky before opening a parachute
7	skydiving	G	a long specially prepared hard surface like a road on which aircraft land and take off
8	force	H	someone who is travelling in a vehicle, plane, boat etc., but is not driving it or working on it
9	direction	I	the goods that are being carried in a ship or plane
10	passenger	J	the time when a plane leaves the ground and begins to fly

3. Match the words from the texts (1-5) with their synonyms (A-E):

1	to provide for	A	to show up
2	to host	B	diapason
3	range	C	to take in
4	purpose	D	to make arrangements
5	to emerge	E	objective

4. Explain in English and then translate the following words and expressions into Russian:

airport landing facilities, pavement technology, prevailing winds, private or public ownership, recreational flying, graded or paved area, primary and secondary runway.

5. Find in the texts the English equivalents for the following expressions:

(1) вести воздушное судно в полете, (2) регулярные пассажирские перевозки, (3) воздушное наблюдение, (4) прыжки с парашютом, (5) взлетно-посадочная полоса, (6) летательные аппараты с поршневым или турбинным двигателем, (7) асфальтированная взлетно-посадочная полоса, (8) боковой ветер, (9) взлет и посадка воздушных судов, (10) различные навигационные средства, (11) маневрирования воздушных судов, (12) техническое обслуживание и ремонт воздушных судов, (13) крупные коммерческие авиаперевозчики, (14) корпоративные и бизнес-перевозки, (15) авиация общего назначения.

6. ***Complete the text with the words from the box***

Airport structure

landside	taxiways	runways	airside
roads	terminals	ramps	parking lots
gates	air traffic control	on-site hotels	customs

Airports are divided into (1) and (2) areas. Landside areas include (3), public transportation train stations and access (4). Airside areas include all areas accessible to aircraft, including (5), (6) and (7). Passengers on commercial flights access airside areas through (8), where they can purchase tickets, clear security check, or claim luggage and board aircraft through (9). Due to their high capacity and busy airspace, many international airports have (10) located on site. Airports with international flights have (11) and immigration facilities. Some airport structures include (12) built within or attached to a terminal building.

7. *Answer the following questions. Begin your answers with such introductory phrases as:* *as far as I know; as far as I remember; to my mind; certainly; probably; of course; if I am not mistaken, etc.*

1) What do airport facilities provide for?

2) How do airports range in size?

3) What does general aviation include?

4) What do an airport's landing facilities consist of?

5) How did the first runways differ from the modern ones?

6) When are some aircraft unable to handle the side forces of the wind?

7) Why is a secondary crosswind runway built to?

8. Translate the following sentences into English:

1. В каждой стране есть аэропорты.

2. С непрерывным увеличением воздушного стало необходимым построить новые здания терминала и построить новые аэропорты.

3. Правила управления воздушным движением были созданы в интересах безопасности полетов.

4. Современный аэропорт представляет собой сложную структуру.

5.Тысячи людей работают в аэропортах.

6. Любой аэропорт можно разделить на две основные части: район посадки (взлетно-посадочные полосы и рулежные дорожки) и район аэродрома (здания, участки для парковки, ангары и т.д.).

Speaking

***Conversation Questions: "Airplanes". Work with a partner and discuss these questions*:**

1. How old were you when you went on your first flight? Where did you go?
2. Do you like to travel by airplane?
3. What was the longest flight you have ever taken?
4. What seat do you prefer: window, center or aisle?
5. What are three things you're supposed to do before the flight takes off?
6. What do you like to do during the flight? Does the plane provide anything to do to pass the time?
7. What do you do when you experience turbulence?
8. What should be done with obese people who practically take up two seats?
9. Can you sleep during the flight?
10. Have you ever seen a female pilot? Why do you think most pilots are men?
11. Would you like to be a flight attendant? What are the benefits and /or downfalls?
12. Are most flight attendants female? Is being a flight attendant considered a good job in your country? What do you think are the qualifications?
13. Are planes really safer than cars? (A study shows that flying is 176 times safer than walking, 15 times safer than driving and 300 times safer than a motorbike).
14. What are the advantages of traveling by airplane? What are the disadvantages?
15. Do you know someone who is afraid of flying in an airplane?
16. What questions should you ask when buying airplane tickets?
17. What is a charter flight?

18. What things can you see in an airport?

19. What questions do they ask you when you check-in at the airport?

20. What questions do they ask you when going through immigration and customs at the airport?

How to emphasize words

To strengthen your proposal, you can emphasize words that are often contracted and/or add and stress auxiliary verbs (do, does, did).

The words in bold are stressed:

- We should **not** worry about these drawbacks through as the advantages far outweigh the advantages.
- Clients **will** get to our offices more easily from the airport and we are going to build an underground garage so that there **will** be more visitor parking.
- In addition, you **do** find good accommodation around the airport.

[Presentations in English, 2012]

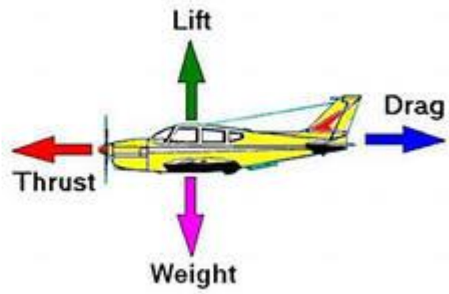
Writing

Compose a written report. Give several reasons and mention various counter-arguments of travelling by plane. Use the following transitional phrases

Continuation	**Conclusion**	**Contrast**	**Comparison/Illustration**
Again Also Similarly Besides Furthermore In addition Moreover Likewise	As a result Consequently Hence So Therefore Thus Accordingly In short In conclusion Because	But However On the contrary On the other hand Yet Instead Conversely In spite of Still Nor Even though Unfortunately	For example That is In other words In fact As a matter of fact

Unit 7

Forces of flight



Definition: The so-called four forces—gravity, drag, lift, and thrust—that act upon an airplane in straight and-level unaccelerated flight.

Significance: Weight and drag are forces of nature inherent of any object lifted from the ground and moved through the air. The forces of lift and thrust are artificially caused to overcome the forces of weight and drag and enable an airplane to fly.

Humans' first attempts to fly, inspired by birds, were limited until humans realized they could not fly like birds. Birds, with their very light weight, great strength, and complex biological design, can use their wings to create both lift and thrust to overcome the natural forces of weight and drag, and to maintain control. Humans, in contrast, had to invent a different approach to meet any success in aviation. The functions of lift and thrust had to be separated. For that, wings and engines were introduced. While wings produce lift, engines produce thrust. Following the first flights made by Orville and Wilbur Wright in December, 1903, the pace of aeronautical development accelerated, and the progress made in overcoming the natural forces in the aviation industry in following decades was dramatic. The understanding of natural forces is thus as important for an airplane's aerodynamics as the creation of artificial forces to counterbalance these natural forces. The engine and propeller combination is designed to produce thrust to overcome drag. The wing is designed to produce lift to overcome weight, or gravity. In unaccelerated, straight-and-level flight, which is coordinated flight at a constant altitude and heading, lift equals weight and thrust equals drag.

Nevertheless, lift and weight will not equal thrust and drag. In everyday vocabulary, the upward forces balance the downward forces, and forward forces balance the rearward forces. This statement is true whether or not the contributions due to weight, drag, lift, and thrust are calculated separately. Any inequality between lift and weight will result in the airplane entering a climb or descent. Any inequality between thrust and drag while maintaining straight-and-level flight will result in acceleration or retardation until the two forces become balanced.

However, there are a couple of paradoxes surrounding this information. The first paradox is that in a low-speed, high power climb, the amount of lift is less than the amount of weight. In this situation, thrust is supporting part of the weight. The second paradox is that in a low-power, high speed descent, the amount of lift is again less than the amount of weight. In this situation, the drag is supporting part of the weight. In light aircraft, the amount of lift ordinarily is approximately ten times the amount of drag. The motion of an aircraft through the air depends on the size of these four forces. The weight of an airplane is determined by the size and material used in the airplane's construction and on the payload and fuel that the airplane carries.

The lift and drag are aerodynamical forces that depend on the shape and the size of the aircraft, air conditions, and the flight speed and direction relative to the air velocity. The thrust is determined by the size and type of the propulsion system used in the airplane and on the throttle setting selected during the flight.

The relative wind velocity acting on the airplane contributes a certain amount of force, called total aerodynamic force. This force can be resolved into two components perpendicular to each other along the directions of lift and drag. Lift is the component of aerodynamic force directly perpendicular to the relative wind velocity. Drag is the component of aerodynamic force acting parallel to the relative motion of the wind. Weight is the force directed always downward toward the center of the earth. It is equal to the mass of the airplane multiplied by the acceleration due to the gravity, or the strength of the gravitational field. Thrust is the force produced by the engine and is usually more or less parallel to the long axis of the airplane.

Exercises

Vocabulary

1. Transcribe the words:

thrust, artificially, aeronautical, strength, inequality, aerodynamical, perpendicular, axis, propulsion

2. Match the words from the texts (1-10) with the definitions (A-J):

1	gravity	A	the things carried by a vehicle with scientific instruments and crew
2	drag	B	the pressure of air that keeps something such as an aircraft up in the air
3	lift	C	the reaction force that pushes an aircraft forward
4	thrust	D	flight path
5	force	E	the force of air that pushes against an aircraft or a vehicle that is moving forward
6	weight	F	the height of an object or place above the sea
7	altitude	G	how heavy something is when you measure it
8	heading	H	the rate at which an object changes position
9	velocity	I	a force that pulls objects
10	payload	J	a push or pull t that causes, accelerates, or stops the motion of objects

3. Explain in English and then translate the following words and expressions into Russian:

straight and-level unaccelerated flight, the pace of aeronautical development, to counterbalance these natural forces, the drag is supporting part of the weight

4. Match the words from the texts (1-5) with their synonyms (A-E):

1	inherent	A	keep
2	retardation	B	essential
3	maintain	C	impressive
4	dramatic	D	deceleration
5	rearward	E	backward

5. Find in the texts the English equivalents for the following expressions:

(1) для преодоления силы тяжести и сопротивления, (2) позволяет самолету летать, (3) аэродинамика самолета, (4) рассчитываются отдельно, (5) примерно в десять раз больше сопротивления, (6) в последующие десятилетия, (7) создание искусственных сил, (8) уравновесить природные силы, (9) винтомоторная группа (установка), (10) координированный полет с постоянной высотой и направлением, (11) любое неравенство между подъемной силой и силой тяжести, (12) самолет набирает высоту или снижается, (13) размер и тип двигательной системы, (14) выбранный во время полета, (15) относительная скорость ветра, (16) установка режима работы двигателя (режим дроссельной заслонки).

6. ***Complete the text with the words from the box***

Forces

push	forces	accelerate	opposite
amount	motion	Scientists	speed
direction	zipper	engines	pull

How do you make something (1)? How do you make it move, change its (2) or (3) or stop? You give it a (4) or a (5). Pushes and pulls are examples of what scientists call (6). When you pull (7) at the on your jacket, you are using force. (8) designing a Moon rocket have to take into account all the forces that will act on it. These include not only the forces generated by its (9) to make it go, but also other forces that affect its (10), such as gravity. Force is described by the (11) of push or pull. It is also described by the direction of the push or pull. When you push on a door, you are using force in one direction. When you pull on that same door, you are using force in the (12) direction.

7. *Answer the following questions. Begin your answers with such introductory phrases as:* *as far as I know; as far as I remember; to my mind; certainly; it's hard to tell; probably; of course; if I am not mistaken, etc.*

1) What forces act upon an airplane in straight- and-level unaccelerated flight?

2) How do birds create both lift and thrust to overcome the natural forces of weight and drag?

3) What forces do wings and engines produce?

4) What will any inequality between lift and weight result in?

5) What will any inequality between thrust and drag result in?

6) What is weight of an airplane determined by?

7) What is weight equal to?

8. Translate the following sentences into English:

1. Подъемная сила, сила сопротивления, сила тяги и вес действуют на самолет в полете.

2. Самолет находится в состоянии равновесия, когда сила тяга и сопротивление равны и противоположны по направлению.

3. Самолет будет продолжать двигаться вперед с той же равномерной скоростью.

4. Если сила тяги или сопротивления становится больше, чем противоположная сила, самолет теряет свое состояние равновесия.

5. Если тяга больше сопротивления, самолет будет ускоряться.

6. Если сопротивление больше тяги, самолет теряет скорость и в конечном итоге снижается.

7. Если подъемная сила больше веса, самолет будет подниматься.

Speaking

Conversation Questions: “Force”

Discuss in pairs. How does each of these move?

bird	fly	grasshopper
helicopter	aircraft	bee

Use the next words: horizontal, vertical, forwards, backwards, lift, fall, rotate, roll, hover, bank, dive, take-off, climb, withstand, accelerate, decelerate

How to prepare for the Conversation

- Before speaking you should identify what can be accomplished by talking. Every communication act has a practical goal or goals (primary and secondary)
- Find information in newspapers, magazines, books, in-house literature, press releases or on the Internet
- Ask something and then go on to answer it yourself
- You must support your ideas with proof

Writing

Compose a written report about forces acting on the aircraft in flight.

Unit 8 Lighter-than-air aircraft



All aircraft are designed to fly through the air. But not all of them fly the same way. In fact, there are two types of aircraft. One is called "lighter-than-air." The other is known as "heavier-than-air." A lighter-than-air craft is able to float. It can become lighter in weight than the air around it. A circus balloon is a simple example of this type of craft. Before it gets filled, the balloon doesn't move. Its weight keeps it down. But fill the bag with helium gas, and the balloon lifts up. Why does this happen? The reason is that helium is much lighter than air.

Why Kites Fly

A heavier-than-air craft is different. It always stays heavier than the air around it. This type of craft flies for another reason. Its surfaces cause moving air to lift up the craft. A simple heavier-than air craft is a kite. Kites come in many shapes and sizes. But they are all made to lift up in the wind. The kites people around the world fly for fun are named after the kite bird. This type of bird is also found all over the world.

Hot-Air Balloons

Most of us have seen them. Big and colorful, hot-air balloons carry people for long rides through the air. How do they do it? These lighter-than-air craft work in several ways. First, every hot-air balloon has an air-filled bag, or envelope. Because of its large size, the bag can move aside a lot of air. But air moved to another place pushes back. In fact, this displaced air presses so hard that it keeps the bag afloat. In other words, the bag is buoyant. But the basket tied to the bag stays on the ground. Its cargo of equipment and people is heavy.

To make the hot-air balloon go up, the pilot turns on a burner under the bag. The burner creates a flame. Hot air quickly rises into the huge bag. This heats up the air molecules inside. They start moving faster. Also, some of them escape through the bottom of the bag. That leaves fewer molecules inside. They are farther apart, too. The inside air, then, is less dense than the air outside, and it weighs less. The result? The hot-air balloon rises. To lower the hot-air balloon, the pilot turns off the burner. The air inside the bag gets cooler. That means the air molecules slow down. They also move closer together. Soon there's room for outside air to re-enter the bag. More air molecules inside make the air in the bag denser—and heavier. So the craft comes down.

Floating Airships

Hot-air balloons can fly, but they cannot be steered. They simply float in whatever direction the wind takes them. An airship is a lighter than-air aircraft, too. But unlike a hot air balloon, the airship has an engine and fins. These allow the ship to be steered in the direction where the pilot wants it to go. The envelope of an airship is long and rounded. Usually helium gas is used to inflate it. The helium is sealed inside. Since helium is lighter than air, the envelope stays afloat.

Exercises

Vocabulary

1. Transcribe the words:

craft, lighter-than-air, heavier-than-air, float, weight, circus balloon, helium gas, kite, hot-air balloon, air-filled bag, envelope, keep afloat, buoyant, burner, molecules, dense, steer, engine, fin, issue, inflate

2. Match the words from the texts (1-5) with their synonyms (A-E):

1	steer	A	powered balloon
2	airship	B	fly
3	shape	C	skin
4	envelope	D	outline
5	engine	E	motor

3. Explain in English and then translate the following words and expressions into Russian:

to fly through the air, a lighter-than-air craft, weight keeps it down, hot-air balloons, an air-filled bag

4. Match the words from the texts (1-10) with the definitions (A-J):

1	airship	A	the structure within a balloon or non-rigid airship containing the gas
2	balloon	B	a part of a cooker, lamp, etc. that emits a flame
3	kite	C	a flexible container with an opening
4	bag	D	a toy consisting of a light frame with thin material stretched over it, flown in the wind at the end of a long string
5	envelope	E	able to keep something afloat
6	buoyant	F	a power-driven aircraft that is kept buoyant by a body of gas (usually helium, formerly hydrogen) which is lighter than air
7	burner	G	a group of atoms bonded together, representing the smallest fundamental unit of a chemical compound that can take part in a chemical reaction
8	molecule	H	a large bag filled with hot air or gas to make it rise in the air, typically one carrying a basket for passengers
9	steer	I	a small flattened projecting surface or attachment on an aircraft, rocket, or car, for providing aerodynamic stability
10	fin	J	guide or control the movement of (a vehicle, vessel, or aircraft), for example by turning a wheel or operating a rudder

5. Find in the texts the English equivalents for the following words and expressions:

(1) two kinds of airplane, (2) a vehicle can fly, (3) sample,(4) upside, (5) contour, (6) dimension, (7) gas-bag, (8) throw back, (9) decelerate, (10) to return into the bag, (11) drive, (12) sail, (13) blow, (14) leave out, (15) shell

6. ***Complete the text with the words from the box***

drag	flown	passengers	pressure
forces	direction	aerial	wing
lift	steerable	applications	aircraft

A kite is a tethered (1). The necessary (2) that makes the kite wing fly is generated when air flows over and under the kite's (3), producing low (4) above the wing and high pressure below it. This deflection also generates horizontal (5) along the (6) of the wind. Kites may be (7) for recreation, art or other practical uses. Sport kites can be flown in (8) ballet, sometimes as part of a competition. Power kites are multi-line (9) kites designed to generate large (10) which can be used to power activities such as kite surfing, kite fishing and a new trend snow kiting. Kites towed behind boats can lift (11) which has had useful military (12) in the past.

7. Find in the texts the English equivalents for the following words and expressions

(1) стать легче, чем окружающий воздух, (2) красочные, воздушные шары, (3) назван в честь птицы сокола, (4) перевозить людей по воздуху, (5) длительные поездки, (6) чтобы воздушный шар поднялся вверх, (7) парить в любом направлении, (8) воздух внутри менее плотный, чем воздух снаружи , (9) горячий воздух быстро поднимается, (10) летательный аппарат легче воздуха.

8. ***Answer the following questions. Begin your answers with such introductory phrases as:*** *as far as I know; as far as I remember; to my mind; certainly; it's hard to tell; probably; of course; if I am not mistaken, etc.*

1) What are aircrafts designed for?
2) What types of aircraft are there?
3) Why does a circus balloon fly?
4) What are kites made for?
5) How do hot-air balloons fly?
6) What is a burner used for?
7) Can any type of aircraft be steered? Which one?

9. Translate the following sentences into English:

1. Кайтсерфинг является экстремальным видом спорта, сочетает кайтинг и серфинг. Во время обучения вы должны изучить основы кайтсерфинга в том числе: развертывание воздушного змея, технику безопасности.
2. Есть много компаний, которые предлагают полет на воздушном шаре. Полет длится один час и обычно проходит на рассвете и вечером, когда нет сильного ветра.
3. Рыбалка при помощи воздушного змея была изобретена в Китае. Воздушные змеи дают возможность ловить рыбу в местах, где это не безопасно для навигации, где рыбы может быть много.
4. Сноукайтинг это открытый зимний вид спорта, где люди используют воздушный змей, чтобы скользить по снегу или льду. Сноукайтинг позволяет спортсмену ехать в гору и спускаться с любым направлением ветра.
5. Соревнования с участием воздушных змеев имеют много общего с фигурным катанием, а также с балетом, который включает в себя художественную интерпретацию музыки. Выступления представляют собой различные фигуры и соединения в воздухе.

Speaking

Give a 5-minute presentation on one of the following topics. Use the Extemporaneous Method of Delivery.

1) Hot-Air Balloons
2) Floating Airships
3) Kites

The Extemporaneous Method of Delivery

This method is described as the most effective one. It is based on:

- thorough preparation;
- memorizing the main ideas;
- abbreviating the manuscript to a number of key words and phrases.

Advantages:

- this method allows you great flexibility (you are not fixed on the exact wording ➔you are free to extemporize depending on the feedback from the audience);
- with this method it is easy to be natural;
- this method comes closest to ‘enlarged conversation’, which is an ideal form of public speaking;
- your physical freedom (you are not tired to the script➔you can move freely, use body language and interact with the audience).

[Основы публичной речи: Learning to Speak in Public, 2002]

Writing

Do some research and write a 100-200 word history of airships (kites, balloons).

Unit 9

What is an airplane

What is the difference between aircraft and airplane? Aircraft is the more general term, and refers to any heavier-than-air craft that is supported by its own buoyancy or by the action of air on its structures. An airplane is a heavier-than-air craft that is propelled by an engine and uses fixed aerodynamic surfaces (i.e. wings) to generate lift. So, every airplane is an aircraft, but not every aircraft is an airplane! Gliders are aircraft that are not airplanes. The Space Shuttle is definitely an aircraft, but it is not an airplane. It does not carry engines for propulsion. Helicopters are also aircraft that are not airplanes because their aerodynamic surfaces are not fixed - they rotate.

Why are there so many different types of airplanes?

The characteristic that most readily identifies the type, performance and purpose of an airplane is the shape of its wings. There are four basic wing types: straight wings, sweep wings (forward-sweep/sweepback), delta wings and the swing-wing (or variable sweep wing). Each shape allows for premium performance at different altitudes and at different speeds.

Another important discriminator between airplanes is speed. Airplanes fly at subsonic, transonic, supersonic and hypersonic speeds. These speed classifications are called the "regimes" of flight. The suffix -sonic refers to the speed of sound, which is dependent on altitude and atmospheric conditions (nominally 340 meters per second). "Mach" is a term used to specify how many times the speed of sound an aircraft is traveling. Mach 1 is one times the speed of sound. Mach 2 is twice the speed of sound, and so on. Mach numbers less than 1 are speeds less than the speed of sound.

Subsonic refers to all speeds less than Mach 1. Transonic refers to all speeds from approximately Mach .9 to Mach 1.5 - that is, the speeds at which an aircraft is going through the speed of sound or "breaking the sound barrier". Supersonic refers to all speeds greater than the speed of sound, which is the same as saying all speeds above Mach 1. Hypersonic refers to all speeds greater than Mach 5. Note that an aircraft flying at hypersonic speeds can also be said to be flying at supersonic speeds.

Every modern aircraft that is built today is built for a specific purpose. Airplanes are designed for different altitudes, different speeds, different weight-carrying capacities, and different performance. Jet fighters are relatively lightweight, highly maneuverable and very fast.

They are designed to carry a relatively small amount of weight, including fuel, which necessitates refueling on long flights. Passenger airplanes are larger, carry more weight, and can fly longer distances. However, they are less maneuverable and slower than jet fighters. Other aircraft like the SR-71, are designed to fly at very high altitudes and high speeds for very long periods of time. Every aircraft fills a particular niche in the gigantic matrix that is modern aviation.

Exercises

Vocabulary

1. Memorize the following vocabulary units.

buoyancy, fixed aerodynamic surfaces, propulsion, performance, hypersonic, jet fighter, fuel, refueling, straight wing, sweep wing, subsonic, transonic, supersonic

2. Transcribe the words:

aircraft, airplane, buoyancy, aerodynamic, propulsion, hypersonic, altitude, design

3. Match the words from the texts (1-5) with their synonyms (A-E):

1	speed	A	sailplane
2	buoyancy	B	productivity
3	glider	C	velocity
4	performance	D	carrying capacity
5	maneuverable	E	easy-to-handle

4. Match the words from the texts (1-10) with the definitions (A-J):

1	craft	A	pushing forwards
2	altitude	B	a type of aircraft which derives both lift and propulsion from one or two sets of horizontally revolving overhead rotors
3	lift	C	spaceship
4	propulsion	D	the capabilities of a machine, product, or vehicle
5	helicopter	E	a rigid horizontal structure that projects from both sides of an aircraft and supports it in the air
6	performance	F	upward force exerted by the air on an aerofoil or other structure
7	wing	G	rapidity of movement or action
8	speed	H	material such as coal, gas, or oil that is burned to produce heat or power
9	fuel	I	a fast military aircraft designed for attacking other aircraft
10	fighter	J	the height of an object or point in relation to sea level or ground level

5. Explain in English and translate the words and expressions into Russian:

airplane, aircraft, propulsion, regimes of flight, hypersonic speed, sound barrier, passenger airplane

6. ***Complete the text with the words from the box***

fixed	shape	engines	pressure
wings	surface	propeller.	forward
blades	air	nose	steer

An airplane is a heavier-than-air craft with (1) wings (that is, wings that don't move) and one or more (2). In many airplanes, the engine turns a (3). Propellers are found mostly on a plane's (4) or (5). The propeller is made of several (6) around a center, or hub. The front (7) of each blade is rounded. It has an airfoil (8). As the propeller rotates, it causes (9) to move faster in front of the blades than behind them. The air (10), then, is lower in front than in back. This difference pulls the propeller (11). The airplane is pulled forward, too. But there's more to flying than moving forward. An airplane pilot also needs to (12) the craft. For this, the plane has "control surfaces." These are moveable flaps on the plane's wings and tail.

7. Find in the texts the Russian equivalents for the following words and expressions:

(1) vehicle, (2) motor, (3) power plant , (4) rotor plane, (5) airfoil, (6) tempo, (7) supersonic Mach number, (8) hypersonic velocity, (9) efficiency

8. Answer the following questions. Begin your answers with such introductory phrases as: *as far as I know; as far as I remember; to my mind; certainly; it's hard to tell; probably; of course; if I am not mistaken, etc.*

1) Is every aircraft an airplane? Why?

2) Why are there so many different types of airplanes?

3) What are four basic wing types?

4) What are the speed classifications?

5) What does the term Mach mean?

6) What purposes are airplanes designed for?

7) Can you compare the performances of passenger airplanes and jet fighters?

Speaking

Give a 5-minute presentation on one of the following topics. Use the Extemporaneous Method of Delivery.

1) Airplanes and aircrafts

2) Speed classification for airplanes

Some guidelines for the effective implementation of the extemporaneous method of delivery*:*

1. Memorize 3 parts of an extemporaneous speech:
   - the opening lines;
   - the major propositions;
   - the closing lines.
2. Memorize the main ideas in the order to their presentation.
3. Write the key phrases of your speech on a sheet of paper or on cards.
4. Rehearse your speech.

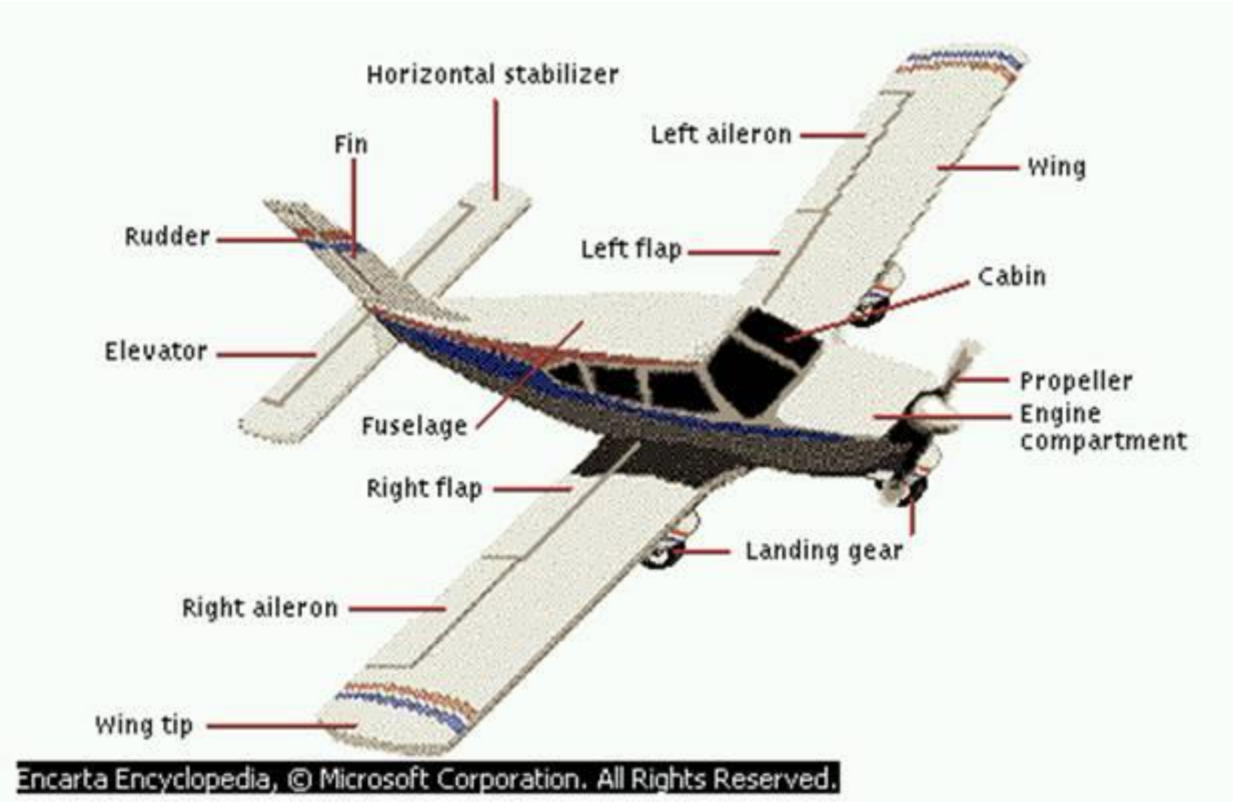
[Основы публичной речи: Learning to Speak in Public, 2002]

Writing

Summarise the airplanes classifications in a short paragraph of 100 words. You can classify from from general to specific or from specific to general. Use the phrases.

Classification from general to specific	**Classification from specific to general**
re classified into …categories	is a type of
can be devided into… types	are parts/ components of
include	constitute
consists of	make up
comprise	

Unit 10 Airplane structure



Definition: A means of air transportation that is propelled by an internal combustion, turboprop, or jet engine.

Nature and Use

Airplanes fly with the help of the laws of physics and engineering. They come in all shapes and sizes and serve different purposes. Some aircraft are used for training; others are used for transporting goods and freight. Military aircraft are used in waging warfare. Passenger airliners are used for the daily transportation of travelers. Although airplanes have different designs and functions, all airplanes share common traits. The fuselage, or body of the aircraft, carries people, cargo, and baggage. Attached to the fuselage are the wings, which provide the lift to carry the aircraft and its payload. To balance the airplane in flight, the tail, or empennage, is very important. The landing gear allows the airplane to operate on the earth’s surface. The flight controls are used to maneuver the aircraft in flight. Flaps provide additional lift and drag for takeoffs and landings

Fuselage

The primary job of the fuselage is to provide space for the flight crew and passengers. The attachment of the wings and other load-bearing structures is also an important function of the fuselage.

Wings

Wings are as varied as other parts of the airplane. They come in different shapes and sizes, depending on the aircraft’s speed and weight requirements. A slower airplane may have a rectangular wing or a tapered wing. A rectangular wing is one in which the chord line, or cross section, rectangular of the wing, remains constant from the root of the wing near the body of the aircraft to the wingtip. A tapered wing is one that becomes narrower toward the tip. High-speed aircraft, such as jet transports, airliners, or fighter aircraft, have swept-wing designs. The purpose of the swept wing is to allow the airplane to fly at higher airspeeds.

Empennage

The empennage is the tail structure of the aircraft, which includes the vertical stabilizer and rudder, along with the horizontal stabilizers and elevator. These essential components provide stability for the airplane in flight.

Landing Gear

In order to move around on the earth’s surface, all aircraft have landing gear. The most common arrangement of the landing gear is the tricycle landing gear, in which the aircraft has two main wheels that extend from either the wing or the fuselage and a third wheel that extends from the nose of the aircraft.

Flight Controls

The flight control system controls the aircraft in flight and comprises the devices that command movement of the aircraft around all three axes: longitudinal, lateral, and vertical. The elevator controls the airplane’s longitudinal movement about its lateral axis. In other words, it causes the airplane’s nose to go up or down. Finally, the rudder controls the airplane about the vertical axis.

Flaps

Airplanes have flaps for both takeoffs and landings. Located on the inboard portion of the wing at the rear, flaps change the shape of the wing in a way that creates both lift and drag. The first half of travel, after takeoff, creates more lift than drag, whereas the last half of travel, before landing, creates more drag without a noticeable increase in lift.

The Power Plant

The internal combustion engine powers many of today’s light airplanes. The most popular arrangement of the engine is in the horizontally opposed configuration. The engine is air-cooled and typically arranged in a flat four- or six-cylinder configuration, allowing the best cooling for all of the cylinders.

"Aero" is a Greek prefix signifying air. Air is made up of a mixture of gasses, and thus is itself a gas. However, in all the reading about aeronautics you have done air is referred to as a fluid. For instance, air obeys the laws of fluid dynamics. The technical definition of a fluid states that a fluid is any substance that flows. Obviously water flows, but so does air and so do powders! So, technically speaking, air and powders are fluids. Most important to our study of aeronautics is the fact that air obeys the physical laws of fluids.

Exercises

Vocabulary

1. Memorize the following vocabulary units.

internal **combustion engine**, turboprop, jet engine, passenger airliner, military aircraft, common traits, cargo, baggage, **empennage**, landing gear, flap, lift, drag, takeoff, landing, crew, load-bearing structure, **fuselage**, rectangular wing, tapered wing, root, wingtip, swept-wing design, vertical stabilizer, rudder, horizontal stabilizer, elevator, tricycle landing gear, longitudinal axis, lateral axis, vertical axis, fluid dynamics

2. Transcribe the words:

combustion, turboprop, fuselage, cargo, baggage, axis, empennage, crew, rectangular, chord, stabilizer, rudder, elevator, vertical, structure, dynamics

3. Match the words from the texts (1-5) with their synonyms (A-E):

1	transportation	A	airfoil
2	tail	B	shipment
3	fuselage	C	fin
4	stabilizer	D	airframe
5	wing	E	empennage

4. Explain in English and then translate the expressions into Russian:

military aircraft, passenger airliners, flight controls, flap, fuselage, rectangular wing, swept wing, empennage, tricycle landing gear

5. Match the words from the texts (1-10) with the definitions (A-J):

1	cargo	A	the longitudinal retarding force exerted by air or other fluid surrounding a moving object
2	fuselage	B	the width of an aerofoil from leading to trailing edge
3	empennage	C	goods carried on a ship, aircraft, or motor vehicle
4	drag	D	the main body of an aircraft
5	chord	E	stabilizing surfaces at the tail of an aircraft
6	wingtip	F	a vertical aerofoil pivoted from the tailplane of an aircraft to control movement about the vertical axis
7	rudder	G	the tip of the wing of an aircraft
8	elevator	H	the undercarriage of an aircraft
9	landing gear	I	an imaginary line about which a body rotates
10	axis	J	a hinged flap on the tailplane of an aircraft, used to control the motion of the aircraft about its lateral axis

6. Find in the texts the English equivalents for the words and expressions:

(1) airfoil, (2) airframe, (3) thrust, (4) end edge, (5) arrow wing, (6) tail assembly, (7) vertical tail surfaces, (8) horizontal tail surfaces, (9) **altitude** control, (10) landing device, (11) **aileron**, (12) engine

7. *Answer the following questions. Begin your answers with such introductory phrases as:* *as far as I know; as far as I remember; to my mind; certainly; it's hard to tell; probably; of course; if I am not mistaken, etc.*

1) What common traits do all airplanes share?

2) What is the difference between a rectangular wing and a tapered one?

3) What does the empennage consist from?

4) What is the most common arrangement of the landing gear?

5) What is air from the aeronautics point of view?

Speaking

Give a 5-minute presentation on one of the following topics. Use the Extemporaneous Method of Delivery. Remember that wordless communication acts to qualify the words. What the non-verbal elements express very efficiently is the emotional side of the message.

1. All airplanes share common traits though they have different designs and functions.

2. There are many variants of wings.

3. Power plant

4. Air

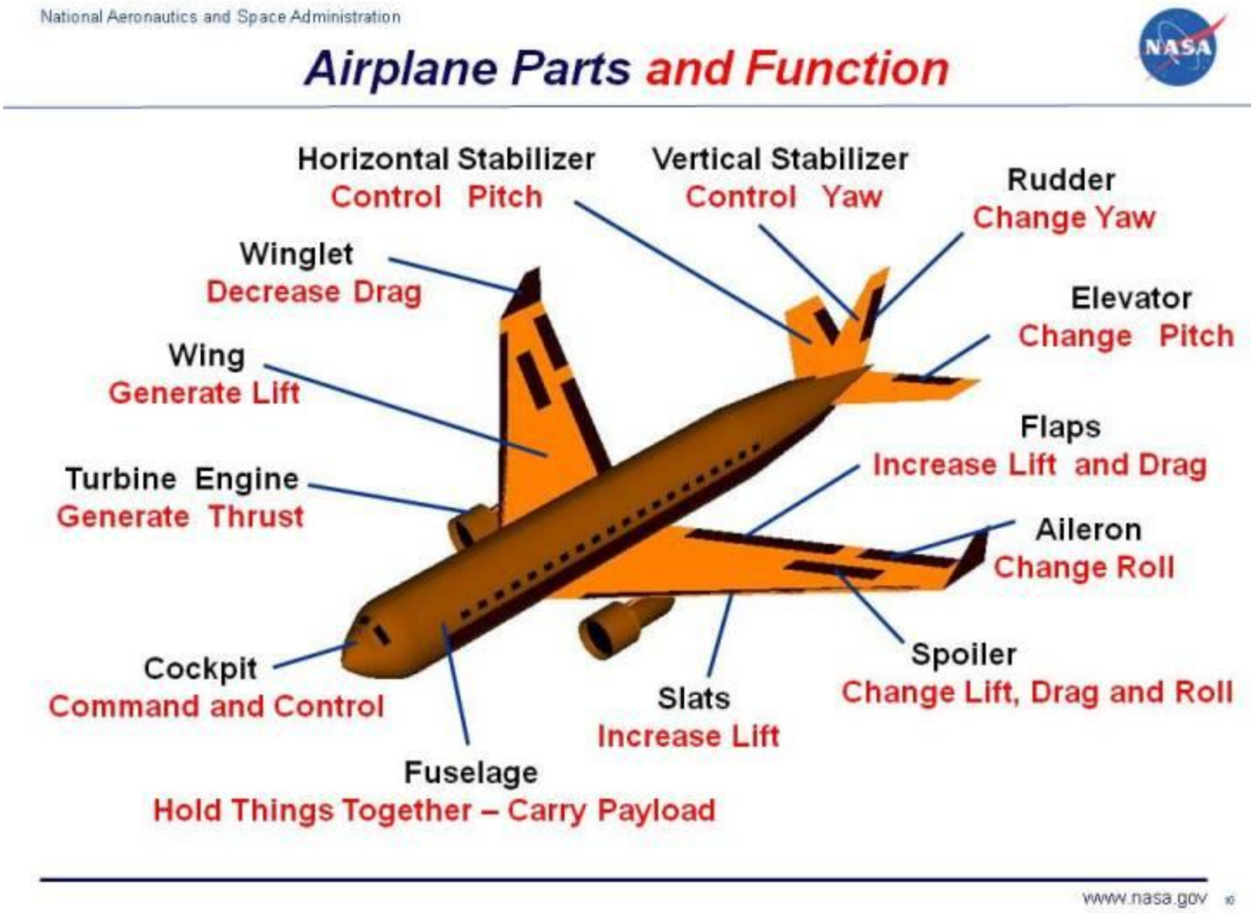
5. There are many different types of airplanes.

Non-Verbal Means of Communication

- Body language is habitual, acquired by human beings together with words.
- Gesture, gesticulation and facial movements of expression usually accompany the act of talking and serve to emphasize the content of what is said.
- We shouldn't rely heavily upon the notes. Reading from the script reduces the opportunity of eye contact with the audience. We should look straight into the listener's eyes and register his reaction.
- Public speech is a performance. Its success is determined by coordination of verbal and non-verbal means of communication.

Writing

Compose a written report about the airplane parts. Use this visual to describe the functions of airplane parts. Organize your material into a definite structure.



Appendix 1

Presentation

Useful language

Welcoming the audience

Good morning/ afternoon, ladies and gentlemen

Hello/ Hi, everyone

First of all let me thank you all for coming here, today.

I/m happy/ delighted to see you.

Introducing yourself

Let me introduce myself, I'm…

For those who don/t know me, my name is…

As you probably know, I'm…

Saying what your topic is

As you can see on the screen, our topic today is…

Today's topic is…

The subject of my presentation is…

Let's start with my presentation. …

I would like to begin by …

Involving the audience

OK, what is..?

How many of you have heard of..?

I'd like us to focus our attention on …..

I'd like you to think about …

Emphasizing

I just like to highlight…

I'd like to stress the importance of…

What is interesting / important here is …..

It is important to notice that …

Changing subject

OK, I'll move on to…

Turning now to…

Now I'll show you …

Let's now turn to …

Let me then turn to the third and final option …

Commenting

I think that's interesting because…

I think what this means is…

The significance of this is …

As we can see …

In addition, …

Summing up

Let me just go over the key points again. …

To sum up …

We can conclude that …

Let me summarize what we’ve looked at. …

I’ll briefly summarize the main issues. …

I’d like to summarize. …

So, we’re now at the end of our presentation. Let’s …

So, that brings me to the end of my presentation. …

Thank you for listening. …

Thank you for your attention. …

Referring to visuals

Let’s look at the chart…

Let me draw your attention to the table

Examples:

1) *So, let’s start then. I will start by telling you what the greenhouse effect is.*
2) *Firstly, I’ll give the background to the project.*
3) *Then, I’ll tell you about the present situation.*
4) *My first point will be to show you the structure of the department.*
5) *My second point will be suggestions for greater efficiency.*
6) *So, we’re now at the end of our presentation.*

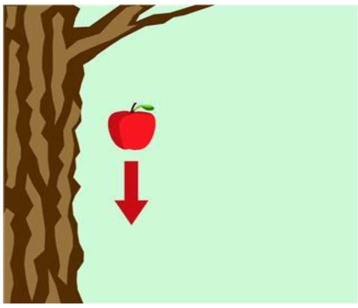
Expressing your opinion

Послушайте, что я вам скажу...	Look, I'll tell you what...
Значит, так...	It's like this. You see...
Начну с того, что...	I'll start by saying that...
На мой взгляд...	As I see it...
По моему мнению...	In my opinion...
Насколько я понимаю...	As far as I can see...
С одной стороны... с другой...	On the one hand... on the other... For one thing... for another...
Общеизвестно, что...	It's common knowledge that...
Учитывая все обстоятельства...	All things considered...
При прочих равных условиях...	All other things being equal...
Следует признать, что...	It must be admitted that...
Мне хотелось бы внести ясность...	I should (I'd) like to make it clear that...
Вы во многом правы, но...	There's much truth in what you're saying, yet...
Однако следует помнить о том, что...	It is as well to remember that...
Нельзя отрицать того, что...	There's no denying that...
Возможно, что то, что я скажу, покажется вам несколько не по теме, но...	What I'm going to say may seem not so relevant, yet...
Я понимаю вас, но...	I see your point, but...
В заключение мне хотелось бы сказать...	In conclusion I'd like to say that...
Таково мое мнение.	This is the way I look at it. This is the way I see it.

Appendix 2

Supplementary reading

Text 1 The discovery of Universal Gravitation



Gravity is the attractive force exerted by all objects on all other objects. By the early seventeenth century, many forces had been identified: friction, gravity, air resistance, electrical, forces people exerted, etc. Newton's mathematical concept of gravity was the first step in joining these seemingly different forces into a single, unified concept.

An apple fell; people had weight; the moon orbited Earth—all for the same reason. Newton's law of gravity was a giant, simplifying concept. Newton's concept of, and equations for, gravity stand as one of the most used concepts in all science. Most of our physics has been built upon Newton's concept of universal gravitation and his idea that gravity is a fundamental property of all matter.

How Was It Discovered?

In 1666, Isaac Newton was a 23-year-old junior fellow at Trinity College in Cambridge. With his fair complexion and long blond hair, many thought he still looked more like a boy. His intense eyes and seemingly permanent scowl pushed people away.

In London, the bubonic plague ravaged a terrified population. Universities were closed, and eager academics like Isaac Newton had to bide their time in safe country estates waiting for the plague to loosen its death grip on the city. It was a frightening time. In his isolation, Newton was obsessed with a question: What held the moon circling the earth, and what held the earth in a captive orbit around the sun? Why didn’t the moon fall down to the earth? Why didn’t the earth fall down to the sun?

In later years Newton swore that this story actually happened. As he sat in the orchard at his sister’s estate, he heard the familiar soft “thunk” of an apple falling to the grass-carpeted ground, and turned in time to see a second apple fall from an overhanging branch and bounce once before settling gently into the spring grass. It was certainly not the first apple Isaac Newton had ever seen fall to the ground, nor was there anything at all unusual about its short fall. However, while it offered no answers to the perplexed young scientist, the falling apple did present Isaac with an important new question, “The apple falls to Earth while the moon does not. What’s the difference between the apple and the moon?

Next morning, under a clearing sky, Newton saw his young nephew playing with a ball. The ball was tied to a string the boy held tight in his fist. He swung the ball, slowly at first, and then faster and faster until it stretched straight out.

With a start Newton realized that the ball was exactly like the moon. Two forces acted on the ball—its motion (driving it outward) and the pull of a string (holding it in). Two forces acted on the moon. Its motion and the pull of gravity—the same pull (force) that made the apple fall.

For the first time, Newton considered the possibility that gravity was a universal attractive force instead of a force that applied only to planets and stars. His deep belief in alchemy and its concept of the attraction of matter led him to postulate that gravitational attraction force did not just apply to heavenly objects, but to all objects with any mass.

Gravity pulled apples to earth, made rain fall, and held planets in their orbits around the sun. Newton’s discovery of the concept of universal gravitation was a major blow to the prevalent belief that the laws of nature on Earth were different from those that ruled the heavens. Newton showed that the machinery that ruled the universe and nature is simple.

Newton developed universal gravitation as a property of all matter, not just of planets and stars. Universal gravitation and its mathematical expression lie at the foundation of all modern physics as one of the most important principles in all science.

Fun Facts**:** The Flower of Kent is a large green variety of apple. According to the story, this is the apple Isaac Newton saw falling to ground from its tree, inspiring his discovery of universal gravitation.

Text 2

Aerodynamics and Birds

Birds have provided humans with much information about heavier-than-air vehicle design. About 8,800 species of birds make up most living organisms capable of flight.

Most birds, however, fly well, and humans learned a lot about heavier-than-air vehicle design from observing them. Birds differ from heavier-than-air aircraft primarily in that their wings are movable, or flappable. Most aircraft have fixed wings, which do not move.

Birds’ bodies are specially engineered for flight. Their skeletons are light, often weighing less than their feathers. Feathers combine the qualities of lightness, strength, and flexibility; a feather, bent double, quickly regains its shape upon release. Made of keratin, feathers also keep birds warm, dry, and protected from injury.

Bird lungs and hearts are designed for the high metabolic rates needed to produce the huge amounts of energy required by all flying machines, biologic or manufactured.

To understand flight requirements, a background in aerodynamics, a branch of fluid dynamics that studies movement of bodies, such as birds or aircraft, through gases such as air, is essential. For example, the fifteenth century Italian artist and engineer Leonardo da Vinci studied bird flight and proposed to enable human beings to fly with flappable wings. His ideas failed because da Vinci knew nothing about aerodynamics, a science which did not exist then.

Any heavier-than-air flying vehicle must conquer gravity before it can climb into the air in controlled flight. Three main forces, exclusive of weight, are involved. The first is thrust, which birds produce by flapping their wings. Flapping merely enables a bird to move forward as long as its design allows enough thrust to exceed the drag caused by the viscosity of the air through which the bird moves. Drag diminishes the speed of moving objects due to air resistance. In vehicle design, thrust-to-drag ratios can be increased by streamlining to minimize drag. The third aerodynamic force, lift, is the key to flight. Lift, enabling an object's rise into the air, operates upward perpendicular to the direction of forward motion, and is supplied in both birds and aircraft by wings and tails (airfoils).

Bird wings are designed so the angle at which they meet air passing them causes it to flow much more rapidly past the upper airfoil surface than past its lower surface.

This design lowers air pressure above the airfoil compared to that under it and engenders the lift that raises a bird into flight. In birds, this unsymmetrical airflow is produced by muscle movement that changes both the positions of wing feathers and the angle at which wings meet the air, known as the angle of attack.

Wing Design and Flight

Birds create lift with down strokes of their wings, attached by flight muscles to a large breastbone. Birds contract flight muscles to cause this down stroke, during which long primary and secondary flight feathers spread out to provide the maximum possible surface area to push against air below. The downstroke is followed by an upstroke in which the feathers fold to minimize air resistance while positioning the wings for the next downstroke. Bird wings have a short upper arm bone that moves up and down during flapping.

There are four basic types of bird flight. In skimming flight, birds such as albatrosses use winds to stay aloft. In soaring flight, birds such as eagles, hawks, and vultures can remain aloft for long periods of time, seeking prey below.

In active flight, birds such as swallows fly all day, flapping their wings continuously. Finally, game birds such as quail conceal themselves and, when endangered, burst into the sky. They pick up speed quickly and fly short distances before landing and hiding again. There is a wing shape most efficient for each flight type. Skimming birds have wings that are long, slender, and ribbon-shaped, with parallel edges and many secondary feathers. Skimming wings are the most highly developed, helping such birds ride the winds. Soaring birds have wings that are large, broad, almost square, and rich in primary feathers. Swallows and other birds engaging in active flight have long, tapering, pointy wings with broad bases and slender tips. Finally, game birds have short wings that beat rapidly, enabling to get to speed quickly. However, these wings are not useful in long flights. No bird has wings designed entirely for one type of flying.

However, in gliding, birds use gravity as thrust to overcome drag and move forward, as their wings produce lift to hold them up. Drag slows down a gliding bird and causes it to sink earthward.

Body Design and Flight

A second group of characteristics enabling bird flight is the design of the bird’s body. Body weight is important to flight: The heavier an object is, the larger its wings need to be to enable liftoff and maintain flight. In birds this problem is met by their relatively small, light bodies. For example, hawks and eagles have cat- or even dog-sized bodies, but they weigh only 25 to 35 percent as much as the earthbound mammals. This special anatomy, combined with wings that engender appropriate amounts of lift, allows birds to fly. Depending on their wing size and shape, birds can fly, soar, or skim.

Energy Needs

To meet the energy needs of flight, birds must eat a relatively large amount of food each day. For their muscles to work well, birds need efficient blood circulation to quickly supply fuel and oxygen and to remove wastes. Bird heartbeat rates are also much faster than those of mammals, usually from 200 to 1,000 beats per minute, compared to 80 in humans. Thus, with its wings; its small, light body; its superbly useful feathers; and its high-capacity heart and lungs, a bird is superbly designed to be airborne.

Text 3 **Sergei Korolev**

The Man Who Started the Space Age

The Russian (Ukraine-born) rocket engineer Sergei Korolev (1907–66) was the driving technical force behind the initial intercontinental ballistic missile (ICBM) program and the early outer space exploration projects of the former Soviet Union. In 1954, he started work on the first Soviet ICBM, called the R-7. This powerful rocket system was capable of carrying a massive payload across continental distances. As part of cold-war politics, Soviet premier Nikita Khrushchev allowed Korolev to use this military rocket to place the first artificial satellite (named Sputnik 1) into orbit around Earth on October 4, 1957. This event is now generally regarded as the beginning of the Space Age. Korolev was also the technical expert responsible for the April 12, 1961, mission that placed the first human (Yuri Gagarin) in orbit around Earth in the Vostok 1 spacecraft.

Korolev was trained in aeronautical engineering at the Kiev Polytechnic Institute and, after receiving a secondary education, cofounded the Moscow rocketry organization GIRD (Gruppa Isutcheniya Reaktivnovo Dvisheniya, Group for Investigation of Reactive Motion). In Russia, GIRD lasted only two years before the military, seeing the potential of rockets, replaced it with the RNII

(Reaction Propulsion Scientific Research Institute). RNII developed a series of rocket-propelled missiles and gliders during the 1930s, culminating in Korolev's RP-318, Russia's first rocket propelled aircraft. Before the aircraft could make a rocket-propelled flight, however, Korolev and other aerospace engineers were thrown into the Soviet prison system in 1937–38, during the peak of Joseph Stalin's political purges.

Korolev at first spent months in transit on the Trans-Siberian railway and on a prison vessel at Magadan. This was followed by a year in the Kolyma gold mines, the most dreaded part of the Gulag. However, Stalin recognized the importance of aeronautical engineers in preparing for the impending war with Hitler and retrieved Korolev and other technical personnel from incarceration. He reasoned that these prisoners could help the Red Army by developing new weapons. Consequently, a system of sharashkas (prison design bureaus) was set up to exploit the jailed talent.

Korolev was saved by the intervention of senior aircraft designer Sergei Tupolev, himself a prisoner, who personally requested Korolev's services in the TsKB-39 sharashka.

Following World War II, Korolev was released from prison and appointed chief constructor for development of a long-range ballistic missile. By April 1, 1953, as Korolev was preparing for the first launch of the R-11 rocket, he received approval from the Council of Ministers for development of the world's first ICBM, the R-7. To concentrate on development of the R-7, Korolev's other projects were spun off to a new design bureau in Dnipropetrovs'k headed by Korolev's assistant, Mikhail Kuzmich Yangel.

This was the first of several design bureaus that would spin off from Korolev's work. It was Korolev's R-7 ICBM that launched Sputnik 1 on October 4, 1957. During the early 1960s, Korolev campaigned to send a Soviet cosmonaut to the Moon. Following the initial reconnaissance of the Moon by the Luna 1, 2, and 3 spacecraft, Korolev established three largely independent efforts aimed at achieving a Soviet lunar landing before the Americans. The first objective, met by

Vostok and Voskhod spacecraft, was to prove that human spaceflight was possible. The second objective was to develop lunar vehicles, which would soft-land on the Moon’s surface to ensure that a cosmonaut would not sink into the dust accumulated by 4 billion years of meteorite impacts. The third objective, and the most difficult to achieve, was to develop a huge booster to send cosmonauts to the Moon. Beginning in 1962, his design bureau began work on the N-1 launch vehicle, a counterpart to the American Saturn V. This giant rocket was to be capable of launching a maximum of 110,000 pounds (50,000 kg) into low-Earth orbit. Although the project continued until 1971 before cancellation, the N-1 never made a successful flight.

On January 14, 1966, Korolev died at a hospital in Moscow. He was only 58 years old. Some of Korolev’s contributions to space technology include the powerful, legendary R-7 rocket (1956); the first artificial satellite (1957); pioneering lunar spacecraft missions (1959); the first human spaceflight (1961); a spacecraft to Mars (1962); and the first space walk (1965). Korolev is now recognized as the brilliant rocket engineer who ushered in the Space Age.

Text 4 Andrey Nikolayevich Tupolev

Andrey Nikolayevich Tupolev, (born October 29 [November 10, New Style], 1888, Pustomazovo, Russia—died December 23, 1972, Moscow), one of the Soviet Union’s foremost aircraft designers, whose bureau produced a number of military bombers and civilian airliners—including the world’s first supersonic passenger plane.

In 1909 Tupolev entered the Moscow Imperial Technical School (now Bauman Moscow State Technical University), where he became a student and disciple of Nikolay Y. Zhukovsky, widely considered the father of Russian aviation. In 1918 they organized the Central Aerohydrodynamics Institute, of which Tupolev became assistant director in 1918. He became head of the institute's design bureau in 1922 and supervised the work of various designers—including Pavel O. Sukhoy, Vladimir M. Myasischev, and Vladimir M. Petlyakov—who later became notable in their own right. This bureau, in producing military and civilian planes that were designated by Tupolev's initials, ANT, made all-metal construction a standard feature of Soviet aviation.

In 1937 Tupolev, in common with many Soviet designers at the time, was arrested on charges of activities against the state. Following his imprisonment, he was placed in charge of a team that was to design military aircraft. From this came the Tu-2, a twin-engine bomber that saw wide use in World War II and, in 1943, earned Tupolev his freedom and a Stalin Prize. Near the end of the war he was given the job of copying the U.S. B-29 Superfortress, three of which had force-landed in the Soviet Far East. This project resulted in the Tu-4 (NATO designation "Bull"), which first flew in 1947 and was the U.S.S.R.'s principal strategic bomber until the mid-1950s.

After adapting jet propulsion to several piston-engine airframes, Tupolev in 1952 introduced the Tu-16 ("Badger"), a medium-range bomber that featured swept wings and light alloy construction. A team under Aleksandr A. Arkhangelsky, Tupolev's longtime associate, designed the Tu-95 ("Bear"), a huge turboprop bomber that first flew in 1954 and became one of the most durable military aircraft ever built. Two civilian aircraft were derived from these—the Tu-104, which appeared in 1955 and became one of the first jet transports to provide regular passenger service, and the Tu-114 long-range passenger plane, the largest propeller-driven aircraft ever in regular service.

In 1963 Tupolev's son Alexey became chief designer of a team that produced the Tu-144 supersonic transport. The Tu-144 broke the sound barrier—the first passenger plane to do so—on a test flight in 1969 and reached twice the speed of sound a year later, but it was plagued by design problems and mismanagement and had only a short life as a passenger jet in 1977–78.

Text 5

How do aeronautical engineers study aircraft and design new ones?

As the use of the scientific method became increasingly important, it also became clear to aircraft designers that testing their hypotheses with human subjects was too risky. Wind tunnels were the first tool of aeronautics to be developed. In the very early 1900s designers built models of their aircraft and placed them in tunnels through which air could be blown to simulate flight. While wind tunnels did provide valuable information and were certainly safer than human flight, there were many questions that were left unsolved simply because the interactions of all the forces on an aircraft were too complex for the analysis methods of the day.

The advent of the computer changed everything. Now massive quantities of data could be gathered from wind tunnel tests and analyzed quickly and efficiently using the computer. In addition, new tools were developed.

Next came flight simulators which enabled a pilot to fly without ever leaving the ground. Flight simulator cockpits were designed to be exact duplicates of real aircraft cockpits. Motion systems were added and have evolved to the point where it is very hard to tell the difference between an airplane ride and a simulator ride.

As computers became more sophisticated, they became able to handle vast amounts of data. Aeronautical researchers began simulating airflow in a computer. Computational Fluid Dynamics was born. As advances in computer graphics have been made, it is now possible to sit at a desk and watch a computer-generated airplane fly - complete with the ability to visualize airflow and pressures as well as fly the airplane from takeoff to landing.

However, even with our increased ability to use computers, simulators and wind tunnels, the final and most definitive test of an aircraft is whether or not a pilot can fly it. Flight test, in which a human climbs into the cockpit and flies the aircraft, was originally the first tool of aeronautics but now remains the final and most important test that an aircraft must undergo. Vast improvements have been made in the safety of flight test and the ability of ground engineers and pilots to predict and avoid hazardous situations. All the tests using the other tools of aeronautics result in an aircraft being far more flight-worthy by the time it reaches flight test than it has in the past.

Text 6

Microwaves for Radar

World War II provided the impetus to harness microwave energy as a means of detecting enemy planes. Early radars were mounted on the Cliffs of Dover to bounce their microwave signals off Nazi bombers that threatened England. The word radar itself is an acronym for RAdio Detection And Ranging.

Radars grew more sophisticated. Special-purpose systems were developed to detect airplanes, to scan the horizon for enemy ships, to paint finely detailed electronic pictures of harbors to guide ships, and to measure the speeds of targets.

These were installed on land and aboard warships. Radar—especially shipboard scales toward an Allied victory in World War II.

Today, few mariners can recall what it was like before radar. It is such an important aid that it was embraced universally as soon as hostilities ended. Now, virtually every commercial vessel in the world has one, and most larger vessels have two radars: one for use on the open sea and one, operating at a higher frequency, to "paint" a more finely detailed picture, for use near shore.

Microwaves are beamed across the skies to fix the positions of aircraft in flight, an essential aid to control the movement of aircraft from city to city across the nation. These radars have also been linked to computers to tell air traffic controllers the altitude of planes in the area and to label them on their screens.

A new kind of radar, phased array, is now being used to search the skies thousands of miles out over the Atlantic and Pacific oceans. Although these advanced radars use microwave energy just as ordinary radars do, they do not depend upon a rotating antenna. Instead, a fixed antenna array, comprising thousands of elements like those of a fly's eye, looks everywhere. It has been said that these radars roll their eyes instead of turning their heads

Text 7

Weight

Weight, or gravity, is the force which always acts downward, toward the center of the earth. It is the total sum of the masses of all its components and contents multiplied by the strength of the gravity, commonly referred to as the number of g's. The weight may be considered to act as a single force, representing all its components and contents, through a single point called the center of gravity.

Weight is the most reliable force, which always acts in the same direction and gradually decreases as airplane fuel is used. The center of gravity shifts as the weight is redistributed. Although the terms "mass" and "weight" are often confused with each other, it is important to distinguish between them. Mass is a property of a body itself and measures a body's quantity of matter. Weight, in contrast, is a force representing the force of gravity acting on a body. It is also loosely called gravity. To illustrate the difference, one could describe an object that is taken to the Moon, where the force of gravity is weaker, about one-sixth that on Earth. On the Moon, the object will weigh only about one-sixth as much as it did on Earth. The mass of the object will be the same on the Moon or anywhere else. In other words, it will continue to have the same amount of matter.

Text 8

Drag

When an object moves relative to a fluid, either a gas or a liquid, the fluid exerts a frictional force on the object. This force which is referred to as a drag force, is due to the viscosity, or stickiness, of the fluid and also, at high speeds, to the turbulence behind and around the object. To characterize the motion of an object at different speeds relative to the fluid and to understand the associated drag, it is useful to understand Reynolds numbers. The Reynolds number depends on the properties, such as length and velocity, of the fluid and the object relative to the fluid. In case of an airplane, which flies through air, the Reynolds number for air is smaller than that for water because of the lower density of the air. For example, an object of one millimeter long moving with a speed of 1 millimeter per second through water has the same Reynolds number as an object 2 millimeters long moving at a rate of 7 millimeters per second in the air. The drag manifests itself differently for different Reynolds numbers associated to it.

When the Reynolds number is less than 1, as in the case of fairly small objects, such as raindrops, the viscous force is directly proportional to the speed of the object. For large Reynolds numbers, usually above a value between about 1 and 10, there will be turbulence behind the body, known as wake, and hence, the drag force will be larger and it increases as the square of the velocity instead of its linear dependence on the velocity. When the Reynolds number approaches a value of around 1,000,000, the drag force increases abruptly. For above this value, turbulence exits in the layer of fluid lying next to the body all along its sides.

Text 9

Lift

Airplane wings and other airfoils are designed to deflect the air so that, although streamline flow is largely maintained, the streamlines are crowded together above the wing. Just as the flow lines are crowded together in a pipe constriction where the velocity is high, so the crowded streamlines above the wing indicate that the airspeed is greater than below the wing. Hence, according to Bernoulli’s principle which states that velocity increases as pressure decreases, the air pressure above the wing is less than that below the wing, and there is a net upward force, which is called dynamic lift, or lift.

In fact, Bernoulli’s principle is only one aspect of the lift on a wing. Wings are usually tilted slightly upward so that air striking the bottom surface is deflected downward. The change in momentum, a product of mass and velocity, of the rebounding air molecules results in an additional upward force on the wing. As the air passes over the wing, it is bent down. The bending of the air is the action; the reaction is the lift on the wing. To generate sufficient lift, a wing must divert air down. To increase the lift, either or both the diverted air and downward velocity must be incremented.

Text 10

Thrust

A force pushing an airplane, or any object, forward is called thrust. The thrust is produced by the engines of the airplane or by the flapping of a bird's wings. The engines push fast-moving air out behind the plane, by either propeller or jet. The fast-moving air causes the plane to move forward, countering drag. Since the Wright brothers first flew in 1903, aeronautical engineers have created a multitude of airplane types, every one of which has dealt with the same four forces of weight, drag, lift, and thrust. All people have to deal with the challenges of stability with respect to these forces. Flying faster than the speed of sound has its own special demands, but the underlying forces of weight, drag, lift, and thrust remain the same.

In some sense, it is easier to fly in space, which is devoid of air, than it is to fly in air. However, spaceflight has its own special challenges. In space, one must deal with only two forces, weight and thrust. Thrust provides the force to lift a rocket into space. Once in orbit, a spacecraft no longer needs propulsion. Short bursts from smaller rockets are used to maneuver the spacecraft. To change its orientation, a spacecraft applies torque, a twisting force, by firing small rockets called thrusters or by spinning internal reaction wheels.

Text 11

Acceleration

Imagine a track meet. The runners all line up at the starting line. At this point, their velocity is 0—they aren't moving. Then, the starting gun goes off, and the runners push off. They begin to increase their speed.

We say that they accelerate. To most people, acceleration means simply "speeding up." In science, though, the word has a different meaning. It is the rate at which velocity changes. Remember that velocity involves the direction in which an object moves as well as its speed. So accelerating the object may involve changing its speed or changing its direction (or both).

Text 12

Balanced and Unbalanced Forces

In a tug-of-war, two teams pull on a rope in opposite directions. The team that uses the most force pulls the other team across a line. This is an example of how motion is affected by unbalanced force. The force of the pull from one team is greater than the force of the pull from the other team. Unbalanced forces acting on an object will change the object's motion. If the two tug of- war teams are evenly matched, however, the situation is different. The teams both pull as hard as they can, but the one force is exactly balanced by the other force. When balanced forces act on an object, they will not change that object's motion. Inertia The unit of measurement for force called the Newton is named in honor of the English scientist and mathematician Isaac Newton. In the late 1600s, Newton discovered three basic laws, or principles, that describe how forces affect objects.

Scientists still rely on these laws of motion when figuring out how to get a spacecraft to the Moon. Newton's first law of motion deals both with objects that are at rest (that is, not moving at all) and with objects that are moving. It says that an object at rest will remain at rest unless it is acted upon by a force strong enough to make it move. The first law also says that an object in motion will move at a constant speed in a straight line unless acted upon by a force strong enough to make it change its speed or direction.

The first law is sometimes called the law of inertia. Inertia is the tendency of an object to resist change in its motion. For example, the passengers in a moving car keep moving forward when the car stops suddenly. The passengers have inertia. The only way to stop inertia is to exert an opposite force. That is what seatbelts do.

Text 13

Weight and Mass

People sometimes think the words weight and mass mean the same thing. But for scientists, they mean different things. Weight is the force of gravity on a person or object at the surface of a planet. When you stand on a scale, the scale measures the force with which Earth pulls on you. Mass is something different. It is a measure of the amount of matter in an object. Far out in space, far from the pull of Earth's gravity, your weight might go down to just about zero, but you would still have the same mass.

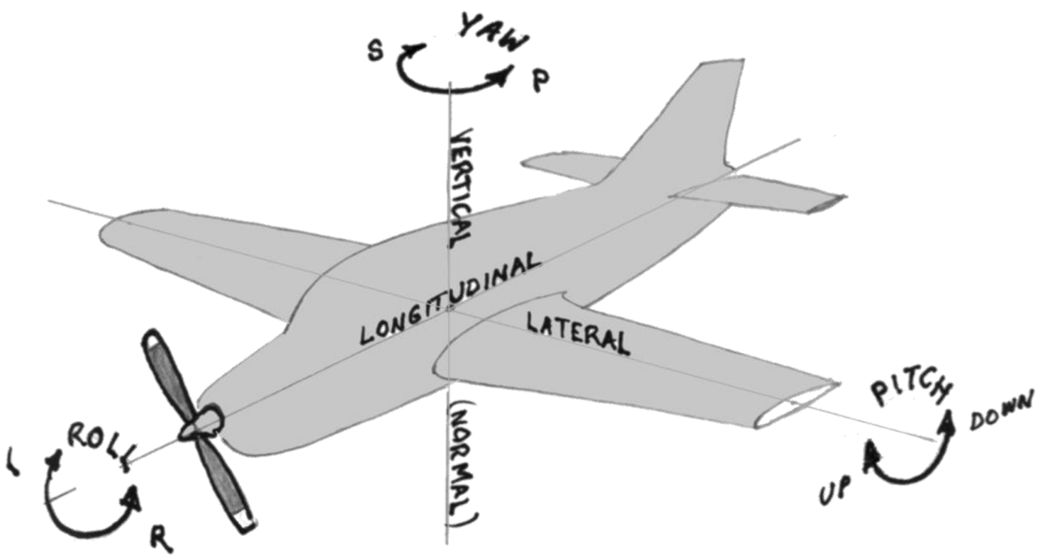
The gravitational pull of an object depends on the amount of mass it has. The greater the mass, the stronger the pull. When you fall off your skateboard, you pull Earth to you at the same time Earth pulls you toward its center. But your mass is tiny compared to that of Earth. So the pull you exert on Earth is much, much weaker than the pull of Earth's gravity on you. Friction is a force that can affect the motion of an object. Friction occurs when two surfaces rub together. Think of the wheels of a skateboard on pavement. It may seem that the wheels and the pavement are both smooth. But actually both have bumps and ridges. Friction is created when the bumps and ridges of the two surfaces come into contact with each other. If a moving object meets continuous friction, sooner or later it will be brought to a stop. Without friction, the object would keep moving at a constant speed forever. With friction, the only way the object can keep moving is if it gets a push (or a pull) from some other force. For the skateboard, you supply the push. How strong the force of friction will depend on a couple of factors. One is the type of surfaces involved. For example, the rougher the surfaces, the greater the friction. Another factor is how hard the surfaces push together. There is more friction if you rub your hands together with some force than if you rub your hands together lightly.

Mass and Payload

Imagine an empty cardboard box. It has very little mass. It is very easy to push. Suppose you fill it with rocks. Now the mass is much greater, and you have to use a lot more force to push it. This fact is explained by Isaac Newton's second law of motion. This science principle says that the amount of force needed to move an object—that is, change its speed or direction—depends on the size of the object's mass. The greater the mass, the greater the amount of force required. The law also says that for a given mass, a greater force will produce a greater change in speed or direction. The change in speed or in direction will occur in the same direction as the force. The cardboard box will move in the direction you push.

Text 14

Stability



The aircraft has now been considered in both the steady flight path condition and during changes of direction (maneuver). It is now necessary to investigate how the designer includes features in order to maintain or encourage either condition.

For example, it will be presumed that a steady flight path is to be maintained. If the aircraft deviates from this flight path, the aircraft should be able to regain it, without control input from the pilot.

In any dynamic system, the ability of the system to regain the desired (set) condition is termed stability. A pendulum is a classic example. It (the weight) normally hangs vertically. If it is displaced and released, it immediately moves back towards the original position. (In fact, of course, it swings past that position - the restoring force of gravity reverses its effect and it swings back again. It will swing to and fro (oscillate) many times before the oscillations (displacements) die away). Such a system is a stable system. But a system can be unstable.

Note that the above is the initial part of considering stability, the immediate reaction or tendency to movement following initial displacement is used to determine the static stability of the system.

Dynamic stability

So, following initial displacements the system may oscillate about the neutral position if the system is statically stable. The manner of the oscillations (meaning the change in amplitude) is used to describe the system dynamic stability. If the amplitude decreases, the aircraft is dynamically stable; if it increases it is dynamically unstable. When the amplitude remains constant, it is neutrally stable in the dynamic sense. Most systems are designed to be statically and dynamically stable.

Aircraft stability

Considering the stability of an aircraft, we might ask two questions. Can it oscillate, and if so, what are the neutral or zero displacement positions?

The first answer is 'yes', where the oscillations are related to angular displacements about any of the three axes. The zero displacements are considered to be those associated with straight and level flight.

Rotation about the lateral axis is termed pitch. Rotation about the longitudinal axis is termed roll. Rotation about the normal axis is termed yaw.

What the Flaps Do

The flap on each wing is called an aileron. The two ailerons work in flying an Airplane opposite directions. When one wing's aileron is raised up, the other one is lowered. The pilot uses them to tilt the plane to one side or another. This motion is known as "roll." The tail area flaps move the plane in other ways. The rudder, which stands upright at the back of the tail, can jut out from the tail to the left or to the right. The pilot uses the rudder to turn the plane left or right. “Yaw” is another name for this motion. Flaps called elevators also are in the tail area. The pilot raises or lowers these two flaps. They make the plane climb up or dive down. This motion is known as “pitch.”

Text 15

Current trends in aircraft design and construction

While the basic principles of flight that the Wright brothers applied still pertain, there have been enormous changes over the years to the means by which those principles are understood and applied. The most pervasive and influential of these changes is the broad variety of applications of computer technology in all aspects of aviation. A second factor has been the widespread development of the use of composite materials in aircraft structures. While these two elements are the results of advances in engineering, they are also indirectly the product of changing social and legal considerations.

The social issues are manifold and include the increasing global interdependence of business, the unprecedented political revolutions in every part of the world, and the universal human desire for travel. All these come at a time when diminishing fossil-fuel resources have caused large increases in fuel prices. As a result, both computers and composite materials are necessary to create lighter, stronger, safer, more fuel-efficient aircraft.

The legal issues are equally complex, but for the purposes of this section revolve around two elements. The first of these is that the design, test, and certification of an aircraft has become such an extraordinarily costly project that only the most well-funded companies can undertake the development of even relatively small aircraft. For larger aircraft it is now common practice for several manufacturers, often from different countries, to ally themselves to underwrite a new design. This international cooperation was done most successfully first with the Anglo-French Concorde supersonic transport and has since been evident in a number of aircraft. A component of this process is the allocation of the production of certain elements of the aircraft in certain countries, as a quid pro quo for those countries not developing indigenous aircraft of a similar type.

Since the mid-1960s, computer technology has been continually developed to the point at which aircraft and engine designs can be simulated and tested in myriad variations under a full spectrum of environmental conditions prior to construction. As a result, practical consideration may be given to a series of aircraft configurations, which, while occasionally and usually unsuccessfully attempted in the past, can now be used in production aircraft. These include forward swept wings, canard surfaces, blended body and wings, and the refinement of specialized airfoils (wing, propeller, and turbine blade). With this goes a far more comprehensive understanding of structural requirements, so that adequate strength can be maintained even as reductions are made in weight.

Complementing and enhancing the results of the use of computers in design is the pervasive use of computers on board the aircraft itself. Computers are used to test and calibrate the aircraft's equipment, so that, both before and during flight, potential problems can be anticipated and corrected. Whereas the first autopilots were devices that simply maintained an aircraft in straight and level flight, modern computers permit an autopilot system to guide an aircraft from takeoff to landing, incorporating continuous adjustment for wind and weather conditions and ensuring that fuel consumption is minimized. In the most advanced instances, the role of the pilot has been changed from that of an individual who continuously controlled the aircraft in every phase of flight to a systems manager who oversees and directs the human and mechanical resources in the cockpit.

The use of computers for design and in-flight control is synergistic, for more radical designs can be created when there are on-board computers to continuously adapt the controls to flight conditions. The degree of inherent stability formerly desired in an aircraft design called for the wing, fuselage, and empennage (tail assembly) of what came to be conventional size and configurations, with their inherent weight and drag penalties. By using computers that can sense changes in flight conditions and make corrections hundreds and even thousands of times a second—far faster and more accurately than any pilot's capability—aircraft can be deliberately designed to be unstable. Wings can, if desired, be given a forward sweep, and tail surfaces can be reduced in size to an absolute minimum. Airfoils can be customized not only for a particular aircraft's wing or propeller but also for particular points on those components.

Text 16

Designing and constructing an aircraft

Small aircraft can be designed and constructed by amateurs as homebuilts. Other aviators with less knowledge make their aircraft using pre-manufactured kits, assembling the parts into a complete aircraft.

Most aircraft are constructed by companies with the objective of producing them in quantity for customers. The design and planning process, including safety tests, can last up to four years for small turboprops, and up to 12 years for aircraft with the capacity of the A380.

During this process, the objectives and design specifications of the aircraft are established. First the construction company uses drawings and equations, simulations, wind tunnel tests and experience to predict the behavior of the aircraft. Computers are used by companies to draw, plan and do initial simulations of the aircraft. Small models and mockups of all or certain parts of the aircraft are then tested in wind tunnels to verify the aerodynamics of the aircraft.

When the design has passed through these processes, the company constructs a limited number of these aircraft for testing on the ground. Representatives from an aviation governing agency often make a first flight. The flight tests continue until the aircraft has fulfilled all the requirements. Then, the governing public agency of aviation of the country authorizes the company to begin production of the aircraft.

There are few companies that produce aircraft on a large scale. However, the production of an aircraft for one company is a process that actually involves dozens, or even hundreds, of other companies and plants, that produce the parts that go into the aircraft. For example, one company can be responsible for the production of the landing gear, while another one is responsible for the radar. The production of such parts is not limited to the same city or country; in the case of large aircraft manufacturing companies, such parts can come from all over of the world.

The parts are sent to the main plant of the aircraft company, where the production line is located. In the case of large aircraft, production lines dedicated to the assembly of certain parts of the aircraft can exist, especially the wings and the fuselage.

When complete, an aircraft goes through a set of rigorous inspection, to search for imperfections and defects, and after being approved by the inspectors, the aircraft is tested by a pilot, in a flight test, in order to assure that the controls of the aircraft are working properly. With this final test, the aircraft is ready to receive the "final touchups" (internal configuration, painting, etc.), and is then ready for the customer.

Библиографический список

1. Миньяр-Белоручева А.П. Англо-русские обороты научной речи: Методич. пос. для оформления курсовых, дипломных и диссертац. работ, для ведения конференций и деловых встреч. – М.: «Изд. дом «Проспект-АП», 2005
2. Формановская Н.И., С.В. Шевцова С.В. Речевой этикет. Русско-английские соответствия (Справочник). – М.: Высш. шк., 1990.
3. Фрейдина Е.Л., Самохина Т.С., Тихонова И.С., Ковалёва Л.Б., Михайлова А.В. Основы публичной речи: Learning to Speak in Public: Учеб. пособие для студ. высш. учеб. заведений. – М.: Гуманит. изд. центр ВЛАДОС, 2002.
4. Erica J.Williams Presentations in English. – Macmillan. 2012.
5. Gruntman M. Blazing the trail: the early history of spacecraft and rocketry –American Institute of Aeronautics and Astronautics, 2004.
6. Harvey B. The New Russian Space Programme: From Competition to Collaboration. – Chichester: PRAXIS PUBLISHING. WILEY-PRAXIS Series in Space Science and Technology. 1996.
7. Hill L.S. The Flyer flew!: The invention of the airplane. – Millbrook Press/Minneapolis, 2006.
8. Irons-Georges T. Encyclopedia of flight. –Salem Press, 2002.
9. Meredith S.M. How Do Aircraft Fly? (Science in the Real World): – Chelsea club house, 2009.

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