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Reader's Book on Chemistry

Учебное пособие

Иваново 2010

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Ивановский государственный химико-технологический университет

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“Reader’s Book on Chemistry”: учебное пособие для студентов Ивановского ВХК ИГХТУ/ А.И. Киркин, Р.М. Москвина, Н.В. Потягалова,/ под ред. Н.К. Ивановой; ГОУ ВПО Иван. Гос. хим-технол. ун-т. Иваново, 2010г.

Учебное пособие “Reader’s Book on Chemistry” предназначено для студентов Ивановского ВХК ИГХТУ, учащихся 10 класса химического лицея, студентов I и II курсов, а также можно рекомендовать для самостоятельной работы.

Пособие включает оригинальные тексты из научно-популярной литературы и имеет аудиоприложения с химическими текстами, которые озвучены дикторами американского радио RCA.

Для эффективного усвоения языкового материала разработаны различные упражнения, стимулирующие мыслительную деятельность и развивающие творческое отношение к изучаемому материалу и позволяющие выражать свое мнение по прочитанному, логически обосновывать свою точку зрения.

Пособие имеет большой образовательный и воспитательный потенциал, помогает студентам расширить кругозор.

Печатается по решению редакционно-издательского совета Ивановского государственного химико-технологического университета.

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От составителя

Настоящее учебное пособие предназначено для студентов Ивановского ВХК ИГХТУ, учащихся 10 класса химического лицея, студентов I и II курсов, учащихся 10 - 11 классов химического лицея. Его можно рекомендовать также для использования при самостоятельной работе студентов. Материалы пособия можно использовать для конференций по различным разделам химии.

Пособие состоит из оригинальных текстов из научно-популярной литературы и аудиоприложений с химическими текстами имеющие большую познавательную ценность.

Учебный материал состоит из вводного курса рассчитанного на 20 занятий и основного курса.

Вводный курс включает 20 уроков, подготавливающих учащихся к усвоению более сложного учебного материала основного курса. Каждый урок содержит текст на химическую тему и словарь, облегчающий понимание химической терминологии. В конце каждого урока разработаны специальные упражнения различных видов, развивающие навыки понимания информации на иностранном языке.

Тексты основного курса состоят из более трудного учебного материала, требующего аналитического разбора на уроке. Упражнения основного курса нацелены на формирование умений анализировать лексические и грамматические формы, глубокое проникновение в смысл текста и подводят студентов к творческой работе с текстовым материалом.

Аудиоприложения озвучены носителями языка. Их цель – развивать слуховое восприятие и способность понимать иностранную речь.

При первом чтении текст произносит диктор. Студенты должны при прослушивании текста выписать как можно больше лексических единиц.

При втором чтении студенты проговаривают текст вслед за диктором в паузах.

Во время третьего чтения студентам дается установка закончить фразу на иностранном языке в паузах.

Весь учебный и иллюстративный материал для пособия взят из Encarta 2006, English Platinum 1999 and Encyclopaedia Britannica Children’s Edition 2005.

CHEMISTRY

A chemistry student conducts an experiment.

Chemistry studies the properties, composition, and structure of substances, which are defined as elements and compounds. It also seeks to explain the transformations that these substances undergo and the energy that is released or absorbed during these processes. The science of chemistry embraces many other subfields, including analytical chemistry, organic chemistry, inorganic chemistry, physical chemistry, colloid chemistry, biochemistry, electrochemistry, nuclear chemistry, and chemical engineering. Biochemistry and organic chemistry, which deal with the chemistry of living things, are examples of how the physical sciences and biological sciences are linked to one another. Other special fields of chemistry deal with its application in various industries. Metallurgy, for example, deals with the recovery of metals from their ores. A branch of metallurgy is concerned with the making of metal alloys for specific purposes. Petroleum chemistry is confined to the commercial manufacture of products from crude oil.

The science of chemistry is the study of matter and the changes matter undergoes. Chemistry is important in improving standards of living. It is used, for example, to make stronger metals, to improve soil, and to destroy bacteria.

It has also made possible the development of substances such as rubber, nylon, and from other, completely different materials.

In general, chemists make their contributions by taking substances apart and putting them together in different, desired combinations. Analysis, or taking a substance apart, enables the chemist to learn what it is made of; then by combining the parts, synthesis, he may produce a completely new substance or an improved substance similar to the old one.

Today chemistry provides employment for a host of people in laboratories, universities, colleges, schools, and business. A knowledge of chemistry is important in a great number of occupations, such as medicine, agriculture, and engineering, to name a few.

Exercises:

1. Answer the following questions:

What does chemistry study?
What subfields does the science of chemistry embrace?
Why is chemistry important in improving standards of living?

2. Practice in pronunciation:

chemistry, science, colloid, biology, recovery, nylon, synthesis, improve, provide, knowledge, petroleum, engineering, embrace, deal, absorb, undergo, energy,

3. Read and translate the following international words:

experiment, composition, structure, substance, transformation, energy, analysis, engineer, biology, metallurgy, product, bacteria, nylon, material, combination, medicine, laboratory.

4. Remember the derivatives of the words:

chemistry, chemist, chemical.
science, scientist, scientific.
differ, difference, different.
engine, engineer, engineering.

5. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

The science of chemistry is the study of society and the changes that occur in it.
Chemistry is important in improving standards of living.
A knowledge of chemistry is important in a great number of occupations, such as literature, mathematics, history and art, to name a few.
It has also made possible the development of substances such as rubber, nylon, and from other, completely different materials.

Chemical Elements

You and everything around you are made of chemical elements. The elements are sort of like LEGO or Tinkertoy pieces. You can put LEGO or Tinkertoy pieces together to make new things. You can take an object built of LEGO or Tinkertoy pieces apart. When there is nothing more to take apart, you have a pile of LEGO or Tinkertoy pieces. The pieces are different from the original object. You cannot take apart a LEGO or Tinkertoy piece without breaking it.

Materials, or substances, that you cannot take apart are called elements. Elements can link together to make all kinds of materials. The elements oxygen and hydrogen, for instance, together make water. Oxygen and the element carbon together make carbon dioxide, a gas that plants need.

WHY CAN'T YOU TAKE ELEMENTS APART?

All materials on Earth are made of tiny pieces called atoms. Atoms are much too small to see. Elements are made of only one kind of atom. Compounds are combinations of more than one kind of atom. Water is a compound. Water has two atoms of hydrogen for every one atom of oxygen. You can separate water into hydrogen and oxygen by separating the hydrogen atoms from the oxygen atoms. All compounds can be turned into completely different substances this way. Separating atoms won't change an element, however, since all its atoms are alike.

WHAT KINDS OF ELEMENTS EXIST?

There are more than 100 elements. Some elements that you may have heard of include aluminum, lead, mercury, uranium, and helium. Elements have different properties. Some are normally solids, some are gases, and a couple are liquids. Elements look different from each other, they weigh different amounts, and they combine in different ways to make compounds. Scientist list all the elements in a chart called the periodic table. Elements that share a column in the table have similar properties. An element is a substance that can't be broken down into simpler material. All substances on Earth are made up of one or more elements.

The element carbon forms diamonds. Diamonds are the hardest natural substance known. They are important in industry because they can be used to cut other hard materials, including steel and glass. Diamonds are also prized as gemstones.The element gold is a soft, yellow metal that does not rust, and it is easier to work with than all other metals. Gold has been used to make coins and jewelry since ancient times.

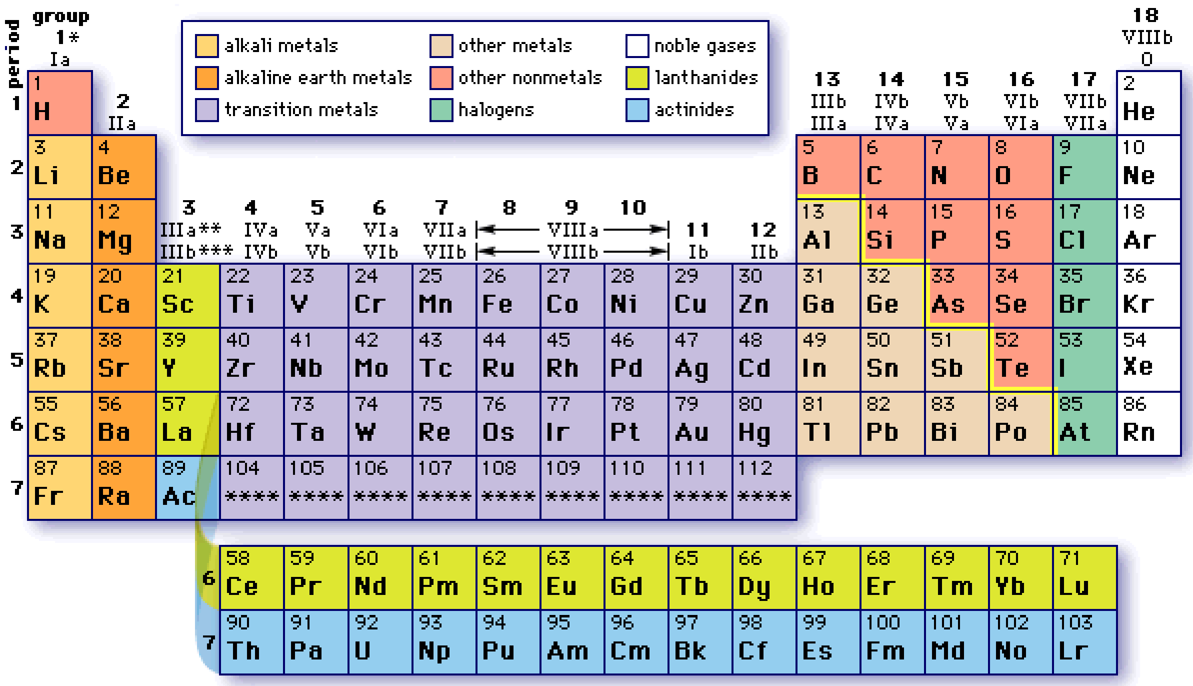
The element silicon is the second most common element on Earth after oxygen. Because it conducts electricity, it is used to make computer chips and other electronic devices.

The arrangement of chemical elements started with Dmitri Mendeleev, a Russian chemist. In 1869 he arranged all the known chemical elements in the order of increasing atomic weights. He found that, for the first 20, each one resembled the eighth element following it in appearance, properties, and activity. Thus lithium, sodium, and potassium are related, as are beryllium, magnesium, and calcium. In the table these series appear in Groups Ia and IIa.

Mendeleev's table had many gaps, and the order by atomic weight introduced several contradictions in the sequence of chemical properties for some elements—cobalt and nickel, for example. But discoveries of other elements filled the gaps, and the use of atomic numbers removed the contradictions.

Atoms are built in an orderly, progressive manner. Hydrogen, the lightest atom, has a nucleus with one proton (positive electric charge) and one electron to match. Adding one positive charge (and two neutrons) to the nucleus of hydrogen and adding one electron make an atom of helium. Other additions of protons and electrons in equal numbers (plus neutrons) build up the other kinds of atoms. Since neutrons do not affect chemical activity, the number of positive charges identifies the kind of atom. This number is called the atomic number.

Atomic numbers also characterize elements. An element is defined as a substance made of atoms that have the same atomic number. Furthermore, the elements are arranged in modern periodic tables according to atomic number rather than atomic weight.



* Numbering system recommended by the International Union of Pure and Applied Chemistry (IUPAC)
** Previous IUPAC numbering system
*** Numbering system recommended by the Chemical Abstracts Service
**** For the names of elements 104–112, see table.

Exercises:

1. Answer the following questions:

What are elements made of?
What are compounds?
All compounds can be turned into completely different substances, can't they?
Why won't separating atoms change an element?
How many elements are there?
Do elements have different properties?
What do scientist list all the elements in?
What properties do elements have in a column?
Who started the arrangement of chemical elements?
In what order did Mendeleyev arrange the chemical elements?
Why did his table have many gabs?
In what manner are atoms built?
Do neutrons affect chemical activity?
What identifies the kind of atom?
The elements are arranged in modern periodic tables according to atomic number, aren't they?

2. Fill in the blanks with necessary prepositions:

All materials ….. Earth are made ….. tiny pieces called atoms.
Water has two atoms ….. hydrogen ….. every one atom ….. oxygen.
You can separate water ….. hydrogen and oxygen ….. separating the hydrogen atoms ….. the oxygen atoms.
The arrangement ….. chemical elements started ….. Dmitri Mendeleev, a Russian chemist
Atoms are built ….. an orderly, progressive manner.
The elements are arranged ….. modern periodic tables ….. atomic number.

3. Insert the missing forms of irregular verbs:

make ….. made

….. put …..

….. took …..

break ….. broken

hear ….. heard

….. had …..

know ….. …..

….. ….. cut


Image Bank/Getty Images/Gary Gladstone

Aluminum

Aluminum is a light-weight metallic element used extensively in construction and as a packaging material. These aluminum ingots are ready for shipping to factories that will turn them into consumer products. Because of its high heat conductivity, aluminum is used in cooking utensils and the pistons of internal-combustion engines.

Aluminium	алюминий
Leight-weight	легкий
Extensively	широко, в значительной степени
Ingots	чушка, болванка
Ship to	отправлять
Turn into	превращать
Consumer goods	потребительские товары
Because of	из-за
Heat	тепло
Conductivity	проводимость
Cooking Utensil	кухонная посуда
Piston	поршень
Internal-combustion engine	двигатель внутреннего сгорания

Exercises:

Answer the following questions:

1. What element is used extensively in construction and as a packaging material?
2. Where are aluminum ingots shipped to?
3. Aluminum is used in cooking utensils, is not it?

Find Participle I and Gerund in the sentences and define their functions:

1. Aluminum is used extensively in construction and as a packaging material.
2. These aluminum ingots are ready for shipping to factories.
3. Aluminum is used in cooking utensils and the pistons of internal-combustion engines.

Insert the missing prepositions:

1. These aluminum ingots are ready ….. shipping ….. factories that will turn them ….. consumer products.
2. ….. its high heat conductivity, aluminum is used ….. cooking utensils and the pistons ….. internal-combustion engines.

Insert the missing letters:

Wei…ht, ing…t, he…t, en…ine, comb…stion, pis…on, cond…ctivity, alu…inim, ute…sil.

Choose opposite adjectives:

Light, high, internal.
External, low, heavy.

Translate into English:

1. Из-за высокой теплопроводимости алюминий используется в кухонной посуде и поршнях двигателей внутреннего сгорания.

Arsenic

The element arsenic is best known as a poison. However, arsenic has many industrial applications and is commonly used in the manufacture of glass and as a semiconductor in some electronics.

Arsenic is used in large quantities in the manufacture of glass to eliminate a green color caused by impurities of iron compounds. Arsenic disulfide (As_2S_2), also known as red orpiment and ruby arsenic, is used as a pigment in the manufacture of fireworks and paints.

Arsenic	мышьяк
Poison	яд
Have application for	иметь применение
Commonly	обычно, как правило
Use in	использовать в
Manufacture	производство
Glass	стекло
As	в качестве
Semiconductor	полупроводник
Quantity	количество
Eliminate	устранять, ликвидировать, уничтожать
Cause	вызывать
Impurity	примесь
Iron	железо
Compound	соединение, смесь
Disulfide	мышьяковый дисульфид
Orpinent	аурипигмент
ruby arsenic	ярко-красный мышьяк
pigment	пигмент
manufacture	производство
paint	краска

Exercises:

Answer the following questions:

1. The element arsenic is best known as a poison, isn't it?
2. Where is arsenic used in?
3. Arsenic eliminates a green color in glass, does not it?
4. What is a green color in glass caused by?
5. What material is used as a pigment in the manufacture of fireworks and paints?

Underline Participle II in the sentence and determine its function :

1. Arsenic is used in large quantities in the manufacture of glass to eliminate a green color caused by impurities of iron compounds.

Insert the missing prepositions:

1. Ruby arsenic is used as a pigment ….. the manufacture ….. fireworks and paints.
2. Arsenic is used ….. large quantities ….. the manufacture ….. glass to eliminate a green color caused ….. impurities ….. iron compounds.

Insert the missing letters:

A…senic, p…ison, gl…ss, qu…ntity, c…lor, impur…ty, co…pound, orpi…ent, p…int, fire…ork, pigm…nt.

Translate into English:

1. Зеленый цвет при производстве стекла вызван загрязнением железных компонентов.

Calcium

Calcium, seen here in unrefined form, is one of the most common elements found on Earth. Many familiar materials, including concrete, cement, marble, and chalk, contain calcium. It is being used to an increasing extent, however, as a deoxidizer for copper, nickel, and stainless steel. Because calcium hardens lead when alloyed with it, lead-calcium alloys are excellent for bearings.

Calcium	кальций
Unrefined	неочищенный
Common element	распространенный
Include	включать
Concrete	бетон
Cement	цемент

Marble	мрамор
Chalk	мел
Contain	содержать
To an increasing extent	в возрастающей степени
Deoxider	восстановитель
Copper	медь
Nickel	никель
Stainless steel	нержавеющая сталь
Harden	твердеть
Lead	свинец
Alloy	сплав
Excellent	отличный
Bearings	подшипник

Exercises:

Answer the following questions:

1. Is calcium one of the most common elements found on Earth?
2. What materials include calcium?
3. Calcium is being used to an increasing extent, however, as a deoxidizer for copper, nickel, and stainless steel, is not it?
4. Why are lead-calcium alloys excellent for bearing?.

Insert the missing letters:

Con…rete, ce…ent, ma…ble, ch…lk, cop…er, nic…el, cal…ium, bea…ing.

Insert the missing prepositions:

1. Calcium, seen here ….. unrefined form, is one ….. the most common elements found ….. Earth.
2. Because calcium hardens lead when alloyed ….. it, lead-calcium alloys are excellent ….. bearings.

Underline Participle I andParticiple II and determine their functions:

1. Many familiar materials, including concrete, cement, marble, and chalk, contain calcium.
2. It is being used to an increasing extent, however, as a deoxidizer for copper, nickel, and stainless steel.
3. Because calcium hardens lead when alloyed with it, lead-calcium alloys are excellent for bearings.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I’m not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Calcium is one of the rarest elements found on Earth.

2. Because calcium hardens lead when alloyed with it, lead-calcium alloys are excellent for bearings.

Chlorine

Chlorine is a faintly yellow-green gaseous element. Chlorine is extremely poisonous and reacts with most other substances its comes in contact with, including water. It is used for bleaching paper pulp and other organic materials, destroying germ life in water, and preparing bromine, tetraethyl lead, and other important products.

Chlorine	хлор
Faintly	бледно, слабо
Gaseous	газообразный
Extremely	чрезвычайно
Poisonous	ядовитый
Substance	вещество
Come in contact with	контактировать
Bleach	отбеливать
Paper pulp	бумажная масса
Destroy	разрушать
Germ life	жизнь микробов
Prepair	приготовлять
Bromine	бром
Tetraethyl lead	тетраэтилсвинец

Exercises:

Answer the following questions:

1. Is chlorine a gaseous or solid elememt?
2. Chlorine is extremely poisonous, is not it?
3. What is chlorine used for?
4. Does it destroy germ life in water?

Find Participle I and Gerund in the sentences and define their functions:

1. It is used for bleaching paper pulp and other organic materials, destroying germ life in water, and preparing bromine, tetraethyl lead, and other important products.
2. Chlorine reacts with most other substances its comes in contact with, including water.

Insert the missing prepositions:

1. Chlorine reacts …. most other substances its comes ….. contact ….., including water.

Translate into English:

1. Хлор используют для отбеливания бумажной массы.
2. Хлор чрезвычайно ядовит и он реагирует с большинством других веществ.

Chromium

Chromium is a shiny metallic element. Brilliant, hard, and corrosion-resistant, chromium makes a durable and attractive coating for other metals and is an important component of stainless steel.

More than half the production of chromium goes into metallic products, and about another third is used in refractories. It is an ingredient in several important catalysts. The chief use of chromium is to form alloys with iron, nickel, or cobalt.

Chromium	хром
Shiny	блестящий
Brilliant	сверкающий
Hard	твердый
Corroison–resistant	коррозийноустойчивый
Durable	прочный, долговечный
Attractive	привлекательный
Coating	покрытие
Component	составная часть
Refractory	огнеупор
Ingredient	составная часть
Catalyst	катализатор
Chief	основной, главный
Form	образовывать
Cobalt	кобальт

Exercises:

Answer the following questions:

1. What does chromium make for other metals?
2. Is chromium an important component of stainless steel?
3. It is an ingredient in several important catalysts, is not it?
4. What is the chief use of chromium?

Translate the following derivatives:

Corrode – corrosion - corrdible
Attract – attraction - attractive
Produce - product - production - productivity - productive
Important - importance
Form – formation - formal – formative
Resist – resistance- resistant

Insert the missing prepositions:

1. More than half the production ….. chromium goes ….. metallic products, and ….. another third is used ….. refractories
2. Chromium makes a durable and attractive coating ….. other metals and is an important component ….. stainless steel.

Inser the missing letters:

C…ating, cat…lys, compo…ent, nick…l, co…alt, chro…ium, in…redient, compone…t, dura…le, i…portant, bril…iant, attra…tive.

Translate into English:

1.С помощью хрома покрытие металлов становится долговременным и привлекательным.

Gallium

The element Gallium is a metal with a melting point lower than body temperature. In this photo, a sample of gallium melts in a person's hand. Gallium, mercury, cesium, and rubidium are the only metal elements that melt near room temperature. Certain gallium compounds are excellent semiconductors and have been extensively used in transistors, photoconductors, and laser and maser diodes.


Corbis/Lester V. Bergman

Gallium	галлий
Melting point	точка плавления
Body	иело
Sample	образец
Melt	плавиться
Mercury	ртуть
Cesium	цезий
Rubidium	рубидий
Maser diode	мазерный диод

Exercises:

Answer the following questions:

1. What is a melting point of gallium?
2. A sample of gallium melts in a person's hand, does not it?.
3. What temperature do gallium, mercury, cesium, and rubidium melt at?
4. Are gallium compounds excellent semiconductors?
5. Where are they used in?

Translate into English:

1. Элемент галлий является металлом с точкой плавления ниже температуры тела.
2. Некоторые соединения галлия являются отличными полупроводниками.

Remember the following chemical terms:

a fusing point	точка плавления
a melting point	точка плавления
a freezing point	точка замерзания
a boiling point	точка кипения
conductor	проводник
semiconductor	полупроводник
isolator	изолятор

Insert the missing prepositions:

1. The element Gallium is a metal ….. a low melting point.
2. A sample … gallium melts ….. a person's hand.
3. Certain gallium compounds are excellent semiconductors and have been extensively used ….. transistors, photoconductors, and laser and maser diodes.

Translate into English:

1. Элемент галлий является металлом с точкой плавления ниже температуры тела.
2. Некоторые соединения галлия являются отличными полупроводниками и используются широко в транзисторах фотопроводниках лазерах и мазерных диодах.

Gold

The element gold is easier to work than any other metal, and it does not oxidize over time. Gold has been used for money since ancient times. Gold is also used in the form of gold leaf in the arts of gilding and lettering. Purple of Cassius, a precipitate of finely divided gold and stannic hydroxide formed by the interaction of auric chloride and stannous chloride, is used in coloring ruby glass. Chlorauric acid is used in photography for toning silver images. Potassium gold cyanide is used in electrogilding. Gold is also used in dentistry. Radioisotopes of gold are used in biological research and in the treatment of cancer. Green gold used in jewelry contains copper and silver; white gold contains zinc and nickel, or platinum metals.

Easy	легко
Oxidize	окислять(ся)
Leaf	лист полоса пластинка
Gilding	покрытие позолотой
Letterig	тиснение, надпись

Purple of Cassius	Кассиев пурпур (краска из багрянки)
Precipitate	осадок
Finely	мелко
Divided	разделенный
Stannic hydroxide	ортооловянная кислота
Interaction	взаимодействие
Auric chloride	хлорид золота
Stannous chloride	хлористое олово
Colour	окрашивать
Chlorauric acid	хлорозолотая кислота
Tone	тонировать
Image	изображение
Potassium gold cyanide	калийно- цианистое золото
Electrogilging	электротиснение
Dentistry	лечение зубов
Isotope	изотоп
Research	исследование
Treatment	лечение
Cancer	рак
Jewelry	ювелирные изделия
Silver	серебро
Zink	цинк
platinium	платина

Exercises:

Answer the following questions:

1. Does gold oxidize over time?
2. Gold has been used for money since ancient times, has not it?
3. Where is gold used in?
4. How is Purple of Cassius formed?
5. What is used in coloring ruby glass?
6. What metals does white gold contain?

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Gold has been used for money since ancient times.
2. Purple of Cassius is used in coloring ruby stones.
3. Radioisotopes of gold are used in biological research and in the treatment of mumps.
4. Chlorauric acid is used in photography for toning glass.

Insert the missing letters:

C…loride, a…id, sil…er, oxid…ze, ru…y, go…d, pot…asium, preci…itate, hy…roxide, cy…ide, pur…le.

Insert the missing prepositions:

1. Gold is also used ….. the form ….. gold leaf ….. the arts ….. gilding and lettering.
2. Chlorauric acid is used ….. photography ….. toning silver images.
3. Radioisotopes ….. gold are used ….. biological research and ….. the treatment ….. cancer.

Keep in yor mind the next chemical terms:

oxidize	окисляться
precipitate	осадок
chloride	хлорид
acid	кислота
contain	содержать
gold	золото
copper	медь
silver	серебро
zinc	цинк
nickel	никель
platinum	платина
ruby	рубин
potassium	калий

Underline Participle II and Gerund and determine their functions in the next sentences:

1. Purple of Cassius, a precipitate of finely divided gold and stannic hydroxide formed by the interaction of auric chloride and stannous chloride, is used in coloring ruby glass.

2. Chlorauric acid is used in photography for toning silver images.

3. Gold is also used in the form of gold leaf in the arts of gilding and lettering.

4. Potassium gold cyanide is used in electrogilding

Translate into English:

1. Кассиев пурпур осадок мелко раскрошенного золота и ортооловянной кислоты, образовавшийся при реакции хлорида золота с хлористым оловом, используется в окрашивании рубинового стекла.

2. Хлорозолотая кислота используется в фотографии для тонирования серебрянных изображений.

3. Калийно-цианистое золото применяется в электротиснении.

Complete the following setences:

1. Gold is also used in the form of gold leaf ____
2. Green gold used in jewelry contains copper and silver ___________________________________
3. Chlorauric acid is used in photography ____
4. The element gold is easier to work than any other metal, and ____________________________

Helium

Helium is an invisible, odorless, gaseous element that is less dense than air. Light-weight objects such as balloons will float if filled with helium. Helium is used to pressurize and stiffen the structure of rockets before takeoff and to pressurize the tanks of liquid hydrogen or other fuel in order to force fuel into the rocket engines. It is useful for this application because it remains a gas even at the low temperature of liquid hydrogen. A potential use of helium is as a heat-transfer medium in nuclear reactors because it remains chemically inert and nonradioactive under the conditions that exist within the reactors. Helium is used in inert-gas arc welding for light metals such as aluminum and magnesium alloys that might otherwise oxidize; the helium protects heated parts from attack by air.

Helium	гелий
Invisible	невидимый
Odorless	без запаха
Dense	плотный
Balloon	шар
Float	плавать
Fill with	наполнять
Pressurize	создавать давление
Stiffen	усиливать, укреплять
Takeoff	отвод
Tank	емкость
Liquid	жидкость
Hydrogen	водород
Fuel	топливо
In order to	для того, что бы
Force	заставлять
Remain	оставаться
Heat transfer medium	средство теплообмена
Nuclear	ядерный
Inert gas	инертный газ
Under the condition	при условии
Exist	существовать
Arc welding	электродуговая сварка
Magnesium	магний
Protect	защищать
Air	воздух

Exercises:

Answer the following questions:

1. What element is helium?
2. Light-weight objects such as balloons will float if filled with helium, will not they?
3. What aim does helium pressurize the tanks of liquid hydrogen?
4. A potential use of helium is as a heat-transfer medium in nuclear reactors, is not it?

5. Does helium protect heated parts from attack by air?

Translate the following adjectives:

Invisible, visible, odorless, gaseous, dense, light, usefu,l inert, active, liquid, filled, heated.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Light-weight objects such as balloons will sink if filled with helium.
2. Helium remains a solid even at the low temperature of liquid hydrogen.
3. The helium protects cooled parts from attack by air.
4. Helium is an invisible, odorless, liquid element.

Insert the missing prepositions:

1. It is useful ….. this application because it remains a gas even ….. the low temperature ….. liquid hydrogen.
2. The helium protects heated parts ….. attack ….. air.
3. Helium is used ….. inert-gas arc welding ….. light metals

Find Participle II in the sentences and define its functions:

1. Light-weight objects such as balloons will float if filled with helium.
2. The helium protects heated parts from attack by air.

Translate into English:

1.Легкие предметы, такие как шары, наполненные гелием, будут летать.
2.Гелий создает давление в емкостях с жидким водородом или другим топливом для того, чтобы заставить топливо перейти в двигатель ракеты..

Lead

The element lead occurs most commonly in the form of lead sulfide (PbS), or galena. Galena usually occurs with small amounts of other metals such as copper, zinc, silver, and gold, which are economically recoverable by mining. As shown here, galena exhibits perfect cubic cleavage.
Lead is used in enormous quantities in storage batteries and in sheathing electric cables. Large quantities are used in industry for lining pipes, tanks, and X-ray apparatus. Because of its high density and nuclear properties, lead is used extensively as protective shielding for radioactive material. Among numerous alloys containing a high percentage of lead are: solder, type metal, and various bearing

metals. A considerable amount of lead is consumed in the form of its compounds, particularly in paints and pigments.

Galena	галенит
Lead	свинец
Occur	встречаться
Lead sulfide	сульфид свинца
Galena	галенит
Ammount	количество
Recoverable	возместимый
Mimimg	разработка месторождений
Exhibit	проявлять
Perfect	совершенный
Cleavage	отслоение осколок
Enormous	огромный
Storage batteries	аккумулятор
Sheat	оболочка
Cable	кабель
Lining	покрытие, обкладка футерование
Pipe	труба
X-ray	ренгеновский луч
Density	плотность
Property	свойство
Shielding	защитный экран
Percentage	процентное отношение
Solder	припой
Various	различный
Considerable	значительный
Consume	потреблять

Exercises:

Answer the following questions:

1. What form does lead occur in?
2. Where is lead used in?
3. Why is lead used extensively as protective shielding for radioactive material?
4. Galena usually occurs with small amounts of other metals such as copper, zinc, silver, and gold, does not it?

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. A considerable amount of lead is consumed in the form of its compounds, particularly in paints and pigments.
2. Galena usually occurs with small amounts of other metals such as brass and nickel.
3. Lead is used in enormous quantities in sheathing electronic tubes.

Keep in your mind the names of metals:

Lead, copper, zink, silver, gold, nickel, brass, tin, tungsten, iron, gallium, mercury, rubidium, cesium, aluminum, cobalt, chromium, magnesium.

Insert the missing prepositions:

1. The element lead occurs most commonly ….. the form ….. lead sulfide
2. Lead is used ….. enormous quantities ….. storage batteries and ….. sheathing electric cables.
3. Large quantities are used ….. industry ….. lining pipes, tanks, and X-ray apparatus.
4. A considerable amount ….. lead is consumed ….. the form ….. its compounds, particularly ….. paints and pigments.

Underline Participle I and define its function:

1. Among numerous alloys containing a high percentage of lead are: solder, type metal, and various bearing metals.

Translate into English:

1. Галенит обычно встречается с небольшим количеством других металлов, таких как медь, цинк, серебро и золото.
2. Большое количество свинца используется в промышленности для футерования труб, емкостей и рентгеновских аппаратов,
3. Из-за высокой плотности и ядерных свойств, свинец используется широко в качестве защитного покрытия от радиоактивного материала.

Magnesium

Magnesium is a light-weight, silvery, metallic element. If ignited in air, it burns with a white light too brilliant to look at. The metal is used when lightness is an essential factor: alloyed with aluminum or copper, it is used extensively in making castings for airplane parts; in artificial limbs, vacuum cleaners, and optical instruments; and in such products as skis, wheelbarrows, lawn mowers, and outdoor furniture.

Magnesium	магний
Ignite	воспламеняться
Burn	гореть
Light	свет
Essencial	существенный необходимый
Casting	отливка литье
Artificial	искусственный
Limb	конечность
Vacuum cleaner	пылесос
Wheelbarrow	тачка

Lawn mower газонокосилка
Furniture мебель аксессуары

Exercises:

Answer the following questions:

1. How does magnesium burn?
2. Where is it used?
3. Magnesium is a light-weight, silvery, metallic element, is not it?
4. What alloys is magnesium used wth in industry?

Insert the missing prepositions:

1. If ignited ….. air, it burns ….. a white light too brilliant to look …...
2.. It is used extensively ….. making castings ….. airplane parts.

Insert the missing letters:

Mag…esium, li…ht, cast…ng, i…nite, bu…n, wei…h,t al…oy, v…cuum.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Magnesium is a heavy-weight, silvery, metallic element.

2. If ignited in air, it burns with a red light too brilliant to look at.

Find Passive Voice and define the Tense.
Underline Participle II and Gerund in the sentence and define their functions:

1. The metal is used when lightness is an essential factor: alloyed with aluminum or copper, it is used extensively in making castings for airplane parts.

Translate into English:

1.Магний в сплаве с алюминием или медью используется широко в изготовлении отливок для частей самолетов.

Complete the following sentences:

1. If ignited in air, it burns with ____

2. Magnesium is a light-weight, silvery ____


Photo Researchers, Inc./Charles D. Winters

Mercury

Mercury is one of the few elements that are liquid at room temperature. Gloves should always be worn when handling mercury because the element is poisonous and can be absorbed through the skin. Mercury is used in thermometers. It is also used in other types of scientific apparatuses, such as vacuum pumps, barometers, and electric rectifiers and switches. Mercury-vapor lamps are used as a source of ultraviolet light and for sterilizing water. Perhaps most significant is the substitution of diaphragm cells for traditional mercury cells in chlorine-alkali production, which once accounted for a large percentage of total mercury consumption.

Mercury	ртуть
Liquid	жидкость
Gloves	перчатки
Wear	носить надевать
Handle	обращаться
Absorb	поглощать
Skin	кожа
Vacuum pump	вакуумный насос
Rectifier	очиститель
Switch	выключатель
Vapor	пар
Source	источник
Ultraviolet	ультрафиолетовый
Sterlize	обеззараживать
Substitution	замена
Cell	элемент
Alkali	щелочь
Account for	объяснять являться причиной
Total	всеобщий

Exercises:

Answer the following questions:

1. Is mercury liqiud at room temperature?
2. Why should gloves always be worn when handling mercury?
3. Where is mercury used in?

Underline Participle I and Gerund and define their functions:

1. Gloves should always be worn when handling mercury
2. Mercury-vapor lamps are used as a source of ultraviolet light and for sterilizing water.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Gloves should always be worn when handling copper because the element is poisonous.
2. Mercury can be absorbed through the skin
3. Mercury-vapor lamps are used as a source of ultraviolet rays.
4. Mercury is used in thermometers.

Iset the missing letters:

Mer…ury, li…uid, pois…n, ab…orb, v…cuum, rec…ifier, swi…ch, vap…r, s…urce, ch…orine, alk…li, ce…l, sub…titution.

Insert the missing prepositions:

1. Mercury-vapor lamps are used as a source ….. ultraviolet light and ….. sterilizing water.
2. Traditional mercury cells ….. chlorine-alkali production accounted ….. a large percentage ….. total mercury consumption.
3. Mercury can be absorbed ….. the skin.

Translate into English:

1. Необходимо всегда надевать перчатки, когда работаешь с ртутью, так как элемент ядовит и может проникать через кожу.
2. Лампы с парами ртути используются в качестве источника ультрафиолетового света и для обеззараживания воды.

Complete the sentences:

1. Mercury is one of the few elements that are ____
2. Gloves should always be worn when handling mercury _______________________________

Nickel

Nickel has been used in coins for hundreds of years. The element is magnetic like iron and is often used in combination with other metals. Perhaps most significant is the substitution of diaphragm cells for traditional mercury cells in chlorine-alkali production, which once accounted for a large percentage of total mercury consumption. Nickel is used chiefly in the form of alloys. It imparts great strength and corrosion resistance to steel.

Nickel	никель
Coin	монета
Perhaps	возможно
Significant	значительный
Substition	замена
Cell	элемент
Consumpion	потребление
Impart	придавать
Strength	прочность
Resistance	сопротивление

Exercises:

Answer the following questions:

1. Nickel has been used in coins for hundreds of years, has not it?
2. What cells did it substitute in chlorine-alkali production?
3. What does nickel impart to steel?

Translate into English:

1. Никель придает особую прочность и коррозоустойчивость стали.
2. Никель используют в основном в виде сплавов.
3. Никель используют в монетах сотни лет.

Insert the missing prepositions:

1. Nickel has been used ….. coins ….. hundreds ….. years.
2. Nickel is used chiefly ….. the form ….. alloys.
3. It imparts great strength and corrosion resistance ….. steel.

Insert the missing letters:

Ir…n, me…cury, al…oy, cor…osion, s…rength, ste…l, resist…nce, nic…el, c…ll, im…art.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Nickel mparts great strength and corrosion resistance to iron.
2. Nickel has been used in money for hundreds of years.
3. The element is magnetic like iron and is often used in combination with other metals.

Complete the following sentences:

1. It imparts great strength and corrosion ____
2. The element is magnetic like iron and is often ____
3. Nickel has been used in ____

Phosphorus

Phosphorus is a nonmetallic chemical element that occurs as three different allotropes. Red, left, and white phosphorus are shown here. White phosphorus ignites spontaneously in air, and must be stored underwater. The bulk of phosphorus-containing compounds are used as fertilizers. Phosphorus compounds are also used in clarifying sugar solutions, fireproofing, and in such alloys as phosphor bronze and phosphor copper. White phosphorus is used in the making of rat poison, and red phosphorus is used in matches.

Phosphorous	фосфор
Allotrope	аллотропная форма
Spontanneously	непроизвольно
Store underwater	хранить под водой
Bulk	основная масса
Fertilizer	удобрение
Clarify	очищать
Solution	раствор
Fireproofing	несгораемый
Bronze	бронза
Rat	крыса
Match	спички

Exercises:

Answer the following questions:

1. What forms does phosphorus occur in?
2. Where must white phophorus be stored?
3. Where are the bulk of phosphorus-containing compounds used as?

Underline Passive Voice and define theTense:

1. Red, left, and white phosphorus are shown here.
2. White phosphorus must be stored underwater.
3. Phosphorus compounds are also used in clarifying sugar solutions, fireproofing.

Underline Participle I and Gerund and define their functions:

1. The bulk of phosphorus-containing compounds are used as fertilizers.
2. Phosphorus compounds are also used in clarifying sugar solutions, fireproofing.

Insert the missing prepositions:

1. White phosphorus ignites spontaneously ….. air.
2. White phosphorus is used ….. the making ….. rat poison, and red phosphorus is used ….. matches.
3. Phosphorus compounds are also used ….. clarifying sugar solutions.

Translate into English:

1. Белый фосфор воспламеняется самотеком на воздухе и поэтому его надо хранить под водой.
2. Белый фосфор используют в изготовлении крысиного яда.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. White phosphorus ignites spontaneously in air, and must be stored under earth.
2. The bulk of phosphorus-containing compounds are used as paints.
3. White phosphorus is used in the making of rat poison, and red phosphorus is used in matches.

Find the corresponding English equivalents to the Russian expressions:

Встречаться, воспламеняться, хранить под водой, фосфорсодержащие соединения, очищать растворы, использовать в качестве.

Platinum

Platinum is an extremely rare metallic element. A 50-ton pile of ore is required to produce one 50-g bar of pure platinum. Because of its chemical inertness and high fusing point, platinum is valuable for laboratory apparatus, such as crucibles, funnels, combustion boats, and evaporating dishes. Small amounts of iridium are usually added to increase its hardness and durability. Platinum is also used for contact points in electrical apparatus and in instruments used for measuring high temperatures.

Platinum	платина
Rare	редкий
Pile	куча
Require	требовать
Produce	вырабатывать
Bar	слиток

Pure	чистый
Fusing point	точка плавления
Valuable	ценный
Cricible	тигель
Funnel	воронка
Combustion boats	посуда под горение
Evaporating dishes	посуда под выпаривания
Irridium	иридий
Add to	добавлять
Increase	увеличивать
Hardness	прочность
Durability	долговечность
Contact points	точки соединения
Measure	измерять

Exercises:

Answer the following questions:

1. Is platinum a rare or abundant element?
2. How many tons of ore is require to produce one 50-g bar of pure platinum?
3. Why is platinum valuable laboratory apparatus?
4. Small amounts of iridium are usually added to increase its hardness and durability, don't they

Keep in your mind the next chemical terms:

Crucible, combustion, evaporate, add to, hardness, durable, measure, rare, pure, inertness, fusing, point, valuable, funnel.

Choose corresponding nouns to the next adjectives:

Rare, pure, chemical, high, small, electrical, evaporating.
Planinum, dishes, temperature, element, inertness, amounts, apparatus.

Insert the missing letters:

1. Pl…tinum, comb…stion, appar…tus, durab…lity, ha…dness, irid…um, cruc…bles, fu…nels, lab…ratory.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Platinum is an extremely abundant metallic element.
2. Great amounts of iridium are usually added to increase its hardness and durability.
3. Platinum is also used for contact points in electrical apparatus and in instruments used for measuring low temperatures.
4. A 50-ton pile of ore is required to produce one 50-rg bar of pure platinum.

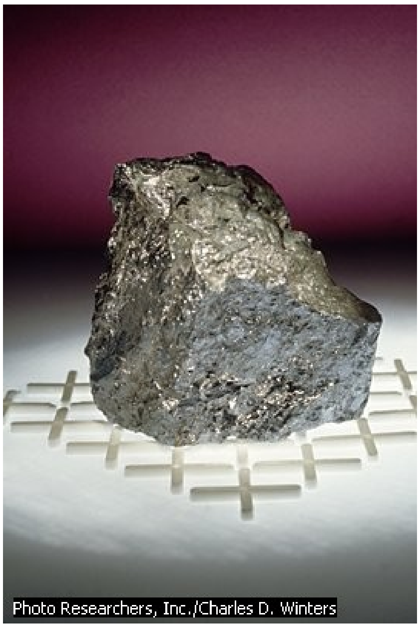
Underline Participle II and Gerund in the sentence and define their functions:

1. Platinum is also used for contact points in electrical apparatus and in instruments used for measuring high temperatures.

Translate into English:

1. Для того чтобы получить 50-и граммовый слиток платины требуется переработать 50-тонную кучу руды.
2. Чтобы увеличить прочность и долговечность в платину обычно добавляют небольшое количество иридия.

Silicon



The element silicon is one of the most abundant elements in Earth's crust, second only to oxygen. Most rocks consist of silicon in combination with other elements. Silicon steel, which contains from 2.5 to 4 percent silicon, is used in making the cores of electrical transformers. A steel alloy, known as duriron, containing about 15 percent silicon, is hard, brittle, and resistant to corrosion; duriron is used in industrial equipment that comes in contact with corrosive chemicals. Silicon is also used as an alloy in copper, brass, and bronze. The ability to control the electrical properties of silicon, and its abundance in nature, have made possible the development and widespread application of transistors and integrated circuits used in the electronics industry.

Silicon	кремний
Abundant	распространенный
Crust	корка земли
Oxygen	кислород
Rock	гора горная порода
Consist of	состоять из
Core	руда
Transformer	трансформатор
Duriron	дурирон
Brittle	хрупкий
Equipment	оборудование
Brass	латунь
Ability	способность
Property	свойство
Possible	возможный
Development	развитие
Widespread application	распространенное применение
Integrated circuit	интегрированная цепь

Exercises:

Answer the following questions:

1. Is the element ne of the most abundant or rare elements in Earth's crust?
2. What do most rocks consist of?
3. How many percent does silicon steel contain silicon?
4. What is duriron?
5. Is duriron hard, brittle, and resistant to corrosion?
6. Why is silicon widely used in transistors and integrated circuits?

Keep in your mind the next chemical terms:

Brittle, abundant, widespread, corrosive, integrated, crust, rock, consist of, silicon, alloy, brass, bronze, property.

Choose corresponding adjectives to the next nouns:

Silicon, transformer, duriron, application, industry, corrosion, equipment, chemicals, circuit.
Electrical, abundan,t brittle, resistant to, industrial, widespread, corrosive, integrated, hard.

Insert the missing letters:

Ste…l, al…oy, cir…cuit, prop…rty, equ…pment, bri…tle, abun…ance, cr…st, c…e, cop…r, br…ss, app…ication.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. The element silicon is one of the most abundant elements in Earth's crust.
2. Silicon steel contains from 2.5 to 4 percent copper.
3. Duriron, containing about 15 percent silicon, is hard, brittle, and resistant to corrosion.
4. Silicon is also used as an impurity in copper, brass, and bronze.

Underline Participle I, Participle II and Gerund in the sentences and define their functions:

1. A steel alloy, known as duriron, containing about 15 percent silicon, is hard, brittle, and resistant to corrosion.
2. Silicon steel, which contains from 2.5 to 4 percent silicon, is used in making the cores of electrical transformers.
3. The ability to control the electrical properties of silicon, and its abundance in nature, have made possible the development and widespread application of transistors and integrated circuits used in the electronics industry.

Translate into English:

1. Способность контролировать электрические свойства кремния и его изобилие в природе позволили развивать и широко применять транзисторы и интегрированные схемы применяемые в электронной промышленности.

2. Силиконовая сталь, которая содержит от 2.5% до 4% кремния, используется для изготовления сердечников электрических трансформаторов.

Silver

A soft, white metallic element in its pure form, silver usually occurs in nature as a wiry aggregate mingled with other mineral ores. Most of the silver produced today is mined in conjunction with lead and copper, both of which yield silver as a by-product. Silver is also widely used in the circuitry of electrical and electronic components. Colloidal silver, dilute solutions of silver nitrate ($AgNO_3$), and some insoluble compounds, such as potassium, are used in medicine as antiseptics and bactericides. Argyrol, a silver-protein compound, is a local antiseptic for the eyes, ears, nose, and throat.

Silver	серебро
Soft	мягкий
Wiry	проволочный
Aggregate	агрегат
Mingled with	смешанный
Ore	руда
Conjuction	соединение
Yield	давать
By-product	побочный продукт
Circuity	цепь
Dilute	разбавленный
Nitrate	нитрат
Insoluble	нерастворимый
Anticeptic	антисептический
Bactericide	бактерицид
Argyrol	аргироль (серебрянно-белковое соединение)

Exercises:

Answer the following questions:

1. What is silver in its pure form?
2. What does silver usually occur in nature as?
3. Where is silver used in?
4. Argyrol, a silver-protein compound, is a local antiseptic for the eyes, ears, nose, and throat, is not it?.

Keep in your mind the next chemical terms:

Occur, mingle with, ore, conjunction, by-product, dilute, insoluble, compound, solution, protein .

Choose corresponding adjectives to the next nouns:

Form, aggregate, ore, component, silver, solution, compound.
Pure,mineral, electronic, insoluble, local, wiry, dilute, colloidal, electrical,soft.

Insert the missing letters:

Pu…e, oc…ur, dil…te, y…eld, wi…y, so…t, inso…uble, pro…ein, so…ution.

Insert the missing preposition:

1. Silver is a soft, white metallic element …. its pure form.
2. Silver usually occurs ….. nature as a wiry aggregate mingled ….. other mineral ores.
3. Most ….. the silver produced today is mined ….. conjunction ….. lead and copper,
4. Argyrol, a silver-protein compound, is a local antiseptic ….. the eyes, ears, nose, and throat.

Translate the derivatives:

Solve – solvent –solution – soluble –insoluble - solubility
Produce – product- production- producer - productive- productivity
Pure - purify – purification - impurity

Underline Participle II and determine its function:

1. Most of the silver produced today is mined in conjunction with lead and copper.

Translate into English:

1. Аргироль, серебрянноблековое соединение, является местным антисептиком для глаз, ушей, носа и горла.
2. Серебро также широко используется в схемах с электрическими и электронными компонентами.
3. Серебро обычно встречается в природе в виде проволочного агрегата смешанного с другими минеральными рудами.

Sulfur

Sulfur in its natural form is a tasteless, odorless, light yellow solid. Hydrogen sulfide (H_2S), a compound that is very similar to water (H_2O), smells like rotting eggs. Sulfur burns with a pale blue flame (shown here), producing sulfur dioxide (SO_2), which when further oxidized and combined with atmospheric moisture, is one of the principal ingredients of acid rain.


Phototake NYC/Yoav Levy

Sulfur	сера
Tasteless	безвкусный

Solid	твердое тело
Similar to	подобный
Smell	пахнуть
Like	подобно
Rotting eggs	тухлый
Pale	бледный
Flame	пламя
Dioxide	двуокись
Moisure	влага
Acid rain	кислотный дождь

Exercises:

Answer the following questions:

1. Is sulfur in its natural form a tasteless, odorless, light yellow solid?
2. Hydrogen sulfide smells like rotting eggs, does not it?
3. What does sulphur produce when it burns?
4. Sulfur dioxide is one of the principal ingredients of acid rain, is not it?.

Keep in your mind the next chemical terms:

Tasteless, odorless, solid, sulfide, compound, smell, burn, dioxide, oxidize, sulphur, moisture, combine, ingredient, acid.

Substitute the Russian words in brackets by the English equivalents:

1. Sulfur in its natural form is (безвкусное, без запаха, легкое) yellow solid.

2. Hydrogen sulfide (H_2S), (соединение) that is very (похоже) water (H_2O), (пахнет) like rotting eggs.

3. Sulfur (горит) with a pale blue (пламя).

4. Sulfur dioxide (SO_2) when further (окисляется) and combined with atmospheric (влага), is one of the principal (составная часть) of acid rain.

Underline Participle I and Participle II and determine their functions:

1. Hydrogen sulfide (H_2S), a compound that is very similar to water (H_2O), smells like rotting eggs.

2. Sulfur burns with a pale blue flame (shown here), producing sulfur dioxide.

3. Sulfur dioxide (SO_2) when further oxidized and combined with atmospheric moisture, is one of the principal ingredients of acid rain.

Insert the missing prepositions:

1. Sulfur ….. its natural form is a tasteless, odorless, light yellow solid.

2. Hydrogen sulfide (H_2S), a compound that is very similar ….. water.

3. Sulfur burns ….. a pale blue flame.

Translate into English:

1. Сера горит бледно голубым пламенем с образованием двуокиси серы, которая при дальнейшем окислении и реакции с атмосферной влагой является составной частью кислотного дождя.

2. Сера в природной форме является безвкусным, без запаха, легким, желтым твердым телом.

3. Водородный сульфид (H_2S) соединение, которое очень похоже на воду (H_2O) пахнет, как тухлые яйца.

Titanium

A combination of strength, low weight, and a high melting point make the element titanium a useful construction material. However, because titanium is difficult to work and more expensive than steel or aluminum, it is used far less than those two metals. Because of its strength and light weight, titanium is used in metallic alloys and as a substitute for aluminum.

Titanium
Expensive
Substitute

Exercises:

Answer the following questions:

1. Is the element titanium a useful construction material?
2. Why is titanium used far less than steel or aluminum?
3. What metal does titanium substitute for?

Insert the missing prepositions:
1. ….. its strength and light weight, titanium is used ….. metallic alloys and as a substitute ….. aluminum.

Insert the missing letters:

Stren…th, w…ight, ti…anium, s…eel, alu…inum, li…ht, all…y, subst…tute, poi…t.

Translate into English:

1. Из-за своей прочности и легкого веса, титан используют в металлических сплавах и в качестве заменителя алюминия.

Complete the following sentences:

1. Because of its strength and light weight, titanium is used in ____________________________

2. A combination of strength, low weight, and a high melting point ________________________

Tungsten

Tungsten is a metallic element nearly twice as dense as lead. The melting point of tungsten is 3422°C (6192°F), higher than for any other metal element. The principal uses of tungsten are as filaments in incandescent lamps, as wires in electric furnaces, and in the production of hard, tenacious alloys of steel. It is used also in the manufacture of spark plugs, electrical contact points, and cutting tools, and as a target in X-ray tubes.

Tungsten	вольфрам
Dense	плотный
Filament	нить накала
Incandescent lamps	лампа накаливания
Wire	проволока
Furnace	печь
Tenacious	крепкий,прочный
Spark plug	штепсельная вилка
Cutting tools	режущий инструмент
Target	антикатод
X-ray tube	рентгеновская трубка

Exercises:

Answer the following questions:

1. What is the melting point of tungsten?
2. The principal uses of tungsten are as filaments in incandescent lamps, as wires in electric furnaces, and in the production of hard, tenacious alloys of steel are not they?

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

1. Tungsten is a metallic element nearly twice as dense as copper.
2. The melting point of tungsten is 3422°C (6192°F), lower than for any other metal element.
3. The principal uses of tungsten are as filaments in incandescent lamps, as wires in electric furnaces, and in the production of hard, tenacious alloys of steel.

Insert the missing letters:

Fila…ent, tun…sten, le…d, incande…cent, f…rnace, to…l, tu…e, de…se, all…y, st…el.

Insert the missing prepositions:

1. Tungsten is used also ….. the manufacture ….. spark plugs, electrical contact points, and cutting tools, and as a target ….. X-ray tubes.

Substitute the Russian words in brackets by the English equivalents:

1. The principal uses of tungsten are as (нить накаливания) in incandescent lamps, as wires in electric (печах), and in the production of hard, tenacious (сплавы) of steel.

2. It is used also in the manufacture of (штепсельные вилки), electrical contact points, and cutting (инструментт), and as a target in (рентгеновские трубки).

Uranium

The element uranium does not occur in pure form in nature but is found in minerals such as carnotite, pictured here.

After the discovery of nuclear fission, uranium became a strategic metal, and its uses were at first restricted mainly to the production of nuclear weapons.

Uranium	уран
Carnotite	карнотит
Nuclear fission	расщепление ядра
Restrict	ограничивать
Nuclear weapon	ядерное оружие

Exercises:

Answer the following questions:

1. Where is uranium found in?
2. After the discovery of nuclear fission, uranium became a strategic metal, did not it?
3. What were its uses at first restricted mainly to?

Insert the missing prepositions:

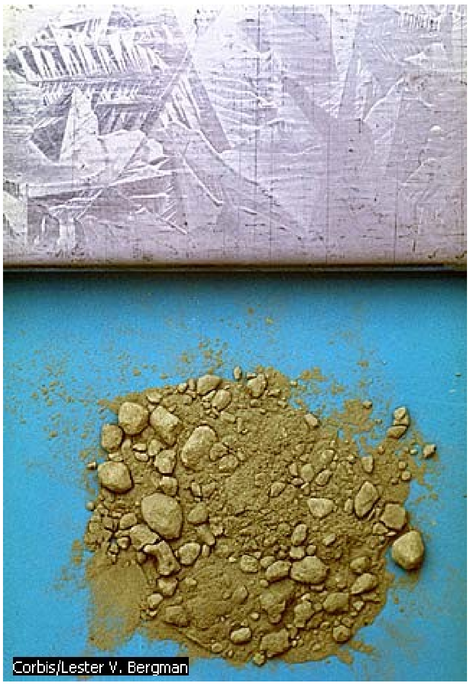
1. The element uranium does not occur ….. pure form ….. nature but is found ….. minerals such as carnotite.
2. ….. the discovery ….. nuclear fission, uranium became a strategic metal, and its uses were ….. first restricted mainly ….. the production ….. nuclear weapons.
Underline Passive Voice and determine its Tense:

1. After the discovery of nuclear fission, uranium became a strategic metal, and its uses were at first restricted mainly to the production of nuclear weapons.

Substitute the Russian words in brackets by the English equivalents:

1. Uranium (стал) a strategic metal.
2. Its uses were at first restricted mainly to the production of (ядерного оружия).
3. The element uranium does not occur in (чистом виде) in nature

Zinc



Zinc, pictured here as a bar and as a powder, is a metallic element. Many alloys contain zinc, and the element is often used in batteries and as a coating to protect other metals from corrosion.

The metal is used principally as a protective coating, or galvanizer, for iron and steel; as an ingredient of various alloys, especially brass; as plates for dry electric cells; and for die castings. Zinc oxide, known as zinc white or Chinese white, is used as a paint pigment. It is also used as a filler in rubber tires and is employed in medicine as an antiseptic ointment. Zinc chloride is used as a wood preservative and as a soldering fluid. Zinc sulfide is useful in applications involving electroluminescence, photoconductivity, and semiconductivity and has other electronic uses. It is employed as a phosphor for the screens of television tubes and in fluorescent coatings.

Zink	цинк
Bar	слиток
Powder	порошок
Protect	защищать
Plate	тарелка
Galvanize	гальванизировать
Rubber tires	резиновые покрышки
Employ	использовать
Ointment	мазь
Chloride	хлорид
Preservative	консервант
Soldering fluid	паяльная жидкость
Electroluminescence	электросвечение

Exercises:

Answer the following questions:

1. What metal protect other metals from corrosion?
2. Is zink employed in medicine as an antiseptic ointment?
3.What is employed as a phosphor for the screens of television tubes and in fluorescent coatings?

Insert the missing prepositions:

1. The element zink is often used ….. batteries and as a coating to protect other metals ….. corrosion.
2. It is employed as a phosphor ….. the screens ….. television tubes and ….. fluorescent coatings.
3. It is also used as a filler ….. rubber tires and is employed ….. medicine as an antiseptic ointment.

Insert the missing letters:

Po…der, corr…sion, c…ating, fi…ler, oin…ment, s…lder, e…ploy, p…int, sulf…de, rubb…r, ir…n, pre…ervative.

Underline Participle I and Participle II and determine their functions:

1. Zinc chloride is used as a wood preservative and as a soldering fluid.

2. Zinc oxide, known as zinc white or Chinese white, is used as a paint pigment.

Substitute the Russian words in brackets by the English equivalents:

1. Many alloys (содержат) zinc, and the element is often used in batteries and as a coating to (защищать) other metals from corrosion.

2. It is also used as a filler in (резиновых шинах) and is employed in medicine as an antiseptic (мазь).

3. The metal is used principally as a protective (покрытие), or galvanizer, for (железа и стали); as an ingredient of various (сплавов), especially (латунь); as plates for dry electric cells; and for (отливок).

OXYGEN

If an astronaut strikes a match in space, nothing happens. On Earth the tip bursts into flame because it reacts with a gas that is part of the air. That gas is oxygen.

WHAT IS OXYGEN?

Oxygen is invisible and has no smell, but it makes up about a fifth of the air around us. Oxygen is an element. Elements are basic substances that combine to form all the materials found on Earth. Water, for example, is a combination of the elements oxygen and hydrogen. Rust is oxygen combined with iron.

Oxygen is the most common element on the planet. Almost half the weight of Earth's crust is oxygen, but the oxygen is combined with other elements in rocks. If we place all the Earth's resources of oxygen on one pan of an imaginary scales and all the rest of the elements on the other, the scales will strike an almost perfect balance. Almost half of the Earth's crust is oxygen. It is everywhere; in water, in the atmosphere, in an enormous number of rocks, in any animal, and plant, and everywhere it plays a very important part.

Oxygen was discovered in 1774 by Joseph Priestley who obtained it by heating mercuric oxide – a method no longer used because of its expense and its low yield. In industry oxygen is obtained by the fractional distillation of liquid air.

Another method which is being employed more and more widely is to decompose water by passing through it a current of electricity. Oxygen prepared in this way is more nearly pure than that obtained from liquid air, but the cost is considerably greater.

The most generally used laboratory method for the preparation of oxygen is based on the thermal decomposition of potassium chlorate. Attention should be called to the fact that the presence of a small portion of manganese dioxide greatly influences the velocity of this reaction. Manganese dioxide serves as a catalyst in this reaction.

Oxygen is a colourless and tasteless gas, odourless, when pure (the laboratory sample smells slightly of chlorine). It is denser than air and slightly soluble in water. (About 3 ml oxygen dissolve in 100 ml water under room conditions). Upon this slight solubility depends the breathing of all aquatic life. At a low temperature and a high pressure it is converted into a liquid boiling at -181C.

As to its chemical behaviour oxygen is very reactive. Oxygen combines directly with most other elements particularly at high temperature, forming oxides. The process is called oxidation. Among the substances unaffected by oxygen mention should be made of the inert gases, iodine, bromine, fluorine, gold, and platinum.

The temperature – 119C is the critical temperature and 50 atmospheres is the critical pressure of the gas. Liquid oxygen is strongly attracted by a magnet and gives an interesting explosive when mixed with charcoal. Liquid oxygen boils at -182,5C, pressure-760 mm. Liquid oxygen is 1.13 times as heavy as an equal amount of water. When frozen it resembles snow in appearance.

Combinations with oxygen liberate heat and light, in which case the process is known as combustion. There are some elements which do not catch fire unless heated. Some substances will ignite even if very slightly heated; others have to be heated to rather high temperature before they take fire. The temperature at which a substance ignites is called its kindling temperature. Once started, these reactions liberate heat and light. The heat liberated maintains the substance at or above its kindling temperature.

The amount of heat liberated by very slow oxidation, such as rusting of metals and the decay of wood, is the same as that liberated by rapid combustion, but there is no rise in temperature because the heat is radiated to the surrounding air. The difference between combustion on the one hand and corrosion and decay on the other is one of the rate of reaction and temperature at which these reactions take place.

Oxygen is neutral to litmus, doesn't burn but supports combustion vigorously. The main uses of oxygen depend upon its ability to support life through respiration. Oxygen is used to enrich the air blast during the production of iron from ore in the blast-furnace and the conversion of iron into steel. This produces a higher furnace temperature, an increased yield of iron and steel, and a purer product. Burning apparatus fed with oxygen and acetylene will give a flame with a temperature of about 3,000C. This flame will melt steel easily. It is used in engineering for welding metal sections together. For small works and factories cylinders of compressed oxygen are most convenient. In engineering works and shipyards where larger quantities of oxygen are used liquid oxygen is delivered and stored in spherical insulated tanks. The oxygen evaporates from these and gaseous oxygen is piped to the work sites.

LIFE NEEDS OXYGEN

Except for a few kinds of bacteria, all living things need oxygen. Without it they would die. Animals that live on land breathe oxygen from the air into their lungs. You are doing that right now. Plants that live on land take in oxygen through tiny openings in their leaves. Insects have tiny holes in their shells that allow oxygen to seep in. Animals and plants that live underwater absorb oxygen that is dissolved in water.

Oxygen gets recycled from plants to animals and back again. Green plants combine the Sun's energy with water and carbon dioxide to create food for themselves. In the process, the plants produce oxygen and release it into the air. Animals, including humans, breathe in the oxygen. Animals breathe out carbon dioxide. Plants use the carbon dioxide to make more oxygen.

HOW DO WE USE OXYGEN?

Matches Need Oxygen

Matches burn because the material in their tips combines with an invisible gas, oxygen, in the air.

Anything that burns needs oxygen. When wood burns, it is actually combining with oxygen. The flame of a candle or a gas stove is produced by oxygen combining with other elements. Fossil fuels such as oil, coal, and natural gas also need oxygen so that they can burn. Burning, a process known as combustion, produces heat. We use the heat to keep buildings warm, cook food, produce electricity, and move our cars and trucks.

Animals use oxygen to keep their bodies working and to move around. Their muscles need oxygen for energy. Hospitals give oxygen to patients who are short of breath. Some pilots and mountain climbers need to breathe oxygen from special tanks in order to travel at high altitudes where the air is too thin to breathe. Divers need tanks containing oxygen so that they can spend time exploring underwater.

Scuba Diver

Scuba divers breathe oxygen from air tanks on their backs. These divers are playing with a dolphin underwater.

Exercises:

1. Answer the following questions:

What element is oxygen?
Where does oxygen occur in nature?
Why do all living things need oxygen?
What produces oxygen?
What is combustion?
Where is oxygen used?

2. Practice in pronunciation:

oxygen, basic, substance, combine, hydrogen, iron, common, weight, balance, enormous, bacteria, dissolve, recycle, breathe, dioxide, create, fuel, patient, altitude, explore.

3. Remember the derivatives of the words:

solve, solvent, solution, soluble, insoluble
dissolve, dissolver, dissolution, dissolved, unsolved, dissoluble, dissolvable
create, creation, creator
explore, explorer, exploration
recycle, recyclable, recycler
visible, visibility, vision

4. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Oxygen is invisible and has a sharp irritating smell, but it makes up about a fifth of the air around us.
Oxygen is the rarest common element on the planet.
Animals that live on land breathe oxygen from the air into their lungs.
In the process, the plants produce hydrogen and release it into the air.
Plants use the carbon dioxide to make more ozone.
Burning is a process known as combustion,

5. Fill in the blanks with necessary prepositions:

The oxygen is combined ….. other elements ….. rocks.
Animals that live ….. land breathe oxygen ….. the air ….. their lungs.
Animals and plants that live ….. water absorb oxygen that is dissolved ….. water.
….. the process, the plants produce oxygen and release it ….. the air.

6. Put the words in a proper order:

is, and, smell, no, has, oxygen, invisible.
for example, hydrogen, the, oxygen, and, water, is, a, of, elements, combination.
living, oxygen, need, things, all.
a, combustion, known, burning, as, process.

7. Find the English equivalents to the Russian expressions:

в соединение с, проходить через крохотные отверстия, дышать кислородом, выделять углекислый газ, выделять тепло, на большой высоте.

SILICON

Silicon, symbol Si, semimetallic element that is the second most common element on Earth, after oxygen. The atomic number of silicon is 14. Silicon is in group 14 (or IVa) of the periodic table. It was first isolated from its compounds in 1823 by the Swedish chemist Baron Jöns Jakob Berzelius. The element's name comes from the Latin word for flint, a mineral that contains silicon. The element silicon is one of the most abundant elements in Earth's crust, second only to oxygen. Most rocks consist of silicon in combination with other elements.

Properties and Occurrence

Silicon is prepared as a brown amorphous powder or as gray-black crystals. It is obtained by heating silica, or silicon dioxide (SiO_2), with a reducing agent, such as carbon or magnesium, in an electric furnace. Crystalline silicon has a hardness of 7, compared to 5 to 7 for glass. Silicon melts at about 1414°C (about 2577°F), boils at about 3265°C (about 5909°F), and has a specific gravity of 2.33. The atomic weight of silicon is 28.086.

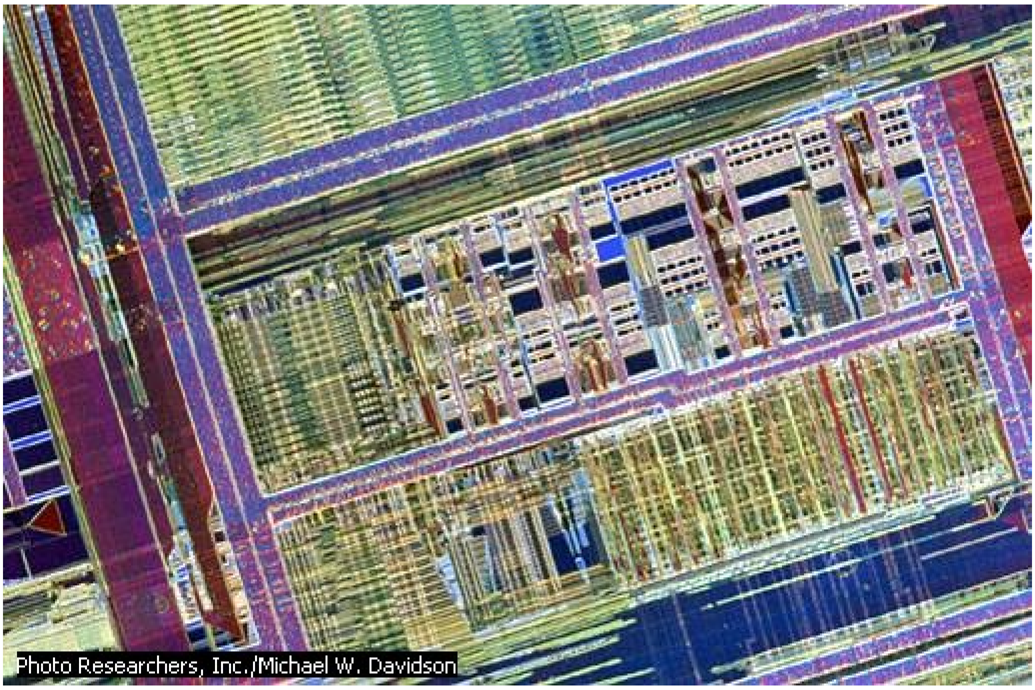
Silicon is not attacked by nitric, hydrochloric, or sulfuric acids, but it dissolves in hydrofluoric acid, forming the gas, silicon tetrafluoride, SiF_4. It dissolves in sodium hydroxide, forming sodium silicate and hydrogen gas. At ordinary temperatures silicon is impervious to air, but at high temperatures it reacts with oxygen, forming a layer of silica that does not react further. At high temperatures it also reacts with nitrogen and chlorine to form silicon nitride and silicon chloride, respectively.

Silicon constitutes about 28 percent of the earth's crust. It does not occur in the free, elemental state, but is found in the form of silicon dioxide and in the form of complex silicates. Silicon-containing minerals constitute nearly 40 percent of all common minerals, including more than 90 percent of igneous-rock-forming minerals. The mineral quartz, varieties of quartz (such as carnelian, chrysoprase, onyx, flint, and jasper), and the minerals cristobalite and tridymite are the naturally occurring crystal forms of silica. Silicon dioxide is the principal constituent of sand. The silicates (such as the complex aluminum, calcium, and magnesium silicates) are the chief constituents of clays, soils, and rocks in the form of feldspars, amphiboles, pyroxenes, micas, and zeolites, and of semiprecious stones, such as olivine, garnet, zircon, topaz, and tourmaline.

USES

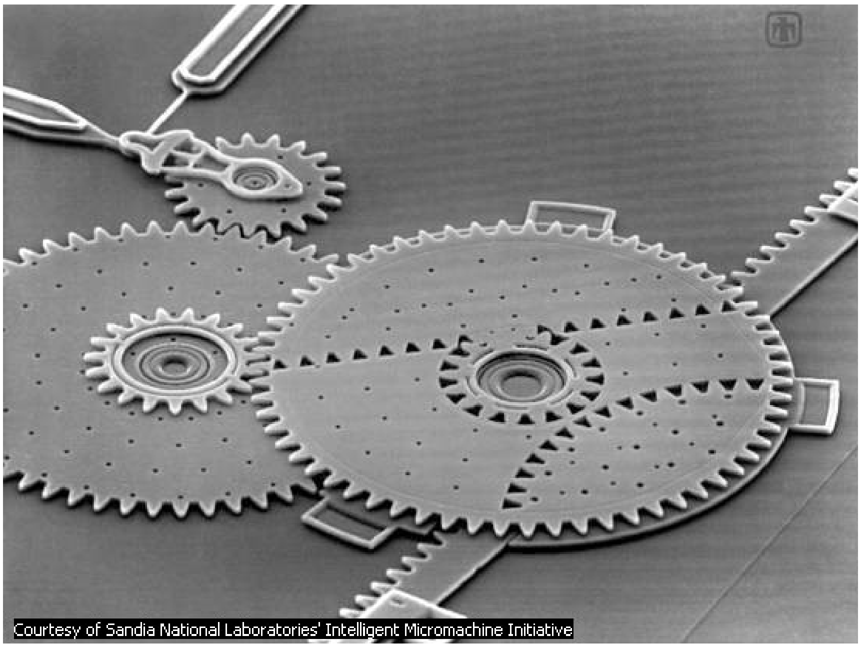
Silicon is used in the steel industry as a constituent of silicon-steel alloys. In steelmaking, molten steel is deoxidized by the addition of small amounts of silicon; ordinary steel contains less than 0.03 percent of silicon. Silicon steel, which contains from 2.5 to 4 percent silicon, is used in making the cores of electrical transformers because the alloy exhibits low hysteresis (*see* Magnetism). A steel alloy, known as duriron, containing about 15 percent silicon, is hard, brittle, and resistant to corrosion; duriron is used in industrial equipment that comes in contact with corrosive chemicals. Silicon is also used as an alloy in copper, brass, and bronze.

Silicon is a semiconductor, in which the resistivity to the flow of electricity at room temperature is in the range between that of metals and that of insulators. The conductivity of silicon can be controlled by adding small amounts of impurities, called *dopants*. The ability to control the electrical properties of silicon, and its abundance in nature, have made possible the development and widespread application of transistors and integrated circuits used in the electronics industry.



Silicon Chip

Silicon chips are the hearts of modern computers. Microscopically thin layers of silicon are etched away to produce the millions of tiny circuits that make up a computer chip.



Micromachine Gearing

Extremely thin layers of silicon only a few millionths of a meter thick can be used to abricate micromachines. The silicon layers can be shaped into levers, gears, and other tiny mechanical devices.

Silica and silicates are used in the manufacture of glass, glazes, enamels, cement, and porcelain, and have important individual applications. Fused silica, a glass made by melting quartz or hydrolyzing silicon tetrachloride, is characterized by a low coefficient of expansion and high resistance to most other chemicals. Silica gel is a colorless, porous, amorphous substance; it is prepared by removing part of the water from a gelatinous precipitate of silicic acid, $SiO_2 \cdot H_2O$, which is formed by adding hydrochloric acid to a solution of sodium silicate. Silica gel absorbs water and other substances and is used as a drying and decolorizing agent.

Sodium silicate, Na_2SiO_3, an important synthetic silicate, is a colorless, water-soluble, amorphous solid that melts at 1088°C (1990°F). It is prepared by reacting silica (sand) and sodium carbonate at a high temperature or by heating sand with concentrated sodium hydroxide under pressure. The aqueous solution of sodium silicate, called water glass, is used for preserving eggs; as a substitute for glue in making boxes and other containers; as a binder in artificial gemstones; as a fireproofing agent; and as a binder and filler in soaps and cleansers. Another important silicon compound is the silicon-carbon compound Carborundum, which is used as an abrasive.

Silicon monoxide, SiO, is used as a coating to protect other materials, the outer surface oxidizing to the dioxide SiO_2. Such layers are applied also as components of interference filters.

Exercises:

***1.* Answer the following questions:**

What mineral contains silicon?
Is silicon one of the most abundant elements in Earth's crust?
Describe in short its physical and chemical properties.
Where is silicon used?

2. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

The element silicon is one of the most abundant elements in Earth's crust, second only to hydrogen.
Silicon dioxide is the principal constituent of sand.
The silicates (such as the complex aluminum, calcium, and magnesium silicates) are the chief constituents of clays, soils, and precious stones, such as diamonds and sapphires.
The ability to control the electrical properties of silicon, and its abundance in nature, have made possible the development and widespread application of transistors and integrated circuits used in the electronics industry.

3. Fill in the blanks with necessary prepositions:

Silicon, is the second most common element ….. Earth, ….. oxygen.
The element silicon is one of the most abundant elements ….. Earth's crust, second only ….. oxygen.
Silicon steel, which contains ….. 2.5 to 4 percent silicon, is used ….. making the cores ….. electrical transformers.
Silicon is a semiconductor, ….. which the resistivity ….. the flow …. electricity ….. room temperature is ….. the range ….. that ….. metals and that ….. insulators.
Sodium silicate, Na2SiO3 is prepared ….. reacting silica (sand) and sodium carbonate ….. high temperature or ….. heating sand ….. concentrated sodium hydroxide ….. pressure.

4. Choose synonyms:

precious, ordinary, widespread, principal to obtain, to occur, artificial, to heat.
usual, abundant, valuable, to get, man-made, to warm, to happen, chief.

5. Complete the sentence:

The ability to control the electrical properties of silicon, and its abundance in nature, have made possible …………………………… .

CARBON

Carbon, nonmetallic chemical element, known by the symbol C, that is the fundamental building block of material in living organisms and is important to many industries. Carbon occurs in nature in nearly pure form in diamond and graphite. It is also the major component of coal, petroleum, asphalt, limestone, and most materials made by plants and animals. The name carbon is derived from the Latin word *carbo*, meaning charcoal, a material that is composed primarily of carbon.

A carbon atom can chemically combine with atoms of other elements, as well as with other carbon atoms, to form molecules. Molecules that contain two or more elements make up compounds. Carbon can form more compounds than can any other element except hydrogen. Carbon is present in all substances known as organic compounds.

Originally, scientists used the term *organic compounds* for materials that could only be obtained from living or dead organisms. Today chemists consider nearly any compound that contains carbon to be organic, whether they obtain it from organisms or synthesize it in a laboratory or in factories. Compounds that do not contain carbon are called inorganic compounds.

Carbon atoms form part or all of the backbone for the major molecules of all living things on Earth, including sugars, proteins, fats, and deoxyribonucleic acids (DNA), the molecules that carry the genetic code of living organisms. Many of the materials that we use in everyday life contain carbon-rich organic compounds. For instance, we wear clothing made of organic compounds—either natural fibers, such as wool, silk, or cotton; or synthetic ones, such as nylon or polyester. We construct our houses and furnishings from organic materials, such as wood and plastics. We burn carbon-rich fossil fuels, including gasoline, natural gas, and coal, for heat and energy. In addition, we use organic compounds as pesticides and medicines, and the foods we eat are carbon compounds.

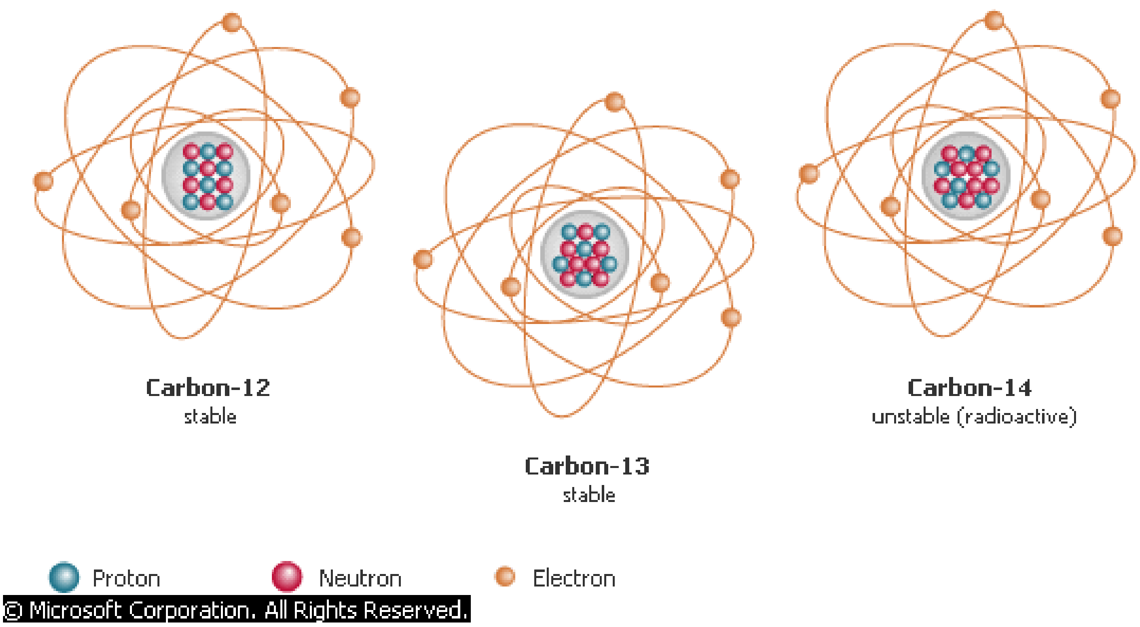
PROPERTIES

Of all the elements, carbon is the only one suitable for building the variety of molecules necessary to sustain life. Carbon atoms can attach to each other to form chains, rings, or a crystal mesh. The chains may be thousands of carbon atoms long and either linear or branched, and the rings usually contain from three to six carbon atoms. Most organic compounds contain many carbon-hydrogen bonds. Some of the other elements that bond to carbon include oxygen, nitrogen, fluorine, chlorine, bromine, iodine, sulfur, and phosphorus.

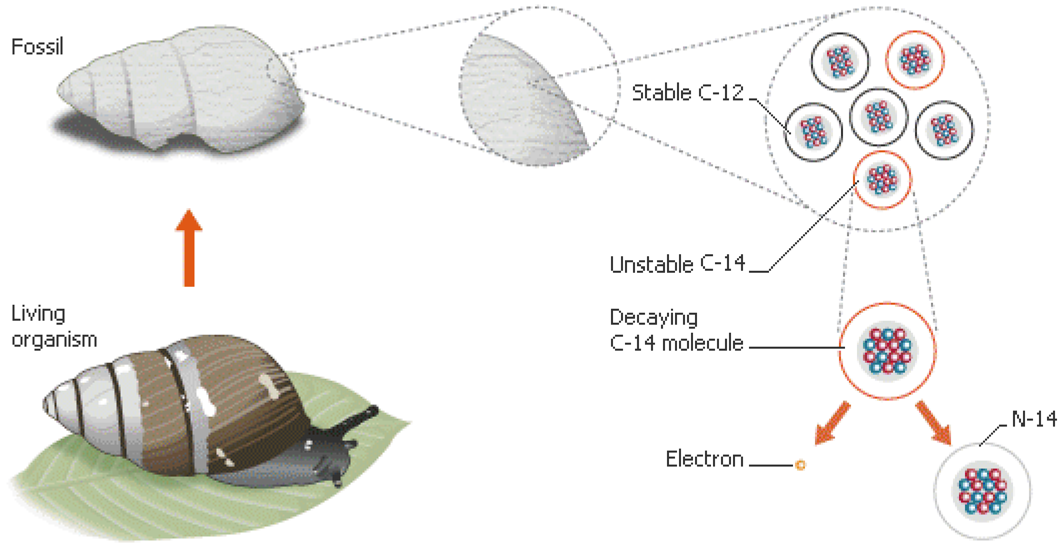
ISOTOPES

Every carbon atom contains six positively charged particles called protons in its nucleus and six or more neutral particles called neutrons. The carbon atom's nucleus is surrounded by six negatively charged electrons. The number of neutrons in a carbon atom's nucleus determines which isotope it is. Isotopes are atoms of the same element that have different numbers of neutrons in the nucleus. Three different isotopes of carbon exist in nature. The important isotopes of carbon are carbon-12, carbon-13, and carbon-14. Scientists identify them by their mass number, which is the sum of the number of protons and neutrons in an atom. Carbon-12 contains six protons and six neutrons, carbon-13 contains six protons and seven neutrons, and carbon-14 contains six protons and eight neutrons.

Isotopes of an element are atoms of the element that have different numbers of neutrons in their nuclei. Carbon has three naturally occurring isotopes, which are shown here with the isotopes of hydrogen. The isotopes of carbon are carbon-12, which constitutes 98.89 of all carbon atoms and serves as the standard for the atomic mass scale; carbon-13, which is the only magnetic isotope, making it very important for structural studies of compounds containing carbon; and carbon-14, which is produced by cosmic rays bombarding the atmosphere. Carbon-14 is radioactive, with a half-life of 5760 years. The amount of carbon-14 remaining in historical artifacts can be used to estimate their age.



In nature, carbon-12 accounts for about 98.89 percent of all carbon. Carbon-13 has a natural abundance of 1.11 percent, and the amount of carbon-14 is negligible. The atomic mass of carbon is 12.011 atomic mass units (AMU), which is the average mass of the isotopes of carbon based on their abundance.

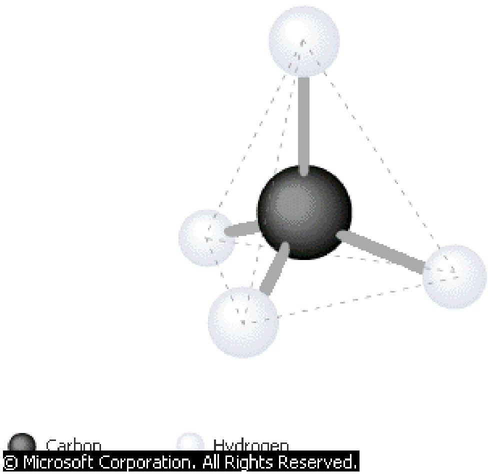


Carbon-14 Dating

The approximate date a fossilized organism died can be determined through a technique called carbon-14 (C-14) dating. All living organisms absorb C-14, an unstable form of the element carbon that slowly decays into nitrogen-14 (N-14). During its lifetime, an organism continually replenishes its supply of C-14 by breathing and eating. After the organism dies and becomes a fossil, C-14 decays without being replaced. Scientists know the rate at which C-14 decays and can detect the electrons that C-14 emits as it decays. Counting these electrons dates the fossil because older fossils contain less C-14 and emit fewer electrons.

Scientists have found some important uses for the less abundant isotopes of carbon. The nucleus of carbon-13 is magnetic. This property enables scientists to detect nuclei of carbon-13 atoms using a technique called nuclear magnetic resonance (NMR). By detecting the location of carbon-13 atoms in carbon-based molecules, scientists can learn about the structure of these molecules. Carbon-14 is radioactive, that is, its nucleus is unstable and can spontaneously change into the nucleus of another element (*see* Radioactivity). In a given sample, half of the carbon-14 nuclei will disintegrate in about 5,730 years. Living organisms constantly replenish carbon in their systems, so that the amount of carbon-14 remains constant as long as an organism is alive. Knowing the original amount of carbon-14 in organisms, scientists can measure the amount of carbon-14 that has disintegrated in a fossilized organism and determine the amount of time that has passed since it died. This technique for determining the age of fossils is called carbon dating.

BONDING



Tetrahedral Bonding in Methane

The methane molecule is the simplest example of how carbon bonds to four other atoms to form a tetrahedral shape. The carbon atom sits at the center, with the four hydrogen atoms at the points of the tetrahedron. Carbon's ability to form four strong bonds is unique among the elements and allows it to form large molecules.

As with all atoms, the electrons in a carbon atom reside in layers, or shells, around the nucleus. Carbon atoms have two electrons in their inner shell, and this shell can only contain two electrons, so it is full. Carbon atoms have four outer, or valence, electrons in their next shell. This outer electron shell can hold eight electrons, and atoms in general are much more stable when their outer shell is full. To obtain a full outer shell, carbon atoms form four covalent bonds with other atoms. A covalent bond is a bond formed when two atoms share a pair of electrons. When two atoms share one pair of electrons, the covalent bond is called a *sigma* bond and it holds the electrons tightly between the two atoms. One pair of shared electrons is also called a single bond. When two atoms share two pairs of electrons (creating a double bond), the first shared pair forms a sigma bond, while the second pair forms a *pi* bond. The pi bond does not hold electrons as tightly as the sigma bond holds the first pair. When two atoms share three pairs of electrons (creating a triple bond), two of the bonds are pi bonds. Electrons in pi bonds are much more reactive than are electrons in sigma bonds. That is, pi electrons more easily split away from the bond and create bonds with other atoms, adding those atoms to the molecule.

Carbon atoms can bond together in chains, rings, and meshlike networks. If a carbon atom bonds with four identical atoms, those atoms will be equally distant from each other—at the tips of an imaginary tetrahedron, or a pyramid with a triangular base. Any two of the bonds form an angle of 109.5° when carbon is in a tetrahedral form.

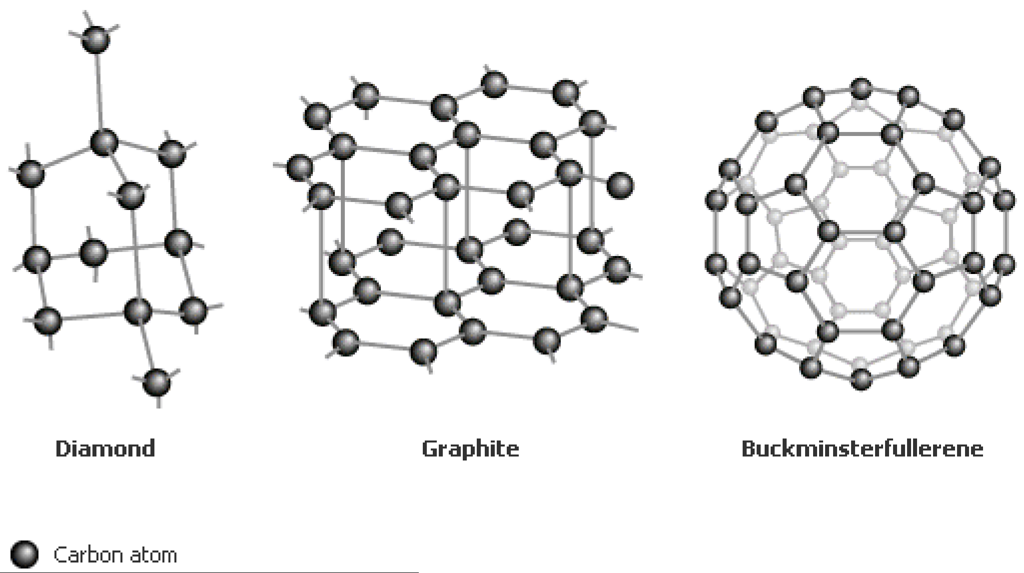
ALLOTROPES

Carbon has multiple allotropes. Allotropes are different physical forms of the same element, such as a hard, highly structured crystal and a soft, less-structured substance. Allotropes differ in the way the atoms bond with each other and arrange themselves into a structure. Because of their different structures, allotropes have different physical and chemical properties. The three common allotropes of carbon are diamond, graphite, and amorphous carbon (examples of amorphous carbon include charcoal, soot, and the coal-derived fuel called coke). The density of diamond is about 3.5 grams per cubic centimeter (g/cm^3), graphite ranges from 1.9 to 2.3 g/cm^3, and amorphous carbon ranges from 1.8 to 2.1 g/cm^3. Diamond is one of the hardest known materials, while graphite is one of the softest. These differences arise from the differences in bonding between the carbon atoms.

In diamond, each carbon atom bonds tetrahedrally to four other carbon atoms to form a three-dimensional lattice. The shared electron pairs are held tightly in sigma bonds between adjacent atoms. Pure diamond is an electrical insulator—it does not conduct electric current. It is colorless and, because of its hardness, is used in industrial cutting tools. Cut diamonds sparkle brilliantly, which makes them treasured gemstones in jewelry.

Allotropic Forms of Carbon

Atoms of the element carbon can link together in several ways to form substances with very different properties. In diamond, the atoms form a three-dimensional network that extends throughout a crystal and makes diamond the hardest naturally occurring substance. Graphite is made up of layers of carbon that can slide over each other easily, making graphite a useful lubricant. In the family of substances called fullerenes, the atoms link to form spherical or cylindrical surfaces.



Diamond and Graphite

Diamond (shown here cut and uncut) and graphite are different allotropes, or forms, of the element carbon. These allotropes form at different depths, and therefore different temperatures and pressures, within the earth. This produces substances with very different crystal structures and physical properties.

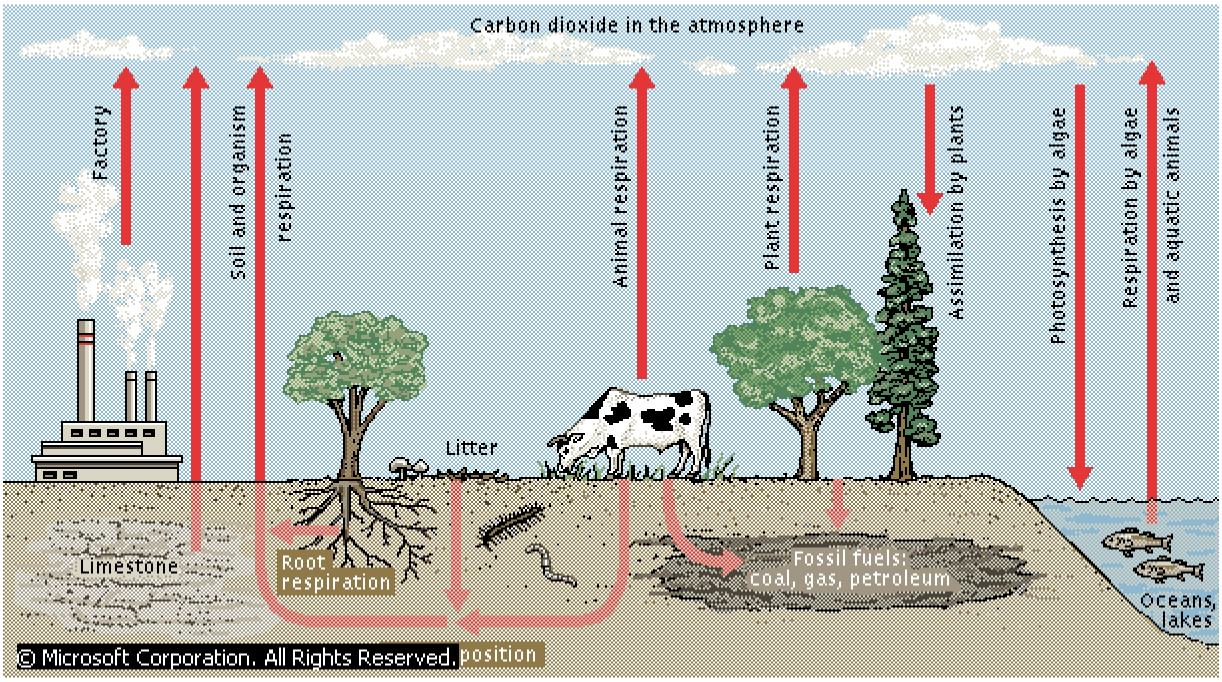
Graphite is black and slippery and conducts electricity. In graphite, the atoms form planar, or flat, layers. Each layer is made up of rings containing six carbon atoms. The rings are linked to each other in a structure that resembles the hexagonal mesh of chicken wire. Each atom has three sigma bonds (with 120° between any two of the bonds) and belongs to three neighboring rings. The fourth electron of each atom becomes part of an extensive pi bond system. Graphite conducts electricity, because the electrons in the pi bond system can move around throughout the graphite. Bonds between atoms within a layer of graphite are strong, but the forces between the layers are weak. Because the layers can slip past each other, graphite is soft and can be used as a lubricant. Rubbing off layers of carbon in graphite is easy; you do it every time you write with a "lead" pencil. The "lead" is not actually lead at all but graphite mixed with clay. Diamond makers can transform graphite into diamond by applying extremely high pressure (more than 100,000 times the atmospheric pressure at sea level) and temperature (about 3000°C or 5000°F). High temperatures break the strong bonds in graphite so that the atoms can rearrange themselves into a diamond lattice. About 90 percent of the diamonds used in tools in the United States are made this way.

Amorphous carbon is actually made up of tiny crystal-like bits of graphite with varying amounts of other elements, which are considered impurities. For example, the coal industry divides coal up into various grades depending on the amount of carbon in the coal and the amount of impurities. The highest grade, anthracite, contains about 90 percent carbon. Lower grades include bituminous coal, which is 76 percent to 90 percent carbon, subbituminous coal, with 60 percent to 80 percent, and lignite, with 55 percent to 73 percent.

In 1985 chemists created a new allotrope of carbon by heating graphite to extremely high temperatures. They named the allotrope buckminsterfullerene, after American architect R. Buckminster Fuller. Fuller designed geodesic domes, rigid structures with a three-dimensional geometry that resemble this form of carbon. Unlike diamond and graphite, which can have an unending crystal structure, the original fullerene forms molecules of 60 carbon atoms (with a molecular formula of C_{60}). The molecules are shaped like tiny soccer balls (called buckyballs), with an atom at each point where the lines on a soccer ball would normally meet. The 60 carbon atoms bond in 20 six-membered rings and 12 five-membered rings. Each carbon atom is at a corner where two six-membered rings and one five-membered ring come together. Scientists have since discovered other fullerenes, including very narrow, long tubes and the C_{70} fullerene, an elongated structure shaped more like a football but rounded on the ends. After scientists discovered fullerenes in the lab, geologists discovered fullerenes in nature—in ancient rocks in New Zealand and in the meteorite-created Ries Crater in Germany.

Scientists, excited by the properties of these recently discovered materials, are exploring ways to use them. When cooled, some fullerene-based compounds that include other noncarbon atoms are superconductors, that is, they can conduct electricity with no resistance. Some pure carbon fullerene tubes are stronger than metals and conduct electricity. Someday we may use them as electrical wires or as fibers to reinforce plastic, making materials that are even stronger than those reinforced with current carbon fibers. Other compounds based on C_{60} appear to inhibit the activity of the virus that causes acquired immunodeficiency syndrome (AIDS).

OCCURRENCE



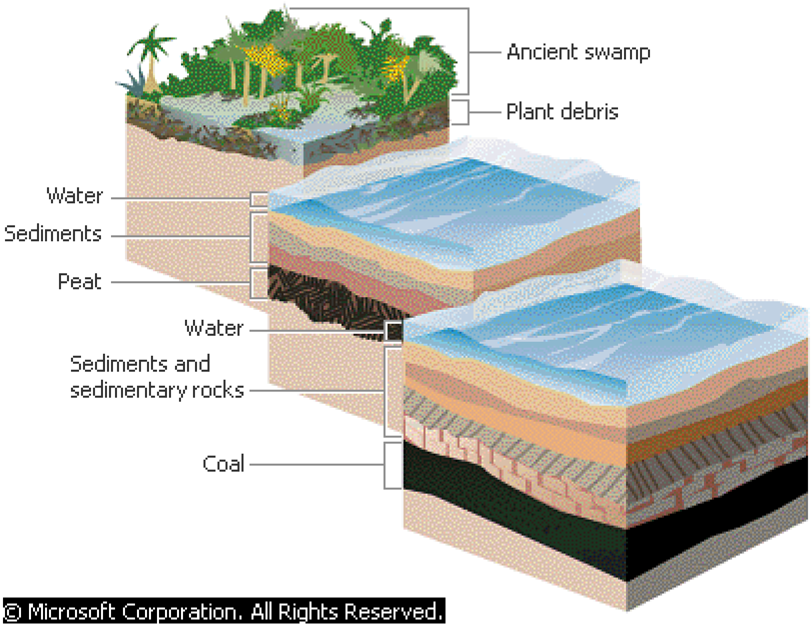
Carbon Cycle

Carbon, used by all living organisms, continuously circulates in Earth's ecosystem. In the atmosphere, it exists as colorless, odorless carbon dioxide gas, which is used by plants in the process of photosynthesis. Animals acquire the carbon stored in plant tissue when they eat and exhale carbon dioxide as a by-product of metabolism. Although some carbon is removed from circulation temporarily as coal, petroleum, fossil fuels, gas, and limestone deposits, respiration and photosynthesis balance to keep the amount of atmospheric carbon relatively stable. Industrialization, however, has contributed additional carbon dioxide to the environment.

Carbon is widely distributed in nature and the universe. We have already discussed how carbon occurs as a pure element and in countless organic compounds on Earth. But carbon also abounds in the Sun, stars, comets, and in the atmospheres of most planets. The atmosphere of Mars is mostly carbon dioxide (carbon bonded with two oxygen atoms, or CO_2). Earth's atmosphere contains only 0.03 percent CO_2. Like virtually all atoms, carbon atoms are made in the interior of stars during a supernova, an explosion of a star that emits vast amounts of energy. These explosions build atoms in thermonuclear reactions, high temperature events that fuse two nuclei together. Hydrogen atoms fuse together into a helium atom, then helium atoms fuse into carbon. Carbon atoms can then fuse with helium into oxygen.

The total mass of carbon on Earth is about 7.5×10^{19} kg (about 1.7×10^{20} lb). When written out, 7.5×10^{19} is 75 followed by 18 zeros. Only about 0.001 percent of this total is found in living plants and animals. As noted earlier, carbon is found in elemental form as amorphous carbon (mostly coal), graphite, and diamond. Large deposits of coal are found in Europe, Asia, Australia, and North America. Large deposits of graphite are found in China, India, North Korea, Mexico, Brazil, the Czech Republic, and the Ukraine. Natural diamonds are found in deposits that are believed to be the remains of ancient volcanic pipes, long tubes of rocky material formed by volcanoes. Diamond-containing pipes occur in South Africa, Russia, and the state of Arkansas in the United States, and in the ocean floor off the Cape of Good Hope in South Africa. Some meteorites contain microscopic diamonds.

Carbon is also found in inorganic compounds bound up in rocks and, most importantly to living organisms, as carbon dioxide in the air and water. Rocks can contain carbon-based inorganic compounds such as carbonates of calcium and magnesium, which make up limestone. Carbon dioxide occurs as a gas in the atmosphere of Earth and also as a dissolved gas in all natural water. Although the percentage of carbon dioxide in Earth's atmosphere is small, it helps keep the planet warm enough to sustain life. Carbon dioxide traps some of the solar radiation, in the same way that a greenhouse or a car with closed windows traps heat (*see* Greenhouse Effect). Based on the distance from the Sun and the amount of solar radiation, Earth would have an average temperature of –18°C (0°F) without this blanket of carbon dioxide. The oceans would be frozen.



How Coal Forms

The coal we find today formed from generations of plants that died in ancient tropical swamps and accumulated on the swamp bottoms. The plant material first formed a compact organic material called peat. As layers of sediment gradually accumulated over the peat, the pressure and heat exerted by the thickening layers gradually drove out the moisture and increased the carbon content of the peat, forming coal.

Carbon dioxide also provides the carbon needed by living organisms to build organic molecules. During the carbon cycle—the continuous exchange of carbon among plants, animals, and their environment—plants capture carbon dioxide from the air. With the aid of sunlight, the plants use the carbon to build complex organic molecules, such as starches and sugars. This process is called photosynthesis. When animals eat the plants or the plants otherwise decompose, the complex organic molecules are broken down again. To complete the cycle, animals exhale carbon dioxide back into the atmosphere. In addition, some carbon gets deposited in rock, but as the rocks weather, they release the carbon. Carbon dioxide also escapes through the vents of volcanoes. In natural processes, the total amount of carbon dioxide returned to the atmosphere equals the amount extracted.

Plants, animals, and other life forms make carbon-based organic molecules that range from small to enormous in size. Small molecules include acetic acid ($C_2H_4O_2$), which gives vinegar its sour taste; the simple sugar glucose ($C_6H_{12}O_6$); and common table sugar, sucrose ($C_{12}H_{22}O_{11}$). The three basic energy-providing nutrients of living organisms, carbohydrates, fats, and proteins, are all based on carbon. Wood from plants is made of a very large carbohydrate, called cellulose, which consists of many, many glucose molecules bonded together.

The human body is about 18 percent carbon by mass, and the biologically significant molecules (other than water) have carbon as part or all of the backbone of their structure. Cell membranes are made up of lipids, which are large organic molecules of carbon, hydrogen, oxygen, nitrogen, and phosphorus. Other large organic molecules of the body are the proteins found in blood, muscle, skin, hair, and every living cell. Ribonucleic acids (RNA) and deoxyribonucleic acids (DNA) are gigantic carbon-based molecules that contain the genetic information, or the blueprints, for a living organism. Biochemical processes, the chemical reactions that create and sustain life, rely on the chemical reactions of carbon-based substances. These life processes involve the complex and coordinated making or breaking of carbon bonds.

Fossil fuels, such as coal, petroleum, and natural gas, are mainly hydrocarbons (molecules containing only carbon and hydrogen). They most likely formed from the remains of organisms that lived approximately 500 million years ago. Coal formed from the remains of plants that were buried and subjected to high pressure and heat over long periods of time. Petroleum, formed from microscopic sea plants and bacteria, is a thick, dark liquid composed of a variety of hydrocarbons. Natural gas, also formed from tiny sea creatures, is usually found with petroleum deposits. It consists mostly of methane (CH_4), but it also contains significant amounts of ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). Liquid petroleum is mainly composed of hydrocarbon molecules that contain from 5 to more than 25 carbons. Products made from petroleum include gasoline, kerosene, jet fuel, diesel fuel, heating oil, lubricating oil, and asphalt.

USES OF CARBON

Scientists, industry, and consumers use different forms of carbon and carbon-containing compounds in many ways. Scientists use the carbon atom as the basic unit of mass and as a clue to the age of an object. Industries use carbon to make steel from iron, purify metals, and add strength to rubber. In the form of diamond, carbon can cut most other substances and shine more brilliantly in jewelry than most other gems. Carbon compounds can be burned as fuel to heat food or homes, as well as form many different molecules for all sorts of human needs.

In 1961 the international unions of physicists and chemists agreed to use the mass of the isotope carbon-12 as the basis for atomic weights. Carbon-12 is defined to have an atomic mass of exactly 12 atomic mass units (AMU). The atomic mass of an element is the average mass of an atom of that element as compared to the mass of a carbon-12 atom.

Carbon-14 dating, a technique originated by American chemist Willard F. Libby in 1947, uses carbon to estimate the age of things that were once alive or artifacts made from them, such as wood sculptures or cloth. The carbon dioxide in the atmosphere includes one atom of radioactive carbon-14 for every 10^{12} (1,000 billion) atoms of the nonradioactive carbon-12. While living, an organism contains this same ratio because it is continuously exchanging carbon with the atmosphere through photosynthesis or through eating and respiration. When an organism dies, exchange with the environment stops, and no additional carbon-14 is taken in. The radioactive isotope carbon-14 decays into nitrogen-14, and the carbon-14 concentration decreases with time. By measuring the carbon-14 to carbon-12 ratio in an archaeological sample, a scientist can estimate how much time has passed since the organism died.

Steel Production

Molten pig iron is poured into a basic oxygen furnace (BOF) for conversion to steel. Steel is a form of iron produced from iron ore, carbon-based coke, and limestone in a blast furnace. Excess carbon and other impurities are removed to make a strong steel.

Photo Researchers, Inc./Farrell Grehan

Photo Researchers, Inc./Spencer Grant

Cut Diamonds

The brilliance of diamonds makes them treasured gemstones. The skill of the gem-cutter lies in angling the facets of the stone so that each light ray entering it is reflected many times before it emerges again. Colored flashes of light occur in a fiery diamond when light is separated into colors.

Carbon has many industrial uses. At high temperatures, carbon combines with iron to make steel. The chemical composition of steel determines its physical properties. Carbon steel with about 1.5 percent carbon is used to make sheet steel and tools. Steel used for automobile and aircraft engine parts contains about 1 percent carbon. High strength steel used for transportation equipment and structural beams contains about 0.25 percent carbon. Stainless steel for engine parts or kitchen utensils contains from 0.03 to 1.2 percent carbon. Carbon, in the form of coke, can also react with tin oxide and lead oxide to yield the pure metals tin and lead. Carbon black, made of fine particles of amorphous carbon, is produced by incomplete combustion of natural gas. It is mainly used as a filler and reinforcing agent for rubber.

Natural and synthetic diamonds can cut nearly every other known material. Gem cutters, surgeons, and manufacturers use diamond knives and drills. General Electric Company produced the first synthetic diamond in 1955. Today tiny synthetic diamonds are commonly used as abrasives. Producers of metal tools use lasers to heat carbon dioxide over a metal surface, making the carbon atoms coat the surface with a diamond film. This diamond coating can make cutting tools last much longer than untreated tools.

People burn fossil fuels to generate energy. Burning, or combustion, is the reaction of a substance with oxygen to produce new substances and energy (in the form of heat). When coal burns, carbon reacts with oxygen to yield carbon dioxide and heat. The higher the carbon content, the greater the energy released in combustion. Therefore, anthracite (containing the most carbon) is the most valuable coal, and lignite (containing the least amount of carbon) is the least valuable. In petroleum, oil, and natural gas, burning releases energy when bonds between the atoms break and when carbon and hydrogen atoms recombine with oxygen to form carbon dioxide and water.

Carbon compounds are the basis of the synthetic organic chemicals, which account for many of the products of the chemical industry. Pharmaceuticals, pesticides, paints, and coatings are among the products made from synthetic organic chemicals. The synthetic fiber, synthetic rubber, and plastics industries depend upon the unique ability of carbon to form stable, long chains, or polymers, made from small organic molecules bonded together. Carbon-based polymers form synthetic fibers, such as nylon, rayon, and polyester. All the plastics, from polyethylene terephthalate (PET) in soft drink bottles to polyvinyl chloride (PVC) in window frames to styrene in car parts, depend on the properties of carbon.

Exercises:

1. Answer the following questions:

What element is the fundamental building block of material in living organisms?

Where does carbon occur in nature in pure form?
What Latin word is the name carbon derived from and what does it mean?
What are organic compounds?
Do inorganic compounds contain carbon?
Carbon atoms form part or all of the backbone for the major molecules of all living things on Earth, including sugars, proteins, fats, and deoxyribonucleic acids, don't they?
What carries the genetic code of living organisms?
What are positively charged particles called in the nucleus?
What are neutrons?
Do isotopes of an element have different or equal numbers of neutrons in their nuclei?
What do carbon atoms form when they attach to each other?
Allotropes are different physical forms of the same element, aren't they?
Why do allotropes have different physical and chemical properties?
What are the main allotropic forms of carbon?

2. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Carbon is rarely distributed in nature and the universe.
Carbon atoms are made in the interior of stars during a supernova, an explosion of a star that emits vast amounts of energy.
Diamond-containing pipes occur in Great Britain, Canada and India and in the ocean floor off the shores of Australia.
Carbon helps keep the planet warm enough to sustain life.
Earth would have an average temperature of –18°C (0°F) without this blanket of ozone.

3. Fill in the blanks with necessary prepositions:

The human body is ….. 18 percent carbon ….. mass.
Other large organic molecules ….. the body are the proteins found ….. blood, muscle, skin, hair, and every living cell.
Carbon dioxide occurs as a gas ….. the atmosphere ….. Earth and also as a dissolved gas ….. all natural water.
….. high temperatures, carbon combines …… iron to make steel.
Stainless steel ….. engine parts or kitchen utensils contains ….. 0.03 ….. 1.2 percent carbon.

Carbon compounds are the basis ….. the synthetic organic chemicals, which account ….. many ….. the products ….. the chemical industry.
All the plastics, ….. polyethylene terephthalate (PET) ….. soft drink bottles ….. polyvinyl chloride (PVC) ….. window frames ….. styrene ….. car parts, depend ….. the properties ….. carbon.

4. Find the English equivalents to the Russian expressions:

углеродосодержащее топливо, определять химические свойства, нержавеющая сталь, алмазное покрытие, образовываться из останков организма, подвергать высокому давлению, дизельное топливо смазывающиеся масла, разрушать связи.

5. Choose synonyms:

to produce, basic, property, to connect, to coat, to heat, valuable, to treat, to react.
to warm, to link, quality, main, to manufacture, to cover, to combine, to process, precious.

6. Translate into English:
окись, окисление, окисляемый, окислять(ся), окислитель.

NITROGEN

Nitrogen is of particular interest and service to man. The position of nitrogen in the Periodic Table would make us expect this element to be active chemically, like its neighbours oxygen and phosphorus, but this is not the case with nitrogen.

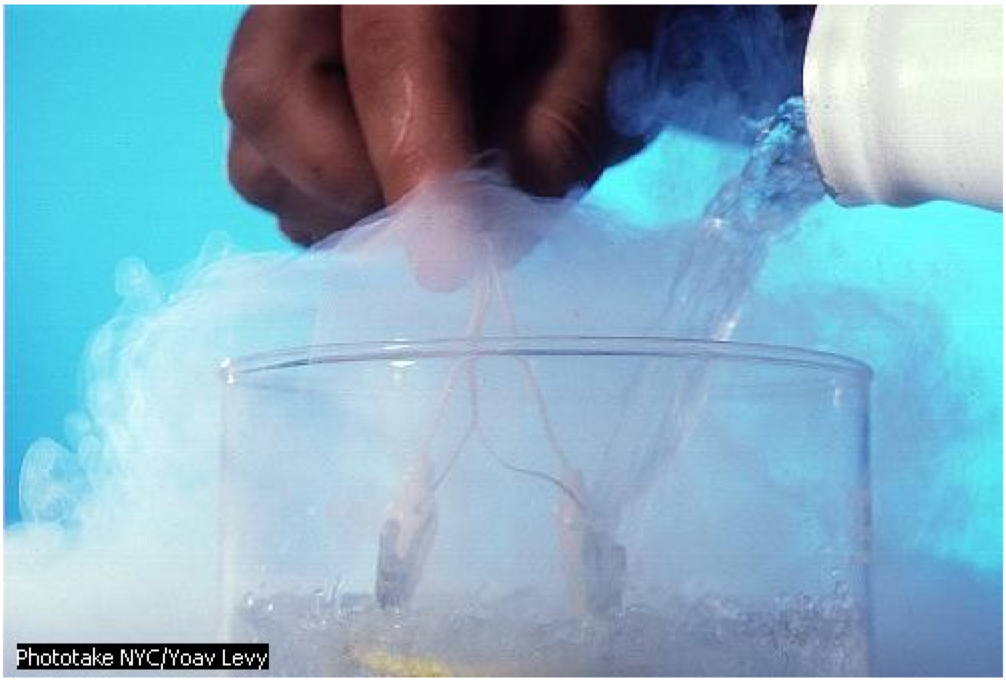
Nitrogen differs from all the other elements of this group in existing at ordinary temperatures as a colourless gas, consisting of diatomic molecules. The strength of the triple bond in the N-N molecule is remarkably great, as much as 274,000 calories being required to decompose a gram molecular weight. This large quantity of energy accounts for the inactivity of the element.

Electric Discharge in Nitrogen

This discharge tube contains nitrogen gas. When the tube is connected to a high voltage source, electrons flow from the cathode at one end of the tube to the anode at the other end. Some of the electrons collide with the nitrogen in the tube, exciting the nitrogen atoms. These excited atoms quickly shed their excess energy by emitting light, whose combined effect results in the purplish glow visible in this photograph.

Nitrogen is like oxygen and hydrogen in having neither colour, taste, nor odour; but in other respects it is very different. Nitrogen does not burn, nor does it support burning. At elevated temperature it combines to some extent with oxygen, forming NO, and more readily with some of the active metals.

On account of its inertness it is difficult to make nitrogen combine with other elements and its compounds are found to be unstable. When electric sparks are passed through a mixture of nitrogen and oxygen, the nitrogen will combine with oxygen to form oxides of nitrogen. In the presence of a suitable catalyst it will combine with hydrogen at a moderately high temperature to form ammonia, which is a gaseous compound of nitrogen and hydrogen. Although these last two reactions take place with difficulty, yet they have recently become of great importance because they enable us to transform the free nitrogen of the air into compounds of nitrogen.



Liquid Nitrogen

Liquid nitrogen is poured like water to cool an electronic device to a temperature of 77 K (-196° C/ -323° F). Liquid nitrogen is produced by liquefying air and is widely used as an inexpensive cryogenic refrigerant. It can be stored for long periods in special containers called Dewar flasks, named after Sir James Dewar, the British scientist who first liquefied hydrogen in 1898. Liquid nitrogen has many everyday uses ranging from the production of frozen foods to the removal of warts. Sperm banks use liquid nitrogen to preserve genetic material. Research laboratories commonly use this versatile refrigerant to trap volatile materials.

Cooling in liquid nitrogen is often a starting point for reaching even lower temperatures using liquid helium.

About one hundred years after the discovery of nitrogen a prominent microbiologist wrote: “Nitrogen is more valuable from the point of view of general biology than the rarest of the noble metals”. And he was quite right. Nitrogen is a constituent of practically all protein molecules. Without nitrogen there is no protein, and without protein there is no life.

Compounds of nitrogen are essential to plant life and animals. These nitrogen compounds which occur naturally are called proteins; they are composed of carbon, nitrogen, oxygen and hydrogen. The plant is able to build them up from the water, carbon dioxide and the inorganic nitrates which it finds in the soil. The protein in animals is obtained entirely from the plants or other animals which they consume. The waste products of plant and animal life contain the nitrogen of the original protein combined in a number of different compounds, which are easily acted upon by bacteria in the soil and turned into ammonium compounds. These ammonium compounds in turn are oxidized by other bacteria to nitrates, which can be taken by plants. This nitrogen makes a cycle through plant and animal life and the soil. Alas, this store is meagre. It holds few compounds containing nitrogen. That is why the soil loses its nitrogen rapidly and requires the addition of nitrogenous fertilizers. It was found that Chile saltpeter to be an excellent nitrogenous fertilizer. Ships loaded with the valuable fertilizer deliver it to all parts of the globe.

Attempts to cause carbon and nitrogen to combine to form cyanogen have always met with failure. The use of a high voltage electrical discharge to which the element is subjected enables an active nitrogen to be produced. Active nitrogen combines readily with many elements, including sulphur and phosphorus with which molecular nitrogen fails to react at all.

Most of the nitrogen used in the chemical industry is obtained by the fractional distillation of liquid air. It is then used to synthesize ammonia. From ammonia produced in this manner, a wide variety of important chemical products are prepared, including fertilizers, nitric acid, urea, hydrazine, and amines. In addition, an ammonia compound is used in the preparation of nitrous oxide (N_2O) a colorless gas popularly known as laughing gas. Mixed with oxygen, nitrous oxide is used as an anesthetic for some types of surgery.

Used as a coolant, liquid nitrogen has found widespread application in the field of cryogenics. With the recent advent of ceramic materials that become superconductive at the boiling point of nitrogen, the use of nitrogen as a coolant is increasing.

The nitrogen of the air is of great importance and value to man and to all forms of life. For example, it dilutes oxygen and therefore retards oxidation. Life, certainly would be quite different from what it is if atmosphere were composed of pure oxygen: it would probably be much shorter. The combustion of fuel in stoves and furnaces would be difficult to control, the corrosion of iron and steel would proceed so rapidly that their use would be impractical. The decay would also be greatly accelerated.

There is plenty of free nitrogen in the atmosphere. Scientists have calculated that if all the nitrogen in the atmosphere were transformed into fertilizers there would be enough to nourish all the plants in the world for more than a million years.

Exercises:

1. Answer the following questions:

What accounts for the inactivity of nitrogen?
What is common between nitrogen and oxygen?
How many calories are being required to decompose a gram molecular weight of nitrogen?
Why are reactions of nitrogen with hydrogen of great importance?
Who first liquefied hydrogen?
Where is liquid nitrogen used?
Compounds of nitrogen are essential to plant life and animals, aren't they?
What are called proteins?
What elements are proteins composed of?
Why is the nitrogen of the air of great importance to man?

2. Remember the derivatives of the words:

to form, to perform, reform, to inform, deformation, performance, to transform.
to compose, composition, composer.
to expend, expenditure, expense, expensive.

3. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Nitrogen is like oxygen and hydrogen in having neither colour, taste, nor odour; but in other respects it is very different.

Most of the nitrogen used in the chemical industry is obtained by the fractional distillation of liquid hydrogen.
If atmosphere were composed of pure oxygen: it would probably be much longer.
There is plenty of free nitrogen in the oceans.

4. Fill in the blanks with necessary prepositions:

….. elevated temperature it combines ….. some extent ….. oxygen.
Compounds ….. nitrogen are essential ….. plant life and animals.
These ammonium compounds ….. turn are oxidized ….. other bacteria ….. nitrates.
Most ….. the nitrogen used ….. the chemical industry is obtained ….. the fractional distillation ….. liquid air.
Ships loaded ….. the valuable fertilizer deliver it ….. all parts ….. the globe.

5. Give three forms of the verbs:

to build, to find, to meet, to become, to make, to take.

6. Underline the Passive Voice constructions in the following sentences, translate them and determine the tense:

These nitrogen compounds which occur naturally are called proteins; they are composed of carbon, nitrogen, oxygen and hydrogen.
Liquid nitrogen is produced by liquefying air.
The use of a high voltage electrical discharge to which the element is subjected enables an active nitrogen to be produced.
From ammonia produced in this manner, a wide variety of important chemical products are prepared.
A wide variety of important chemical products of nitrogen are prepared,

PHOSPHORUS

Phosphorus was discovered about 1669 by the German alchemist Hennig Brand in the course of experiments in which he attempted to prepare gold from silver. The element's name was drawn from the Greek word *phosphoros*, "light bearing," because many phosphorus compounds are phosphorescent: they store light and give it off later.

Phosphorus is widely distributed in nature and ranks 11th in abundance among the elements in Earth's crust. It does not occur in the free state but is found mostly as a phosphate, as in phosphate rock and apatite. It is also found in the combined state in all fertile soil and in many natural waters. The element is important in plant and animal physiology and is a constituent of all animal bones, in the form of calcium phosphate.

The element phosphorus is located below nitrogen in Group V of the Periodic Table. As it is expected, these two elements resemble each other in many respects, but there are many points in which they differ radically. The most striking difference between these two elements is that nitrogen is quite inactive under ordinary conditions, while phosphorus reacts readily both with metals and with non-metals. They differ also in that nitrogen is gas at an ordinary temperature, whereas phosphorus is a solid.

Ordinarily obtained phosphorus is a soft waxlike solid, white when first prepared but slowly turning yellow. It is ordinary stick phosphorus which is called white phosphorus to distinguish it from the other allotropic forms of the element. When heated much above the boiling point, the molecules begin to dissociate, one per cent of the molecules being dissociated at 800 ^{0}C and more than 50 per cent at 1200 ^{0}C. Phosphorus is almost insoluble in water, 0,0033 g. dissolving in a liter of ice water. Phosphorus dissolves in many solvents, the best solvent being carbon disulphide, one part of which will dissolve nine parts of phosphorus.

Phosphorus

Phosphorus is a nonmetallic chemical element that occurs as three different allotropes. Red, left, and white phosphorus are shown here. White phosphorus ignites spontaneously in air, and must be stored underwater.

One has to keep in mind that the most striking property of white phosphorus is its activity with oxygen. When exposed to air at room temperature the oxidation of phosphorus begins slowly and as the temperature rises spontaneous combustion may result, the ignition temperature ranging from 35 ^{0}C to 45 ^{0}C. Because of the ease with which it takes fire, it must be kept under water, and such operations as cutting and moulding should be performed there.

White phosphorus is very poisonous, colourless, and practically water-insoluble substance. When exposed out of contact with air, it melts readily, turning into a colourless liquid. If one remains long in an atmosphere containing the vapour, the effect in chronic poisoning may result.

Upon exposure to air, white phosphorus undergoes slow oxidation even at ordinary temperatures. When it oxidizes, white phosphorus glows like fire-flies, remaining cold. The phenomenon is an example of the direct transformation of chemical energy into light. White phosphorus is one of the most readily igniting substance in existence. It ignites at the slightest heating(even at the temperature of the human body) and burns, generating much heat and forming phosphorus pentoxide. Burns caused by burning phosphorus heal with great difficulty, and white phosphorus should therefore be handled with extreme caution.

Red phosphorus being a more stable form, its reactions are much less violent. It doesn't ignite in the air until heated to a temperature of 240 ^{0}C, but the products formed are the same as those produced by white phosphorus. It is sometimes said "Without phosphorus there is no thought". This is true, because cerebral tissues contain many complex phosphorus compounds. But neither is there life without phosphorus. Without it respiratory processes would be impossible and muscles could store no energy. Finally, phosphorus is one of the most important "bricks" of any living organism. As a matter of fact, the principal component of bony tissues is calcium phosphate. Calcium phosphate is a constituent of the skeleton and imparts hardness to it. Organic compounds of phosphorus are constituents of nerve and muscle tissues. Every flow of thought in our minds and every contraction of a muscle involves chemical transformations of these compounds.

The most important commercial compounds of phosphorus are phosphoric acid and the salts of phosphoric acid, called phosphates. The bulk of phosphorus-containing compounds are used as fertilizers. Phosphorus compounds are also used in clarifying sugar solutions, weighing silk, and fireproofing, and in such alloys as phosphor bronze and phosphor copper. White phosphorus is used in the making of rat poison, and red phosphorus is used in matches.

Exercises:

1. Answer the following questions:

Who discovered phosphorus?
What does the element's name "phosphorus" mean?
Phosphorus is widely distributed in nature, isn't it?
Does it occur in the free state?
Where is it found?
Does nitrogen resemble phosphorus in many respects?
What is the most striking difference between these two elements/
What is the most best solvent for phosphorus?
Why must phosphorus be kept under water?

Why should white phosphorus be handled with extreme caution?
Explain why phosphorus is of great importance for life.

2. Remember the derivatives of the words:

to differ, different, difference, to differentiate.
to discover, discovery, discoverer.
to solve, solvent, solution, soluble.

3. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Phosphorus was discovered about 1669 by the English scientist Roger Bacon.
It occurs abundantly in the free state.
The element is important in plant and animal physiology and is a constituent of all animal bones, in the form of calcium phosphate.
Upon exposure to air, white phosphorus undergoes fast oxidation even at ordinary temperatures.
Red phosphorus being a more stable form, its reactions are much more violent.
Cerebral tissues contain many complex phosphorus compounds.
The principal component of bony tissues is calcium phosphate.

4. Underline the Passive Voice constructions in the following sentences, translate them and determine the tense:

Because of the ease with which phosphorus takes fire, it must be kept under water,
Such operations as cutting and moulding should be performed there.
White phosphorus should be handled with extreme caution.
Phosphorus compounds are used in clarifying sugar solutions, weighing silk, and fireproofing.
The bulk of phosphorus-containing compounds are used as fertilizers.

5. Fill in the blanks with necessary prepositions:

Phosphorus was discovered ….. 1669 ….. the German alchemist Hennig Brand ….. the course …… experiments.
The element phosphorus is located ….. nitrogen ….. Group V ….. the Periodic Table.
These two elements resemble each other ….. many respects,
The most striking difference …… these two elements is that nitrogen is quite inactive ….. ordinary conditions.

White phosphorus is used ….. the making ….. rat poison, and red phosphorus is used ….. matches.
There is no life ….. phosphorus.
It ignites ….. the slightest heating

6. Insert the missing forms of irregular verbs:

draw ..... drawn

…..gave …..
find found …..
….. began …..
leave ….. …..
…..left left
strike ….. struck
….. kept …..
burn burnt …..
cut …..cut
undergo ….. …..
…..rose risen

7. Translate into English:

Ожоги, вызванные горящим фосфором, вылечиваются с большой трудностью.
Если долго оставаться в атмосфере, содержащей испарения фосфора, то может произойти хроническое отравление.
С белым фосфором следует обращаться с предельной осторожностью.

8. Choose synonyms:

to heat, to begin, to occur, to expect, to resemble, to strike, to react, to obtain, to store, to turn, to remain, to heal.
to start, to suppose, to hit, to get, to change, to treat, to warm, to happen, to look like, to combine, to keep, to stay.

9. Put in English words instead of Russian words in the following sentences:

Upon exposure to air, white phosphorus undergoes <u>медленному окислению</u> even at ordinary temperatures.
Calcium phosphate is a <u>составной частью</u> of the skeleton and imparts hardness to it.
White phosphorus is one of the most readily <u>воспламеняющихся</u> substance in existence.

As a matter of fact, the principal component of костной ткани is calcium phosphate.

OZONE

Ozone is an allotropic modification of oxygen. In normal conditions, ozone is a pale blue gas. It contains oxygen atoms, but the bonding of three atoms per molecule gives it distinctive properties. Ozone boils at a higher temperature -111,9^{0}C than oxygen, its colour is more intense, and it is more soluble in water. Ozone has a sharp irritating odour and is very toxic. Liquid ozone is dark blue; in the solid state it is a dark violet crystal. The molecule of ozone is unstable, and ozone decomposes explosively in large concentrations.

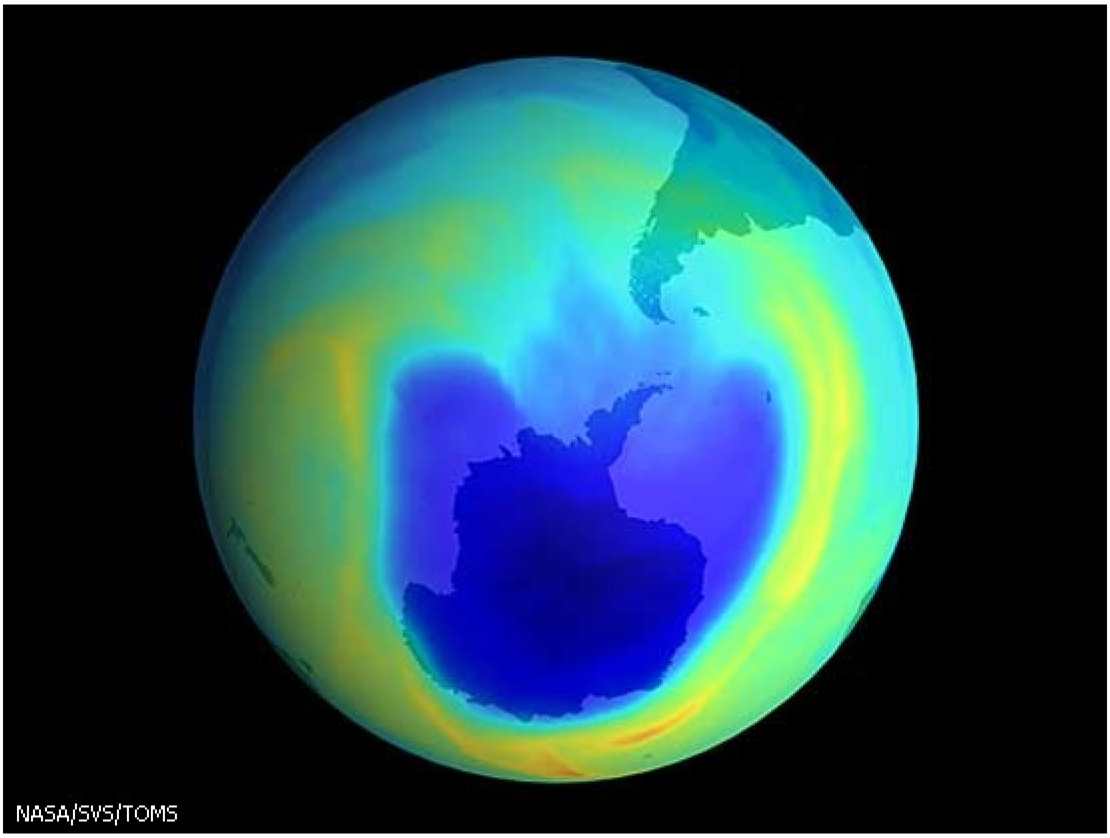
Your breath comes easier after a thunderstorm. The air is clear and charged with freshness. This is not just a poetical image. Thunderclaps result in the formation of ozone gas in the atmosphere, and it is this gas that makes the air seem cleaner.

Ozone is essentially oxygen. The difference is that the oxygen molecule contains two atoms of the element while the ozone molecule contains three. One atom more or one atom less of oxygen, should that make a big difference?

It does make a very big difference: ozone and oxygen are entirely different substances. Without oxygen there is no life. On the other hand, ozone in large concentrations kills all living things. It is a most powerful oxidizing agent, second only to fluorine. On combining with organic substances ozone immediately destroys them. When attacked by ozone all the metals, except for gold and platinum, change rapidly into their oxides. It is two-faced! A murder of all living things, ozone also promotes life in many ways. This paradox is easy to explain.

Ozone is formed in electrical discharges, and accounts for the freshness of the air after thunderstorm or near electrical equipment. In natural conditions ozone is formed from oxygen during fighting discharges, and at altitudes 10-30 km high through the action of solar radiations. Solar radiations contain ultraviolet rays. If they reached the Earth’s surface, life on Earth would be impossible because these rays carry an immense amount of energy and are fatal to living organism. Fortunately, only a very small fraction of the Sun’s ultraviolet rays reaches the Earth’s surface. Most of them lose their force in the atmosphere at an altitude of 10-30 km. At this level there is a great deal of ozone. Ozone removes harmful ultraviolet radiation from sunlight and absorbs the Earth’s own ultra-red radiation thus protecting it against cooling.

By the way, one of the present-day theories of the origin of life on Earth relates the appearance of the first organisms to the time of formation of the ozone layer in the atmosphere. Chlorofluorocarbons, or CFCs, and some other air pollutants that diffuse into the ozone layer destroy ozone. In the mid 1980s, scientists discovered that a ”hole”- an area where the ozone is up to 50% thinner than normal-develops periodically in the ozone layer above Antarctica. This severe regional depletion, explained as a natural seasonal depletion, appears to have been exacerbated by the effect of CFCs, and may have led to an increase in skin cancer caused by UV exposure. Restrictions on the manufacture and use of CFCs and other ozone-destroying pollutants were imposed in 1978.



Ozone Layer Hole

The ozone hole over the South Pole is apparent in this false-color image taken by a satellite in October 1999. Low levels of ozone are shown in blue. Ozone is a gas that blocks harmful ultraviolet sunlight. Industrial chemicals released into the atmosphere have caused ozone to break down, opening holes in the ozone layer that tend to concentrate at the poles.

Launching Ozone Balloon, Antarctica

Scientists launch a balloon carrying scientific instruments from the roof of a building at McMurdo research base in Antarctica. The balloon will be used to study Earth's ozone layer.

The chemical industry needs thousands and thousands of tons of ozone very badly. Oil industry workers use its strong oxidizing power. The petroleum of many oil fields contains sulphur. Sour oils, as they are called, cause a great deal of trouble, for one thing, by rapidly corroding equipment for instance, boiler stokers at power stations. With ozone such oils could be freed from sulphur, and the sulphur removed could be utilized to double or even treble the present production of sulphuric acid.

We drink chlorinated water. It is harmless, but its taste is inferior to that of spring water. Being a powerful oxidizing agent, ozone is used to purify drinking water and disinfect air, and in chemical synthesis of various kinds. Drinking water treated with ozone is absolutely free from pathogenic bacteria and has no unpleasant taste.

Ozone can renew old automobile tyres and bleach fabrics, cellulose, and yarn. There are many other things it can do. And that is why scientists and engineers are working on the design of high-capacity industrial ozonizers.

Exercises:

1. Answer the following questions:

What is the difference between ozone and oxygen?
Ozone and oxygen are entirely different substances, aren't they?
Explain why ozone also promotes life in many ways.
What destroys the ozone layer?
What purposes is strong oxidizing power of ozone used for in industry?

2. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Ozone is a most powerful oxidizing agent, second only to nitrogen.
On combining with organic substances ozone immediately reduces them.
Chlorofluorocarbons, or CFCs, and some other air pollutants that diffuse into the ozone layer destroy ozone.
In normal conditions, ozone is a colourless, odourless gas.
Ozone has a sharp irritating odour and is very toxic.

3. Fill in the blanks with necessary prepositions:

….. combining ….. organic substances ozone immediately destroys them.
….. the other hand, ozone ….. large concentrations kills all living things.
Ozone is formed ….. electrical discharges, and accounts ….. the freshness ….. the air ….. thunderstorm.
Thunderclaps result ….. the formation ….. ozone gas ….. the atmosphere.
When attacked ….. ozone all the metals, except ….. gold and platinum, change rapidly ….. their oxides.

4. Put in English words instead of Russian words in the sentences:

The связь of three atoms per molecule gives it отличительные свойства.
Ozone разлагается explosively in large concentrations.
A murder of all living things, ozone also способствует life in many ways.
Ozone is formed in electrical разрядах, and объясняет for the freshness of the air after thunderstorm.
Ozone удаляет harmful ultraviolet radiation from sunlight and поглощает the Earth's own ultra-red radiation thus protecting it against cooling.

5. Choose antonyms:

dark, easy, clean, big, different, powerful, rapid, living, natural, harmful.

helpful, artificial, slow, small, dirty, same, light, difficult, dead, weak.

6. Complete the sentences:

Ozone can renew old automobile tyres and bleach ………
Oil industry workers use its ………..
Chlorofluorocarbons, or CFCs, and some other air pollutants that diffuse ……….
Fortunately, only a very small fraction of the Sun's ultraviolet rays ………..
When attacked by ozone all the metals, except for gold and platinum, ……….

HYDROGEN

Lightest chemical element, chemical symbol H, atomic number 1.

A colourless, odourless, tasteless, flammable gas, it occurs as the diatomic molecule H2. Its atom consists of one proton (the nucleus) and one electron; the isotopes deuterium and tritium have an additional one and two nuclear neutrons, respectively. Though only the ninth most abundant element on Earth, it represents about 75% of all matter in the universe. Hydrogen was formerly used to fill airships; nonflammable helium has replaced it. It is used to synthesize ammonia, ethanol, aniline, and methanol; to treat petroleum fuels; as a reducing agent (see reduction) and to supply a reducing atmosphere; to make hydrogen chloride (see hydrochloric acid) and hydrogen bromide; and in hydrogenation (e.g., of fats). Liquid hydrogen (boiling point −423 °F [−252.8 °C]) is used in scientific and commercial applications to produce extremely low temperatures and as a rocket propellant and a fuel for fuel cells. Combustion of hydrogen with oxygen gives water as the sole product. The properties of most acids, especially in water solutions, arise from the hydrogen ion (H+, also referred to as the hydronium ion, H3O+, the form in which H+ is found in a water environment). See also hydride; hydrocarbon.

The Sun

The Sun outshines everything else in the sky. Hydrogen makes up the bulk of the Sun and provides fuel for the nuclear reactions that make the Sun shine.

A star is a big ball of hot, glowing gas. The gas is mostly hydrogen and helium. Stars give off heat, light, and other kinds of energy.

A star has several layers. The part at the center of a star is called its core. A star shines because of its core. The core is so hot and tightly packed that atoms crunch together. Atoms are tiny bits of matter much too small to see. Hydrogen atoms crunch together and become helium atoms. This is called nuclear fusion. Nuclear fusion gives off enough energy to make the stars shine.

The lightest and most abundant element in the universe, pure hydrogen is a gas without taste, color, or odor. It is believed to have formed, with helium, all of the heavier elements and is estimated to compose three quarters of the mass of the universe. On Earth, hydrogen occurs chiefly in combination with oxygen in water (its name comes from the Greek for “water-forming”). It is also present in organic matter such as living plants, petroleum, and coal, and sparingly as a free element in the atmosphere. It combines with other elements, sometimes explosively, to form hundreds of thousands of compounds. It reacts with other hydrogen atoms to form hydrogen molecules (H2).

Hydrogen can be produced by passing steam over heated carbon (coke or coal). When heated, natural gas decomposes into hydrogen and carbon black. Hydrogen is also produced by the electrolysis of water, by displacement from acids, and by the action of certain hydroxides on aluminum.

Hydrogen is a colourless, odourless, tasteless, flammable gas when pure. It is sixteen times lighter than oxygen, being the lightest of all known substances. The solubility of hydrogen in water is very slight, compared with that of oxygen. 100 volumes of water at 0C absorb about 2,15 volumes of gas. It is not poisonous. Its atom consists of one proton and one electron; the isotopes deuterium and tritium have an additional one and two neutrons, respectively.

Hydrogen is liquefied by compression when cooled below its critical temperature - 234C. Liquid hydrogen is also colourless, and when allowed to evaporate rapidly, it freezes to a colourless solid. Hydrogen burns in the air forming water. Although hydrogen is readily combustible, yet it is not a supporter of combustion, that is, substances will not burn in it. At ordinary temperatures hydrogen is not an active element. But under certain conditions it combines with many elements. For example, if a mixture of hydrogen and chlorine is exposed to the sunlight, the two gases will combine with explosion forming hydrogen chloride. Under the right conditions hydrogen combines with nitrogen forming ammonia, and with sulphur forming hydrogen sulphide. If a mixture of hydrogen and oxygen is heated to about 88C, a violent explosion occurs and water is formed.

Hydrogen doesn’t react at room temperature in the absence of catalysts. Hydrogen combines with many non-metals, but doesn’t react with metals at all. The readiness with which hydrogen will combine with oxygen and certain other non-metals makes it able to remove oxygen and chlorine from their compounds with the other elements. Thus, when hydrogen is passed over hot ferric oxide, lead oxide, nickel oxide, etc., hydrogen combined with the oxygen of the oxide leaves behind the metal.

For general laboratory work hydrogen is prepared by the action of dilute hydro chloric acid or sulphuric acid on granulated zink. The most important industrial methods for making hydrogen are extracting from water gas by electrolysis.

Hydrogen was discovered by the famous English physicist Henry Cavendish in the sixteenth century by the action of sulphuric acid on iron. R.Boyle at the end of the 18^{th} century proved that unlike air the gas was inflammable. Lavoiser suggested the name hydrogen (water producer) in 1783, because when the gas burnt in air water was formed.

Hydrogen was a most valuable find to chemists. It helped them to get an insight into the structure of acids and bases. It became an indispensable laboratory reagent for precipitating metals from solutions of salts, and for reducing metallic oxides. Had hydrogen not been discovered in 1766, the progress of chemistry would have been retarted for along time.

Horsehead Nebula

Stars are born from nebulas like the Horsehead Nebula, which is more than 1,000 light-years from the Earth. The nebula consists mainly of hydrogen gas. Hydrogen is the most common element in the universe.

This gas also drew the attention of physicists. And they found out a great deal of information which enriched science many times over. The hydrogen atom enabled the Danish physicist Niels Bohr to work out a theory of the arrangement of electrons around the atomic nucleus. Then the physicists passed the baton to their close relatives by profession, to the astrophysicists who studied the composition and structure of the stars. The astrophysicists stated that hydrogen is element Number One in the universe. It is the main component of the Sun, the stars and the basic "filler" of interstellar space. There is more hydrogen in outer space than all the other chemical elements taken together. Nothing like on Earth, where its content amounts to less than one per cent. Our Sun and all the stars are luminous because of the thermonuclear reactions occurring in them, involving the transformation of hydrogen into helium with the release of enormous amounts of energy. A prominent chemist on Earth, hydrogen is an outstanding chemist in outer space.

Another remarkable property of hydrogen is that its atom emits radiations having a wave-length of 21 centimetres. This is called a universal constant because it is the same throughout the universe. And scientists have taken up the problem of organizing radio communications with other inhabited worlds on the hydrogen wave. If these worlds are inhabited by intelligent creatures, they should have an idea of what 21 centimetres is.

Hydrogen is one also present in nearly all organic compounds and in many gases. It is one of the main constituents of animal and vegetable tissue.

Rocket Fuel

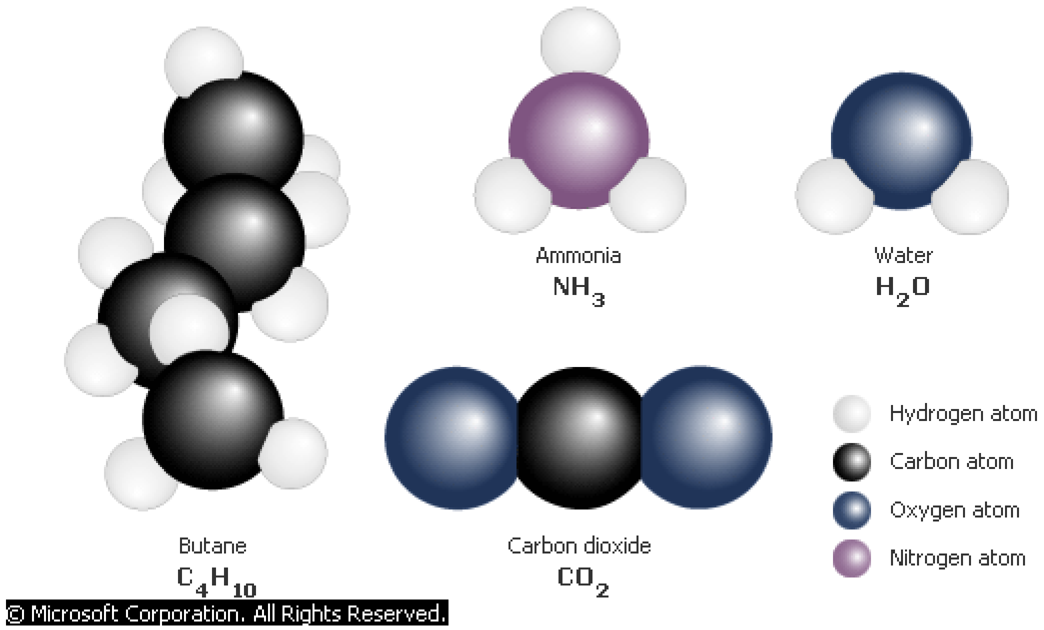
Hydrogen is regularly used to power space rockets. The Saturn V rocket, which took astronanuts to the Moon, was powered by liquid hydrogen and oxygen.

Varieties of Hydrogen Atoms

Hydrogen is the lightest element because it is composed of only two particles—the smallest number that can form a neutral atom. Its nucleus consists of a single proton bearing a positive electrical charge. Associated with this nucleus is an electron bearing a negative electrical charge.

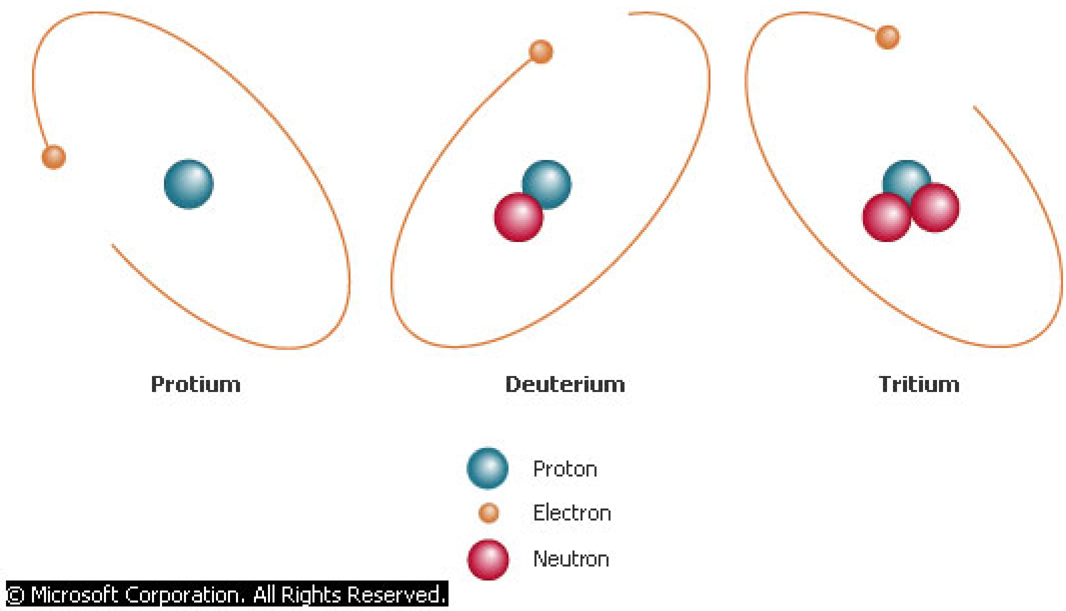
This simple atom of two particles is the most common type, or isotope, of hydrogen. Chemists call it protium. Two other isotopes have been found. Double-weight hydrogen, with a mass number of 2, has one neutron as well as a proton in its nucleus. It is called deuterium. “Heavy water,” which is denser than ordinary water, can be prepared by burning deuterium. Triple-weight hydrogen, or tritium, has two neutrons and one proton in its nucleus. It is radioactive and is produced naturally in the Earth's upper atmosphere. It can be prepared artificially by bombarding lithium with neutrons in an atomic reactor. Both deuterium and tritium are used in the manufacture of hydrogen bombs.

In 1929 it was demonstrated that, apart from isotopes, hydrogen gas under ordinary conditions is a mixture of two kinds of molecules, known as ortho- and para-hydrogen. These forms of hydrogen differ from one another by the spins of their electrons and nuclei, and thus their physical properties differ as well. (For more information on particle spin, see Nuclear Physics.) Normal hydrogen at room temperature contains 25 percent of the para form and 75 percent of the ortho form.



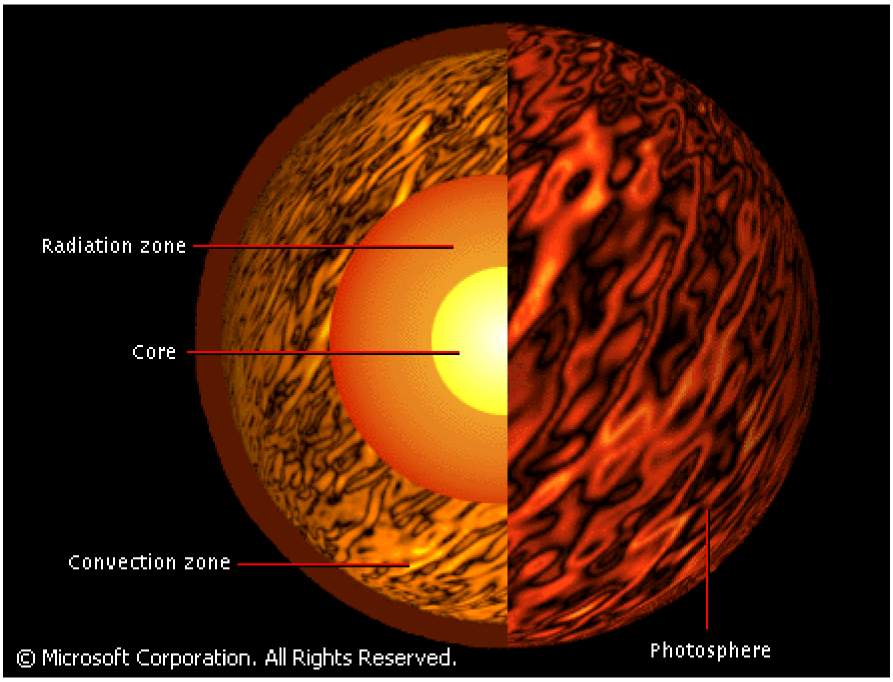
Common Molecules

Many common molecules contain hydrogen. In these molecules, butane contains ten hydrogen atoms, ammonia contains three hydrogen atoms, and water contains two hydrogen atoms.



Hydrogen Isotopes

Atoms of an element that have different numbers of neutrons in their nuclei are called isotopes of that element. Isotopes all usually share the same chemical behavior, but have different masses. The isotopes of hydrogen are protium (with no neutrons), deuterium (with one neutron), and tritium (with two neutrons). Hydrogen always has one proton in its nucleus. These illustrations are schematic representations of the atom and are not to scale.



Interior of the Sun

Regions of the Sun include the core, radiation zone, convection zone, and photosphere.The Sun's energy is produced in the core through nuclear fusion of hydrogen atoms into helium. Gases in the core are about 150 times as dense as water and reach temperatures as high as 16 million degrees C (29 million degrees F).

Exercises:

1. Answer the following questions:

Is hydrogen the most abundant element on Earth?
Why did helium replace hydrogen to fill airships?
What purpose is liquid hydrogen used in scientific applications for?
What is nuclear fusion?
What makes the stars shine?
Describe the ways of preparing of hydrogen.

How is hydrogen produced in for general laboratory work?
Who discovered hydrogen?
Why did Lavoiser suggest the name hydrogen?
Why would the progress of chemistry been retarted for a long time, had hydrogen not been discovered in 1766?

2. Practice in pronunciation:

proton, electron, isotope, deuterium, tritium, neutron, helium, hydrogen, synthesize, ammonia, ethanol, aniline, methanol, fuel, hydride, petroleum, acid.

3. Remember the derivatives of the words:

purify, purity, pure, purification, impure, impurity
nuclear, nucleus, nuclei
flame, inflammable, flammable, flammability

4. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Liquid hydrogen (boiling point −423 °F [−252.8 °C]) is used in scientific and commercial applications to produce extremely high temperatures.
On Earth, hydrogen occurs chiefly in a free state in nature.
Hydrogen supports readily combustion.
The most important industrial methods for making hydrogen are extracting from water gas by electrolysis.
The hydrogen atom enabled the British physicist Ernest Rutherford to work out a theory of the arrangement of electrons around the atomic nucleus.
Both deuterium and tritium are used in the manufacture of hydrogen bombs.

5. Fill in the blanks with necessary prepositions:

The hydrogen atom enabled the Danish physicist Niels Bohr to work ….. a theory ….. the arrangement ….. electrons ….. the atomic nucleus.
Hydrogen is liquefied ….. compression when cooled ….. its critical temperature -234C.
Hydrogen makes ….. the bulk ….. the Sun and provides fuel ….. the nuclear reactions that make the Sun shine.
….. Earth, hydrogen occurs chiefly ….. combination ….. oxygen ….. water.
Scientists have taken ….. the problem …… organizing radio communications ….. other inhabited worlds ….. the hydrogen wave.

6. Insert English words instead of Russian words in the sentences:

The lightest and most распространенный element in the universe, чистый hydrogen is a gas without вкуса, цвета или запаха.
Hydrogen was открыт by the famous English physicist Henry Cavendish in the sixteenth century by the action of серной кислоты on iron.
It became an необходимым laboratory reagent for выпадения metals from растворов of salts, and for восстановления metallic oxides.
Our Sun and all the stars are luminous because of the thermonuclear reactions происходящих in them, involving the transformation of hydrogen into helium with the выбросом of enormous количества of energy.

7. Insert the verbs in brackets in the right form and translate the sentences:

But under certain conditions hydrogen (to combine) with many elements.
Hydrogen (to provide) fuel for the nuclear reactions that (to make) the Sun shine.
Hydrogen (to discover) by the famous English physicist Henry Cavendish in the sixteenth century.
Under the right conditions hydrogen (to combine) with nitrogen (to form) ammonia,
Scientists (to take up) the problem of (to organize) radio communications with other inhabited worlds on the hydrogen wave.

8. Complete the sentences:

Its nucleus consists of a single proton bearing ………...
It can be prepared artificially by bombarding lithium with ……….
"Heavy water," which is denser than ordinary water, can be prepared by
There is more hydrogen in outer space than all the other ……….
It helped chemists to get an insight ……….
The most important industrial methods for making hydrogen are ……….
Nuclear fusion gives off enough energy ………..

CALCIUM

Calcium, symbol Ca, reactive, silvery-white metallic element. In group 2 (or IIa) of the periodic table (*see* Periodic Law), calcium is one of the alkaline earth metals. The atomic number of calcium is 20.

The British chemist Sir Humphry Davy isolated calcium in 1808 by means of electrolysis.

Calcium

Calcium, seen here in unrefined form, is one of the most common elements found on Earth. Many familiar materials, including concrete, cement, marble, and chalk, contain calcium.

PROPERTIES AND OCCURRENCE

Calcium has six stable and several radioactive isotopes. A malleable and ductile metal, calcium rapidly tarnishes to yellow on exposure to air. Calcium melts at 842°C (1548°F), boils at 1484°C (2703°F), and has a specific gravity of 1.55; its atomic weight is 40.08.

Calcium is fifth in abundance among the elements in Earth's crust, but it is not found uncombined in nature. It occurs in many highly useful compounds, such as calcium carbonate ($CaCO_3$), of which calcite, marble, limestone, and chalk are composed; calcium sulfate ($CaSO_4$) in alabaster or gypsum; calcium fluoride (CaF_2) in fluorite; calcium phosphate ($Ca_3(PO_4)_2$) in rock phosphate; and in many silicates. In cold, dry air, calcium is not readily attacked by oxygen, but when heated it unites vigorously with the halogens, oxygen, sulfur, phosphorus, hydrogen, and nitrogen. Calcium reacts violently with water, forming the hydroxide $Ca(OH)_2$ and releasing hydrogen.

CALCUIM COUNTS

Calcium is one of the earth's most abundant elements, found in compounds as diverse as marble, gypsum, and chalk. Although its durability makes it an important component of industrial products such as cement, calcium is probably best known for its contributions to the health of our own teeth and bones. As this article from the *FDA Consumer* suggests, women, in particular, must be especially diligent in finding new ways to add calcium to their diets.

Your skeletal calcium bank has to last through old age. Frequent deposits to this retirement account should begin in youth and be maintained throughout life to help minimize withdrawals. Most women get much less calcium than they need—as little as half.

Nutritionists recommend meeting your calcium needs with foods naturally rich in calcium. Adequate calcium intake in childhood and young adulthood is critical to achieving peak adult bone mass, yet many adolescent girls replace milk with nutrient-poor beverages like soda pop. “Bone health requires a lot of nutrients and you're likely to get most of them in dairy products,” says Connie Weaver, Ph.D., who heads the department of food and nutrition at Purdue University, Indiana. “They're a huge package rather than just a single nutrient.” With so many low-fat and nonfat dairy products available, it's easy to make dairy foods part of a healthy diet. People who have trouble digesting milk can look for products treated to reduce lactose. A serving of milk or yogurt contains about 350 milligrams (mg) of calcium. Fortified products have even more.

“People who don't consume dairy foods can meet their calcium needs with foods that are fortified with calcium, such as orange juice, or with calcium supplements,” says Mona S. Calvo, Ph.D., in FDA's Office of Special Nutritionals. Other good sources of calcium are broccoli and dark-green leafy vegetables like kale, tofu (if made with calcium), canned fish (eaten with bones), and fortified bread and cereal products.

Nutrition labels can help you identify calcium-rich foods. But keep in mind that the label value is a guideline based on a FDA's Daily Value for calcium, which is 1,000 mg, and your calcium needs may be greater, Calvo says.

What about too much calcium? As much as 2,000 mg per day seems to be safe for most people, but those at risk for kidney stones should discuss calcium with their doctors. Calcium is critical, but even a high intake won't fully protect you against bone loss caused by estrogen deficiency, physical inactivity, alcohol abuse, smoking, or medical disorders and treatments.

The metal is obtained mainly by electrolysis of fused calcium chloride, a costly process. Until recently the pure metal had little use in industry. It is being used to an increasing extent, however, as a deoxidizer for copper, nickel, and stainless steel. Because calcium hardens lead when alloyed with it, lead-calcium alloys are excellent for bearings, superior to ordinary lead antimony for grids in storage batteries, and more durable as sheathing for lead-covered cable. Calcium is present in the chemically combined state in lime (calcium hydroxide), cement and mortar (as calcium hydroxide or a variety of silicates of calcium), teeth and bones (as a calcium hydroxyphosphate), and in many body fluids (as complex proteinaceous compounds) essential to muscle contraction, the transmission of nerve impulses, and the clotting of blood.

Exercises:

1. Answer the following questions:

Who isolated calcium?
Where does calcium occur?
How does calcium contribute to the health?
What products are rich in calcium?
What causes bone loss?

2. Insert English words instead of Russian words in the following sentences:

When heated it реагирует энергично with the halogens, oxygen, sulfur, phosphorus, hydrogen, and nitrogen.
Calcium is probably best known for its вклад to the health of our own teeth and костей.
Nutritionists recommend meeting your calcium needs with пищей naturally богатой in calcium.
People who don't потребляют молочные продукты can meet their calcium needs with foods that are fortified with calcium, such as orange juice, or with calcium supplements.
As much as 2,000 mg per day seems to be безопасно for most people,
Lead-calcium сплавы are excellent for подшипников.
Calcium присутствует in the chemically combined состоянии in lime, cement, teeth and bones, and in many body fluids необходимых to muscle сокращений, the transmission of nerve impulses, and the clotting of blood.

SODIUM

Chemical element, one of the alkali metals, chemical symbol Na, atomic number 11.

A very soft, silvery white metal, the sixth most abundant element on Earth, it occurs mainly as halite, never free. Extremely reactive, it is used as a chemical reagent and raw material, in metallurgy, as a heat exchanger (in nuclear power generators and certain types of engines), and in sodium-vapour lamps.

Sodium is essential for life but rarely deficient in diets; high intake is linked to hypertension. Sodium in compounds, many of great industrial importance (including bicarbonate of soda, caustic soda, sodium nitrate [Chile saltpetre], and sodium chloride), has valence 1. Sodium carbonate, one of the four most important basic chemical commodities, is used in making glass, detergents, and cleansers. Sodium hypochlorite, familiar as household bleach, is also used to bleach paper pulp and textiles, to chlorinate water, and in some medicines. The sulfate is used in the kraft process and also used to make paperboard, glass, and detergents. The thiosulfate (hyposulfite, or "hypo") is used to developed photographs.

Life could not exist without compounds of sodium. These compounds hold water in body tissues, and a severe deficiency of sodium can cause death. Blood contains sodium compounds in solution. Sodium compounds are used in industry in the manufacture of chemicals and pharmaceuticals, in metallurgy, in sodium vapor lamps, and in the production of hundreds of everyday products. One of the most common sodium compounds is table salt, or sodium chloride (NaCl). In its pure form sodium is a silver-white, soft and waxy metallic element. It is the sixth most abundant element on Earth and occurs in more than trace amounts in the stars and sun.

Potassium compounds are similar to the parallel sodium compounds. One can generally be substituted for the other in industry. For example, sodium silicates, potassium silicates, or both can be used in glassmaking .

Sodium and potassium are equally abundant in the Earth's crust, but sodium compounds are more widely used in industry because they are less expensive. The secret that led to low-cost production was learned in 1789, when the French chemist Nicolas Leblanc discovered how to make soda out of common salt. Chemists never matched this discovery in working with potassium compounds.

Salt Crystals

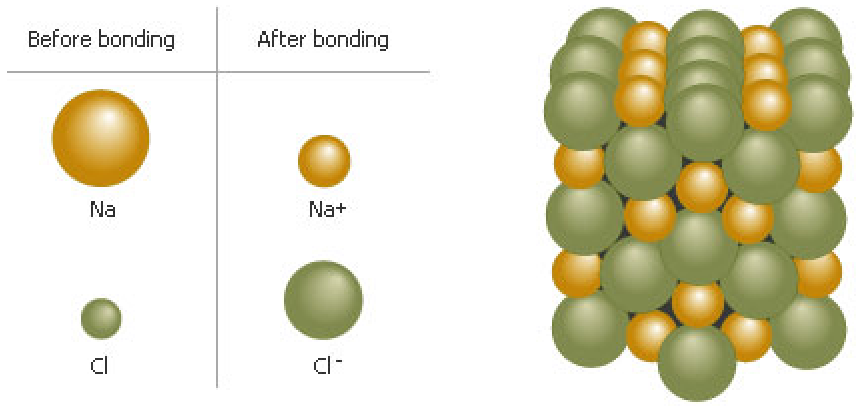
This scanning electron micrograph shows pure salt, or sodium chloride, that has been recrystallized from distilled water. The crystal is built up from a cubic lattice of sodium and chloride ions.

The compound called soda is sodium carbonate (Na2CO3). Crude sodium carbonate is called soda ash. The carbonate also combines with water in crystals known as washing soda, or sal soda. Soda is used in manufacturing soap, glass, dyestuffs, and explosives and as the basis for making other sodium compounds. Other sodium compounds, with some of their uses, are: baking soda (sodium bicarbonate), an ingredient of baking powder; borax (sodium borate), a food preservative; and caustic soda, or lye (sodium hydroxide), used in soapmaking (see Soap and Detergent).

Sodium nitrate (NaNO3) is used as a nitrogenous fertilizer and as a component of dynamite. It is commonly called Chile saltpeter, or Chile niter, because of the vast deposits that exist in northern Chile, the principal source of the compound.

Sodium belongs to the group of elements known as alkali metals (see Alkali Metals). It is never found uncombined in nature and was first isolated by the English scientist Sir Humphry Davy in 1807. Lighter than water, pure sodium can be cut with a knife at room temperature and is brittle at low temperatures. It conducts heat and electricity easily and exhibits a photoelectric effect; that is, it emits electrons when exposed to light. In its pure form, sodium oxidizes instantly when exposed to the air and reacts vigorously with water, seizing the oxygen and a part of the hydrogen to form sodium hydroxide. The remaining hydrogen is liberated and may ignite from the heat of the reaction. Pure metallic sodium—usually obtained by the electrolysis of sodium hydroxide—must be stored in kerosene to keep it from air and moisture. One of the few uses of pure sodium is in vapor lamps along highways (see Electronics).

The Leblanc process produces soda by first heating salt (sodium chloride) with sulfuric acid. The sodium in the salt and the hydrogen in the acid change places,



producing hydrogen chloride, or hydrochloric acid, and sodium sulfate, or “salt cake.” Additional steps yield a mixture of sodium carbonate and calcium sulfide. The two are separated by washing out the sodium carbonate with water.

Ionic Bonding: Salt

The bond (*left*) between the atoms in ordinary table salt (sodium chloride) is a typical ionic bond. In forming the bond, sodium becomes a cation (a positively charged ion) by "giving up" its valence electron to chlorine, which then becomes an anion (a negatively charged ion). This electron exchange is reflected in the size difference between the atoms before and after bonding. Attracted by electrostatic forces (*right*), the ions arrange themselves in a crystalline structure in which each is strongly attracted to a set of oppositely charged "nearest neighbors" and, to a lesser extent, all the other oppositely charged ions throughout the entire crystal.

Another manufacturing process, the Solvay process, was named after its developer, a Belgian manufacturer. Put on a commercial basis in about 1863, it has largely superseded the Leblanc process. In the Solvay method strong ammonia-saturated salt brine is treated with carbon dioxide gas that is bubbled through the brine from below. This causes reactions that produce ammonium chloride, or sal ammoniac, and sodium bicarbonate (NaHCO3), or baking soda. The sodium bicarbonate forms a crystalline precipitate, which is filtered out. This is then heated, driving off hydrogen, carbon, and oxygen and leaving sodium carbonate (soda).

In an even newer process—the electrolytic process— an electric current is passed through a solution of sodium chloride, splitting the salt molecules into atoms of sodium and chlorine (see Electrochemistry). The sodium atom displaces one of the hydrogen atoms of the water, forming caustic soda (NaOH).

Exercises:

1. Answer the following questions:

Where is sodium used?
What can a severe deficiency of sodium cause?
What are potassium compounds similar to?
Why are sodium compounds more widely used in industry?
What chemist discovered how to make soda out of common salt?

2. Translate explanations for the following adjectives:

soft 1. easily shaped, bent, or cut,
2. giving way to applied externally applied pressure or weight
(a soft cushion)

abundant 1. plentiful: present in great quantities
2. well-supplied: providing a more than plentiful supply of something

abundant in natural resources

essential 1. necessary: of the highest importance for achieving something
It's essential that we arrive on time.
an essential ingredient

2. basic: being the most basic element or feature of something
reinforcing the essential organizational framework

deficient 1. lacking: lacking a particular quality, element, or ingredient, especially one that is expected or necessary
deficient in tact
2. inadequate: inadequate or not good enough

important having value or significance: worthy of note or consideration, especially for its interest, value, or relevance
an important scientific discovery
an important author

basic most important: most important or essential
a few basic guidelines

severe stern: looking stern or serious

common 1. everyday: often occurring or frequently seen
a common sight in cities
2. widely found: describes a widely found species of plant or animal

pure 1. not mixed: not mixed with any other substance
This jacket is pure wool.
2. free from contamination: clean and free from impurities
The water from the spring is completely pure

similar 1. like: sharing some qualities, but not identical
2. identical: exactly the same

equal identical: identical in size, quantity, value, or standard
equal quantities of flour and sugar

expensive costing a lot: costing a large amount of money

3. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Attracted by electrostatic forces (right), the ions arrange themselves in a crystalline structure.
Another manufacturing process, the Solvay process, was named after its developer, an American manufacturer.
Sodium belongs to the group of elements known as alkali metals.
Sodium was first isolated by the English scientist Joseph Priestley in 1807.
Heavier than water, pure sodium can be cut with a knife at room temperature and is brittle at low temperatures.
Pure metallic sodium must be stored in benzene to keep it from air and moisture.

4. Fill in the blanks with necessary prepositions:

The bond ….. the atoms ….. ordinary table salt (sodium chloride) is a typical ionic bond.
This electron exchange is reflected ….. the size difference ….. the atoms ….. and ….. bonding.
An electric current is passed ….. a solution ….. sodium chloride, splitting the salt molecules ….. atoms ….. sodium and chlorine
The Leblanc process produces soda ….. first heating salt (sodium chloride) ,,,,, sulfuric acid.

5. Insert English words instead of Russian one:

легче than water, чистый sodium can be cut with a knife at room temperature and is хрупкий at low temperatures.
The remaining hydrogen is выделяется and may воспламениться from the heat of the reaction.
It проводит тепло and electricity легко and проявляет a photoelectric effect; that is, it испускает electrons when выставлении to light.

POTASSIUM

Chemical element, one of the alkali metals, chemical symbol K, atomic number 19.

It is a soft, silvery white metal, not found free in nature and rarely used as the metal (except as a chemical reagent) because of its extreme reactivity. Potassium is essential for life and is present in all soils. Potassium ions (K+) and sodium ions act at cell membranes in electrochemical impulse transmission and in transport. Potassium in compounds has valence 1. The chloride is used as a fertilizer and a raw material for producing other compounds, and the hydroxide for making liquid soaps and detergents and in preparing various salts. The iodide is added to table salt to protect against iodine deficiency. The nitrate is also called saltpetre, and the carbonate is called potash.

The chemical element potassium is essential to life. In higher animals potassium ions together with sodium ions act at cell membranes in transmitting electrochemical impulses in nerve and muscle fibers and in balancing the activity of food intake and waste removal from cells.

Discovered in 1807 by the English chemist Humphry Davy, who obtained it from molten potassium hydroxide (KOH), potassium, a soft, silver-white metal, was the first metal to be isolated by electrolysis. It belongs to the family of elements known as the alkali metals (see Alkali Metals). It oxidizes rapidly in air and also reacts violently with water, yielding potassium hydroxide and hydrogen gas (which ignites). Because of this, potassium is stored submerged in mineral oil (see Metal and Metallurgy). It is never found alone and is difficult to isolate from its compounds. Most potassium is present in insoluble minerals, making it difficult to obtain, but it can be prepared commercially by electrolysis from some refinable minerals.

The major commercial source is salt deposits, but a small fraction is obtained from plant and animal sources. Water-soluble potassium compounds are economically recovered. They are frequently found as dry mineral deposits and as brines. Most potassium is present in insoluble minerals, making it difficult to obtain, but it can be prepared commercially by electrolysis from some refinable minerals.

Photo Researchers, Inc./Astrid and Hanns-Frieder Michler

Potassium

Potassium is a very soft, highly reactive metallic element. It can be cut with a knife and reacts violently with water, producing potassium hydroxide and hydrogen gas.

Potassium compounds have many commercial uses. Potassium chloride (KCl) is used in preparing other potassium compounds and in fertilizers. Electrolysis of potassium chloride yields potassium hydroxide, also called caustic potash, a water-absorbing substance used in making soaps and detergents. Caustic potash is also used for preparing many potassium salts, such as potassium carbonate (K2CO3), a water-absorbing substance used in making glass and textile dyes and for cleaning and electroplating metals.

Potassium nitrate (KNO_3), also known as niter or saltpeter, has wide use as a fertilizer and in fireworks and explosives. It also serves as a food preservative. Potassium chlorate ($KClO_3$), as a source of oxygen, is used in fireworks, matches, and explosives. The iodide of potassium (KI) is added to table salt and animal feed to protect against iodine deficiency. It is also used to treat goiter and certain fungal infections. Applications for potassium sulfate (K_2SO_4) include use as a laxative and in the production of fertilizer, rubber, and potassium carbonate. Potassium cyanide (KCN) is a poison used in some insecticides and is a source for the fumigant hydrogen cyanide. It is also used to extract gold and silver from their ores. (See also Fertilizer; Sodium.)

Exercises:

1. Answer the following questions:

What is potassium essential for?
What chemist discovered potassium?
How did Humphry Davy obtain it?
Why is potassium stored on mineral oil?
How does it react with water?
Where does potassium occur?

2. Practice in pronunciation:

alkali, essential, sodium, potassium, ion, fertilizer, various, saltpeter, isolate, frequently, insoluble, electrolysis, submerge, violently.

3. Remember the derivatives of the words:

protect, protectant, protection, protector, protective, protectorate
include, inclusion, inclusive
violate, violation, violator, violence, violent

4. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

It is a soft, silvery white metal, not found free in nature and rarely used as the metal because of its extreme inertness.
Potassium ions (K^+) and sodium ions act at cell membranes in mechanical impulse transmission and in transport.

The chloride is used as a fertilizer and a raw material for producing other compounds.
Most potassium is present in insoluble minerals, making it difficult to obtain, but it can be prepared commercially by distillation from some refinable minerals.
Potassium nitrate (KNO3), also known as niter or saltpeter, has wide use as a fertilizer and in fireworks and explosives.

5. Underline Passive Voice constructions in the sentences and translate them into Russian:

The chloride is used as a fertilizer and a raw material for producing other compounds.
It can be cut with a knife and reacts violently with water, producing potassium hydroxide and hydrogen gas.
The iodide is added to table salt to protect against iodine deficiency.
The nitrate is also called saltpetre, and the carbonate is called potash.
The major commercial source is salt deposits, but a small fraction is obtained from plant and animal sources.
Potassiun is a soft, silvery white metal, not found free in nature and rarely used as the metal.
Potassium can be prepared commercially by electrolysis from some refinable minerals.
The major commercial source is salt deposits, but a small fraction is obtained from plant and animal sources.
Water-soluble potassium compounds are economically recovered.

6. Fill in the blanks with necessary prepositions:

It can be cut ….. a knife and reacts violently ….. water, producing potassium hydroxide and hydrogen gas.
Potassium chloride (KCl) is used ….. preparing other potassium compounds and ….. fertilizers.
Caustic potash is also used ….. preparing many potassium salts.
Most potassium is present ….. insoluble minerals, making it difficult to obtain, but it can be prepared commercially ….. electrolysis ….. some refinable minerals.

7. Put the verbs in brackets in the correct Tense:

Potassium compounds …… many commercial uses. (to have)
It ….. a soft, silvery white metal, not found free in nature. (to be)
The chemical element potassium ….. essential to life. (to be)
The English chemist Humphry Davy ….. it from molten potassium hydroxide. (to obtain)
It ….. to the family of elements known as the alkali metals. (to belong)
It ….. rapidly in air and also ….. violently with water. (to oxisize, to react)

8. Insert English words instead Russia one in he following sentences:

Most potassium присутствует in нерастворяемых minerals,
It окисляется rapidly in air and also reacts бурно with water.
Potassium is необходим for life and is present in all soils
Because of this, potassium is хранят погруженным in mineral oil.

MAGNESIUM

Chemical element, one of the alkaline earth metals, chemical symbol Mg, atomic number 12.

The silvery white metal does not occur free in nature, but compounds such as the sulfate (Epsom salts), oxide (magnesia), and carbonate (magnesite) have long been known. The metal, which burns in air with a bright white light, is used in photographic flash devices, bombs, flares, and pyrotechnics; I is also a component of lightweight alloys for aircraft, spacecraft, cars, machinery, and tools. The compounds, in which it has valence 2, are used as insulators and refractories and in fertilizers, cement, rubber, plastics, foods, and pharmaceuticals (antacids, purgatives, laxatives). Magnesium is an essential element in human nutrition; it is the cofactor in enzymes of carbohydrate metabolism and in chlorophyll.

Magnesium

Magnesium is a light-weight, silvery, metallic element. If ignited in air, it burns with a white light too brilliant to look at.

The lightest common metal is magnesium. It weighs one-third less than an equal volume of aluminum and is the eighth most abundant element in the Earth's crust. As a result, it has found extensive use in the aerospace industry. An airplane component that would weigh 70 pounds (32 kilograms) if made of steel weighs only 15 pounds (7 kilograms) if made of magnesium. Because the pure metal is not very strong, however, alloys have been developed to improve its hardness, tensile strength, corrosion resistance, and ability to be cast, welded, and machined. These alloys are used in making parts for aircraft and spacecraft, rocket components, automotive equipment, light machinery, portable tools, and household appliances.

Magnesium powder, filings, filaments, and foil burn fiercely and with a dazzling white flame. Because of these properties, magnesium is used in flares, fireworks, and photographic flashbulbs. Sir Humphry Davy, a British chemist, isolated magnesium in 1808. He produced the metal by electrolyzing a mixture of moist magnesia and mercuric oxide, then evaporatingthe magnesium from the mixture.

Magnesium does not occur uncombined, but there are many compounds of magnesium in nature. Many soils and rocks contain magnesium compounds. Two of the most common minerals containing magnesium are magnesite (magnesium carbonate) and dolomite (calcium magnesium carbonate). In the digestive process of animals the enzymes that change foodstuffs to nutrients are aided by magnesium ions. A magnesium atom is part of every chlorophyll molecule. Seawater contains the chloride and the sulfate of magnesium; it is the chloride that imparts the bitter taste characteristic of seawater. Most metallic magnesium is now obtained by an electrolytic process from seawater or brine from deep wells.

Some useful magnesium compounds include magnesium oxide, an ingredient of plastics, synthetic rubber, fertilizers, cements, and refractory bricks for lining high-temperature furnaces. Another is magnesium carbonate, which is a component of insulating materials, some inks, and many cosmetics.

Magnesium chloride is used in making oxychloride cement, the binder in heavy-duty flooring compositions. It is also an ingredient in some fertilizers. Magnesium hydroxide (milk of magnesia) and magnesium sulfate (Epsom salts) are well known for their medical applications; magnesium sulfate is also used in the tanning, textile, and fertilizer industries. A complex compound of magnesium is included in many silicones. (See also Silicones.)

Exercises:

1. Answer the following questions:

Where is magnesium used?
Is magnesium an essential element?
How does it burn in air?
In what way did Sir Humphry Davy produce magnesium?

2. Choose suitable nouns for the following adjectives:

bright	***use***
essential	***flame***
pure	***light***
equal	***element***

abundant	***volume***
dazzling	***taste***
bitter	***application***
complex	***tools***
digestive	***compound***
insulating	***process***
extensive	***material***
medical	***metal***
portable	***mineral***

3. State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

The silvery white metal occurs free in nature.
The metal burns in air with a bright white light.
Sir Humphry Davy, an American chemist, isolated magnesium in 1808.
Most metallic magnesium is now obtained by an electrolytic process from seawater.
Alloys have been developed to improve its hardness, tensile strength, corrosion resistance, and ability to be cast, welded, and machined.

4. Fill in the blanks with necessary prepositions:

The metal, which burns ….. air ….. a bright white light.
Magnesiuim is the eighth most abundant element ….. the Earth's crust.
These alloys are used ….. making parts ….. aircraft and spacecraft, rocket components.
A magnesium atom is part ….. every chlorophyll molecule.
A complex compound ….. magnesium is included ….. many silicones.
Most metallic magnesium is now obtained ….. an electrolytic process ….. seawater.

5. Insert English equivalents instead of Russian ones:

Many soils and rocks <u>содержат</u> magnesium <u>соединения.</u>
Magnesium <u>порошок,</u> filings, filaments, and foil <u>горят</u> fiercely and with a <u>ослепительное</u> white <u>пламя.</u>
Because the <u>чистый</u> metal is not very strong, however, <u>сплавы</u> have been developed to <u>улучшать</u> its hardness, tensile strength, corrosion resistance.

METALS

Since the earliest days the preparation of metals for mechanical use was vital to the advance of civilization. Gold, silver and copper were the first to be used by a primitive man, as they were found free in nature. Today we know over 65 metals available in large enough quantities to be used in industry.

On the whole, metals resemble one another. They are mostly solids at ordinary temperatures and possess comparatively high melting points with the exception of mercury. They are for the most part good conductors of heat and electricity, and silver is the best in this respect. They can be drawn into fine wires and hammered into thin sheets.

Metals, group of chemical elements that exhibit all or most of the following physical qualities: they are solid at ordinary temperatures; opaque, except in extremely thin films; good electrical and thermal conductors; lustrous when polished; and have a crystalline structure when in the solid state. Metals and nonmetals are separated in the periodic table by a diagonal line of elements. Elements to the left of this diagonal are metals, and elements to the right are nonmetals. Elements that make up this diagonal—boron, silicon, germanium, arsenic, antimony, tellurium, polonium, and astatine—have both metallic and nonmetallic properties.

The common metallic elements include the following: aluminum, barium, beryllium, bismuth, cadmium, calcium, cerium, chromium, cobalt, copper, gold, iridium, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, osmium, palladium, platinum, potassium, radium, rhodium, silver, sodium, tantalum, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, and zinc. Metallic elements can combine with one another and with certain other elements, either as compounds, as solutions, or as intimate mixtures. A substance composed of two or more metals, or a substance composed of a metal and certain nonmetals such as carbon are called alloys. Alloys of mercury with other metallic elements are known as *amalgams.*

As to their chemical properties the first point to be mentioned is that they vary widely in degree of chemical activity. Some are enormously active and others are inert. When two elements react, the outermost electron shells of their atoms are rearranged. The atoms of one of the elements give away electrons, and those of the other accept them. Now, generally speaking, which atoms part with their electrons more easily and which accept them more readily? Atoms which have few electrons on their outermost shell find it more convenient to give them away, and those which have many of them find it more profitable to complete their electron octets by acquiring them. The alkali metals have only a single electron on their outsides. These metals think nothing of parting with it. Once they have done so they find the stable electron shell of the nearest inert gas on their outside. That is why the alkali metals are chemically the most active of all known metals. And the "very most active" among them is francium.

Metallurgists divide all metals into ferrous and non-ferrous. The ferrous metals include iron and its alloys. All the rest are non-ferrous metals, except for the noble ones, their "Majesties" Silver, Gold and Platinum and Co. This is a very crude division and even the metals themselves object strongly to such lack of discrimination. Each metal actually has its own particular hue. Its dark, dull, or silvery base always has a definite tint. Scientists have become convinced of this by studying metals in the very pure state. Many of them when left in the air become coated sooner or later with a very thin film of oxide which masks their true colours. The observant eye can discern metals with bluish, greenish-blue and greenish shades, with a reddish or yellowish play of colours, dark-grey like sea water on a cloudy autumn day, and shiny, silvery ones which reflect solar rays like a mirror. Most metals are grayish in color, but bismuth is pinkish, copper is red, and gold is yellow. Some metals display more than one color, a phenomenon called *pleochroism.* The colour of a metal depends on many factors. Among others, it depends upon the method of its production.

Melting Gallium

Gallium metal has a melting point of 30° C (86° F), which is lower than our body temperature. In this photo, a sample of gallium melts in a person's hand. Gallium, mercury, cesium, and rubidium are the only metal elements that melt near room temperature.

Within the general limits of the definition of a metal, the properties of metals vary widely. The melting points of metals range from about -39° C (about -38° F) for mercury to 3410° C (6170° F) for tungsten. Osmium and iridium (specific gravity 22.6) are the most dense metals, and lithium (specific gravity 0.53) is the least dense. The majority of metals crystallize in the cubic system, but some crystallize in the hexagonal and tetragonal systems. Bismuth has the lowest electrical conductivity of the metallic elements, and silver the highest at ordinary temperatures. The conductivity of most metals can be lowered by alloying. All metals expand when heated and contract when cooled, but certain alloys, such as platinum and iridium alloys, have extremely low coefficients of expansion.

Physical Properties

Metals are generally very strong and resistant to different types of stresses. Though there is considerable variation from one metal to the next, in general metals are marked by such properties as hardness, the resistance to surface deformation or abrasion; tensile strength, the resistance to breakage; elasticity, the ability to return to the original shape after deformation; malleability, the ability to be shaped by hammering; fatigue resistance, the ability to resist repeated stresses; and ductility, the ability to undergo deformation without breaking.

Chemical Properties

Metals typically have *positive valences* in most of their compounds, which means they tend to donate electrons to the atoms to which they bond. Also, metals tend to form basic oxides. Typical nonmetallic elements, such as nitrogen, sulfur, and chlorine, have *negative valences* in most of their compounds—meaning they tend to accept electrons—and form acidic oxides

Metals typically have low ionization potentials. This means that metals react easily by loss of electrons to form positive ions, or cations. Thus, metals can form salts (chlorides, sulfides, and carbonates, for example) by serving as reducing agents (electron donors).

Answer the following questions:

What physical qualities do metals exhibit?
What are metals and nonmetals separated in the periodic table by?
What elements have both metallic and nonmetallic properties?
What metals do the common metallic elements include?
What are called alloys?
How do metals behave when heated and when cooled?
What properties are metals generally marked by?
What elements have negative valences?
What valences do metals have?

IRON

How is a paper clip like a skyscraper? How is blood like a car? The answer to both questions is the same. All of these things contain iron. Iron is one of the most useful metals. Its strength makes it ideal for building things that will last. Yet it can also be easily worked and shaped. People have been using iron for a long time. Iron beads 6,000 years old have been found in Africa.

Of all metals to be utilized in industry iron remains by far the most important. Modern industry needs considerable quantities of this metal either in the form of iron or steel. Each year about 12 per cent of the metal produced is lost to mankind, falls victim to a merciless enemy, corrosion. Chemists have studied all kinds of corrosion mechanism in sufficient detail. Special organic and inorganic substances called inhibitors are used to weaken or decrease corrosion. Hundreds of chemical corrosion inhibitors of all kinds are known today.

WHERE IS IRON FOUND?

Our planet contains a huge amount of iron. Scientists believe that Earth's core is about nine-tenths iron. This giant ball of iron generates Earth's magnetic field and makes compasses work.

We can't get at the iron at the center of the planet. But there is plenty of iron in Earth's outer layer, or crust. Iron is the second-most common metal in the crust after aluminum.

Iron is rarely found in a pure state. The purest natural iron comes from meteorites that have fallen from space. Meteorite iron was the first form of iron that ancient peoples used. Iron is usually found combined with other elements in rocks. These rocks are called iron *ores*. They are found in many parts of the world.

Iron often occurs in a mineral called hematite. Hematite is made of iron combined with oxygen. Once the hematite has been mined and separated from other minerals the iron has to be separated from the oxygen.

Red-Hot Steel

Iron and steel have to be heated in furnaces to temperatures of thousands of degrees. This heat softens the metal and makes it easier to shape by rolling or pounding.

HOW IS IRON USED?

Iron must be purified from its ores by *smelting.* In this process, rocks that contain iron are crushed and melted in a very hot furnace. Molten iron is separated out. People first discovered how to do this around 1350 BC. Iron is much harder than bronze, which was the most commonly used metal until that time. Iron made stronger tools and weapons.


Photo Researchers, Inc./Eunice Harris

Blacksmith

In the past blacksmiths would forge, or shape, hot iron by hand. They used a hammer and chisel to cut the iron on a big chunk of metal called an anvil.

Iron's strength and abundance make it especially useful. But most of the iron we use today is in the form of steel. Today, steel is used to make automobiles and ships. It is used for tall buildings, bridges, and for making many kinds of tools.

STEEL IS MADE FROM IRON

Pure iron breaks easily. It also combines with oxygen in the air. This combination produces the flaky, reddish material we call rust. For this reason, most of the iron we use today is not pure.

Ironbridge, Telford, England

Ironbridge, in Telford, England, was the first large structure made of cast iron. The bridge was considered a remarkable feat of engineering at the time of its completion in 1779.


Robert Harding Picture Library

Iron can be made much stronger if it is heated together with a bit of carbon. Iron and carbon combine to make steel. Nearly all the iron mined today goes into making steel. Steel can be formed into many sizes and shapes, depending on how it is used.

Small amounts of other elements can be added to steel. For example, adding chromium and nickel makes stainless steel. Stainless steel stays shiny and resists rust. It is used for many things, including pots and pans, forks, knives, and spoons. It is also used to make surgical tools and to patch broken bones.

EATING IRON

Except for some bacteria, all living things require iron to live. That's why people are often told to add more iron to their diet. Of course, this does not mean gnawing on a chunk of metal! Certain foods contain tiny amounts of iron combined with other elements. Grains such as wheat, meat (especially liver), beans, and some green vegetables are rich in iron.

Your body uses iron to carry oxygen from your lungs to the rest of your body. The iron in *hemoglobin,* a substance found in blood, does that job. The iron combined with oxygen in hemoglobin also gives blood its red color.

State whether these sentences are true or false using the following clichés:

I must disappoint you ….
If I'm not mistaken ….
To my mind….
It seems to me….
I think that ….

Iron is one of the most useful metals.
Our planet contains a huge amount of iron.
Iron is the second-most common metal in the crust after copper.
Iron is rarely found in a pure state.
Hematite is made of iron combined with ozone.
Iron and carbon combine to make steel.
Stainless steel stays shiny and resists rust.
Grains such as wheat, meat (especially liver), beans, and some green vegetables are rich in proteins.
The iron combined with oxygen in hemoglobin also gives blood its blue color.
Iron can be made much stronger if it is heated together with a bit of magnesium.
Iron is much harder than cobalt.
Adding chromium and nickel makes stainless steel.
Iron often occurs in a mineral called hematite.

COPPER

Have you used anything copper today? If you bought something and received change, there was copper in the coins. Did you use any electrical devices? The electricity was carried to your home by copper wires. There are even tiny amounts of copper inside you. Your body needs it for digesting food and keeping your blood healthy.

Copper-Coated Pennies

Most coins used the United States contain copper. Pennies, *shown here,* are made of zinc with a thin coating of copper. They actually have less copper than other U.S. coins!

WHAT IS COPPER?

Copper is a reddish-yellow metal. When it's found in pure form in the ground it's called native copper. Usually, though, copper is found combined with other elements in rocks. These rocks are called copper ores.

When combined with other elements, copper is often greenish in color. The Statue of Liberty is made mostly of copper. Its greenish color comes from copper combined with the element oxygen from the air.

Copper was one of the first metals discovered by human beings. People were making tools and jewelry from native copper over 10,000 years ago.

HOW COPPER IS USED

Pure copper is a soft metal. Early humans found that it made poor tools and weapons. They discovered that copper is much stronger when mixed with other metals. People made bronze by combining the metals copper and tin. They made brass by combining copper with zinc. Today, bronze and brass often contain other metals. But copper is still their main ingredient.

Molten Copper

Glowing, melted copper pours into a mold in a factory. The copper is so hot that the worker standing nearby has to wear special clothes as a shield from the heat.

Copper has long been used for making coins. Copper coins were always less valuable than silver or gold coins, because silver and gold are rarer metals. Most coins used in the United States today contain some copper.

Copper sheets were once used to cover the bottoms of wooden sailing ships. They kept the wood from rotting or being eaten by sea animals.

Substances that contain copper are used to make blue-green inks and dyes. Other copper compounds are used as insect and weed poisons on farms or to purify water.

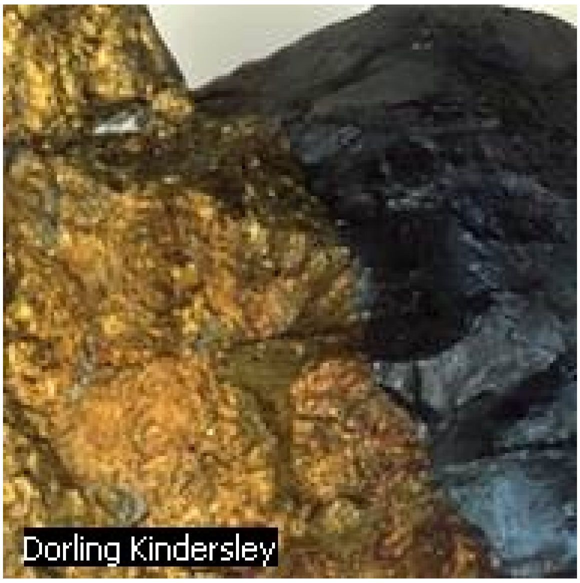
COPPER AND ELECTRICITY

Copper became more valuable in the late 1800s. That was when people discovered how to use electricity. Of all metals, copper is the second-best conductor of electricity. (Silver is better, but copper is much cheaper.)

Most copper mined today is used in the electrical industry. The wires in power lines are mostly copper. So is the wiring in electrical appliances and cords. Copper can be stretched into wires as thin as 0.001 inch (about 0.025 millimeters).

WHERE DOES COPPER COME FROM?

In ancient times, copper came mostly from the island of Cyprus in the Mediterranean Sea. (In fact, the name *Cyprus* means "copper.") The ancient Egyptians, Greeks, and Romans made tools and weapons from Cyprus's copper.



Copper Ore

This chunk of rock contains two common kinds of copper ore: chalcopyrite, *left,* and bornite, *right*. Copper ore is found throughout the world.

Native Americans used copper too. They mined copper in what is now Michigan. Copper ornaments from this region were traded all over America.

Today, much of the world's copper comes from Chile. Arizona, Utah, and New Mexico are leading copper-mining states.

Copper Mine in Chile

Chile exports huge amounts of copper to other countries. This open-pit copper mine is in the Atacama Desert of northern Chile.

Insert English equivalents instead of Russian ones:

When combined with other elements, медь is often greenish in цвету. Чистая copper is a мягкий metal.
Its greenish color comes from copper в соединении with the element кислородом from the воздуха.
People made bronze by соединяя the metals copper and олово.
Copper монеты were always less ценным than серебро or gold coins, because silver and gold are редкие metals.
Other copper соединения are used as insect and weed poisons on farms or to очищать water.
Of all metals, copper is the second-best проводник of electricity.

GOLD

Corbis/H.D. Thoreau

"Gold! Gold! Gold!" screamed the newspaper headlines. "Gold discovered in California!" That was in 1848. The news brought 100,000 people rushing to California. They came seeking the yellow metal that could make them rich.

Gold Coins

Gold has been used as money since ancient times. The metal is valuable because it is beautiful and easy to form into jewelry and other objects.

People since ancient times have used gold for jewelry and money. They used it in religious objects and works of art. Wars have been fought over gold. And sometimes, as in California, gold changed the course of history.

WHY IS GOLD VALUABLE?

Gold is unusual among metals. It does not rust or *tarnish* (grow dull and discolored). Gold coins recovered from sunken treasures are still as shiny as when they sank.

Gold is soft enough to be easily shaped into jewelry and other items. An ounce (31 grams) of gold can be hammered into a sheet 16 feet (5 meters) on each side. It can be stretched into a wire 62 miles (100 kilometers) long.

People find gold beautiful. And it is rare. All the gold in the world would fit in a cube 65 feet (20 meters) on each side. Because it is so rare, its value doesn't change much from one year to the next. In ancient times, people could easily carry a lot of wealth in the form of a small bag of gold.

MINING GOLD

The easiest way to mine gold is with a pan. You fill the pan with sand or gravel that contains tiny bits of gold. Then you swirl the pan under a gentle stream of water. The lighter gravel or sand gradually washes out with the water. The heavier gold particles collect at the bottom of the pan. Gold is so heavy that it doesn't take many tiny flakes to make an ounce.

Panning for Gold

Panning is a way to separate tiny bits of gold from sand or gravel. Swirling water washes the sand and gravel away, but the heavy gold particles settle to the bottom of the pan. Many people used this method during the gold rush in California.

Gold in Quartz Rock

Gold can be found in its pure state in layers of rock underground. The gold veins here are in quartz rock.

Today, gold is most often mined by digging underground with machines. Rock that contains gold is treated with chemicals to separate out the gold. Nuggets of solid gold are quite rare. The largest nugget ever found weighed about 130 pounds (59 kilograms). It was found in Australia in 1869. About two-thirds of all gold mined today comes from South Africa.


Corbis/Layne Kennedy


Corbis/Reuters

Gold Nugget

Most gold is found as tiny particles in layers of rock, but occasionally gold nuggets are found. The nugget shown here weighs about 51 pounds (23 kilograms). It was found in Australia in 1995.

HOW IS GOLD USED?

Gold is used for many things besides coins, decorations, and jewelry. Gold conducts electricity very well. It is used in tiny electrical circuits. There are very small amounts of gold in your computer.

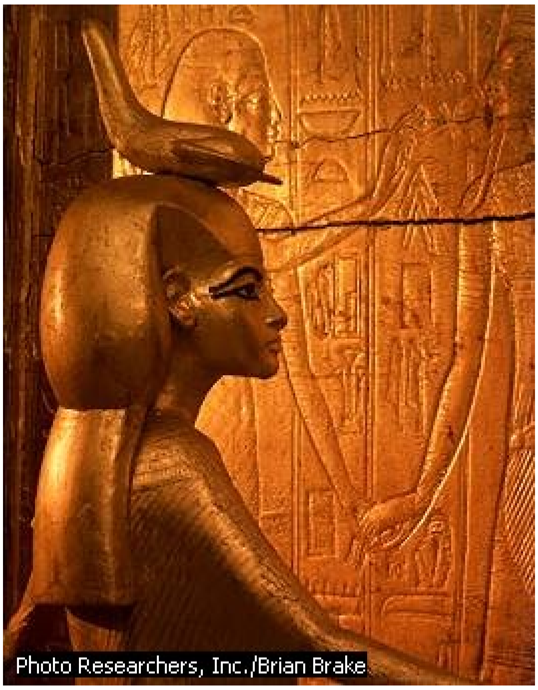


Photo Researchers, Inc./Brian Brake

Gold Leaf

Gold leaf covers this ancient Egyptian statue. Gold leaf is made by hammering solid gold metal until it is very thin.

Gold is also used to protect tall buildings and spaceships from the Sun's heat. The Sun's rays bounce off even a thin coating of gold. Gold-coated mirrors are used in telescopes. Dentists use gold for tooth fillings. Gold is even used in medicine, to treat cancer and arthritis.

GREEDY FOR GOLD

Gold has always made people who controlled it wealthy. Folktales of many peoples tell of greed for gold. The ancient tale of King Midas tells of a greedy king. Midas wished that everything he touched would turn to gold. But he was sorry when his wish was granted. He could not eat because his food and water also turned to gold.

Golden Treasure

The Incas of Peru were were famous for making gold objects such as this mask. The Spanish conquered the Incas during the 1500s and stole all of their gold.


D. Donne Bryant/Museo del Banco Central del Ecuador-Quito

Death Mask of Tutankhamun


Bridgeman Art Library, London/New York

The death mask of Egyptian pharaoh Tutankhamun is made of gold inlaid with colored glass and semiprecious stone. The mask comes from the innermost mummy case in the pharaoh's tomb, and stands 54 cm (21 in) high.

Ancient Egyptians buried their pharaohs (kings) with treasure and beautiful art. This golden death mask was found in the tomb of the pharaoh Tutankhamun, who ruled Egypt about 3,300 years ago.

In the 1500s, the Spanish conquered Mexico and Peru while searching for gold. They brought back tons of gold looted from native peoples. The peoples of those regions had never considered gold very valuable.


Photo Researchers, Inc./Tom McHugh

Gold Bullion

Many people buy and sell gold bricks, known as bullion, in the stock market. Gold is considered by many to be a safe investment during uncertain economic times.

The discovery of gold in parts of western America and Australia brought in thousands of people seeking quick fortunes. Many stayed on and settled those regions.

1. Answer the questions:

When was gold discovered in California?
What have people used gold for?
Why doesn't its value change much from one year to the next.
What is the easiest way to mine gold?
How is gold mined today?
Where and when was the largest gold nugget found?

2. Fill in the blanks with the proper adjectives:

They came seeking the ….. metal that could make them rich.
The metal is ….. because it is ….. and easy to form into jewelry and other objects.
Gold is ….. among metals.
It does not rust or tarnish (grow ….. and …..).
….. coins recovered from ….. treasures are still as ….. as when they sank.
Gold is ….. enough to be easily shaped into jewelry and other items.
Because it is so …… , its value doesn't change much from one year to the next.
Gold is so ….. that it doesn't take many ….. flakes to make an ounce.

Bronze

Bronze is a metal compound containing copper and other elements. The term bronze was originally applied to an alloy of copper containing tin, but the term is now used to describe a variety of copper-rich material, including aluminum bronze, manganese bronze, and silicon bronze.

Bronze Age Weapons

The Bronze Age in Europe occurred around 2200 to 700 BC. Bronze was used for weapons such as spearheads, swords, and knives. The two swords, bottom, were cast with long blades for slashing. The upper sword is from France. The Danish sword below it has been cleaned to show its original color.

Bronze was developed about 3500 BC by the ancient Sumerians in the Tigris-Euphrates Valley. Historians are unsure how this alloy was discovered, but believe that bronze may have first been made accidentally when rocks rich in ores of copper and tin were used to build campfire rings (enclosures for preventing fires from spreading). As fire heated these stones, the metals may have mixed, forming bronze. This theory is supported by the fact that bronze was not developed in North America, where natural tin and copper ores are rarely found in the same rocks.

Objects of the Bronze Age

An alloy of tin and copper, bronze is a shiny gold color when new, which made it popular for objects such as jewelry. This neck ring was a symbol of status in the Celtic-speaking world. It was made in the 6th century BC from a single strand of twisted bronze. The object on the left was a decorative pin made after 2000 BC. The object in the center was an ornament worn around the waist.

Around 3000 BC, bronze-making spread to Persia, where bronze objects such as ornaments, weapons, and chariot fittings have been found. Bronzes appeared in both Egypt and China around 2000 BC. The earliest bronze castings (objects made by pouring liquid metal into molds) were made in sand; later, clay and stone molds were used. Zinc, lead, and silver were added to bronze alloys by Greek and Roman metalworkers for use in tools, weapons, coins, and art objects. During the Renaissance, a series of cultural movements that occurred in Europe in the 14th, 15th, and 16th centuries, bronze was used to make guns, and artists such as Michelangelo and Benvenuto Cellini used bronze for sculpting *See also* Metalwork; Founding.

Today, bronze is used for making products ranging from household items such as doorknobs, drawer handles, and clocks to industrial products such as engine parts, bearings, and wire.

Tin bronzes, the original bronzes, are alloys of copper and tin. They may contain from 5 to 22 percent tin. When a tin bronze contains at least 10 percent tin, the alloy is hard and has a low melting point. Leaded tin bronzes, used for casting, contain 5 to 10 percent tin, 1.5 to 25 percent lead, and 0 to 4.5 percent zinc. Manganese bronze contains 39 percent zinc, 1 percent tin, and 0.5 to 4 percent manganese. Aluminum bronze contains 5 to 10 percent aluminum. Silicon bronze contains 1.5 to 3 percent silicon.

Liberty Bell

The Liberty Bell, which is a symbol of American independence, is made of 943 kg (2,080 lb) of bronze. The metallurgical composition of the bell is approximately 70% copper, 25% tin, 2% lead, 1% zinc, and smaller amounts of other metals. As bronze weathers, a brown or green film forms on its surface. The brown film that has formed on the surface of the Liberty Bell inhibits corrosion.

Bronze is made by heating and mixing the molten metal constituents. When the molten mixture is poured into a mold and begins to harden, the bronze expands and fills the entire mold. Once the bronze has cooled, it shrinks slightly and can easily be removed from the mold.

Bronze is stronger and harder than any other common metal alloy except steel. It does not easily break under stress, is corrosion resistant, and is easy to form into finished shapes by molding, casting, or machining.

The strongest bronze alloys contain tin and a small amount of lead. Tin, silicon, or aluminum is often added to bronze to improve its corrosion resistance. As bronze weathers, a brown or green film forms on the surface. This film inhibits corrosion. For example, many bronze statues erected hundreds of years ago show little sign of corrosion. Bronzes have a low melting point, a characteristic that makes them useful for brazing—that is, for joining two pieces of metal. When used as brazing material, bronze is heated above 430°C (800°F), but not above the melting point of the metals being joined. The molten bronze fuses to the other metals, forming a solid joint after cooling.

Lead is often added to make bronze easier to machine. Silicon bronze is machined into piston rings and screening, and because of its resistance to chemical corrosion it is also used to make chemical containers. Manganese bronze is used for valve stems and welding rods. Aluminum bronzes are used in engine parts and in marine hardware.

Bronze containing 10 percent or more tin is most often rolled or drawn into wires, sheets, and pipes. Tin bronze, in a powdered form, is *sintered* (heated without being melted), pressed into a solid mass, saturated with oil, and used to make self-lubricating bearings.

Insert English equivalents instead of Russian ones:

Bronze is a metal соединение содержащее медь and other elements.

The term bronze was originally применялся к сплаву of copper containing tin,

Historians are unsure how this alloy was discovered, but believe that bronze may have first been made accidentally when породы богатые рудой меди и оловом were used to build campfire rings.

Цинк, свинец и серебро добавлялись к bronze alloys by Greek and Roman metalworkers for use in tools, weapons, coins, and art objects.

When a tin bronze contains at least 10 percent tin, the alloy is твердый и имеет низкую точку плавления.

When the molten mixture is заливают в форму and begins to harden, the bronze расширяется и заполняет всю форму.

Once the bronze has cooled, it немного дает усадку and can легко вынуть from the mold.

Tin, silicon, or aluminum is often added to bronze для того, чтобы улучшить ее антикоррозийную стойкость.

As bronze подвергается атмосферным влияниям, a brown or green пленка образуется на поверхности.

This film препятствует corrosion.

ALUMINIUM

Aluminum (in Canada and Europe, aluminium), symbol Al, the most abundant metallic element in Earth's crust. The atomic number of aluminum is 13; the element is in group 13 (IIIa) of the periodic table (*see* Periodic Law). The element’s name comes from the aluminum-containing compound alum, which was known in ancient times.

Hans Christian Oersted, a Danish chemist, first prepared impure aluminum in 1825, using a chemical process involving potassium amalgam. Between 1827 and 1845, Friedrich Wöhler, a German chemist, improved Oersted's process by using metallic potassium. He was the first to measure the specific gravity of aluminum and show its lightness. In 1854 Henri Sainte-Claire Deville, in France, obtained the metal by reducing aluminum chloride with sodium. Aided by the financial backing of Napoleon III, Deville established a large-scale experimental plant and displayed pure aluminum at the Paris Exposition of 1855.

Properties

Aluminum is a lightweight, silvery metal. The atomic weight of aluminum is 26.9815; the element melts at 660°C (1220°F), boils at 2519°C (4566°F), and has a specific gravity of 2.7. Aluminum is a strongly electropositive metal and extremely reactive. In contact with air, aluminum rapidly becomes covered with a tough, transparent layer of aluminum oxide that resists further corrosive action. For this reason, materials made of aluminum do not tarnish or rust. The metal reduces many other metallic compounds to their base metals. For example, when thermite (a mixture of powdered iron oxide and aluminum) is heated, the aluminum rapidly removes the oxygen from the iron; the heat of the reaction is sufficient to melt the iron. This phenomenon is used in the thermite process for welding.

Aluminum

Aluminum is a light-weight metallic element used extensively in construction and as a packaging material. These aluminum ingots are ready for shipping to factories that will turn them into consume products.

The oxide of aluminum is amphoteric—showing both acidic and basic properties. The most important compounds include the oxide, hydroxide, sulfate, and mixed sulfate compounds. Anhydrous aluminum chloride is important in the oil and synthetic-chemical industries. Many gemstones—ruby and sapphire, for example—consist mainly of crystalline aluminum oxide.

USES

A given volume of aluminum weighs less than one-third as much as the same volume of steel. The only lighter metals are lithium, beryllium, and magnesium. Its high strength-to-weight ratio makes aluminum useful in the construction of aircraft, railroad cars, and automobiles, and for other applications in which mobility and energy conservation are important. Because of its high heat conductivity, aluminum is used in cooking utensils and the pistons of internal-combustion engines. Aluminum has only 63 percent of the electrical conductance of copper for wire of a given size, but it weighs less than half as much. An aluminum wire of comparable conductance to a copper wire is thicker but still lighter than the copper. Weight is particularly important in long-distance, high-voltage power transmission, and aluminum conductors are now used to transmit electricity at 700,000 V or more.

The metal is becoming increasingly important architecturally, for both structural and ornamental purposes. Aluminum siding, storm windows, and foil make excellent insulators. The metal is also used as a material in low-temperature nuclear reactors because it absorbs relatively few neutrons. Aluminum becomes stronger and retains its toughness as it gets colder and is therefore used at cryogenic temperatures. Aluminum foil 0.018 cm (0.007 in) thick, now a common household convenience, protects food and other perishable items from spoilage. Because of its light weight, ease of forming, and compatibility with foods and beverages, aluminum is widely used for containers, flexible packages, and easy-to-open bottles and cans. The recycling of such containers is an increasingly important energy-conservation measure. Aluminum's resistance to corrosion in salt water also makes it useful in boat hulls and various aquatic devices.

A wide variety of coating alloys and wrought alloys can be prepared that give the metal greater strength, castability, or resistance to corrosion or high temperatures. Some new alloys can be used as armor plate for tanks, personnel carriers, and other military vehicles.

1. Answer the questions:

What chemist first prepared impure aluminum?
Who improved Oersted's process?
In 1854 Henri Sainte-Claire Deville, in France, obtained the metal by reducing aluminum chloride with sodium, didn’t he?
What does aluminum rapidly becomes covered in contact with air?
Why don’t materials made of aluminum tarnish or rust?
Does aluminum reduce many other metallic compounds to their base metals?
What is used in the thermite process for welding?
Where is aliminum used?

2. Complete the sentences:

Friedrich Wöhler, a German chemist, improved Oersted's process by …………….
In 1854 Henri Sainte-Claire Deville, in France, obtained the metal by…………….
Aluminum rapidly becomes covered with a tough, transparent layer of ……………
Because of its high heat conductivity, aluminum is used in cooking ……………….
An aluminum wire of comparable conductance to a copper wire is thicker ………..

Aluminum siding, storm windows, and foil ………………………………….
Aluminum's resistance to corrosion in salt water also makes it useful ……………
Aluminum becomes stronger and retains its toughness as it gets colder …………..

Alloys

A metal made of two or more mixed and fused pure **metals** is an alloy. A few alloys are made with a metal and one or more non**metals**. Alloys are used in millions of ways each day: Airplanes, automobiles, building **metals**, and cooking pots are typical objects made of alloys. We usually speak of metal articles as though they were made of such pure elements as iron, aluminum, or copper, but in fact almost all of them are alloys.

Metals in their pure states do not have a great many uses. A pure aluminum cooking pot would be weak and soft and would wear away quickly. One made of aluminum alloyed with copper or silicon can be used daily year after year. A pure-iron knife blade would become dull with its first use because pure iron is relatively soft. A knife made of iron alloyed with carbon and other elements, however, will cut well and retain its sharp edge.

Atomic Structure

A pure metal consists of identical atoms packed closely together in an orderly (lattice-like) arrangement. The atoms are held in place by electrostatic forces.

When elements are mixed to make an alloy, the metallic element present in the largest amount by weight is called the parent metal and the others are the alloying agents. The alloying agents are dissolved in the parent metal but do not combine chemically with it. Instead, they also arrange themselves in a regular pattern, filling the spaces between the atoms of the parent metal without disturbing its basic atomic structure.

This need for orderly arrangement explains why some elements do not form alloys. Imagine a large box in which many balls are to be stacked. If all the balls are the same or nearly the same size, as basketballs and volleyballs, the job is easy. It is impossible, however, to neatly stack balls that differ widely in size, such as basketballs and golf balls. The same is true for atoms. For alloying to take place, the diameters of the atoms of the parent metal and alloying agents cannot differ by more than 15 percent. Thus, the number of possible alloys is limited.

Crystalline Structure

Alloys are made up of regularly shaped crystals, some of which are so large that they can be seen with the naked eye. To study the crystals, scientists use microscopes, spectroscopes, and X rays. They have discovered that alloy crystals are collections of tiny grains between which there is a boundary material.

Some grains are hard and some are soft, because of the different elements mixed in the alloy. The hard grains support loads and resist wear. The soft grains, being more pliable, permit the hard grains to move. Thus, if one attempts to bend a piece of metal that has only hard grains, it breaks. But if hard and soft grains are intermixed, the piece can be bent.

In general, fine-grained **metals** are tougher than large-grained **metals**. In large-grained alloys, the boundaries may be continuous. Such a structure is weak because fewer grains interlock. This makes most large-grained alloys brittle, for they will fracture readily along their boundary lines.

The Steel Alloys

Iron is the major constituent of the most frequently used alloys, the ferrous alloys, from the Latin *ferrum,* meaning "iron." When carbon is dissolved in iron, the resulting alloy is steel. The simplest such alloy, called plain carbon steel or wrought carbon steel, has varying qualities depending upon its carbon content. It can be given other qualities by including other elements. Steel containing manganese is easier to shape in rolling mills; so most steels contain it. Steels with nickel are rust resistant. Chromium steels are hard and strong. Silicon steels have magnetic properties that make them ideal in electric generators and other electrical devices.

Chromium

Chromium is a shiny metallic element. Brilliant, hard, and corrosion-resistant, chromium makes a durable and attractive coating for other metals and is an important component of stainless steel.

Stainless steels, so called because they resist rust and acid corrosion, are usually alloys of iron with 10 to 20 percent chromium and 5 to 10 percent nickel. They are used to make eating utensils, lighting fixtures, decorative trim for automobiles, and many other articles. Stainless steels are also employed in machinery and vats for processing and storing chemicals that would destroy ordinary steels.

Tungsten

Tungsten is a metallic element nearly twice as dense as lead. The melting point of tungsten is 3422°C (6192°F), higher than for any other metal element.

Automotive spring steels, which contain chromium, are elastic and absorb road shocks well. High-speed tool steels, so named for their use in high-speed cutting tools, retain a cutting edge even when red-hot. They can be made hard enough to cut almost any material, including other very hard steels. High-speed tool steels are made of iron, tungsten, chromium, and vanadium. Tungsten is the most important element in these steels because of its high melting temperature of 3,370° C (6,098° F).

Nonferrous Alloys

Bronze Vessel of the Shang Dynasty

The Bronze Age culture of the Shang dynasty (1570?-1045? BC) in China developed a sophisticated metallurgy industry that produced large numbers of bronze ritual vessels. The intricate designs were achieved through the piece-mold casting process, in which molten bronze was poured into clay molds that contained impressions of the desired design.

Alloys that contain no iron are called nonferrous. Of these, the copper alloys are the largest group. Most copper alloys are brasses and bronzes. Brass is copper alloyed with zinc. Most kinds of brass are easily shaped and have a pleasing appearance. Bronze originally meant copper alloyed mostly with tin. Many different alloys classed as bronzes are now made by substituting other elements (zinc, lead, aluminum, phosphorus, silicon) for part or all of the tin. Most bronzes possess strength, toughness, and elasticity.

Alloys containing aluminum or magnesium are structurally strong and lightweight. They are used in spacecraft, airplanes, kitchenware, and automobiles. Monel metal, a very corrosion-resistant alloy, consists on the average of 67 percent nickel, 28 percent copper, and 5 percent other elements. Copper is often alloyed with precious **metals** to make coins.

Fusible Alloys

Alloys with a low melting point are called fusible alloys. They are used in solders, electric fuses, safety plugs such as those used in building sprinkler systems, and in other special applications.

Babbitt metal is one of the most important fusible alloys. It is an alloy of tin, antimony, and copper. It is used where a spinning steel shaft in a machine must be supported. In general, less friction develops between dissimilar **metals** than between **metals** that resemble one another, and Babbitt metal and steel are very dissimilar. In addition, because Babbitt metal melts at a low temperature, it can be poured into a mold fitted around a steel shaft without harm to the shaft. Once cooled, the metal forms a bearing in which the shaft rotates with little wear.

Most kinds of solders are alloys of lead and from one third to two thirds tin. Alloyed, these **metals** melt at a lower temperature than either does by itself. Brazing solder, which forms stronger joints than ordinary solder, is made of equal parts of copper and zinc. Silver is added for jewelry work.

Bismuth, lead, tin, and cadmium are combined to make Wood's fusible metal, an alloy that melts at 71° C (160° F). This metal makes a good fuse in an electric circuit, for when it is heated by an excess of current that might damage electrical apparatus or cause a fire, it melts, stopping the flow of current. Safety plugs made of similar alloys are used in boilers, water heaters, and pressure cookers. When the internal heat in such vessels passes the danger point, the plug melts, allowing steam to escape before the vessel explodes. Sprinkler systems hold water under pressure with a safety plug that melts and releases the water when fire causes the room temperature to rise. Some fire alarm systems use a similar safety plug.

1. Answer the questions:

What is an alloy?
Do metals in their pure state have a great many uses?
What is called the parent metal?
Do the alloying agents combine chemically with the parent metal?
What scientists use to study the crystals?
Where is a boundary material?
What steels are rust resistant?
What steels are ideal in electric generators and other electrical devices?
Do nonferrous alloys contain iron?
What metals does babbitt metal contain?
What temperature does Wood's fusible metal melt at?
What alloy is used in an electric circuit to stop the flow of current?

2. Find the Passive Voice constructions, underline them and translate into Russian:

Alloys are used in millions of ways each day: Airplanes, automobiles, building metals, and cooking pots are typical objects made of alloys.
The atoms are held in place by electrostatic forces.
When elements are mixed to make an alloy, the metallic element present in the largest amount by weight is called the parent metal and the others are the alloying agents.
The alloying agents are dissolved in the parent metal but do not combine chemically with it.
Thus, the number of possible alloys is limited.
Alloys are made up of regularly shaped crystals, some of which are so large that they can be seen with the naked eye.
When carbon is dissolved in iron, the resulting alloy is steel.
Stainless steels are used to make eating utensils, lighting fixtures, decorative trim for automobiles, and many other articles.
Stainless steels are also employed in machinery and vats for processing and storing chemicals that would destroy ordinary steels.
High-speed tool steels are made of iron, tungsten, chromium, and vanadium.
Alloys that contain no iron are called nonferrous.
Babbitt metal melts at a low temperature, it can be poured into a mold fitted around a steel shaft without harm to the shaft.
Silver is added for jewelry work.
Bismuth, lead, tin, and cadmium are combined to make Wood's fusible metal.
Safety plugs made of similar alloys are used in boilers, water heaters, and pressure cookers.

AUDIO SUPPLEMENT

UNIT 1

PRETEXT EXERCISES:

1. Practice in pronunciation:

contain, atom, mean, break, element, change, discover, occur, naturally, artificial, laboratory, combine, compound, chemically.

2. Read and translate the following international words:

Element, substance, contain, atom, naturally, laboratory, metal, combine.

3. Remember the derivatives of the words:

possibility possible possibly

combine combination combined combinative

contain container containable contained containing

Read the text "Element"

An element is a substance that contains only one kind of atom. Atoms cannot be broken down by chemical means, so it is impossible to break up an element into simpler substances by chemical changes. So far 109 elements have been discovered; 92 occur naturally, the other 17 are artificial elements that can be made only in the laboratory. There are two main kinds of elements - metals and nonmetals. Some elements chemically combine with other elements to form substances called compounds.

play pause stop

ASSIGNMENTS:

1. Answer the questions:

What atom does an element contain?

What way can atoms be broken down by?

How many elements have been discovered?

How many elements can be made only in the laboratory?

What are two main kinds of elements?

What do elements form when they combine with other elements?

2. State whether these sentences are true or false using the following clichés:

As far as I know ….	Well, it seems ….
I suppose ….	To start with ….
I mean ….	I think …..
I must confess ….	I suggest ….
I must disappoint you ….	I believe ….
The thing is ….	In fact ….
I hope ….	If I'm not mistaken ….
Actually ….	Frankly speaking ….
I guess ….	The fact is ….
In my opinion ….	I'm afraid ….
They say …,.	To tell the truth ….
Unfortunately …..	Most likely …..

An element is a substance that contains only one kind of atom.

Atoms can be broken down by chemical means.

It is possible to break up an element into simpler substances by chemical changes.

There are two main kinds of elements - metals and nonmetals.

Some elements chemically combine with other elements to form substances called liquids.

3. Fill in the blanks with necessary prepositions:

Atoms cannot be broken ….. ….. chemical means.

It is impossible to break ….. an element ….. simpler substances ….. chemical changes.

17 artificial elements can be made only ….. the laboratory.

Some elements chemically combine ….. other elements to form substances called compounds.

4. Insert the missing forms of the irregular verbs:

….. broke …..

….. ….. made

5. Find the English equivalents to the Russian expressions:

An element is a substance that содержит only one вид of atom.

Some elements chemically реагируют with other elements to form вещества called соединения.

So far 109 elements have been открыты; 92 встречаются в природе, the other 17 are искусственные elements that can be made only in the laboratory.

Atoms cannot be broken down с помощью химических средств, so it is невозможно to break up an element into простые substances by chemical changes.

6. Choose synonyms:

break, substance, occur, combine, call.

name, destroy, react, matter, happen

7. Complete the sentences:

Some elements chemically combine with other elements …………………..

Atoms cannot be broken down by chemical means …………………….

So far 109 elements have been discovered ………………………

UNIT 2

PRETEXT EXERCISES:

1. Practice in pronunciation:

carbon, scientist, fossil, however, produce, industry, example, pesticide, plastics, synthetic.

2. Read and translate the following international words:

chemistry, organic, laboratory, industry, plastics, pesticide, synthetic, substance.

3. Remember the derivatives of the words:

chemistry, chemist, chemical

differ different, difference

produce product, production, productive producer

Read the text " Organic Chemistry"

Organic chemistry is the study of compounds containing carbon. It is called "organic" because scientists used to think that these compounds were found only in living things or fossils. However, vast numbers of different carbon-containing compounds can now be produced artificially in laboratories and factories, for use in industry. For example, drugs, plastics, and pesticides are all synthetic organic substances. About 4.5 million of the 5 million compounds known today contain carbon.

play	pause	stop

ASSIGNMENTS:

1. Answer the questions:

What does organic chemistry study?

Why is it called "organic"?

Vast numbers of different carbon-containing compounds can now be produced artificially in laboratories and factories, can't they?

Are drugs, plastics, and pesticides synthetic organic substances?

How many organic compounds are known today?

2. State whether these sentences are true or false using the following clichés:

As far as I know ….

I suppose ….

I mean ….

I must confess ….

I must disappoint you ….

The thing is ….

I hope ….

Actually ….

I guess ….

Well, it seems ….

To start with ….

I think …..

I suggest ….

I believe ….

In fact ….

If I'm not mistaken ….

Frankly speaking ….

The fact is ….

In my opinion …. I'm afraid ….

They say …,. To tell the truth ….

Unfortunately ….. Most likely …..

Organic chemistry is the study of compounds containing nitrogen.

It is called "organic" because scientists used to think that these compounds were found only in nature.

Vast numbers of different carbon-containing compounds can now be produced artificially in laboratories and factories.

Drugs, plastics, and pesticides are all synthetic organic substances.

3. Fill in the blanks with necessary prepositions:

….. example, drugs, plastics, and pesticides are all synthetic organic substances.

It is called "organic" because scientists used to think that these compounds were found only ….. living things or fossils.

Vast numbers ….. different carbon-containing compounds can now be produced artificially ….. laboratories and factories, ….. use ….. industry.

4. Insert the missing forms of the irregular verbs:

think …..   …..

….. found …..

….. ….. known

5. Find the English equivalents to the Russian expressions:

It is called "organic" because ученые used to think that these compounds were found only in living things or окаменелостях.

Vast numbers of разных carbon-containing соединений can now be produced искусственно in laboratories and factories

For example, лекарства, пластмасса, and pesticides are all synthetic organic вещества.

About 4.5 million of the 5 million compounds known today содержат carbon.

6. Choose synonyms:

study, call, find, produce, artificial, factory, substance.

plant, matter, man-made, manufacture, learn, name, seek.

7. Complete the sentences:

Organic chemistry is the study …………………..

For example, drugs, plastics, and pesticides…………………..

However, vast numbers of different carbon-containing compounds …………..

It is called "organic" because scientists used ……………

UNIT 3

PRETEXT EXERCISES:

1. Practice in pronunciation:

carbon, occur, naturally, allotrope, graphite, diamond, buckminsterfullerence, different, size.

2. Read and translate the following international words:

element, naturally, form, allotrope, graphite, combination, atom.

3. Remember the derivatives of the words:

importance important

form formation formative

differ difference different differential

occur occurrence occurrent occurring

Read the text " Carbon"

An important nonmetallic element, carbon occurs naturally in three forms, or allotropes. There are graphite, diamond and buckminsterfullerence. Carbon can form millions of different compounds (combinations of elements). This is because a carbon atom can bond with up to four atoms (of carbon or other elements) and because the carbon atoms can link up in chains and rings of different sizes and patterns.

play pause stop

ASSIGNMENTS:

1. Answer the questions:

In what forms does carbon occur in nature?

Carbon can form millions of different compounds, can't it?

Why can carbon form millions of different compounds?

How can the carbon atoms link up?

2. State whether these sentences are true or false using the following clichés:

As far as I know ….	Well, it seems ….
I suppose ….	To start with ….
I mean ….	I think …..
I must confess ….	I suggest ….
I must disappoint you ….	I believe ….
The thing is ….	In fact ….
I hope ….	If I'm not mistaken ….
Actually ….	Frankly speaking ….
I guess ….	The fact is ….
In my opinion ….	I'm afraid ….
They say …,.	To tell the truth ….
Unfortunately …..	Most likely …..

An important nonmetallic element, carbon occurs naturally in three forms, or allotropes.

The carbon molecules can link up in chains and rings of different sizes and patterns.

A carbon atom can break with four atoms (of carbon or other elements).

3. Fill in the blanks with necessary prepositions:

The carbon atoms can link …..   ….. chains and rings ….. different sizes and patterns.

A carbon atom can bond …..   …..   ….. four atoms.

Carbon can form millions ….. different compounds.

An important nonmetallic element, carbon occurs naturally ….. three forms.

4. Find the English equivalents to the Russian expressions:

An important nonmetallic element, carbon встречается в природе in three forms.

This is because a carbon atom can соединяться с four atoms.

The carbon atoms can link up цепью и кольцами of different размеров and форм.

5. Choose synonyms:

occur, different, bond, link.
connect, various, happen, bind.

6. Make up sentences:

element, an, occurs, important, three, in, naturally, forms, nonmetallic, carbon.

can, of, compounds, different, millions, form, carbon.

the, rings, and, carbon, atoms, in, up, can, chains, link.

7. Complete the sentences:

An important nonmetallic element, carbon occurs ………………….

Carbon can form millions ……………………..

This is because a carbon atom can bond with up to four atoms ……………

UNIT 4

PRETEXT EXERCISES:

1. Practice in pronunciation:

certain, property, conduct, heat, electricity, similarity, determine, suitable, particular, rarely, pure, usually, alloy.

2. Read and translate the following international words:

metal, group, element, conduct, electricity, structure, mix, form, combination,

3. Remember the derivatives of the words:

Read the text " Metals "

Metals are a group of elements that share certain properties. They conduct heat and electricity well, which is why cooking pans and electrical wires are made of metal. They are also strong and can be shaped easily; this is why they are used to make structures such as bridges. Although there are many similarities between metals, there are also differences that determine how suitable a metal is for a particular use. Of the 109 elements known today, 87 are metals. They are rarely used in their pure state - they are usually mixed with other metals or nonmetals to form combinations known as alloys.

play **pause** **stop**

ASSIGNMENTS:

1. Answer the questions:

Metals share certain properties, don't they?

Do metals conduct heat and electricity well?

Why are cooking pans and electrical wires made of metal?

Where else are metals used?

What determines the suitability of a metal for a particular use?

How many metals are known today?

Are metals often used in their pure state?

What are they mixed with?

What are alloys?

2. State whether these sentences are true or false using the following clichés:

As far as I know ….

I suppose ….

I mean ….

I must confess ….

I must disappoint you ….

The thing is ….

I hope ….

Well, it seems ….

To start with ….

I think …..

I suggest ….

I believe ….

In fact ….

If I'm not mistaken ….

Actually ….

Frankly speaking ….

I guess ….

The fact is ….

In my opinion ….

I'm afraid ….

They say …,.

To tell the truth ….

Unfortunately …..

Most likely …..

Metals are a group of elements that share certain properties.

They conduct water and gases well, which is why cooking pans and electrical wires are made of metal.

They are rarely used in their pure state - they are usually mixed with other metals or nonmetals to form combinations known as alloys.

Metals are also strong and can be shaped hardly.

3. Fill in the blanks with necessary prepositions:

Cooking pans and electrical wires are made ….. metal.

There are many similarities ….. metals.

Differences ….. metals determine how suitable a metal is ….. a particular use.

They are rarely used …… their pure state.

They are usually mixed ….. other metals or nonmetals to form combinations known as alloys.

4. Insert the missing forms of the irregular verbs:

make …..   …..

….. knew   ……

5. Find the English equivalents to the Russian expressions:

They проводят тепло and electricity well.

Сковородки and electrical провода are made of metal.

They are also strong and can be придавать форму easily.

Differences that определяют how пригоден a metal is for a particular use.

They are редко used in their чистом состоянии.

They are usually mixed with other metals or nonmetals to form combinations known as <u>сплавы.</u>

6. Choose synonyms:

share, conduct, make, shape, suit, pure.
clean, form, pass, divide, manufacture, fit.

7. Complete the sentences:

They conduct heat and electricity well, ……………………….

They are rarely used in their pure state …………………………

Although there are many similarities between metals, …………………….

Metals are a group of elements that ……………………….

Audio Supplement

Acids are substances that release hydrogen ions in water. Alkalis are substances that release hydroxide ions (ions made up of hydrogen and oxygen) in water. If acids and alkalis are mixed, the two types of ions cancel each other out, and a new substance called a chemical salt is formed. The acidity or alkalinity of a substance can be measured using the pH (potential for hydrogen) scale, which runs from 1 to 14. All acids have a pH lower than 7; the stronger the acid, the lower the pH. All alkalis have a pH greater than 7; the stronger the alkali, the higher the ph. Neutral substances, such as water, are neither acidic nor alkaline. They have a pH of 7.

play **pause** **stop**

An important nonmetallic element, carbon occurs naturally in three forms, or allotropes. There are graphite, diamond and buckminsterfullerence. Carbon can form millions of different compounds (combinations of elements). This is because a carbon atom can bond with up to four atoms (of carbon or other elements) and because the carbon atoms can link up in chains and rings of different sizes and patterns.

play **pause** **stop**

Organic (carbon-containing) compounds can be divided into two major groups - aliphatic and aromatic compounds - according to the way in which the carbon atoms bond. In aliphatic compounds, the carbon atoms are linked in chains. These chains can contain anything from two to many thousands of carbon atoms, with other types of atoms attached to each carbon atom. In aromatic compounds, the carbon atoms are joined in a ring.

play **pause** **stop**

A chemical reaction occurs when substances change into new substances. For this to happen, the bonds between atoms and molecules must break and re-form in different ways. Because the bonds can be strong, energy, usually in the form of heat, is often needed to start a reaction. The new substances (products) have properties different from those of the original substances (reactants). Chemical reactions do not occur only in laboratories; they happen all around us - for example, when cars rust and when food is cooked.

play **pause** **stop**

Metals are a group of elements that share certain properties. They conduct heat and electricity well, which is why cooking pans and electrical wires are made of metal. They are also strong and can be shaped easily; this is why they are used to make structures such as bridges. Although there are many similarities between metals, there are also differences that determine how suitable a metal is for a particular use. Of the 109 elements known today, 87 are metals. They are rarely used in their pure state - they are usually mixed with other metals or nonmetals to form combinations known as alloys.

play **pause** **stop**

Many substances form crystals. A crystal is a type of solid matter that always forms the same shape. For example, crystals of common salt always for tiny cubes, and emerald crystals are always hexagonal (six-sided). Crystals often form when molten rocks cool down and solidify or when solutions containing minerals evaporate. Crystals can also be made in the laboratory. Some crystalline substances, such as rubies and diamonds, are used in jewelry. Others are useful in industry; quartz, for example, is used in watches. play pause stop

A solid is a compact substance, created by closely packed atoms that form a regular pattern called a lattice. There are strong forces holding the atoms together, which allow only slight movement. The hardness of a solid depends on the pattern and movement of its atoms. The element carbon, for example, can exist in a soft form called graphite, or in one of the hardest solid forms on Earth, the diamond.

play pause stop

A solution forms when one substance (usually a solid) dissolves in another (usually a liquid). The solid (called the solute) breaks up into tiny particles and spreads throughout the liquid (the solvent) so that you can no longer see any solid. Solutions are always clear; if the mixture is cloudy, it is a suspension. In a suspension, solid particles spread throughout the liquid, but the particles are bigger than those of a solution. If you leave a suspension to stand, most of the solid particles will eventually sink. A solution will not separate out in this way.

play pause stop

At room temperatures, water is a clear, tasteless, and odorless liquid. It is made up of hydrogen and oxygen atoms grouped together as molecules. The molecules draw together at the surface of water to from surface tension, which acts like a kind of skin. They are also drawn to the molecules of other substances, which is why water "wets" things, like drinking glasses, or our bodies when we swim.

play pause stop

A compound is a substance in which the atoms of two or more elements are joined together by chemical bonds. Because of these bonds, it is very difficult to split a compound into its individual elements. The type and number of bonds formed depend on the electrons (particles with a negative electrical charge) in each atom. The properties of a compound can be very different from those of the elements it contains. For example, the salt we use in our food is a harmless compound, yet it is made up of two dangerous elements - sodium, which reacts violently with air; and chlorine, which is poisonous in large quantities. play pause stop

A molecule is group of atoms joined together by chemical bonds. The molecules of an element are identical and contain atoms of one type only. Oxygen gas, for example, has molecules made up of two oxygen atoms. The molecules of a compound are also identical, but in this case each molecule contains atoms of more than one type. In water, for example, each molecule is made up of two hydrogen atoms and one oxygen atom. All gases, most liquids, and many nonmetallic solids consist of molecules.

play **pause** **stop**

Organic chemistry is the study of compounds containing carbon. It is called "organic" because scientists used to think that these compounds were found only in living things or fossils. However, vast numbers of different carbon-containing compounds can now be produced artificially in laboratories and factories, for use in industry. For example, drugs, plastics, and pesticides are all synthetic organic substances. About 4.5 million of the 5 million compounds known today contain carbon.

play **pause** **stop**

All substances are made up of tiny particles called atoms; they are the building blocks of everything on Earth. Atoms are so small that a pinhead contains about 60 billion of them. The ancient Greeks first guessed that matter might be made up of small particles. Atoms contain even smaller particles called protons, neutrons, and electrons.

play **pause** **stop**

Isotopes are different forms of the same element (simple type of substance). They have identical chemical properties and occupy the same place in the periodic table (the word isotope means "same place"). It is their physical properties that differ, because their atoms (tiny particles) have different masses. Each "isotopic form" has a different number of neutrons, in the nucleus (center) of its atoms, which gives it a different mass. Hydrogen gas, for example, can exist naturally in three isotopic forms: common hydrogen, heavy hydrogen, and radioactive hydrogen.

play **pause** **stop**

There are two types of nuclear reactions: nuclear fission and nuclear fusion. Nuclear power stations use fission to produce their energy. Fast-moving atomic particles called neutrons are fired at the nucleus (center) of an atom to split it. This splitting is called fission and it causes other atoms to split in a chain reaction. Some mass (the number of heavy particles inside an atom) is lost in the process. This is converted into large amounts of nuclear energy.

play **pause** **stop**

The study of the nucleus (center) of an atom is known as nuclear physics. As a result of this study, scientists have discovered ways of splitting the nucleus to release huge amounts of energy. One nucleus is split, causing many others to split, in what is called a nuclear chain reaction. A controlled nuclear reaction inside a power station can be used to provide heat and light for our homes.

play **pause** **stop**

Everything consists of tiny atoms, which are made up of even smaller particles. Particle physics is the study of these smaller particles, which form the most basic building blocks of all matter in the univers. The study of particles enables scientists to learn more about the univers and the nature of all matter. Scientists generally agree that the universe started with a huge explosion in space, which they call the "big bang".

play pause stop

Matter is anything that occupies a space, including everything on the Earth and throughout the universe. Drops of water and specks of dust are kinds of matter, and so are plants, animals, and even planets. All matter has a mass, which is a measure of the particles (atoms and molecules) that is consists of. Particles can group together in many different ways, varying the structure of matter. That is why so many different kinds of matter exist. All kinds can be classified as either solid, liquid, or gas.

play pause stop

An element is a substance that contains only one kind of atom. Atoms cannot be broken down by chemical means, so it is impossible to break up an element into simpler substances by chemical changes. So far 109 elements have been discovered; 92 occur naturally, the other 17 are artificial elements that can be made only in the laboratory. There are two main kinds of elements - metals and nonmetals. Some elements chemically combine with other elements to form substances called compounds.

play pause stop

The Earth provides all the raw materials we need. The problem is to separate the substances we want from the mixtures in which they naturally exist. Chemists use a variety of different methods of separation, depending on the type of mixture and the properties of the substances it contains. We sometimes need to separate substances at home, too. In a coffee-maker, for example, a filter separates the ground coffee beans from the liquid coffee. This is known as filtration.

play pause stop

Gases, like other forms of matter, are made up of atoms that form groups called molecules.Gas molecules move very freely, spinning around at high speeds and filling up large spaces. As they move, the energetic gas molecules collide with one another and with the walls of their containers. Vapour can also be classified as a gas, although it behaves slightly differently.

play pause stop

Heat is a form of energy that transfers from one object or body to another if there is a difference in temperature between the two. When you are hot, for example, and the air outside your body is cooler, you lose heat to the air. A change in a body's level of heat results in a change in the energy of its molecules. This gives rise to a temperature change, which may in turn lead to a change of state.

play pause stop

Nuclear Fusion is a type of nuclear reaction that creates huge amounts of energy. It takes place naturally inside the sun, creating the heat energy that we need to survive on Earth. At temperatures of about 25 million F dgr. (14 million C dgr.) the nuclei (centers) of two hydrogen atoms fuse, or join together. In the process, some mass (the number of heavy particles inside an atom) is lost and converted into energy. Scientists are trying to develop this form of nuclear reaction as a safer alternative to the nuclear fission that takes place in power stations.

play	pause	stop

We determine how hot or cold something is by a measure called temperature. This tells us how much energy the atoms (tiny particles) inside a body contain. The more energy the atoms contain, the faster they move, and the higher the temperature. For each element (simple type of substance), there are specific temperatures at which changes of state occur. These are known as melting and freezing points. Scientists believe that absolute zero is the lowest possible temperature, below which atoms would have no energy.

play	pause	stop

A liquid is a substance that moves more freely than a solid, but not as freely as a gas. The tiny particles that make up liquids have more energy than those of solids, but not us much as those of gases. Liquids also differ from gases because they cannot be compressed into smaller spaces. The ability of a liquid to resist flowing is called its viscosity. Thick liquids, like syrup, have a high viscosity and flow slowly, whereas thin, runny liquids, like water, have a low viscosity.

play	pause	stop

Most animals are ectothermic, which means that their body temperature changes according to the outside temperature. Ectothermic animals are more active in the heat because chemical reactions inside cells work faster at higher temperatures. Animals behave in particular ways to control their body temperature. For example, lizards lie out on the rocks in the morning sun to gain heat. They burrow at night to conserve heat. Birds and mammalas are able to maintain a constant high body temperature. Such animals are called endothermic.

play	pause	stop

Unlike current electricity, static electricity does not flow. It is created when an electrically neutral substance loses or gains electrons (negatively charged particles), making it, respectively, positively or negatively charged. You can create static electricity by rubbing a balloon on your clothing. Electrons will move from the clothing to the balloon, making the balloon negatively charged and the clothing positively charged. The resulting static electricity on each will attract small, light objects such as pieces of paper.

play	pause	stop

Everything happens because of energy: without it, there would be no life on Earth. Scientists classify energy into several different types, including chemical energy, light energy, and nuclear energy. Most types of energy can switches from one form to another. It is when energy switches form that things happen, or work is done. In a car, for example, gasoline provides chemical energy, which turns into mechanical energy, heat energy, electrical energy, and sound energy when the engine is started.

play **pause** **stop**

An object made of metal is usually much heavier than a wooden one of the same volume. They are both occupying the same amount of space, but the metal object has a greater density. Density is the amount of mass, or atoms, that an object contains in a given space. The metal object contains more tightly packed atoms than the wooden therefore it has a greater density.

play **pause** **stop**

The different behavior of matter in its solid, liquid, and gaseous states is explained by kinetic theory. The state of any particular matter is determined by the amount of energy contained inside its atoms (the tiny particles that make up all matter). Changes of state occur when the energy levels of atoms change. The atoms in a gas have the most energy, those in a solid the least. The total amount of energy contained by the atoms of a substance is known as the kinetic energy of the substance. The substance's temperature and the pressure it is under affect its kinetic energy; so does the volume of its container.

play **pause** **stop**

Almost any form of energy can be converted into electricity. The most common methods of producing electricity are those used in batteries or generators. Power from batteries is generated by converting chemical energy into electrical energy. Most generators convert heat energy (from burning fuel) into electrical energy. Some generators exploit such natural resources as sunlight or wind to obtain electrical energy.

play **pause** **stop**

Magnets are attracted to iron and to any material that contains iron. Magnets have two poles, a north pole and a south pole. Unmagnetized iron and steel have magnetic regions of atoms called domains that are jumbled up and point in lots of different directions. When iron or steel becomes magnetized, the domains become aligned and they all point in the same direction. One end of each domain points toward the magnetic north pole.

play **pause** **stop**

Rays of light, like all forms of energy that travel in waves, can be reflected. Light rays are reflected when they hit a shiny or silvered surface, such as a still pool of water or a mirror. Reflection involves two light rays - the incident, or incoming ray, from an object, and the reflected, or outgoing, ray, which bounces off the reflecting surface. The two rays are at identical angles to the reflecting surface on either side of an imaginary line.

play **pause** **stop**

Refraction is a property of all types of energy that travel in waves, including light. Light waves normally travel in straight lines, but when they pass from one transparent material to another, they usually refract, or bend. Refraction occurs because light travels at different speeds in different materials. As light from a material with a low density, such as air, enters a material with a high density, such as water, its speed is reduced. This causes it to bend (except when it enters a material at a right angle).

play **pause** **stop**

White light is a combination of lights of different colors: red, orange, yellow, green, blue, indigo, and violet. These colors are known as the spectrum and are revealed when white light passes through a prism. When an object is heated it begins to glow, giving off electromagnetic waves that we see as colors. The object changes color as it gets hotter (starting at red and ending at white) because the wavelengths become shorter.

play **pause** **stop**

Electricity is a flow of negative charges called electrons. (Electrons are particles that form a part of all atoms.) These electric charges are measured in units called coulombs. Electricity is a very versatile form of energy that can be converted into many other forms of energy, including light and heat. There are two types of electricity: direct current (DC), which flows in one direction only, and alternating current (AC), which changes direction 60 times per second.

play **pause** **stop**

The Earth is one of nine planets that travel around the sun in the solar system. Of these planets, the Earth is the third nearest the sun. It is the only planet known to support life. About 5 billion years ago, a cloud of gas and dust began to condense into a solid mass - the young Earth. At first, this mass was very cold, but later it was melted by radioactivity. Heavy metals collected at the center and rocks floated near the surface. After millions of years, the rocks formed a hard crust and the oceans and the atmosphere appeared.

play **pause** **stop**

Of all species, humans have the greatest effect on the environment. Some of our activities threaten the world's habitats and therefore the Earth's biodiversity (its range of plants and animals).The balance of nature is upset by activities such as overfishing, overhunting, and cutting down too many trees. We also damage the environment by polluting the land, the air, and oceans, rivers, and lakes. One of the causes of over-activity is the sheer number of people in the world. This number is rising.

play **pause** **stop**

Living things are sensitive to their surroundings. They can detect a stimulus and respond in a suitable way. Animals have sense organs, such as eyes and ears that rapidly send information to the nervous system's control center, the brain. The brain processes the information and responds by sending instructions to the parts of the body that need to react. These may be the muscles that make the animal produce sounds, or the muscles that enable it to bite into food.

play **pause** **stop**

Living organisms consist mostly of water. It is the substance in which chemicals are transported around the organism, and all the cells' chemical reactions happen in water. Whatever the conditions outside, a constant balance of water must be maintained inside the organism. The amounts of water taken in and lost have to be carefully controlled. Plants depend on water not only for cell metabolism and transporting chemicals, but also for cooling and support. Plants without water wilt and die. Plants close pores in their leaves to avoid losing water when it is in short supply and when the weather is hot.

play **pause** **stop**

Air is a mixture of gases that surrounds the Earth and supports all life on it. We breathe in air to stay alive, and rely on it for heat, as fire cannot burn without it. The layer of air that we breathe stretches for only 7 miles above the Earth's surface. The gases that make up air are mixed in approximately the same proportions all over the planet. Oxygen and nitrogen are the key elements, with water vapour, carbon dioxide, and other gases making up the total. The amount of water vapour in the air varies and is referred to as humidity.

play **pause** **stop**

The sun and the nine planets in orbit around it make up the solar system. The nine planets, which are drawn to the sun by its gravity, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. The sun is the heaviest of these bodies.

play **pause** **stop**

There are billions of stars in the univers. Stars are massive, energy-filled globes of fiery gases. The force of gravity holds these gases together. At a star's core, atoms of hydrogen join together to form helium in a process called nuclear fusion. The energy generated by this process produces a star's heat and light. Collections of stars are called galaxies, and each galaxy contains many different types of stars.

play **pause** **stop**

The part of the Earth and its atmosphere that can support living organisms is called the biosphere. This consists of the air and land, as well as lakes, rivers, and oceans. Organisms usually live alongside other members of the same species to form a population. Lots of different populations share the same habitat. Together, they all form a community. The members of a community constantly react with one another and their environment, creating a balanced, living system called an ecosystem, such as an ocean or a rain forest. The study of all these interactions is called ecology.

play pause stop

Some bacteria, viruses, protists, and fungi (often called germs) can invade living tissues, and may kill the organism unless it defends itself. Animals' skins act as germ-proof barriers, but if germs get into the body through cuts, breathing, or food, two defense mechanisms fight infection. One is nonspecific: germs are hunted and eaten by white blood cells that patrol the body. The other, the immune system, is specific: chemicals called antibodies are produced by white blood cells to destroy specific germs. Plants have only a protective epidermis, or "skin," to keep germs out.

play pause stop

VOCABULARY

A

ability -   способность
abound in - изобиловать
absorb - поглощать
abundant - распространенный
abundance -изобилие
accelerate - ускорять
according to -согласно
account - отчет
on account of - вследствие
accurate - точный
achieve - достигать
acid - кислота
acquire -приобретать
act - действовать
add - добавлять
addition – добавление
admixture - примесь
affect –воздействовать на
air - воздух
alkali - щелочь
alkaline - щелочной
alloy - сплав
alter -изменять
alternate - переменный
ammonia - аммиак
amount -количество
apparently - очевидно
appear – появляться
apply - применять
application - применение
appreciate - оценивать
aqueous - водный
argent - серебро
arrange - располагать
arrangement - расположение
artificial - искусственный
as – в качестве
ash -зола
attack – воздействовать на

attract - притягивать
available - доступный
average – средний

B

balance - весы
band - диапазон
base – база основание
basic - основной
bath - ванна
behave – вести себя
benzene - бензол
benzene - бензин
besides - кроме
bleach - отбеливать
body - тело
boil - кипятить
boiler - котел
boiling - кипячение
boiling point – точка кипения
bond - связь
bottle - бутылка
bottom - дно
bowl - чаша
branch - отрасль
break down - разлагаться
brief - короткий
bright - яркий
brittle - хрупкий
bronze - бронза
bubble - пузырек
burn - гореть
burner -горелка
burning - горение
by-product – побочный продукт

C

calculate - вычислять
capacity -емкость
carbon -углерод

carry out - осуществлять
cause - вызывать
chain - цепь
chamber - камера
change – изменять
charcoal – древесный уголь
charge - заряд
chemist - химик
chemistry -химия
chlorine - хлор
chlorate – хлорат
chloride - хлорид
clear - прозрачный
cloud – мутить
coal - уголь
coat - покрывать
coating - покрытие
colour - цвет
combination - соединение
combine – соединяться
combustible - горючий
combustion - горение
common - распространенный
common salt – поваренная соль
complex - сложный
complicate - усложнять
component – составная часть
compose - составлять
composition - состав
compound - соединение
compress - сжимать
condenser -холодильник
condition - условие
conduct - проводить
conductor - проводник
connect - соединять
connection - соединение
conserve - сохранять
consist of –состоять из
constituent - составная часть
constitute -составлять
contain - содержать
container - сосуд
content - содержание
convert - превращать

cool - охлаждать
corrode - ржаветь
corrosion - ржавчина
crucible -тигель
crust - кора
current – ток

D

deal - количество
decay - распад
decompose - разлагаться
decrease - уменьшаться
define - определять
dense - плотный
density - плотность
depend on – зависеть от
design - проектировать
dessicator - дессикатор
destroy - уничтожать
determine -определять
develop – разрабатывать
deviate - отклоняться
diamond - алмаз
differ from – отличаться от
diffuse - диффундировать
dilute - разбавлять
dilution - разбавление
dioxide - двуокись
disappear - исчезать
discharge - разряд
discover - открывать
disintegrate - распадаться
displace - вытеснять
display – выставлять проявлять
distinct - отчетливый
distinctive - отличительный
distinguish – различать(ся)
distribute - распределять
divide - делить
double - двойной
drop -капля
droplet - капелька

dry - сушить
due to - благодаря
durable - прочный

E

earth –земля
easily - легко
effect - действие
emit - выделять
enrich -обогащать
equal -равняться
equation - уравнение
equip - оборудовать
equipment -оборудование
essential - необходимый
estimate - определять
ether - эфир
evaporate - испаряться
evident - очевидный
evolve - выделять
exact(ly) - точно
examine - исследовать
example - пример
exceed - превышать
except - кроме
excess - избыток
exert - оказывать
exhibit - проявлять
exist - существовать
expand - расширяться
explode - взрывать
explore - исследовать
explosion - взрыв
expose – выставлять на
extent - степень
to some extent – до некоторой степени
external - внешний
extract - извлекать

F

facilitate -способствовать

failure - неудача
fertilizer -удобрение
fiber - волокно
fill - наполнять
fine - мелкий
fire - огонь
firm - прочный
fit - годиться
fix - устанавливать
flame -пламя
flask - колба
force - сила
form - образовывать
fraction - фракция
frequency - частота
full - полный
fume - дымить
fumes -пары
furnace - печь
fuse – плавить

G

gain - приобретать
gas -газ
gaseous - газообразный
gasoline -бензин
gauze – металлическая решетка
glass - стекло
grade - марка
graduated - градуированный
ground - земля

H

handle - обращаться
hard - твердый
harmful - вредный
heat - тепло
heavy - тяжелый
hydrocarbon - углеводород
hydrochloric acid – соляная кислота
hydrogen - водород

hydrogen peroxide – перекись водорода
hydroxide - гидроокись

I

identical - одинаковый
ignite - воспламеняться
immerse - погружать
impurity - примесь
incandescence - накал
increase -увеличивать
indicate - указывать
indivisible - неделимый
inflame - воспламеняться
inflammable - горючий
influence – влияние
initial - начальный
insist on – настаивать на
insoluble - нерастворимый
instance - пример
instead - вместо
invent - изобретать
invisible - невидимый
iodine - йод
iron - железо
isolate – выделять

K

kind – вид сорт
kindling temperature - температура воспламенения

L

lacquer - лак
lattice - решетка
layer - слой
lead - свинец
length - длина
level - уровень
liberate - выделять
light – свет легкий

lime - известь
link - связь
liquefy - сжижать
liquid - жидкость
lustre - блеск
lustrous – блестящий

M

machinery - машинное оборудование
make - производить
manner - способ
manufacture - производить
marble - мрамор
matter - вещество
means - средства
  by means of - посредством
measure - измерять
melt - плавиться
melting point – точка плавления
mercury - ртуть
mica - слюда
mix - смешивать
mixture - смесь
mode - способ
modify - видоизменять
moist - влажный
moisture - влага
mould - формовать
move - двигаться
movement - движение
multiply –умножать

N

narrow -узкий
necessary - необходимый
natrium - натрий
nitrate - нитрировать
nitric acid – азотная кислота
nitric oxide – окись азота
nitrogen - азот

nitrous acid – азотная кислота
non-conductor - изолятор
note- замечать
notice – замечать
nuclear – ядерный
nuclei - ядра
nucleous – ядро

O

object - предмет
observe - наблюдать
obtain - получать
obvious - очевидный
occur - происходить
odour - запах
odourless – без запаха
ore - нефть
owing to - благодаря
oxidation - окисление
oxide - окись
oxidizing agent - окислитель
oxygen – кислород

P

paint - краска
particle- частица
pass - пропускать
pattern - строение
pentoxide - пятиокись
per cent - процент
peroxide - перекись
petroleum - нефть
phenomenon – явление
plant- растение завод
plastics - пластмасса
plate - пластинка
point - точка
poison - яд
poisonous - ядовитый
porcelain - фарфор

possess - обладать
potassium - калий
powder -порошок
power – мощь энергия
precipitate - осаждать
precise - точный
prepare - приготовлять
pressure - давление
proceed - протекать
produce - производить
production - производство
property - свойство
protect -защищать
prove -доказывать
provide – снабжать
pure - чистый
purification - очистка
purify – очищать

Q

quality - качество
quantity - количество
quantum -квант
quick- быстрый

R

raise - повышать
range – диапазон
rapid - быстрый
raw -сырой
readily - легко
reduce - восстанавливать
reducing agent - восстановитель
reduction - восстановление
refine - очищать
reflect - отражать
replace - замещать
require - требовать
research - исследовать
resemble in – быть похожим
resist - сопротивляться

resistance - сопротивление
retard - замедлять
reveal - обнаруживать
rock – горная порода
rod - палочка
rubber - резина
rust - ржавчина

S

safe - безопасный
salt -соль
sample - образец
saturatенасыщать
scale - накипь
semiconductor - полупроводник
separate - разделять
settle - оседать
shape - форма
shell - оболочка
silicon - кремний
silver - серебро
similar - похожий
size - размер
slightly - слегка
smell - запах
sodium - натрий
sophisticated - сложный
soft - мягкий
soil - почва
solar - солнечный
solid – твердое вещество
solubility - растворимость
soluble- растворимый
solute – растворяемое вещество
solution - раствор
solve - растворять
solvent - растворитель
spark - искра
species - образец
specific gravity – удельный вес
specimen - образец
speed - скорость
stage – фаза стадия

steadily - постоянно
steam - пар
steel - сталь
stone – камень
sublimate - возгонять
suitable - годный
sulphur - сера
sulphuric - серный
sulphurous - сернистый
surface – поверхность

T

table -таблица
tap -кран
taste - вкус
test – испытывать
test-tube - пробирка
tin - олово
tint - оттенок
top - вершина
trace - след
treat - обрабатывать
tube – труба

U

undergo - подвергаться
unit - единица
unless – если не
until - до тех пор, пока не
use - использовать
utilize – применять

V

valence - валентность
valuable - ценный
value - ценность
vaporize - испаряться
vapour - пар
variety - разнообразие
various - различный

vary - изменяться
velocity - скорость
vessel -сосуд
vigorously – энергично бурно
violently – энергично бурно
visible - видимый
volatile - летучий
volume - объем

W

warm - нагревать
water - вода
wave - волна
wax - воск
weak - слабый
weigh - весить
weight -вес
withstand - выдержать
wood - дерево
wool - шерсть
wrong - ошибочный

Y, Z

yield - выход
zero-нуль
zinc - цинк

Table of Contents

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