**Міністерство освіти і науки України**

**НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ   
«ОДЕСЬКА ПОЛІТЕХНІКА»**

**Методичні вказівки до практичних занять   
з англійської мови**«Хімічні технології та інженерія»

для здобувачів І курсу   
Інституту хімічних технологій та фармації

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Передмова

Метою методичних вказівок до практичних занять з англійської мови «Хімічні технології та інженерія» для здобувачів І курсу Інституту хімічних технологій та фармації за спеціальністю 161 Хімічні технології та інженерія е формування впродовж 90 годин самостійної роботи (вхідний рівень володіння мовою – В1) вмiнь та навичок читання за тематикою спеціалізації 161 “Хімічні технології та інженерія” на І курсі навчання (вихідний рівень володіння мовою – В2). За рахунок тренування і виконання читання текстів і комунікативних завдань здобувачі зможуть досягти практичного володіння англійською мовою за фахом.

Практичне володіння іноземною мовою в рамках даного курсу припускає наявність таких умінь, які дають можливість:

вільно читати оригінальну літературу іноземною мовою у відповідній галузі знань;

оформляти витягнуту з іноземних джерел інформацію у вигляді перекладу або резюме;

робити повідомлення і доповіді іноземною мовою на теми, пов'язані з науковою роботою майбутнього фахівця;вести бесіду за фахом.

Кожний урок складається з тексту й комплексу мовних вправ, які розраховані на удосконалення навичок активізації словарного і граматичного мінімуму професійного спрямування.

“Методичні вказівки” забезпечують підготовку до міжнародного усного спілкування англійською мовою для спеціальних цілей, а саме - оволодіння лексичними, граматичними і стилістичними навичками, а також умінням читати, перекладати, згортати і розгортати усну англомовну інформацію наукового функціонального стилю, що передбачено вимогами Програми вивчення іноземних мов у нефілологічному ВНЗ.

UNIT 1  
Chemistry in Everyday Life

**1**. **Look up new words given below in your dictionary and memorise them.**

to undergo, extensively, oil deposits, fields of study, sample, flux of nutrients, rate of exchange, to take advantage, properties of substances, depletion, application, nutrition, to get sore, magnifying

**2. Read and translate the text.**

**Chemistry in Everyday Life.**

Chemistry is the study of matter and the changes that material substances undergo. Of all the scientific disciplines, it is perhaps the most extensively connected to other fields of study. Geologists who want to locate new mineral or oil deposits use chemical techniques to analyze and identify rock samples. Oceanographers use chemistry to track ocean currents, determine the flux of nutrients into the sea, and measure the rate of exchange of nutrients between ocean layers. Engineers consider the relationships between the structures and the properties of substances when they specify materials for various uses. Physicists take advantage of the properties of substances to detect new subatomic particles. Astronomers use chemical signatures to determine the age and distance of stars and thus answer questions about how stars form and how old the universe is. The entire subject of environmental science depends on chemistry to explain the origin and impacts of phenomena such as air pollution, ozone layer depletion, and global warming. The disciplines that focus on living organisms and their interactions with the physical world rely heavily on biochemistry, the application of chemistry to the study of biological processes. A living cell contains a large collection of complex molecules that carry out thousands of chemical reactions, including those that are necessary for the cell to reproduce. Biological phenomena such as vision, taste, smell, and movement result from numerous chemical reactions. Fields such as medicine, pharmacology, nutrition, and toxicology focus specifically on how the chemical substances that enter our bodies interact with the chemical components of the body to maintain our health and well-being. For example, in the specialized area of sports medicine, a knowledge of chemistry is needed to understand why muscles get sore after exercise as well as how prolonged exercise produces the euphoric feeling known as “runner’s high.”



Although most people do not recognize it, chemistry and chemical compounds are crucial ingredients in almost everything we eat, wear, and use. A woman taking down notes while looking at a computer screen with various things around her desk. The chemical compounds which make up these items are highlighted with magnifying pointers. The chemical compounds are caffeine in cup of coffee, NaCl in bowl of chips, H2O in glass of water, LiCoO2 in iPod, Graphite in notepad, Vitamin C in orange.

**3. Answer the questions.**

1. What is chemistry?

2. What disciplines is chemistry connected to?

3. Why is chemistry so important for environmental science?

4. What does a living cell contain?

5. What does any biological phenomena depend on?

6. What fields of science investigate the interaction between substances and chemical components of the body?

**4. Match the sentences.**

|  |  |
| --- | --- |
| 1.An understanding of chemistry is essential for understanding much | a. disciplines, including astronomy, geology, paleontology, biology, and medicine. |
| 2. Chemistry is the study of matter | b. of the natural world and is central to many other disciplines. |
| 3. It is essential for understanding much of the natural world and central to many other scientific | c. and the changes material substances undergo. |

**5. Compose a story on one of the topics (up to 100 words):**

* The relationship between the chemistry and other disciplines.
* How is chemistry used in our everyday life?

UNIT 2  
What is Chemistry?

**1. Look up new words given below in your dictionary and memorise them.**

[matter](http://www.chem4kids.com/files/matter_intro.html), density, acid, to dissolve, stuff, equipment, to observe, quality, to take up, in terms of, weight, environment, unit, property, to arrange, average, tiny, to investigate

**2. Read and translate the text.**

**What is Chemistry?**

Chemistry is the scientific study of [matter](http://www.chem4kids.com/files/matter_intro.html). As a chemist, you might look at the amount of space an object can fill (density). As a chemist, you might measure the energy of atoms (state of matter). Chemists also look at the way acids can dissolve certain compounds (reactions). Chemistry always goes back to the study of matter. Over thousands of years, chemists have come to understand many different ways that matter changes and moves across the Universe.

**Chemistry and Matter**

 If chemistry is the study of matter, what is matter? Matter is the stuff around you. Matter is the air you breathe, the water you drink, the ground you walk on, the flowers you smell, and the food you taste. Any object you can see, smell, or touch is made of matter. There are also very small pieces of matter that you can’t see or touch. Chemists use special equipment to study those little units of matter. Scientists theorize all of the matter we can observe makes up about 5% of the Universe. The rest is made of dark matter and dark energy.

There are two main qualities of matter. Matter takes up space. Even the smallest particles and pieces of atoms take up some space. Matter also has a mass. Technically, mass is the amount of matter you have. For now, you can think of mass in terms of weight. You don’t need chemistry to tell you an elephant has a lot of mass, a butterfly has less mass, and an atom has even less mass. Holding an object will tell you the object’s weight and give you a good idea of its mass when compared to other objects.

Just so you know, mass and weight are different. Mass is an amount of matter that is the same everywhere in the Universe. One kilogram of iron (Fe) will have the same mass on the Earth or the Moon. Weight is based on the gravity of the environment. That kilogram of iron will weigh more on the Earth because the Earth has a stronger gravity than the Moon. Since Jupiter is much larger than the Earth (stronger gravitational force), the weight of that iron on Jupiter will be much heavier. The mass will be the same.

**Atoms in Chemistry**

[Atoms](http://www.chem4kids.com/files/atom_intro.html" \o "atoms) are the smallest and most basic units of matter that have the properties of an element. All atoms have the same basic parts (electrons, protons, and neutrons), but they are arranged in different ways. Because they have different numbers of parts, atoms of each element have different masses. Hydrogen (H) has an average atomic mass of 1 while carbon (C) is about 12 and calcium (Ca) is about 40.  
You might say, “Why doesn’t chemistry focus on electrons? Shouldn’t chemists work with the smallest pieces of matter?” Yes, electrons are smaller than atoms and there are subatomic particles that are smaller than electrons. But those tiny particles don’t have the properties of an element. When the small parts are combined into atoms, chemists can start to see properties and patterns in their behavior.

**3. Answer the following questions.**

1. What do chemists usually investigate?

2. What is matter? How can it be studied?

3. What are two main qualities if matter?

4. What is the difference between mass and weight?

5. What are the smallest parts of matter?

**4. Fill in the gaps.**

Pieces of chemical atoms element work protons are called

**What are elements?**

[Elements](http://www.chem4kids.com/files/elem_intro.html" \o "element) are 1. \_\_\_\_\_\_\_\_\_\_\_\_ of matter where all of the atoms have the same 2. \_\_\_\_\_\_\_\_\_\_\_ properties. Elements are made 3. \_\_\_\_\_\_\_ similar atoms. We want to say the atoms are exactly the same, but that’s not quite true. An 4. \_\_\_\_\_\_\_\_\_\_\_\_\_ is made of atoms that have the same number of 5. \_\_\_\_\_\_\_\_\_\_\_\_. If you have a batch of atoms and they all have the same number of protons, they are all one element.

For example, if the atoms all have four protons, they are beryllium (Be) atoms. Some of those 6. \_\_\_\_\_\_\_\_\_\_\_ may have four electrons (neutral). Some atoms may have three electrons, leaving the atom with a positive charge ([ions](http://www.chem4kids.com/files/atom_ions.html)). Those ions are still considered beryllium atoms. Neutrons 7. \_\_\_\_\_\_\_\_\_\_\_ the same way. You may have four neutrons, but you might also have three or five neutrons. Atoms with the same number of protons and different numbers of neutrons 8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [isotopes](http://www.chem4kids.com/files/atom_isotopes.html) of an element. Isotopes and ions are still the same element even though they have different numbers of neutrons and electrons.

**5. Compose a story on one of the topics (up to 100 words):**

* What is matter and its types in chemistry?
* What are the 4 types of matter in chemistry?

UNIT 3  
Matter

**1. Look up new words given below in your dictionary and memorise them.**

to define, to lead, to fill, weight, gravity’s pull, to occupy, marble , to explore, to remove, property, brittle, to apart, odor, condensation , deposition, vaporization , ionization, deionization, freezing , sublimation

**2. Read and translate the text.**

**Matter**

What is matter? Matter is everything around you. [Atoms](http://www.chem4kids.com/files/atom_intro.html) and compounds are all made of very small parts of matter. Those atoms go on to build the things you see and touch every day. Matter is defined as anything that has mass and takes up space (it has volume).

What is mass? Mass is the amount of matter in an object. You might have a small object with a lot of mass such as a statue made of lead (Pb). You might have a large object with very little mass such as a balloon filled with helium (He). You should also know there is a difference between mass and weight. Mass is a measure of the matter in an object while weight is a measure of gravity’s pull on an object.

What is volume? Volume is the amount of space something occupies. Words such as big, little, long, or short are used to describe volumes. A marble takes up a small volume while a star occupies a large volume. Different states of matter will fill volumes in different ways.

Even though matter can be found all over the Universe, you will only find it in a few forms (states) on Earth. We cover five [states of matter](http://www.chem4kids.com/files/matter_states.html) on the site. Each of those states is sometimes called a phase. There are many other states of matter that exist in extreme environments. Scientists will probably discover more states of matter as we continue to explore the Universe.

**Five States of Matter**

What are the main states of matter? Everyone should know about [solids](http://www.chem4kids.com/files/matter_solid.html), [liquids](http://www.chem4kids.com/files/matter_liquid.html), [gases](http://www.chem4kids.com/files/matter_gas.html), and [plasmas](http://www.chem4kids.com/files/matter_plasma.html). Scientists have always known about solids, liquids, and gases. Plasma was a new idea when it was identified by William Crookes in 1879. We also like to talk about the [Bose-Einstein condensate](http://www.chem4kids.com/files/matter_becondensate.html) (BEC). It’s a fun state of matter when you remove almost all energy from a system. The scientists (Cornell, Ketterle, and Wieman) who worked with the Bose-Einstein condensate received a Nobel Prize for their work in 2001.

What makes a state of matter? It's all about the physical state and energy in the atoms and molecules. Think about solids. Physical properties of a solid often include "hard" and "brittle." Liquids are fluidy, move around a little, and fill up containers. Gases are always around you, but the molecules of a gas are much farther apart than the molecules in a liquid. If a gas has an odor, you’ll often be able to smell it before you can see it. The BEC is all about atoms that are closer and less energetic than atoms in a solid.

**3. Answer the questions.**

1. What are atoms made of? - [Atoms](http://www.chem4kids.com/files/atom_intro.html) are all made of very small parts of matter.

2. What is the difference between mass and matter. Give an example. - Mass is the amount of matter in an object. You might have a small object with a lot of mass such as a statue made of lead (Pb). You might have a large object with very little mass such as a balloon filled with helium (He). You should also know there is a difference between mass and weight. Mass is a measure of the matter in an object while weight is a measure of gravity’s pull on an object.

3. How many states of matter is known (in non-extreme environments)? – 5 states

4. When was plasma identified? - Plasma was a new idea when it was identified by William Crookes in 1879.

5. Who worked with the Bose-Einstein condensate? - The scientists (Cornell, Ketterle, and Wieman)

**4.** **Fill in the gaps.**

**Changing States of Matter**

Can hydrogen peroxide made up atomic variety molecules chemical formula has the same structure properties

What is a physical change in matter? Molecules 1. \_\_\_\_\_\_\_\_\_\_ move from one physical state to another ([phase change](http://www.chem4kids.com/files/matter_chemphys.html)) and not change their 2. \_\_\_\_\_\_\_\_\_\_\_\_ structure. [Oxygen](http://www.chem4kids.com/files/elements/008_speak.html) (O2) gas 3. \_\_\_\_\_\_\_\_\_\_\_ the same chemical 4. \_\_\_\_\_\_\_\_\_\_\_ as liquid oxygen. The liquid state is colder and denser (less energy), but the 5. \_\_\_\_\_\_\_\_\_\_\_\_\_ are the same. Water (H2O) is another example. A water molecule is 6. \_\_\_\_\_\_\_\_\_\_\_\_\_ of two [hydrogen](http://www.chem4kids.com/files/elements/001_speak.html) (H) atoms and one oxygen (O) atom. It has the same molecular 7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ whether it is a [gas](http://www.chem4kids.com/files/matter_gas.html), [liquid](http://www.chem4kids.com/files/matter_liquid.html), or [solid](http://www.chem4kids.com/files/matter_solid.html). Although its physical state may change because of different amounts of energy, its atomic structure remains 8. \_\_\_\_\_\_\_\_\_\_\_\_\_.  
  
So what is a chemical change in matter? Let's start with that glass of pure water. If the 9. \_\_\_\_\_\_\_\_\_\_\_\_\_ of water were to change, that would be a 10. \_\_\_\_\_\_\_\_\_\_\_\_ change. If you could add a second oxygen atom to a water (H2O) molecule, you would have 11. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (H2O2). The molecules would not be "water" anymore. In reality, there are a 12. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of steps that go into creating hydrogen peroxide from water.

**5. Compose a story on one of the topics (up to 100 words):**

* Microscopic view of a gas, liquid and solid.
* Bose-Einstein condensates state.

UNIT 4  
The Periodic Table

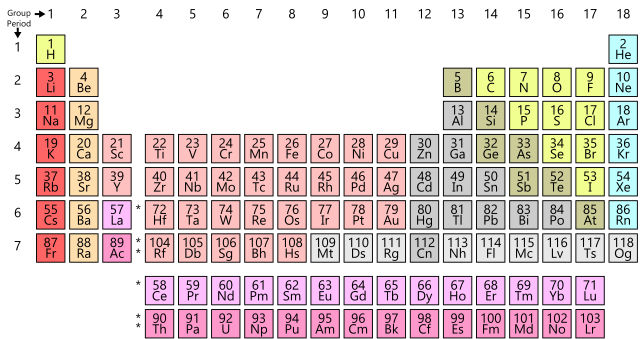
**1. Look up new words given below in your dictionary and memorise them.**

include, to contain, to consist of, outer shell, to line up, row, column, to be skipped in order, stable, to tend, alkali, align, to predict, a bit, to be named after, to observe.

**2. Read and translate the text.**

**The Periodic Table**

The Periodic table is a way of listing the [elements](https://www.ducksters.com/science/elements.php). Elements are listed in the table by the structure of their atoms. This includes how many protons they have as well as how many electrons they have in their outer shell. From left to right and top to bottom, the elements are listed in the order of their atomic number, which is the number of protons in each atom.

[](https://www.ducksters.com/science/periodic_table_lg)

The Periodic Table of Elements

**Why is it called the Periodic Table?**

It is called "periodic" because elements are lined up in cycles or periods. From left to right elements are lined up in rows based on their atomic number (the number of protons in their nucleus). Some columns are skipped in order for elements with the same number of valence electrons to line up on the same columns. When they are lined up this way, elements in the columns have similar properties.–Each horizontal row in the table is a period. There are seven (or eight) total periods. The first one is short and only has two elements, hydrogen and helium. The sixth period has 32 elements. In each period the left most element has 1 electron in its outer shell and the right most element has a full shell.

**Groups**  
 Groups are the columns of the periodic table. There are 18 columns or groups and different groups have different properties.–One example of a group is the noble or inert gases. These elements all line up in the eighteenth or last column of the periodic table. They all have a full outer shell of electrons, making them very stable (they tend not to react with other elements). Another example is the alkali metals which all align on the left-most column. They are all very similar in that they have only 1 electron in their outer shell and are very reactive. You can see all the groups in the table below.–This lining-up and grouping of similar elements helps chemists when working with elements. They can understand and predict how an element might react or behave in a certain situation.–Each element has its own name and abbreviation in the periodic table. Some of the abbreviations are easy to remember, like H for hydrogen. Some are a bit harder like Fe for iron or Au for gold. For gold the "Au" comes from the Latin word for gold "aurum".

**3. Answer the questions.**

1. How are elements listed in the table? - Elements are listed in the table by the structure of their atoms.

2. Why is the table called “periodic”? - It is called "periodic" because elements are lined up in cycles or periods.

3. What do elements have in common, when they are lined up? - When they are lined up this way, elements in the columns have similar properties.  
4. What is a period? - Each horizontal row in the table is a period.

5. How many pediods are there in the table? - There are seven (or eight) total periods.

6. Which period is the shortest? - The first one is short and only has two elements, hydrogen and helium.

7. What are groups? - Groups are the columns of the periodic table.

8. Why is it necessary to understand the lining-up and grouping of similar elements? – The chemists can understand and predict how an element might react or behave in a certain situation.

**4. Choose the correct synonym for each term.**

1. renowned **a** famous b unknown

2. raise a lower **b** elevate

3. use **a** employ b enable

4. deteriorate a strengthen **b** weaken

5. expand a excite **b** increase

6. equilibrium **a** balance b liquid

7. terminate a begin **b** end

8. substantial **a** massive b less

**5. Compose a story on one of the topics (up to 100 words):**

* The history of creation of the Periodic table.
* Interesting facts about some elements.

UNIT 5  
Some important elements

**1. Look up new words given below in your dictionary and memorise them.**

percent = per cent, to make up, blowtorch, welding, to split, huge, to release, to float, pressure, to breathe, to purify, to bounce up and down, resort

**2. Read and translate the text.**

**Some important elements**

Over ninety percent of all the [atoms](http://www.chem4kids.com/files/atom_intro.html) in the Universe are hydrogen atoms. By mass, hydrogen makes up about 75% of all matter in the Universe. Hydrogen atoms are also the smallest and lightest of all the atoms with only one electron and one proton in a common single hydrogen atom (called **protium**). Where can it be found?

**Welding**

Sometimes you see someone working with a blowtorch to cut or welding to bring things together. Those processes need gases that can burn very hot. In welding, electricity splits hydrogen molecules and when the atoms recombine, huge amounts of heat are released.

**Rocket Fuel**

Hydrogen is awesome as a rocket fuel because of all of the energy released. The hydrogen is compressed into a liquid form(H2) and stored in tanks. It is combined with liquid [oxygen](http://www.chem4kids.com/files/elements/008_speak.html) (O2) to create the most efficient reaction and release of energy.

Similar to [hydrogen](http://www.chem4kids.com/files/elements/001_speak.html) (H), helium(He) is usually found as a [gas](http://www.chem4kids.com/files/matter_gas.html) and has no color or smell. Helium is found everywhere in the Universe and is the second most common element, just behind hydrogen. As far as we're concerned, helium is a "happy" element. It is inert, because its outermost electron orbital is full with two electrons. You can also find helium in compressed air tanks, lasers, and as coolants in nuclear reactors.

**Balloons**

Have you ever gotten a balloon as a present? You know how that balloon always tries to float away? That's because there is helium inside. Helium is a very light element. When you put it inside a balloon it tries to float.

**Compressed Air Tanks**

Whenever you see a SCUBA diver in the water, you should know that he has some helium in his air tank. Divers combine helium and regular air in those tanks at very high pressures. When they go deep in the water the helium makes it easier for them to breathe.

**Lasers**  
Sometimes helium is used in lasers. It's a good element to use because it is non-reactive. Even at really high temperatures helium will not bond with other elements.

Lithium is the third element of the periodic table and was discovered in 1817 by a chemist named

**Arfvedson.**

You might find lithium in everyday objects, such as medicines and batteries.  
This is the first [metal](http://www.chem4kids.com/files/elem_metal.html) encountered in the periodic table, and it is a silvery colored solid when purified. One thing to remember is that lithium is never found alone in nature. It is always [bonded](http://www.chem4kids.com/files/atom_bonds.html) to other elements.

**Batteries**

You have batteries in many of your toys. In flashlights you need batteries. In your watch you probably have a battery. Most of those batteries need lithium to work. Lithium is an important element in the way a battery makes electricity.

**Medicine**

Lithium is used as a medicine too! When you take lithium it acts on nerves in your brain and changes the way you act.

**Rocks and Soil**

Lithium is a metallic element and is found in many rocks. When you're out gathering interesting looking rocks, lithium is probably one of the elements inside.

**Hot Springs**

Sometimes people take vacations at resorts. Some of those resorts are near "Springs". We're not talking about a spring that bounces up and down, but mineral water springs that come out of the ground. Many people think that is healthy and fun to find these springs.`

**Nuclear Reactors**Lithium is a very important element in Nuclear Reactors. It is a very light element which makes it important to scientists. It is used in many chemical reactions and processes.

**Air Conditioners**

Next time it's really hot out and you're nice and cool inside, you should thank lithium. Lithium is used in air conditioning systems. You know that everyone uses air conditioning. That means everyone is using some lithium.

**3.** **Answer the questions.**

1. What is the most widespread atom in the Universe?

2. Why can hydrogen be used in welding?

3. What is the second most common element?

4. Can lithium be found in a purified way?

5. Where is lithium used in the everyday life?

**4. Fill in the gaps.**

*scientist versatile large find nature convert trace crystals meat found properties use*

**Selenium**

Selenium is one of the more 1. \_\_\_\_\_\_\_\_\_\_ elements of the periodic table. You can 2. \_\_\_\_\_\_\_\_\_\_\_\_ it in many forms (allotropic forms) including reddish 3. \_\_\_\_\_\_\_\_\_\_\_\_ and metallic gray. It was named after the moon when discovered in 1817 by the 4. \_\_\_\_\_\_\_\_\_\_\_\_\_ Berzelius. While rare, selenium is normally 5. \_\_\_\_\_\_\_\_\_\_\_\_\_ in minerals.  
Of the lesser members in the sulfur family, selenium is the most abundant in 6. \_\_\_\_\_\_\_\_\_\_\_\_, often found in copper and lead mining. Tellurium and polonium are other members in the same family (and found in the same column of the periodic table).

7. \_\_\_\_\_\_\_\_\_\_\_\_\_ amounts of selenium will act as a poison but you need

8. \_\_\_\_\_\_\_\_\_\_\_\_\_ amounts of this mineral to survive. You usually get selenium in your diet when you eat 9. \_\_\_\_\_\_\_\_\_\_\_\_. Probably one of the most well-known uses for selenium is its 10. \_\_\_\_\_\_\_\_\_\_ in solar cells. Selenium has photovoltaic 11. \_\_\_\_\_\_\_\_\_\_\_\_\_. That term means that it can convert light into energy. It just makes sense that selenium is an important part of any equipment design to 12. \_\_\_\_\_\_\_\_\_\_\_\_\_ the Sun's energy into electricity.

**5. Compose a story on one of the topics (up to 100 words):**

* Important elements for human health.
* Most widespread elements in industry.

UNIT 6   
Lab equipment

**1. Look up new words given below in your dictionary and memorise them.**

|  |
| --- |
| exposure to, harmful chemicals, safety gear, ensure, vulnerable, eye rash, loss of vision, spill, splash, emergency, **flame,** contamination, burn, tongs, spatula, measure, shallow dish, sample, nozzle, solution, burette, clamp. |

**2. Read and translate the text:**

Working in a chemistry lab is always exciting; however, there are potential dangers of exposure to harmful chemicals. Hence it is always advised to wear the proper gear, also known as personal protective equipment (PPE), before entering the chemistry lab. The safety gear to work in the chemistry lab mainly consists of three things:

**Safety goggles:**As the name suggests, safety goggles ensure the safety of your eyes. They are one of the most important safety gear, as the eyes are the most vulnerable part of the human body. Several chemicals like acids may cause a severe injury to eyesight, such as eye rash or a permanent loss of vision.

**Lab coat:**The lab coat is a general uniform of medical and chemical professionals. The knee-long coat ensures the safety of the body and clothing from accidental spills and splashes of harmful chemicals. Moreover, in case of emergencies like fire or contamination, a lab coat can be easily and quickly removed.

**Latex/Nitrile gloves:**Chemicals can be very reactive, and physical contact with such chemicals cause severe burns. Latex or nitrile gloves work as a barrier between human skin and protect it from injuries.

**Tongs** are scissor-like tools used to grip and lift objects and avoid the risk of getting burnt. They are used to hold, transfer or pick small objects out of a reaction container.

**A spatula** is a tool used to carry, mix, or spread solid or paste materials in the chemistry lab. They come in various shapes and sizes and are usually made of stainless steel. For easier handling, some of them have a plastic handle or a fixed hardwood grip.

**Pipettes** can have various sizes. These are narrow glass cylindrical pipes, used for measuring an exact volume of liquid and placing it into another container.

**A petri dish** is a shallow, transparent cylindrical tube used to carry out biochemical reactions in general. It’s typically composed of heat-resistant glass and comes with a lid to keep the sample safe from contamination.

**The dropper**, also known as Pasteur pipette, is a common small apparatus, usually made up of plastic or glass cylinder, having a small nozzle on one side and a rubber holder on the other. It is used to put the liquids or solutions in any medium dropwise, that is, one drop at a time, necessary equipment when any reagent is required in an extremely small amount in a solution

**Burettes**: Very popular equipment, mostly used in the titration reactions, and is used to deliver a known volume of any substance to other equipment. This apparatus is a long-graduated tube, with a stopcock present at the lower end and a narrow opening at the bottom. They are usually set up by using a burette clamp in combination with a ring stand. It usually comes in the sizes of 10ml, 25ml, or 50ml.

**Ring stands, rings, and clamps**: These are the apparatus that are used to suspend burettes, flasks, crucibles, etc. either above other containers or above Bunsen burners for heating purposes. While heating these flasks, wire mesh is a necessary apparatus for the even distribution of the heat.

**3. Answer the questions.**

**1.** Why is it necessary to wearpersonal protective equipment? - There are potential dangers of exposure to harmful chemicals.

**2.** How many things does the personal protective equipment consist of? Name them. **-** The safety gear to work in the chemistry lab mainly consists of three things:Safety goggles, Lab coat, Latex/Nitrile gloves.

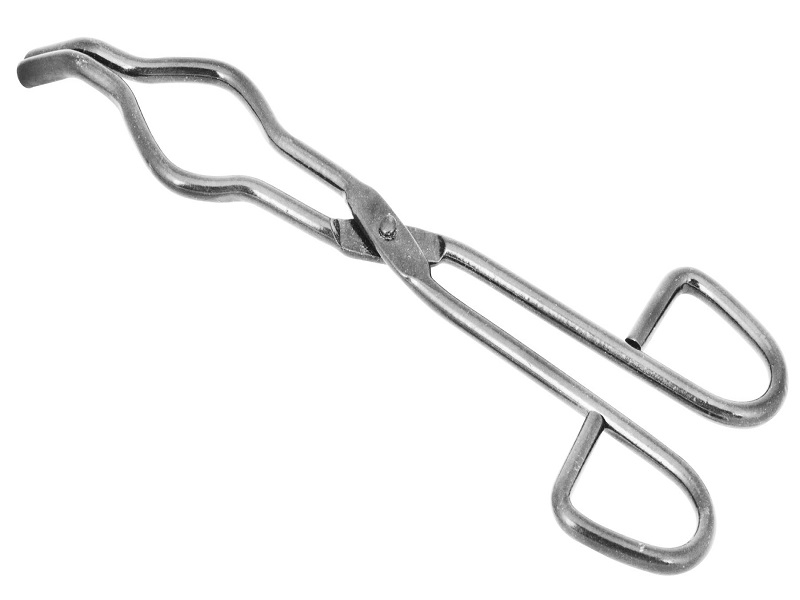
**3.** What part of equipment is the most important and why? – The safety goggles ensure the safety of your eyes. They are one of the most important safety gear, as the eyes are the most vulnerable part of the human body.

**4.** How can the tongs be used? - They are used to hold, transfer or pick small objects out of a reaction container.

**5.** What is a petri dish usually composed of? - It’s typically composed of heat-resistant glass and comes with a lid to keep the sample safe from contamination.

**6.** Which equipment is used to deliver liquid to another container? **–** Burettes, very popular equipment, mostly used in the titration reactions, and is used to deliver a known volume of any substance to other equipment, and pipettes can have various sizes. These are narrow glass cylindrical pipes, used for measuring an exact volume of liquid and placing it into another container.

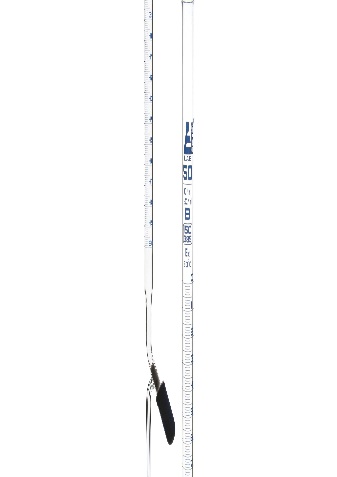
**4. Match the pictures with the description.**



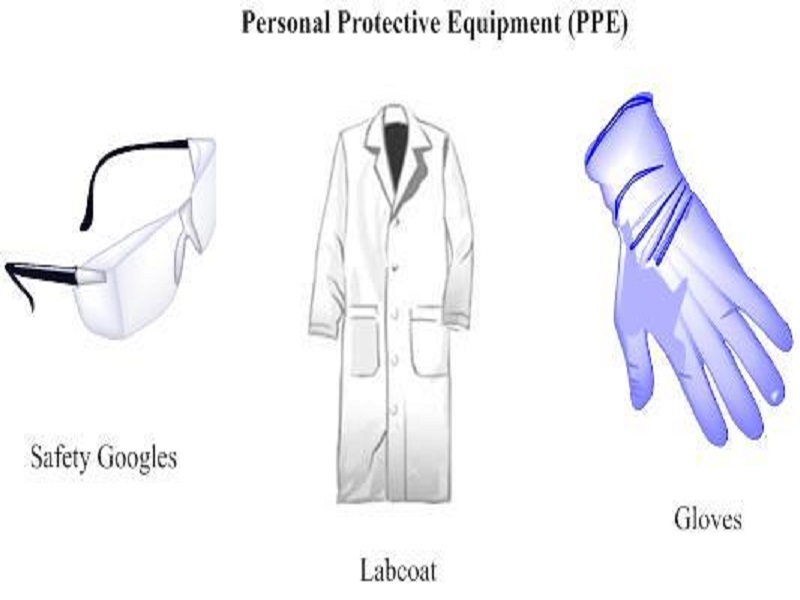
a. b. c.

. 

d. e

f. g.



**5. Compose a story on one of the topics (up to 100 words):**

* Laboratory safety rules.
* Types of laboratory equipment.

UNIT 7  
Inorganic chemistry

**1. Read and translate the words. Learn the words by heart.**

to be adopted, either, require, vital force, to be exerted, ammonium cyanate, to prove, to be abandoned, permanent, to conform, chemical bonds, covalent, electrovalent, attract, affect, hydrogen fluoride, remove, charged particles, vicinity, reverse

**2. Read and translate the text.**

**Inorganic chemistry**

The modern idea of the nature of a chemical compound—a single substance containing fixed proportions of two or more elements—was adopted early in the 19th century. The number of known compounds then was growing fast as chemists learned to separate and analyze the substances found in nature. To organize and simplify the facts concerning these compounds, they classified those obtained from living organisms—plants and animals—as organic and all others as inorganic. This seemed especially logical as long as no one knew how to convert any compound of either class into any compound of the other. Many scientists believed that the formation of organic compounds required the action of some unidentified vital force that could be exerted only by living things.

In 1828 the German chemist Friedrich Wohler made the organic compound urea by heating the inorganic compound ammonium cyanate. He thereby proved that no vital force is needed, but the idea continued to affect the thinking of some chemists for many years. By the time the concept was abandoned, the division of chemical compounds into organic and inorganic had become permanent. All of the organic compounds contain carbon, but very few of the inorganic ones do, so the definition of organic compounds was changed to conform to this fact: any compound of carbon is an organic compound except carbon monoxide, carbon dioxide, carbonates, cyanides, cyanates, thiocyanates, and certain carbides.

Once the definition of inorganic compounds has been decided, inorganic chemistry can be defined as the study of these compounds and of the elements from which they are formed.

More than 100 chemical elements are known and the atoms of all but two of them (helium and neon) form compounds by combining with atoms of other elements. There are two main kinds of forces, or chemical bonds, that hold atoms together in compounds: covalent and electrovalent.

A covalent bond forms when two atoms attract the same pair of electrons, which is said to be shared. A covalent bond affects only two atoms, but most atoms can form more than one covalent bond at a time. The compound hydrogen fluoride consists of molecules in which one atom of hydrogen and one atom of fluorine are held together by a covalent bond. Atoms of oxygen or sulfur, however, form two covalent bonds in many of their compounds. Atoms of nitrogen or phosphorus form three or five. Two atoms can share two or three pairs of electrons, forming double or triple covalent bonds.

Covalent bonds are not formed between atoms that differ greatly in their attraction for electrons. In these cases, the atom with the stronger attraction completely removes one or more electrons from the other. The atom that gains electrons becomes a particle with a negative electric charge, and the atom that loses electrons becomes positively charged. The charged particles are called ions, and the electrical attraction between oppositely charged particles is the force called the electrovalent bond. This bond differs from the covalent bond because a positive ion attracts every negative ion in its vicinity. The reverse is also true. Instead of forming molecules in which each bond affects only two nearby atoms, ions of opposite charge pack closely together, forming arrangements in which each kind is surrounded by the largest possible number of the other kind. For any combination of positive and negative ions, the possibilities are limited by their relative sizes and charges.

**3. Answer the questions.**

1. When did the number of known compounds start to increase?

2. What did many scientists believe?

3. What happened in 1828?

4. What is the difference between inorganic and organic chemistry?

5. What are two main kinds of forces or chemical bonds?

**4. Fill in the gaps.**

**common; on; chemistry; matter; carbon; inorganic; focuses; vinegar**

**Two types of chemistry**

So much of our life relies 1. **\_\_\_\_\_\_\_\_\_**chemistry. Organic chemistry gives us pharmaceuticals, dyes and detergents — just to name a few. Physical chemistry looks at how 2. **\_\_\_\_\_\_\_\_\_\_\_\_**behaves on an atomic level. Biochemistry 3. \_\_\_\_\_\_\_\_\_\_ on processes within living organisms, including humans. Plus, analytical chemistry deals with the “maybes” and “what ifs” of the field. Of the five branches, one we tend to take for granted is inorganicchemistry, which looks at interactions that don’t involve 4. **\_\_\_\_\_\_\_\_\_\_\_\_**atoms. Let’s take a closer look at this branch and what it takes to study this field.

Carbon is one of the most 5. **\_\_\_\_\_\_\_\_\_\_\_**elements on the planet. It’s literally the stuff of life. Chemical reactions that involve carbon or have carbon atoms present fall under organic 6.\_\_\_\_\_\_\_\_\_\_\_ .However, the majority of reactions are 7.**\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This branch of chemistry covers every response where carbon isn’t present. If you’ve ever made a spewing volcano by mixing baking soda and 8.**\_\_\_\_\_\_\_\_\_\_\_\_\_**, for example, you’ve experimented with inorganic chemistry.

**5. Compose a story on one of the topics (up to 100 words):**

* The difference between organic and inorganic chemistry.
* Primary types of bonding.

Unit 8   
Acids and Bases

**1. Read and translate the words. Learn the words by heart.**

Acid, water solution, react with, promote, common, occur, corrosive, sour, bubbles, digestion, body tissues, inject, dilute, exhibit, pure [compound](https://www.merriam-webster.com/dictionary/compounds), soluble in water, to be handled with care, organic derivatives, plaque bacteria, dissolve grease, bromothymol blue, indicator, litmus

**2. Read and translate the text.**

**Acids and bases**

**Acid** is any substance that in [water](https://www.britannica.com/science/water) [solution](https://www.britannica.com/science/solution-chemistry) tastes sour, changes the colour of certain indicators, reacts with some [metals](https://www.britannica.com/science/metal-chemistry) to liberate [hydrogen](https://www.britannica.com/science/hydrogen), reacts with [bases](https://www.britannica.com/science/base-chemical-compound) to form [salts](https://www.britannica.com/science/salt-acid-base-reactions), and promotes certain [chemical reactions](https://www.britannica.com/science/chemical-reaction).

Acids are very common substances that are used widely in everyday life. Some occur naturally, and some are synthetic or man made. Some acids can be dangerous because they are corrosive, they can eat away metals and burn your skin. Car batteries, for example, contain sulfuric acid (H2SO4); and hydrochloric acid (HCl) is used to clean mortar from bricks. However, many acids are safe to eat and drink. They have a sour taste, for example, citrus fruits and tomatoes which contain citric acid. Yoghurt contains lactic acid, vinegar contains acetic acid, and grapes contain tartaric acid. The bubbles in soft drinks are due to carbon dioxide which dissolves in water to form carbonic acid. The hydrochloric acid in your stomach is essential for digestion, and the DNA that makes you different from everybody else is deoxyribonucleic acid.

Acids on your skin sting because they are corrosive and attack your body tissues. This is why lemon juice stings if you get it in a cut on your finger. And bees and ants sting because they inject you with formic acid. You can eat fruit which contains acids because the acid is very dilute. A dilute acid is one which contains a large amount of water and a small amount of acid. The opposite of dilute is concentrated, and concentrated acids need to be handled with care.

**Base is** any substance that in [water](https://www.britannica.com/science/water) solution is slippery to the touch, tastes bitter, changes the colour of indicators (e.g., turns red litmus paper blue), reacts with [acids](https://www.britannica.com/science/acid) to form salts, and promotes certain chemical reactions. Examples of bases are the hydroxides of the [alkali](https://www.britannica.com/science/alkali) and alkaline earth metals and the water solutions of [ammonia](https://www.britannica.com/science/ammonia) or its organic derivatives. Such substances produce [hydroxide](https://www.britannica.com/science/hydroxide) ions (OH-) in water solutions. Broader definitions of a base, to include substances that exhibit typical basic behaviour as pure [compounds](https://www.merriam-webster.com/dictionary/compounds) or when dissolved in solvents other than water, are given by the [Brønsted-Lowry theory](https://www.britannica.com/science/Bronsted-Lowry-theory) and the [Lewis theory](https://www.britannica.com/science/Lewis-theory).

Bases are used in the home for two purposes. They neutralize (cancel out the effect of acids). For example, toothpaste is a weak base used to neutralize the acids formed by plaque bacteria on your teeth. Bases are also used to dissolve grease and dirt. Oven cleaners and drain cleaners usually contain caustic soda (sodium hydroxide, NaOH) which dissolves grease. Other household cleaners contain ammonia, which can be used to remove dirt from floors or clean windows. Bases which are soluble in water are called alkalis. The reason they feel soapy is because they turn the oils on your skin into soap.

**Indicators.** Some solutions are acidic and some are basic, while others are neutral (not acidic or basic). For example tap water is usually neutral.

A quick way to tell whether a solution is acidic or basic is to use an acid - base indicator. Such substances indicate when an acid or base is present by changing their colour. Some indicators occur naturally in dyes in plants. For example, litmus comes from lichens, which grow on the bark of trees and on rocks. In an acidic solution, litmus turns red; and in a basic solution it turns blue. There are also a number of synthetic or man-made indicators. One of these is bromothymol blue.

To be sure that a substance is an acid (or a base) you must observe a change in the colour of an indicator. Suppose you test a solution with bromothymol blue, and it stays blue. You cannot say from this that the solution is basic. It could be water. You would need to use another indicator, e.g. red litmus, and see if it changes colour in the solution.

Most indicators have only two colours, but Universal indicator is a mixture of several different indicators. Because of this, universal indicator can be many different colours, depending on how acidic or basic the solution is.

**3. Answer the questions.**

1. What is acid?

2. Where are acids used in everyday life?

3. What is base?

4. Where do we use bases?

5. How do we identify if the solution is acidic or basic?

**4. Make up sentences**

1. The / of / into / has / substances /classification / acids / bases / greatly changed / chemistry/ and.
2. of/ a/ in/ of/ The theory / ionic / has / played / dissociation / great / the / development / chemistry / role.
3. The problem / of / is / nomenclature / still / important /in /very /chemistry.
4. Any explosive substance must be handled with care.
5. theory / The atomic / was / contribution / a / great / to / the science / world’s.
6. The / important / is / chemical / property / most / of / oxygen / its / acidity.
7. sulphuric / Pure/ acid / a colourless / liquid/ is / about / as / heavy / twice/ as water.
8. branch / No / of / science / broader/ in / is / its / scope / chemistry/ than.
9. is / the / Water / most / distributed / widely / compound.
10. must/ The data / be / into / account/ in / taken / article /this.

**5. Compose a story on one of the topics (up to 100 words):**

* Acids in everyday life
* Bases in everyday life

UNIT 9  
Chemical Equilibrium

**1. Read and translate the words. Learn the words by heart.**

be in equilibrium, at the same rate, in detail, explore, measure, affect, define, run full course, completion, proceed, reverse, irreversible, take place, decrease, reactant, dissolve, release

**2. Read and translate the text.**

Systems in equilibrium are balanced. For example, if you are running on a treadmill you are in constant motion. However, you are not moving forward or backwards. As fast as you run forward the treadmill is moving you backwards. You are in equilibrium with the treadmill.

In the same way chemical reactions can be in equilibrium (the products and reactants are produced at the same rate). We will begin by exploring chemical equilibrium in more detail. To define chemical equilibrium we need to ask some important questions about reactions:

1. Does a reaction always run its full course so that all the reactants are used up?
   * When all the reactants in a reaction are used up the reaction is said to have **gone to completion**. However, in some reactions not all the reactants are used.
2. Does a reaction always proceed in the same direction or can it be reversed? In other words, does a reaction always proceed *reactants*→→*products*, or is it possible that a reaction will reverse and go *products*→→*reactants*?
   * Reactions that go to completion are *irreversible*. However, in some reactions the reactants form products (in a forward reaction), and the products can change back into reactants (in a reverse reaction).
3. Can a reaction reach a point where reactants are still present, but there does not seem to be any further change taking place in the reaction?
   * In all reactions, as the amount of reactant in a reaction decreases the product is formed more slowly. In a reversible reaction, as the amount of product increases the reactant is formed more quickly. Eventually the rate of the forward reaction (reactants →→ products) equals the rate of the reverse reaction (products →→ reactants).

At this point there are still reactants present but there does not *appear* to be any further change taking place. The reaction is said to be in chemical equilibrium.

Chemical equilibrium is the state of a reversible reaction where the rate of the forward reaction equals the rate of the reverse reaction. While a reaction is in equilibrium the concentration of the reactants and products are constant.

There are many examples of chemical equilibrium all around you. One example is a bottle of fizzy cool drink. In the bottle there is carbon dioxide (CO2) dissolved in the liquid. There is also CO2 gas in the space between the liquid and the cap. There is a constant movement of CO2 from the liquid to the gas phase, and from the gas phase into the liquid. However, if you look at the bottle there does not appear to be any change. The system is in equilibrium.

CO2(g)+H2O(l)⇌H2CO3(aq)CO2(g)+H2O(l)⇌H2CO3(aq)

Without chemical equilibrium life as we know it would not be possible. Another example of equilibrium in our everyday lives goes on within our very bodies. Haemoglobin is a macromolecule that transports oxygen around our bodies. Without it we would not survive. The haemoglobin has to be able to take up oxygen, but also to release it and this is done through changes in the chemical equilibrium of this reaction in different places in our bodies.

**3. Answer the questions.**

1. What is the example of the system in equilibrium?

2. What reaction is said to have gone to completion?

3. What is a reverse reaction?

4. What reaction is said to be in chemical equilibrium?

5. What is chemical equilibrium?

**4. Make questions for the given answers:**

## **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

With increase in temperature, the equilibrium constant decreases during an exothermic reaction.

## **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

## A catalyst has no effect on the chemical equilibrium

## **3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

There is no effect on chemical equilibrium on addition of inert gas.

## **4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

A reaction in which the reactants are converted to products only is called a forward reaction.

## **5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

## A reaction in which the products are converted back to reactants is called backward reaction.

**5. Compose a story on one of the topics (up to 100 words):**

* Chemical equilibrium
* Factors affecting chemical equilibrium

UNIT 10  
Organic Chemistry

**1. Read and translate the words. Learn them by heart.**

wide-ranging, overlap, besides, starch, divide into, in addition to, to be composed of, dye, on the other hand , durable, to occur, charcoal, lubricant, rust, sublimation point, linear pattern

**2. Read and translate the text.**

**Organic chemistry**

Organic chemistry is the study of compounds that contain the element [carbon](https://www.ducksters.com/science/chemistry/carbon.php). This is a wide-ranging topic that overlaps with other sciences like biochemistry, medicine, and materials science. Organic chemists study the properties, structure, and chemical reactions of organic compounds.  
Carbon is the central element to all living organisms. It is the basis to all life on earth. By studying carbon and organic compounds, scientists can learn more about life, the human body, and how it works.  
Most organic molecules are made up of long rings or chains of carbon atoms with atoms of other elements attached. Common elements besides carbon (C) that are found in organic compounds include hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), and sulfur (S). Some examples of organic molecules include:

* [Carbohydrates](https://www.ducksters.com/science/biology/carbohydrates.php) - Carbohydrates consist only of carbon, hydrogen, and oxygen. They include starches and sugars and play an important role in our daily lives.
* [Lipids](https://www.ducksters.com/science/biology/lipids.php) - Lipids include fats and waxes. They are used for long term storage of energy in life forms.
* [Proteins](https://www.ducksters.com/science/biology/proteins_and_amino_acids.php) - Proteins are made up of long chains of amino acids. Proteins play an important role in nearly every process that takes place in cells.
* [Nucleic Acids](https://www.ducksters.com/science/biology/dna.php) - Nucleic acids make up long chains of components such as DNA and RNA. DNA carries information such as genes for protein molecules to use. The RNA helps to move the DNA code from storage to where it can be used.

There are a number of types of organic compounds. Scientists divide these up into functional groups based on the type of element common to the group in addition to carbon. These groups have similar properties because they have similar molecules.

Hydrocarbons form a functional group of organic compounds that are composed of only [hydrogen](https://www.ducksters.com/science/chemistry/hydrogen.php) and carbon atoms. Within the group of hydrocarbons are other groups such as alkanes. Alkanes include ethane, propane, methane, and butane. A lot of these compounds are used for heating and cooking. Other groups of hydrocarbons are alkenes, and alkynes. Other elements that carbon combines with to form organic compounds include oxygen, nitrogen, sulfur, phosphorus, and boron. Organic synthesis is the process of making organic compounds. Many of the products we use everyday are made from organic compounds produced in large factories. Examples of these include plastics, alcohols, rubber, and dyes.

We learned that organic chemistry is the study of compounds containing carbon. Biochemistry, on the other hand, is the study of chemical processes in biological systems. These two sciences often overlap as organic compounds play an important role in many chemical processes.  
Carbon occurs in its pure form in nature as graphite and diamond.

* Around 18 percent of the human body is carbon atoms.
* Charles Goodyear found that combining rubber with sulfur allowed the rubber to be more durable across temperatures.
* Synthetic dyes made from organic compounds have allowed the manufacture of dyes rather than using plants for dyes.
* DNA molecules are very long. If you stretched one out it would be about three feet long.

**3. Are the sentences True or False? Correct the false sentences**

1. Hydrogen is the central element to all living organisms

2. Organic chemistry overlaps with other sciences like inorganic chemistry, physics and physical education

3. By studying organic compounds, people can learn more about the human body and how it works.

4. Lipids include fats and starches

5. Proteins are made up of short chains of amino acids, but they play an important role in nearly every process that takes place in cells.

6. Alkanes include ethyne, propyne, butyne, pentyne.

7. More than half of all atoms of human organism is carbon ones.

8. Synthetic dyes made from organic compounds save the plants.

**4. Match the sentences.**

|  |  |
| --- | --- |
| 1. Carbon is the basis for organic chemistry\_\_\_\_\_\_ | a \_\_\_\_\_\_ forming nearly ten million compounds. |
| 2. Carbon is a nonmetal that can bond with itself and many other chemical elements, \_ | b \_\_\_\_\_\_ The German and French words for charcoal are similar. |
| 3. Elemental carbon can take the form of one of the hardest substances (diamond) \_\_\_\_\_\_\_\_\_\_ | c \_\_\_\_\_\_ hydrogen, helium, and oxygen are found in higher amounts, by mass. |
| 4. Carbon is made in the interiors of stars, \_\_\_\_\_\_\_\_ | d \_\_\_\_\_\_ and has been known since prehistoric time. |
| 5. Carbon compounds have limitless uses. In its elemental form, diamond is a gemstone and used for drilling/cutting; graphite is used in pencils, as a lubricant, and to protect against rust; \_\_\_\_\_\_\_\_\_\_\_ | e \_\_\_\_\_\_\_\_ as it occurs in all living organisms. |
| 6. Carbon has the highest melting/sublimation point of the elements. The melting point of diamond is ~3550°C, \_\_\_\_\_\_\_\_\_ | f \_\_\_\_\_\_ though it was not produced in the Big Bang. |
| 7. Pure carbon exists free in nature \_\_\_\_\_\_\_\_\_\_\_\_\_ | g \_\_\_\_\_\_or one of the softest (graphite). |
| 8. The origin of the name 'carbon' comes from the Latin word carbo, for charcoal; \_\_\_\_\_\_\_\_\_\_ | h \_\_\_\_\_\_ although inhalation of fine particles, such as soot, can damage lung tissue. |
| 9. Pure carbon is considered non-toxic, \_\_\_\_\_\_\_\_\_\_\_ | i \_\_\_\_\_\_ while charcoal is used to remove toxins, tastes, and odors. |
| 10. Carbon is the fourth most abundant element in the universe, though \_\_\_\_\_\_\_\_\_\_ | j \_\_\_\_\_\_ with the sublimation point of carbon around 3800°C. |

**5. Compose a story on one of the topics (up to 100 words):**

* Organic chemistry as a science
* Carbon as a central element of organic chemistry

UNIT 11  
Pharmacology

**1. Look up new words given below in your dictionary and memorise them.**

Pharmacology, mode, drugs, cells, to fail, to treat, [treatise](https://www.merriam-webster.com/dictionary/treatise), herbal plant, purify, crude plant, vast array, [chemical synthesis](https://www.britannica.com/science/chemical-synthesis), become aware of, to seek, medical [compounds](https://www.merriam-webster.com/dictionary/compounds), engage in, administer drugs, carry out, vast expansion

**2. Read and translate the text:**

Pharmacology is more than the study of the mode of action of drugs. It is a science which uses the basic concepts of biology and chemistry to determine how drugs affect the organism; it gives a unique perspective in understanding how cells, organ systems, and organisms function. Unlike other basic science fields, pharmacology is a special field in which one can systematically investigate the mechanism for a biological event--from the molecular level to the whole animal. Pharmacology also allows us to study how biological systems fail to function, providing information on the etiology of disease. Pharmacologic research is essential for the development, testing and clinical use of drugs to treat disease

The first Western pharmacological [treatise](https://www.merriam-webster.com/dictionary/treatise), a listing of herbal plants used in classical medicine, was made in the 1st century AD by the Greek physician Dioscorides. A truly scientific pharmacology developed only after advances in [chemistry](https://www.britannica.com/science/chemistry) and [biology](https://www.britannica.com/science/biology) in the late 18th century enabled drugs to be standardized and purified. By the early 19th century, French and German chemists had isolated many active substances—morphine, strychnine, atropine, [quinine](https://www.britannica.com/science/quinine), and many others—from their crude plant sources.

Pharmacology was firmly established in the later 19th century by the German Oswald Schmeiderberg (1838–1921). He defined its purpose, wrote a textbook of pharmacology, helped to found the first pharmacological journal, and, most importantly, headed a school at Strasbourg that became the nucleus from which independent departments of pharmacology were established in universities throughout the world.

In the 20th century, and particularly in the years since [World War II](https://www.britannica.com/event/World-War-II), pharmacological research has developed a vast array of new drugs, including antibiotics, such as penicillin, and many hormonal drugs, such as insulin and cortisone. Pharmacology is presently involved in the development of more effective versions of these and a vast array of other drugs through [chemical synthesis](https://www.britannica.com/science/chemical-synthesis) in the laboratory. It also seeks more efficient and effective ways of administering drugs through clinical research on large numbers of patients.

During the early 20th century, pharmacologists became aware that a relation exists between the [chemical](https://www.britannica.com/science/chemical-analysis) structure of a [compound](https://www.merriam-webster.com/dictionary/compound) and the effects it produces in the body. Since that time, increasing emphasis has been placed on this aspect of pharmacology, and studies routinely describe the changes in drug action resulting from small changes in the chemical structure of the drug. Because most medical [compounds](https://www.merriam-webster.com/dictionary/compounds) are [organic](https://www.britannica.com/science/organic-chemistry) chemicals, pharmacologists who engage in such studies must necessarily have an understanding of organic chemistry.

Important basic pharmacological research is carried out in the research laboratories of [pharmaceutical](https://www.britannica.com/technology/pharmaceutical) and chemical companies. After 1930 this area of pharmacological research underwent a vast and rapid expansion, particularly in the [United States](https://www.britannica.com/place/United-States) and Europe.

**3. Answer the questions:**

1. What is pharmacology?

2. What concepts does pharmacology use?

3. What is the difference between pharmacology and other sciences?

4. What did Oswald Schmeiderberg do?

5. What achievements have been made since World war II?

6. What area of pharmacological research underwent a vast and rapid expansion after 1930?

**4. Complete the gaps with a word from the box.**

***predict deals routine test clinical observations***

The work of pharmacologists in industry 1. \_\_\_\_\_\_\_ also with the exhaustive tests that must be made before promising new [drugs](https://www.britannica.com/science/drug-chemical-agent) can be introduced into medical use. Detailed 2. \_\_\_\_\_\_\_\_\_ of a drug’s effects on all systems and organs of laboratory animals are necessary before the physician can accurately 3. \_\_\_\_\_\_\_\_\_ both the effects of the drug on patients and their potential toxicity to humans in general. The pharmacologist does not himself 4. \_\_\_\_\_\_\_\_ the effects of drugs in patients; this is [done](https://www.britannica.com/dictionary/done) only after exhaustive tests on animals and is usually conducted by physicians to determine the 5. \_\_\_\_\_\_\_\_ effectiveness of new drugs. Constant testing is also required for the 6. \_\_\_\_\_\_\_ control and standardization of drug products and their potency and purity.

**5. Compose a story on one of the topics (up to 100 words):**

* Pharmacology in the history of the mankind
* Pharmacology as a science

UNIT 12  
Pharmacology and pharmacy

**1. Look up new words given below in your dictionary and memorise them.**

reduce, side effects, addiction, renal, intracellular metabolism, intracellular regulation, health care provider, to be considered, [harmful](https://kids.kiddle.co/Harm) effect, to prevent, [abuse](https://kids.kiddle.co/Abuse), absorption, distribution, excretion, get rid of, bile, are often licensed, over-the-counter

**2. Read and translate the text.**

**Pharmacology and pharmacy**

Pharmacology is the science of drugs and their effect on living systems, or, in other words,it is the study of how medicine and other things have an effect on living [organisms](https://kids.kiddle.co/Organism) and change how they function. Pharmacology could also be defined as the study of how medicine actually works.

You can find pharmacology everywhere, when you visit the dentist and when you take any type of medicine. Pharmacology is responsible for painkillers, caffeine drinks and antibiotics. Without pharmacologists we wouldn’t be able to:

* discover new medicines to help fight diseases
* improve their effectiveness and reduce unwanted side effects
* understand why people have different responses to medicines, and why some work better for some people than others
* understand why some drugs cause addiction

A variety of topics involved with pharmacology, including neuropharmacology, renal pharmacology, human [metabolism](https://kids.kiddle.co/Metabolism), intracellular metabolism, and intracellular regulation.

Mind that pharmacology is not exactly the same as [pharmacy](https://kids.kiddle.co/Pharmacy), and a pharmacologist is not exactly the same as a [pharmacist](https://kids.kiddle.co/Pharmacist). A pharmacologist is a scientist who studies how medicine actually works, and usually works in a science lab. Pharmacologists work in a team with [biochemists](https://kids.kiddle.co/Biochemist), [geneticists](https://kids.kiddle.co/Genetics), [microbiologists](https://kids.kiddle.co/Microbiology), [toxicologists](https://kids.kiddle.co/Toxicology) and [pharmacists](https://kids.kiddle.co/Pharmacist) to run clinical tests on how drugs work.

A pharmacist is a health care provider who usually works at a pharmacy. However, there is an overlap between these two fields. A pharmacist could be considered a type of pharmacologist. While in school, pharmacists do take many classes in pharmacology.

If something can be used as a [medicine](https://kids.kiddle.co/Medicine), it is called a pharmaceutical. Pharmacology includes how drugs are made, how they interact with living [organisms](https://kids.kiddle.co/Organism), what [harmful](https://kids.kiddle.co/Harm) effects they could have, how they can be used as medicines, and if they can be used to prevent illness.

The development of drugs is very important to medicine, but it also has strong economical and political uses. To protect people and prevent [abuse](https://kids.kiddle.co/Abuse), some countries try to control the way in which drugs are made, sold, and administered.

When a pharmacologist is talking about pharmacokinetic properties of a chemical, they are interested in four things: ADME.

* **Absorption** - How is the medication absorbed (through the skin, the intestine, the mouth)?
* **Distribution** - How does it spread through the organism?
* **Metabolism** - Is the medication converted chemically inside the body, and into what. Are these new substances active? Could they be toxic?
* **Excretion** - How does the organism get rid of the chemical (through the [bile](https://kids.kiddle.co/Bile), [urine](https://kids.kiddle.co/Urine), [breath](https://kids.kiddle.co/Breathing), [skin](https://kids.kiddle.co/Skin))?

Drugs that are given to people to help cure them of a medical condition or help reduce the symptoms are often licensed. They can be divided into three groups: over-the-counter, where anybody can buy the drug from a shop; prescription-only medicine, where a [doctor](https://kids.kiddle.co/Medical_doctor) has to say that a person is allowed to take a drug; and in some countries, pharmacy medicines, where only a registered [pharmacy](https://kids.kiddle.co/Pharmacy) can sell a drug. Most over-the-counter medication will not hurt a person if they take a bit more than they are meant to. Medications are often produced by pharmaceutical companies and are often [patented](https://kids.kiddle.co/Patent). Drugs that are not patented are called generic drugs.

**3. Answer the questions:**

1. What is pharmacology?

2. What is the difference between the pharmacy and pharmacology?

3. What is a side effect?

4. What things is a pharmacologist interested in?

5. What groups can we divide drugs into?

6. What drugs are called generic?

**4. Fill in the gaps.**

***prevent interactions negative side effects food avoided milk***

### ****Drug interactions.****

**Drug - drug interactions can be positive or 1. \_\_\_\_\_\_\_\_\_\_\_\_\_**. For example – many drugs negatively interact with one another. One drug can 2. \_\_\_\_\_\_\_\_\_\_\_\_\_ the metabolism of another drug, increasing the risk of 3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and toxic reactions. Some drugs prevent the mechanism of action of other drugs. There are too many drug interactions to list here and you are not expected to know all these 4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. However, it is important you are aware of how drugs can interact with one another.

Similarly, drugs can interact with 5. \_\_\_\_\_\_\_\_\_\_\_\_\_. The antibacterial drug class, tetracyclines, for example, interacts with calcium ions. This means that, if the patient takes 6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ along with their tetracycline drug, it interacts with and prevents the antibacterial drug from working. For this reason, milk must be 7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ before/after the patient takes the drug. There are hundreds of other food-drug interactions.

**5. Compose a story on one of the topics (up to 100 words):**

* Pharmacology and medicine
* Drug interactions

UNIT 13  
Biochemistry

**1. Look up new words given below in your dictionary and memorise them.**

crossover fields, single-celled, to survive, rely on, reactant, eventually, citric acid, breakdown, plenty of, pathway, digest, cornerstones, substrate, grab on, pick up, clot

**2. Read and translate the text.**

**Biochemistry**

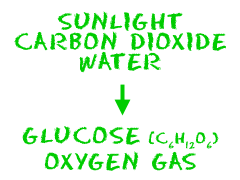
Biochemistry is one of the crossover fields of chemistry. Biochemists have to understand both the living world and the chemical world. Even if you don’t want to become a biochemist, you'll still have to understand [atoms](http://www.chem4kids.com/files/atom_intro.html) and molecules as a biologist. You'll also have to know about [organic chemistry](http://www.chem4kids.com/files/bio_organic.html); a much bigger area of chemistry.

The key thing to remember is that biochemistry is the chemistry of the living world. Plants, animals, and single-celled organisms all use the same basic chemical [compounds](http://www.chem4kids.com/files/atom_compounds.html) to live their lives. Biochemistry is not about the cells or the organisms. It's about the smallest parts of those organisms, the molecules. It's also about the cycles that create those biological compounds.

You can probably guess that biochemical [cycles](http://www.chem4kids.com/files/bio_cycles.html) repeat over and over. Those cycles allow living creatures to survive on Earth. It could be the constant process of photosynthesis that creates [sugars](http://www.chem4kids.com/files/bio_carbos.html) in plants or building complex proteins in the cells of your body. Also, cycles rely on [enzymes](http://www.chem4kids.com/files/bio_enzymes.html) and other [proteins](http://www.chem4kids.com/files/bio_proteins.html) to move the atoms and molecules. Understanding the helper molecules is as important as learning about the cycles themselves.

Every cycle has a place, and each one is just a small piece that helps an organism survive. In each cycle, molecules are used as reactants and then transformed into products. Life is one big network of activity where each piece relies on all of the others. A compound, such as an herbicide, may only break one part of one cycle in a plant. However, because everything needs to work together, the whole plant eventually dies. [Environmental chemists](http://www.chem4kids.com/files/bio_environment.html) look at the way chemical compounds affect living things and the world around you.

We may have been talking about cycles to this point. However, we think it's important that you understand the different types of molecules you will find in biochemistry. We aren't going to go into the citric acid cycle and its ten steps. We won't even look at the eleven steps involved in the breakdown of glucose. At your level of understanding, it's enough to know the difference between a [steroid](http://www.chem4kids.com/files/bio_lipids.html), an [amino acid](http://www.chem4kids.com/files/bio_aminoacid.html), and a carbohydrate. There will be plenty of time for you to memorize the pathways and the movement of molecules during each step of a cycle.

Metabolism is such a big word to explain a simple idea. We all need energy to survive. Whether we are plants, animals, or bacteria, we all need energy. Energy doesn't just float around in a form we can use to survive. We need to eat (mainly sugars) and digest food. That process of chemical digestion and its related reactions is called metabolism. Metabolism is the total of all the chemical [reactions](http://www.chem4kids.com/files/react_intro.html) an organism needs to survive. Sounds a lot like biology. Why is it here in biochemistry? There are two main chemical processes that make our world go round, involving two simple chemical reactions. The first is called glycolysis. That's the breakdown of [sugars](http://www.chem4kids.com/files/bio_carbos.html). The second process is called photosynthesis. That is the series of reactions that builds sugars. You need to remember that the overall metabolism of an organism includes thousands of chemical reactions. The reactions in glycolysis and photosynthesis are just the cornerstones to life.

**3. Are the sentences true or false?**

1. Biochemists have to understand only the living world and molecules construction.

2. Just the simplest organisms use basic chemical compounds to live.

3. Biochemistry is a science about the cells.

4. Biochemical [cycles](http://www.chem4kids.com/files/bio_cycles.html) rely on [enzymes](http://www.chem4kids.com/files/bio_enzymes.html) and other [proteins](http://www.chem4kids.com/files/bio_proteins.html).

5. Photosynthesis is the total of all the chemical [reactions](http://www.chem4kids.com/files/react_intro.html) an organism needs to survive.

**4. Fill in the gaps.**

***molecule pick up enzymes combined grab ready bonds***

**Four Steps of Enzyme Action**

1. The enzyme and the substrate are in the same area.

Some situations have more than one substrate 1. \_\_\_\_\_\_\_\_\_\_\_\_\_ that the enzyme will change.  
  
2. The enzyme grabs on to the substrate at a special area called the active site.

The combination is called the enzyme/substrate complex. 2. \_\_\_\_\_\_\_\_\_\_\_\_\_ are very, very specific and don't just 3. \_\_\_\_\_\_\_\_\_\_ on to any molecule. The active site is a specially shaped area of the enzyme that fits around the substrate. The active site is like the grasping claw of the robot on the assembly line. It can only 4. \_\_\_\_\_\_\_\_\_\_\_\_ one or two parts.  
  
3. A process called catalysis happens.

Catalysis is when the substrate is changed. It could be broken down or 5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ with another molecule to make something new. It will break or build chemical 6. \_\_\_\_\_\_\_\_\_\_\_\_\_. When done, you will have the enzyme/products complex.  
  
4. The enzyme releases the product.

When the enzyme lets go, it returns to its original shape. It is then 7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ to work on another molecule of substrate.

**5. Compose a story on one of the topics (up to 100 words):**

* Biochemistry as a science
* Metabolism

UNIT 14  
Environmental chemistry

**1. Look up new words given below in your dictionary and memorise them.**

occur, chemical species, soil, aquatic chemistry, analytical chemistry, uncontaminated environment, release, substance, sophisticated, harmful effect, approach, apparent, research, body, nutrients, leach, eutrophication, impervious surfaces, hydrocarbon compound, sediment, organometallic compound

**2. Read and translate the text:**

Environmental chemistry is the scientific study of the chemical and biochemical phenomena that occur in natural places. It can be defined as the study of the sources, reactions, transport, effects, and fates of chemical species in the air, soil, and water environments; and the effect of human activity on these. This is an interdisciplinary science that includes atmospheric, aquatic and soil chemistry, as well as analytical chemistry.

Environmental chemistry starts by understanding how the uncontaminated environment works. It identifies the chemicals that are present naturally and studies the concentration and effects of those chemicals. Then, it accurately studies the effects humans have on the environment through the release of chemicals.

This branch of science is closely connected with contamination. A contaminant is a substance present in nature at a level higher than typical levels or that would not otherwise be there. This may be due to human activity. The term contaminant is often used interchangeably with pollutant, which is a substance that hurts the surrounding environment. While a contaminant is sometimes defined as a substance present in the environment as a result of human activity, but without harmful effects, it is sometimes the case that toxic or harmful effects from contamination only become apparent at a later date.

Environmental chemistry is used by the Environment Agency (in England and Wales), the Environmental Protection Agency (in the United S tates) the Association of Public Analysts, and other environmental agencies and research bodies around the world to detect and identify the nature and source of pollutants. These can include:

* Heavy metal contamination of land by industry. These can then be transported into water and be taken up by living organisms.
* Nutrients leaching from agricultural land into water, which can lead to algal blooms and eutrophication.
* Urban runoff of pollutants washing off impervious surfaces (roads, parking lots, and rooftops) during rain storms. Typical pollutants include gasoline, motor oil and other hydrocarbon compounds, metals, nutrients and sediment (soil).
* Organometallic compounds.

Quantitative chemical analysis is a key part of environmental chemistry, since it provides the data that frame most environmental studies.

Common analytical techniques used for quantitative determinations in environmental chemistry include classical wet chemistry, such as gravimetric, titrimetric and electrochemical methods. More sophisticated approaches are used in the determination of trace metals and organic compounds.

Other parameters often measured in environmental chemistry are radiochemicals. These are pollutants which emit radioactive materials, such as alpha and beta particles, posing danger to human health and the environment.

**3. Answer the questions:**

1. What does environmental chemistry study?

2. What does this science include?

3. What is a contaminant?

4. How do we start the study of environmental chemistry?

5. What is this branch of science closely connected with?

6. What environmental agencies use this branch of science?

7. What is a key part of environmental chemistry? Why?

**4. Write derivatives:**

Contamination \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

pollution \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

surround \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

emit \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dangerous \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

environment \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

identify \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**5. Compose a story on one of the topics (up to 100 words):**

* Key parts of environmental chemistry
* Contamination

UNIT 15  
Analytical Chemistry

**1. Look up new words given below in your dictionary and memorise them.**

indicate, visible, sample, reveal, amount, impart, ignite, pure, quantify, constitute, bench chemistry, [precipitation](https://kids.kiddle.co/Chemical_precipitation), extraction, [distillation](https://kids.kiddle.co/Distillation), solubility, odor, chromatography, [contiguous](https://www.merriam-webster.com/dictionary/contiguous), solvent extraction, versatile, attogram, [forensic science](https://www.britannica.com/science/forensic-science), abused drugs,

**2. Read and translate the text:**

Over the years, chemists have discovered chemical reactions that indicate the presence of such elemental substances by the production of easily visible and identifiable products. Iron can be detected by chemical means if it is present in a sample to an amount of 1 part per million or greater. Some very simple qualitative tests reveal the presence of specific chemical elements in even smaller amounts. The yellow colour imparted to a flame by sodium is visible if the sample being ignited has as little as one-billionth of a gram of sodium. Such analytic tests have allowed chemists to identify the types and amounts of impurities in various substances and to determine the properties of very pure materials.

Analytical chemistry studies and uses instruments and methods to [separate](https://kids.kiddle.co/Separation_process), identify, and quantify matter. A sample job would be trying to see how much [zinc](https://kids.kiddle.co/Zinc) is in a piece of [brass](https://kids.kiddle.co/Brass). In practice, separation, identification or quantification may constitute the entire analysis or be combined with another method. [Qualitative analysis](https://kids.kiddle.co/Qualitative_analysis) finds out what [chemical species](https://kids.kiddle.co/Chemical_species) are in the sample and how much there is of each component in the substance. Components are often separated before this analysis.

Analytical chemistry consists of classical, [wet chemical methods](https://kids.kiddle.co/Wet_chemistry) and modern, [instrumental methods](https://kids.kiddle.co/Analytical_chemistry#Instrumental_methods).

Wet chemistry (or classic chemistry/ classical chemistry) studies [chemical reactions](https://kids.kiddle.co/Chemical_reaction) that [occur](https://kids.kiddle.co/) in the [liquid](https://kids.kiddle.co/Liquid) [phase](https://kids.kiddle.co/States_of_matter). It is also called bench chemistry because many of the tests performed are done at a lab bench. Wet chemistry uses [laboratory glassware](https://kids.kiddle.co/Laboratory_glassware), such as [beakers](https://kids.kiddle.co/Beaker) and [flasks](https://kids.kiddle.co/Flask), without [quantitative chemical analysis](https://kids.kiddle.co/Analytical_chemistry) using [instrumentation](https://kids.kiddle.co/Instrumentation). Many high school and college [laboratories](https://kids.kiddle.co/Laboratory) teach students basic wet chemistry methods, but now many of them have been [automated](https://kids.kiddle.co/Automation) and [computerized](https://kids.kiddle.co/Computer) for faster analysis.

Classical qualitative methods use separations such as [precipitation](https://kids.kiddle.co/Chemical_precipitation), extraction, and [distillation](https://kids.kiddle.co/Distillation). Identification may be based on differences in color, odor, melting point, boiling point, solubility, radioactivity or reactivity. Classical quantitative analysis uses mass or volume changes to quantify amount.

Instrumental methods may be used to separate samples using [chromatography](https://kids.kiddle.co/Chromatography), electrophoresis or field flow fractionation.

**Chromatography**, technique for separating the components, or [solutes](https://www.britannica.com/science/solute), of a mixture on the basis of the relative amounts of each solute distributed between a moving fluid stream, called the [mobile phase](https://www.britannica.com/science/mobile-phase), and a [contiguous](https://www.merriam-webster.com/dictionary/contiguous) [stationary phase](https://www.britannica.com/science/stationary-phase-chromatography). The mobile phase may be either a [liquid](https://www.britannica.com/science/liquid-state-of-matter) or a [gas](https://www.britannica.com/science/gas-state-of-matter), while the stationary phase is either a [solid](https://www.britannica.com/science/solid-state-of-matter) or a liquid.

As a separation method, chromatography has a number of advantages over older techniques—crystallization, solvent extraction, and [distillation](https://www.britannica.com/science/distillation), for example. It is capable of separating all the components of a multicomponent chemical mixture without requiring an extensive foreknowledge of the identity, number, or relative amounts of the substances present. It is versatile in that it can deal with molecular species ranging in size from [viruses](https://www.britannica.com/science/virus) composed of millions of [atoms](https://www.britannica.com/science/atom) to the smallest of all molecules—[hydrogen](https://www.britannica.com/science/hydrogen)—which contains only two; furthermore, it can be used with large or small amounts of material. Some forms of chromatography can detect substances present at the attogram (10−18 gram) level, thus making the method a superb trace [analytical](https://www.merriam-webster.com/dictionary/analytical) technique extensively used in the detection of chlorinated [pesticides](https://www.britannica.com/technology/pesticide) in biological materials and the [environment](https://www.merriam-webster.com/dictionary/environment), in [forensic science](https://www.britannica.com/science/forensic-science), and in the detection of both therapeutic and abused drugs. Its resolving power is unequaled among separation methods.

Chromatography is much used in [biochemistry](https://kids.kiddle.co/Biochemistry) and [analytical chemistry](https://kids.kiddle.co/Analytical_chemistry).

**3. Answer the questions:**

1. How can most materials that occur on the Earth be defined?

2. Can you give examples of a pure chemical substance?

3. What is analytical chemistry?

4. What reveals the presence of specific chemical elements in even small amounts of a product?

5. What allows chemists to identify the types and amounts of impurities in various substances and to determine the properties of very pure materials?

6. What is the difference between qualitative and quantitative analysis?

7. What is chromatography?

**4. Fill in the gaps with an appropriate words**

*chemists techniques narrow analytic material components identify accurate billion instrument*

Sophisticated analytic instruments have improved the accuracy with which 1. \_\_\_\_\_\_can identify substances and have lowered detection limits. An 2. \_\_\_\_\_ technique in general use is [gas chromatography](https://www.britannica.com/science/gas-chromatography), which separates the different 3. \_\_\_\_\_\_\_ of a gaseous mixture by passing the mixture through a long, 4. \_\_\_\_\_\_\_ column of absorbent material. The different gases interact differently with this absorbent 5. \_\_\_\_\_\_\_ and pass through the column at different rates. As the separate gases flow out of the column, they can be passed into another analytic 6. \_\_\_\_\_\_ called a [mass spectrometer](https://www.britannica.com/science/mass-spectrometer), which separates substances. A combined [gas](https://www.britannica.com/science/gas-state-of-matter) chromatograph–mass spectrometer can rapidly 7. \_\_\_\_\_\_\_ the individual components of a chemical mixture which concentrations may be no greater than a few parts per 8. \_\_\_\_\_\_. Similar or even greater sensitivities can be obtained under favourable conditions using 9. \_\_\_\_\_\_\_ such as atomic absorption, polarography, and neutron activation. The rate of instrumental [innovation](https://www.merriam-webster.com/dictionary/innovation) is such that analytic instruments often become outdated within 10 years. Newer instruments are more 10. \_\_\_\_\_\_ and faster and are employed widely in the areas of environmental and medicinal chemistry.

**5. Compose a story on one of the topics (up to 100 words):**

* Analytical chemistry and its methods
* [Qualitative analysis](https://www.thoughtco.com/definition-of-qualitative-analysis-604626) and [quantitative analysis](https://www.thoughtco.com/definition-of-quantitative-analysis-604627) in analytical chemistry.

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Keys

**Unit 1**

ex 4 1. b, 2. c, 3. a

**Unit 2**

**ex 4**

[Elements](http://www.chem4kids.com/files/elem_intro.html) are pieces of matter where all of the atoms have the same chemical properties. Elements are made of similar atoms. We want to say the atoms are exactly the same, but that’s not quite true. An element is made of atoms that have the same number of protons. If you have a batch of atoms and they all have the same number of protons, they are all one element.

For example, if the atoms all have four protons, they are beryllium (Be) atoms. Some of those atoms may have four electrons (neutral). Some atoms may have three electrons, leaving the atom with a positive charge ([ions](http://www.chem4kids.com/files/atom_ions.html)). Those ions are still considered beryllium atoms. Neutrons work the same way. You may have four neutrons, but you might also have three or five neutrons. Atoms with the same number of protons and different numbers of neutrons are called [isotopes](http://www.chem4kids.com/files/atom_isotopes.html) of an element. Isotopes and ions are still the same element even though they have different numbers of neutrons and electrons.

**Unit 3**

**ex 3** 1. What are atoms made of? - [Atoms](http://www.chem4kids.com/files/atom_intro.html) are all made of very small parts of matter.

2. What is the difference between mass and matter. Give an example. - Mass is the amount of matter in an object. You might have a small object with a lot of mass such as a statue made of lead (Pb). You might have a large object with very little mass such as a balloon filled with helium (He). You should also know there is a difference between mass and weight. Mass is a measure of the matter in an object while weight is a measure of gravity’s pull on an object.

3. How many states of matter is known (in non-extreme environments)? – 5 states

4. When was plasma identified? - Plasma was a new idea when it was identified by William Crookes in 1879.

5. Who worked with the Bose-Einstein condensate? - The scientists (Cornell, Ketterle, and Wieman)

**Ex 4** What is a physical change in matter? Molecules can move from one physical state to another ([phase change](http://www.chem4kids.com/files/matter_chemphys.html)) and not change their atomic structure. [Oxygen](http://www.chem4kids.com/files/elements/008_speak.html) (O2) gas has the same chemical properties as liquid oxygen. The liquid state is colder and denser (less energy), but the molecules are the same. Water (H2O) is another example. A water molecule is made up of two [hydrogen](http://www.chem4kids.com/files/elements/001_speak.html) (H) atoms and one oxygen (O) atom. It has the same molecular structure whether it is a [gas](http://www.chem4kids.com/files/matter_gas.html), [liquid](http://www.chem4kids.com/files/matter_liquid.html), or [solid](http://www.chem4kids.com/files/matter_solid.html). Although its physical state may change because of different amounts of energy, its atomic structure remains the same. So what is a chemical change in matter? Let's start with that glass of pure water. If the formula of water were to change, that would be a chemical change. If you could add a second oxygen atom to a water (H2O) molecule, you would have hydrogen peroxide (H2O2). The molecules would not be "water" anymore. In reality, there are a variety of steps that go into creating hydrogen peroxide from water.

**Unit 4**

**ex 3. Answer the questions.**

1. How are elements listed in the table? - Elements are listed in the table by the structure of their atoms.

2. Why is the table called “periodic”? - It is called "periodic" because elements are lined up in cycles or periods.

3. What do elements have in common, when they are lined up? - When they are lined up this way, elements in the columns have similar properties.

4. What is a period? - Each horizontal row in the table is a period.

5. How many pediods are there in the table? - There are seven (or eight) total periods.

6. Which period is the shortest? - The first one is short and only has two elements, hydrogen and helium.

7. What are groups? - Groups are the columns of the periodic table.

8. Why is it necessary to understand the lining-up and grouping of similar elements? – The chemists can understand and predict how an element might react or behave in a certain situation.

**ex 4** 1. renowned **a** **famous** b unknown

2. raise a lower **b** **elevate**

3. use **a** **employ** b enable

4. deteriorate a strengthen **b** **weaken**

5. expand a excite **b** **increase**

6. equilibrium **a** **balance** b liquid

7. terminate a begin **b** **end**

8. substantial **a** **massive** b less

**Unit 5**

**ex 4**

**Selenium**

Selenium is one of the most versatile elements of the periodic table. You can find it in many forms (allotropic forms) including reddish crystals and metallic gray. It was named after the moon when discovered in 1817 by the scientist Berzelius. While rare, selenium is normally found in minerals.  
Of the lesser members in the sulfur family, selenium is the most abundant in nature, often found in copper and lead mining. Tellurium and polonium are other members in the same family (and found in the same column of the periodic table).

**Large** amounts of selenium will act as a poison but you need **trace** amounts of this mineral to survive. You usually get selenium in your diet when you eat **meat**.

Probably one of the most well-known uses for selenium is its **use** in solar cells. Selenium has photovoltaic **properties**. That term means that it can convert light into energy. It just makes sense that selenium is an important part of any equipment design to **convert** the Sun's energy into electricity.

**Unit 6**

**ex 3**

**1.** Why is it necessary to wearpersonal protective equipment? - There are potential dangers of exposure to harmful chemicals.

**2.** How many things does the personal protective equipment consist of? Name them. **-** The safety gear to work in the chemistry lab mainly consists of three things:Safety goggles, Lab coat, Latex/Nitrile gloves.

**3.** What part of equipment is the most important and why? – The safety goggles ensure the safety of your eyes. They are one of the most important safety gear, as the eyes are the most vulnerable part of the human body.

**4.** How can the tongs be used? - They are used to hold, transfer or pick small objects out of a reaction container.

**5.** What is a petri dish usually composed of? - It’s typically composed of heat-resistant glass and comes with a lid to keep the sample safe from contamination.

**6.** Which equipment is used to deliver liquid to another container? **–** Burettes, very popular equipment, mostly used in the titration reactions, and is used to deliver a known volume of any substance to other equipment, and pipettes can have various sizes. These are narrow glass cylindrical pipes, used for measuring an exact volume of liquid and placing it into another container.

**Unit 7**

**ex 4** 1. **on;** 2. **matter;** 3. **focuses;** 4. **carbon;** 5. **common;** 6. **chemistry;** 7. **inorganic;** 8. **vinegar**

**Two types of chemistry**

So much of our life relies 1. **on** chemistry. Organic chemistry gives us pharmaceuticals, dyes and detergents — just to name a few. Physical chemistry looks at how 2. **matter** behaves on an atomic level. Biochemistry 3. **focuses** on processes within living organisms, including humans. Plus, analytical chemistry deals with the “maybes” and “what ifs” of the field. Of the five branches, one we tend to take for granted is inorganicchemistry, which looks at interactions that don’t involve 4. **carbon** atoms. Let’s take a closer look at this branch and what it takes to study this field.

Carbon is one of the most 5. **common** elements on the planet. It’s literally the stuff of life. Chemical reactions that involve carbon or have carbon atoms present fall under organic 6. **chemistry**.

However, the majority of reactions are 7. **inorganic**. This branch of chemistry covers every response where carbon isn’t present. If you’ve ever made a spewing volcano by mixing baking soda and 8. **vinegar**, for example, you’ve experimented with inorganic chemistry.

**Unit 8**

**ex 4**

1. The classification of substances into acids and bases has greatly changed.

2. The theory of ionic dissociation has played a great role in the development of chemistry.

3. The problem of nomenclature is still very importantin chemistry.

4. Any explosive substance must be handled with care.

5. The atomic theory was a great contribution to the world’s science.

6. The most important chemical property of oxygen is its acidity.

7. Pure sulphuric acid is a colourless liquid about twice as heavy as water.

8. No branch of science is broarder in its scope than chemistry.

9. Water is the most widely distributed compound.

10. The data must be taken into account in this article.

**Unit 9**

**ex 4**

1. What is the effect of temperature on equilibrium constant during an exothermic reaction?

2. What is the effect of a catalyst on a chemical equilibrium?

3. What is the effect of addition of inert gas during chemical equilibrium?

4. What is meant by forward reaction?

5. What is meant by backward reaction?

**Unit 10**

**ex** **3. True or False**

1. Hydrogen is the central element to all living organisms **(Carbon)**

2. Organic chemistry **overlaps** with other sciences like inorganic chemistry, physics and physical education **(biochemistry, medicine, and materials science)**

3. By studying organic compounds, people can learn more about the human body and how it works. **(Yes, it is true)**

4. Lipids include fats and starches **(waxes).**

5. Proteins are made up of short chains of amino acids, but they play an important role in nearly every process that takes place in cells. **(long)**

6. Alkanes include ethyne, propyne, butyne, pentyne. **(ethane, propane, methane, and butane= alkynes).**

7. More than half of all atoms of human organism is carbon ones. **(Only around 18 percent of the human body is carbon atoms.)**

8. Synthetic dyes made from organic compounds save the plants. **(Yes, synthetic dyes made from organic compounds have allowed the manufacture of dyes rather than using plants for dyes.)**

**Ex 4**

1e; 2a; 3g; 4f; 5i; 6j; 7d; 8b; 9h; 10c

**Unit 11**

**ex 4** The work of pharmacologists in industry deals also with the exhaustive tests that must be made before promising new [drugs](https://www.britannica.com/science/drug-chemical-agent) can be introduced into medical use. Detailed observations of a drug’s effects on all systems and organs of laboratory animals are necessary before the physician can accurately predict both the effects of the drug on patients and their potential toxicity to humans in general. The pharmacologist does not himself test the effects of drugs in patients; this is [done](https://www.britannica.com/dictionary/done) only after exhaustive tests on animals and is usually conducted by physicians to determine the clinical effectiveness of new drugs. Constant testing is also required for the routine control and standardization of drug products and their potency and purity.

1. deals 2. observations; 3. predict; 4. test; 5. clinical; 6. routine

**Unit 12**

**ex 4 Drug interactions**

**Drug - drug interactions can be positive or negative.** For example – many drugs negatively interact with one another. One drug can **prevent** the metabolism of another drug, increasing the risk of **side effects** and toxic reactions. Some drugs prevent the mechanism of action of other drugs. There are too many drug interactions to list here and you are not expected to know all these **interactions.** However, it is important you are aware of how drugs can interact with one another.

Similarly, drugs can interact with **food**. The antibacterial drug class, tetracyclines, for example, interacts with calcium ions. This means that, if the patient takes **milk** along with their tetracycline drug, it interacts with and prevents the antibacterial drug from working. For this reason, milk must be **avoided** before/after the patient takes the drug. There are hundreds of other food-drug interactions.

1. negative, 2. prevent 3. side effects, 4. interactions, 5. food, 6. milk, 7. avoided

**Unit 13**

**ex 3. True or False.**

**1.** Biochemists have to understand only the living world and molecules construction. False. Biochemists have to understand both the living world and the chemical world.

2. Just the simplest organisms use basic chemical compounds to live. False. Plants, animals, and single-celled organisms all use the same basic chemical [compounds](http://www.chem4kids.com/files/atom_compounds.html) to live their lives.

3. Biochemistry is a science about the cells. False. Biochemistry is not about the cells or the organisms. It's about the smallest parts of those organisms, the molecules.

4. Biochemical [cycles](http://www.chem4kids.com/files/bio_cycles.html) rely on [enzymes](http://www.chem4kids.com/files/bio_enzymes.html) and other [proteins](http://www.chem4kids.com/files/bio_proteins.html). True

5. Photosynthesis is the total of all the chemical [reactions](http://www.chem4kids.com/files/react_intro.html) an organism needs to survive. False. Metabolism is the total of all the chemical [reactions](http://www.chem4kids.com/files/react_intro.html) an organism needs to survive.

**Ex 4 Four Steps of Enzyme Action**

1. The enzyme and the substrate are in the same area.

Some situations have more than one substrate **molecule** that the enzyme will change.

2. The enzyme grabs on to the substrate at a special area called the active site.

The combination is called the enzyme/substrate complex. **Enzymes** are very, very specific and don't just **grab** on to any molecule. The active site is a specially shaped area of the enzyme that fits around the substrate. The active site is like the grasping claw of the robot on the assembly line. It can only **pick up** one or two parts. 3. A process called catalysis happens.

Catalysis is when the substrate is changed. It could be broken down or **combined** with another molecule to make something new. It will break or build chemical **bonds**. When done, you will have the enzyme/products complex.

4. The enzyme releases the product.

When the enzyme lets go, it returns to its original shape. It is then ready to work on another molecule of substrate.

**Unit 14**

* **Ex 4** Contamination - [contaminant noun](https://www.oxfordlearnersdictionaries.com/definition/english/contaminant" \o "Definition of contaminant noun in English); [contaminate verb](https://www.oxfordlearnersdictionaries.com/definition/english/contaminate)

pollution - [pollute verb](https://www.oxfordlearnersdictionaries.com/definition/english/pollute); [polluter noun](https://www.oxfordlearnersdictionaries.com/definition/english/polluter)

surround - [surrounding ; surrounded adjective](https://www.oxfordlearnersdictionaries.com/definition/english/surrounding)

emit - [emission noun](https://www.oxfordlearnersdictionaries.com/definition/english/emission); emitted, emitting adjective

dangerous - [danger noun](https://www.oxfordlearnersdictionaries.com/definition/english/danger); [dangerously adverb](https://www.oxfordlearnersdictionaries.com/definition/english/dangerously)

environment - [environmental adjective](https://www.oxfordlearnersdictionaries.com/definition/english/environmental) [environmentally adverb](https://www.oxfordlearnersdictionaries.com/definition/english/environmental)

identify - [identification noun](https://www.oxfordlearnersdictionaries.com/definition/english/identification-parade); [identifier noun](https://www.oxfordlearnersdictionaries.com/definition/english/identifier)

**Unit 15**

**ex 4** Sophisticated analytic instruments have improved the accuracy with which **chemists** can identify substances and have lowered detection limits. An **analytic** technique in general use is [gas chromatography](https://www.britannica.com/science/gas-chromatography), which separates the different **components** of a gaseous mixture by passing the mixture through a long, **narrow** column of absorbent material. The different gases interact differently with this absorbent material and pass through the column at different rates. As the separate gases flow out of the column, they can be passed into another analytic **instrument** called a [mass spectrometer](https://www.britannica.com/science/mass-spectrometer), which separates substances. A combined [gas](https://www.britannica.com/science/gas-state-of-matter) chromatograph–mass spectrometer can rapidly **identify** the individual components of a chemical mixture whose concentrations may be no greater than a few parts per **billion**. Similar or even greater sensitivities can be obtained under favourable conditions using **techniques** such as atomic absorption, polarography, and neutron activation. The rate of instrumental [innovation](https://www.merriam-webster.com/dictionary/innovation) is such that analytic instruments often become outdated within 10 years. Newer instruments are more **accurate** and faster and are employed widely in the areas of environmental and medicinal chemistry.