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Module teaching technology in studying chemistry

Module teaching technology gives us opportunity to assert theoretical material by block-modules. The opportunity of applying of the modeling teaching technology on the chemistry lessons of the 10th class is considered. According to this technology the modules of the topic «Periodic table» are worked out. The methodical treatment is given. By applying this technology the quality of the lesson and interest of the students are increased.

Key words: modular education, system education, block-modules, quality knowledge, psychological-pedagogical direction, radioactivity.

State Program of education development for 2005–2010 years in Republic of Kazakhstan states: «The aim of the secondary education is to educate personality, who uses his knowledge and professional skills to freely analyze variable situations, who enforces his knowledge to life» [1].

Education system is essential basis of development of any country. Nowadays it's vital to develop our education system according to our national model, at the same time not being behind international level. Therefore, the main goal of today's school is to educate qualified and self-searching students. Changeable society problems force us to renew the individual's education. We need to train self-dependent person of wide learning with a high level of ability of thinking, using his knowledge in experiments on its own initiative [2].

One of the best methods to achieve these results is module education. Module teaching is a student-centered, which can optimize the learning process and ensure its integrity to reach the goals of learning, development of cognitive and personal sphere of students. This technology is based on self-searching of students while working with educational, non-fiction and reference books. Modular technology allows you to combine a rigid control of the cognitive activity of students and big opportunities of self-studying.

The content of module teaching consists of:

- Setting a goal of training;
- Concretize a common formed goal;
- Checking the level of students in advance;
- Study in total;
- Checking results.

According to the content, the structure is made of blocks. Each block contains:

- 1) Prologue — teacher explains the aim and structure.
- 2) Speaking part — dividing class into groups containing 2–6 pupils, where they work in teamwork, listen, record, cooperate with each other, and explore the issues.
- 3) Result part — checking part of knowledge which is gained in the second part.

In order to completely understand the topic:

- Repeat studying material;
- Asking every student;
- Solving problems are essential [3].

The annual chemistry program for 10th grades contains 10 hours of «Periodic law and periodic table». We made 1 module to this topic. The block contains 10 lessons, where 4 lessons are prologues, 4 lessons are speaking parts and 2 lessons are checking parts.

Here I introduce to you 6th lesson on topic «Radioactivity» according to the module teaching:

1. Chemistry in Action.
2. We begin by comparing nuclear reactions with ordinary chemical reactions.

We learn to balance nuclear reactions in terms of elementary particles like electrons, protons, neutrons, and alpha particles.

3. Next, we examine nuclear fission and fusion, the atomic bomb, nuclear reactors, the hydrogen bomb.
4. Uses of isotopes, radiocarbon dating.
5. The lesson concludes with a discussion of the biological effects of radiation.

Table 1

Module of «Periodic Law»

Part	Lesson	Content	Duration
Prodrome	1 st lesson	Modern atomic theory Electrons in atoms. Pauli's exclusion. Hund's rule. Klechkovsky's principles. Homework	35 min 5 min
	2 nd lesson	Quantum numbers. Periodic laws and elements Homework	40 min 5 min
Speaking part	3 rd lesson	Electron configuration Result Homework	30 min 5 min 5 min
	4 th lesson	Isotopes. Periodic table Result Homework	40 min 3 min 2 min
Resulting part	5 th lesson	Test Solving exercises	30 min 15 min
	6 th lesson	Radioactivity Homework	40 min 5 min
Speaking part	7 th lesson	Electronegativity	10 min
		Valency, oxidation number	10 min
		Periodic change of main group elements	20 min
		Homework	5 min
Speaking part	8 th lesson	Uses of radioactivity Solving exercises Homework	40 min 5 min
	9 th lesson	Periodic table Solving problems	30 min 15 min
Resulting part	10 th lesson	Exam	45 min

Chemistry in Action

If you eat processed food, you have probably eaten ingredients exposed to radioactive rays. Food is exposed to high levels of radiation to kill insects and harmful bacteria. It is then packaged in airtight containers, in which it can be stored for months without deterioration. The radiation sources for most food preservation are cobalt-60 and cesium-137, both of which are emitters, although X rays and electron beams can also be used to irradiate food [4].

Table 2

Comparison of chemical reactions and nuclear reactions

Chemical reactions	Nuclear reactions
Atoms are rearranged by the breaking and forming of chemical bonds	Elements (or isotopes) are converted from one to another
Only electrons in atomic or molecular orbitals are involved in the breaking and forming of bonds	Protons, neutrons, electrons, and other elementary particles may be involved
The amount of energy released is small	The amount of energy released is tremendous
Rates are influenced by temperature, pressure, concentration, and catalysts	Rates are not affected by temperature, pressure, and catalysts

The spontaneous emission of radioactive rays by an unstable atomic nucleus is called *radioactivity*.

Most radioactive elements have the following properties:

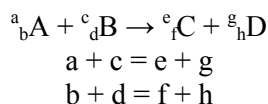
- The ratio between the numbers of neutrons and protons in a nucleus is greater than 1.5.
- The atomic number is bigger than 83 (excludes for example $^{14}_6\text{C}$).

A radioactive substance decays by making three types of emissions. These emissions are named as *alpha*, *beta* and *gamma*, and represented by symbols α , β and γ .

The symbols for elementary particles are as follows:

- alpha particle — ${}^4_2\alpha$ (or ${}^4_2\text{He}$);
- beta particle — ${}^0_{-1}\beta$ (or electron particle);
- gamma particle — ${}^0_0\gamma$;
- neutron — 1_0n ;
- proton — 1_1p (or ${}^1_1\text{H}$).

The balancing of nuclear reactions:



Problems which can be solved during a lesson:

Write the equations of radioactive decay for the following examples:

- a) Alpha emission by ${}^{181}_{78}\text{Pt}$ (Answer: ${}^{181}_{78}\text{Pt} \rightarrow {}^{177}_{76}\text{X} + {}^4_2\text{He}$)
 b) Beta emission by ${}^{25}_{11}\text{Na}$ (Answer: ${}^{25}_{11}\text{Na} \rightarrow {}^{25}_{12}\text{X} + {}^0_{-1}\beta$)
 c) Electron capture by ${}^{37}_{18}\text{Ar}$ (Answer: ${}^{37}_{18}\text{Ar} + {}^0_{-1}\text{e} \rightarrow {}^{37}_{17}\text{X}$)

Nuclear fission

When heavier nuclei bombarded by slow neutrons, the nuclei of lighter elements are formed. This process is called nuclear fission. It produces huge amount of energy and more neutrons than the number of neutrons used to bombard. The produced neutrons may also strike other element (isotopes) and causes new fissions as it shown in the Figure. The new nuclear fission reactions also produce neutrons with huge amounts of energy, and so on. This continuous process is said to be the *atomic bomb*, and is the basic principle of nuclear reactors.

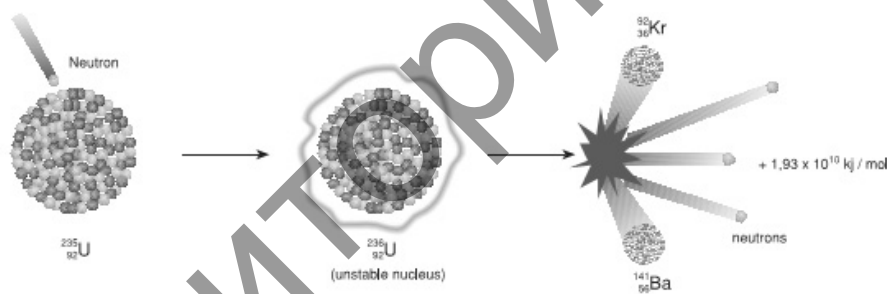


Figure. Disintegration of an ${}^{235}_{92}\text{U}$ nucleus into ${}^{92}_{36}\text{Kr}$ and ${}^{141}_{56}\text{Ba}$ as a result of neutron bombardment

A peaceful but conversational application of nuclear fission is the generation of electricity using heat from a controlled chain reaction in a *nuclear reactor*.

Nuclear fusion

The combination of two or more lighter nuclei to form a heavier is called *nuclear fusion*. The amount of energy released in fusion reactions is greater than the amount of energy released in fission reactions. However, a huge amount of activation energy is needed to initiate nuclear fusion reactions.

Nuclear fusion reactions occur naturally in the sun for about five billion years. These reactions are the only source of energy sustaining life on our planet.

Nuclear fusion is the basis of *hydrogen bomb*. The igniter of hydrogen bomb is an atomic bomb. The power of a hydrogen bomb is about 1000 times greater than that of an atomic bomb [5].

Biological effect of radiation

Radiation is known to be a danger, but this is not totally correct.

Many sources of radiation already exist in our world. In fact, electrical devices such as TV, cellphones, photocopy machines, x-ray machines are common examples.

It has been found that the effects of radiation on some vital tissues (bone marrow, spleen, blood and reproduction cells) are seen more quickly than on other tissues. Because these tissues grow faster than others,

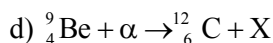
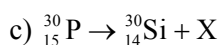
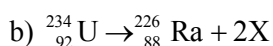
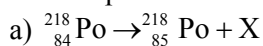
any type of damage in the cells can be easily and quickly transferred into new cells. All cells can be affected by this chain reaction. This can result in tumors, which explains the carcinogenic effect of radiation.

The most important danger is the changes in the DNA structure of a cell. Any change in the structure of DNA causes a change in the structure of chromosomes, which can cause the loss of information stored there. By the formation of a new genetic structure, a new genotype (not similar to the parents) of offspring appears. This change is called «*mutation*».

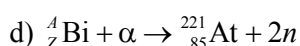
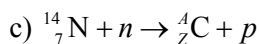
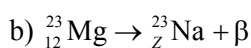
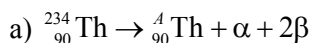
Homework is given for students as follows:

Supplementary questions:

1. When a proton of a radioactive nucleus is transmuted into a neutron, which particles are produced?
2. Find the particles which are represented by X in the following nuclear reaction equations.



3. Find the values of A and Z in the following nuclear reaction equations.



4. If an atom radiates 1α and $2\beta^-$ emissions, what will be the change in the atomic mass number and in the atomic number of the atom?

5. When the element X emits two α particles successively, the isotope ${}_{84}^{218}\text{Po}$ forms. Find the number of neutrons of X.

6. If the radioactive nucleus of ${}_{91}^{234}\text{Pa}$ emits 2α and 1β particles successively, what will be the number of neutrons of the new nucleus produced?

7. What changes are caused by radioactive rays on the human organism?

8. What are the radioactive isotopes and their fields of usage in medicine?

9. Which creature is the most durable in the face of radioactivity?

Now I'd like to write some uses of radioactivity that you will pass on 8th lesson of the module:

Some uses of radioactivity

Smoke detectors. Smoke alarms contain a weak source made of Americium-241.

Thickness control. In paper mills, the thickness of the paper can be controlled by measuring how much beta radiation passes through the paper to a Geiger counter.

Sterilizing. Gamma rays can be used to kill bacteria, mould and insects in food even after it has been packaged.

Radioactive dating. The age of ancient organic material can be found by measuring the amount of carbon-14 that remains. Animals and plants have a known proportion of carbon-14 in their tissues.

Radioactive tracers. Radioisotopes can be used for medical purposes, such as checking for a blocked kidney.

Cancer treatment. Because gamma rays can kill living cells, they are used to kill cancer cells without having to resort to difficult surgery. This is called radiotherapy and works because, unlike healthy cells, cancer cells cannot repair themselves when damaged by gamma rays.

In the petroleum industry. A small amount of radioisotope is placed into oil pipes in order to observe the circulation of oil.

Radiography. A picture can be obtained on film or sensitive plaque with the help of radioactive emissions. This is known in medicine a roentgen film.

The module plan and the lesson above are worked out for 10 grade students and have increased their academic performance.

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Химияны оқытуда модульдік технологияны қолдану

Модульдік оқыту технологиясы теориялық материалдарды блок-модульдермен бекітуге мүмкіндік береді. Мақалада модульдік оқыту технологиясын оныншы сыныптарда қолдану мүмкіндігі көрсетілген. Осы технология бойынша «Периодтық заң» тақырыбына бір модуль талданған және сабақтың әдістемелік ұсыныстары берілген. Технологияны қолдану барысында сабақтың сапасы артады және де тақырыпқа қызығушылық туады.

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Применение модульной технологии при обучении химии

Технология модульного обучения характеризуется опережающим изучением теоретического материала — укрепленными блоками-модулями. В статье рассмотрена возможность применения технологии модульного обучения на уроках в десятом классе. По данной технологии разработан один модуль по теме «Периодический закон» и приведена методическая разработка занятия. Применение технологии позволило повысить качество изучения темы, а также интерес к изучаемому материалу.

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