TEACHING THE TOPIC OF THE STRUCTURE OF ATOMIC ELECTRONIC LAYERS BASED ON INTERACTIVE EDUCATIONAL TECHNOLOGIE

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Abstract: This article presents effective interactive methods for teaching the topic of the structure of atomic electron shells**.**

Keywords: Pedagogy, methodology, brainstorming, chemical rebus, “Confirm” method, “Joy of Knowledge” method, non-standard test

Аннотация: в этой статье представлены эффективные интерактивные методы обучения структуре атомных электронных слоев.

Ключовые слова: Педагогика, методика, мозговой штурм, химический ребус, метод «Подтверждение», метод «Удовольствие от познания», нестандартный тест

We begin the statement of this article with a parable that has been told for a long time. One day, a hungry man by a lake came across a wise man who was fishing and addressed him: "I am hungry, help me!" The wise man responded as follows: "I can give you a fish, you will be full quickly, and after some time, you will again be just as hungry and will ask me for help again. I can give you a fishing rod, but it might break one day, and then you will have to turn to me again. It is better that I teach you how to make a fishing rod; it is long and difficult, but later you will not need my help. Choose your own path..."

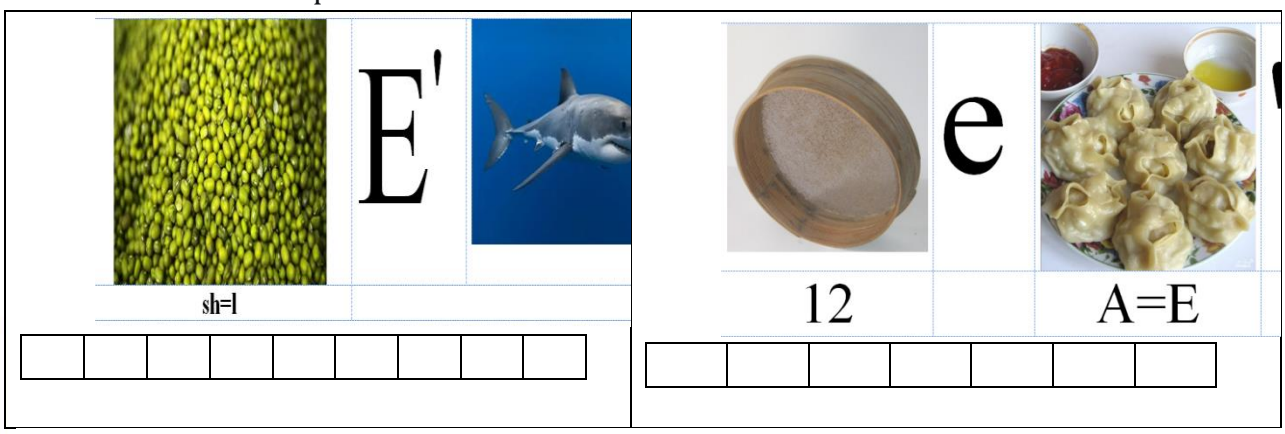
The conclusion drawn from the above parable is that a good teacher must teach the student "how to make a fishing rod," and a smart student, in turn, must learn it. The faster and more solidly students learn "how to make a fishing rod," the more they will be able to obtain their own "catch" without being dependent on others. Researchers confirm that the results of numerous pedagogical experiments conducted in various educational institutions demonstrate that new interactive and non-traditional pedagogical technologies are very helpful in implementing such tasks[1].

Therefore, it is absolutely essential for teachers working in educational institutions to know how to properly use innovative technologies in their lessons within their fields. Interactive methods, by their nature, ensure achieving a certain degree of efficiency in realizing educational or upbringing goals; however, each of them has various capabilities for ensuring productivity in an educational or upbringing process. For this reason, it is appropriate for professor-teachers (pedagogues) to focus on the topic being studied, the problem, or the issue that needs to be resolved when choosing interactive methods. Furthermore, the effectiveness of interactive methods increases even more when their application considers the age, psychological characteristics, worldview level, and life experiences of the students. This requires professors and teachers (pedagogues) to possess professional skill, qualification, knowledge, and sensitivity.

In mastering chemistry, explaining the chemical properties of elements, and clarifying the structure of atomic electron shells and the filling of shells with electrons are considered crucial. Explaining this topic requires specific skills from the teacher, which is why using interactive methods to develop students' skills in understanding the structure of atomic electron shells is highly relevant. Below, we will dwell on the methodology for teaching the topic of the electronic structure of atoms[2].

Chemical Rebus. Every lesson usually begins with a question-and-answer session on the topics covered. However, we recommend starting lessons using various game technologies to increase students' interest in chemistry. One such recommendation is the use of chemical rebuses. Chemical rebuses are puzzles based on various images, with various chemical terms hidden beneath these images. When rebuses are used, even students with low interest and knowledge in chemistry participate actively. This leads to such students listening to the teacher's explanation of the new topic more attentively, assimilating new information in chemistry, and ultimately increases the number of students interested in chemistry.

Below are examples of several chemical rebuses:



In addition, the following handout questions can be used to review covered topics:

"Find the Pair"

^{1}H, ^{2}D, ^{3}T	ISOBAR
^{40}Ar, ^{40}K, ^{40}Ca	ISOELEKTRON
Al, Si; Cu, Zn	**ISOTOPE**
Na^{+} Ne, H_2O, CH_4	ISOTON

"Find the Extra"

a) 1s, 2s 2p 2d, 3s

b) 1s, 1p, 2s, 2p, 3s, 3p, 3d

c) 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 4f

We will begin the presentation of the new topic using the "intellectual assault" method and continue it based on the principle of visual demonstration.

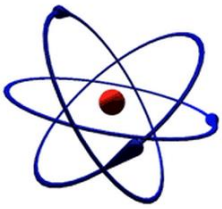
Intellectual Assault: Why don't the negatively charged electrons, being attracted to the positively charged nucleus, just fall into it?

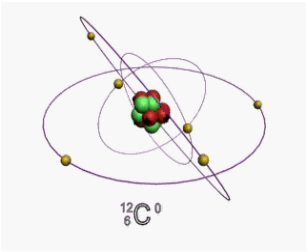
Each electron in a chemical atom moves around the nucleus at a very high speed. As a result, a centrifugal force is generated, preventing it from falling into the nucleus.

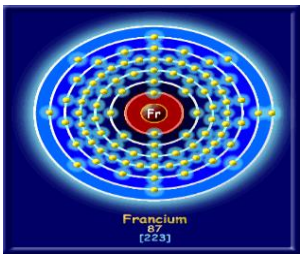
Organizing chemistry lessons based on the **principle of visual demonstration** is considered crucial for enhancing students' knowledge and deepening their chemical understanding. The importance of this principle is especially invaluable when explaining the topic of the electronic structure of atoms. Since the atom is extremely small, even the most

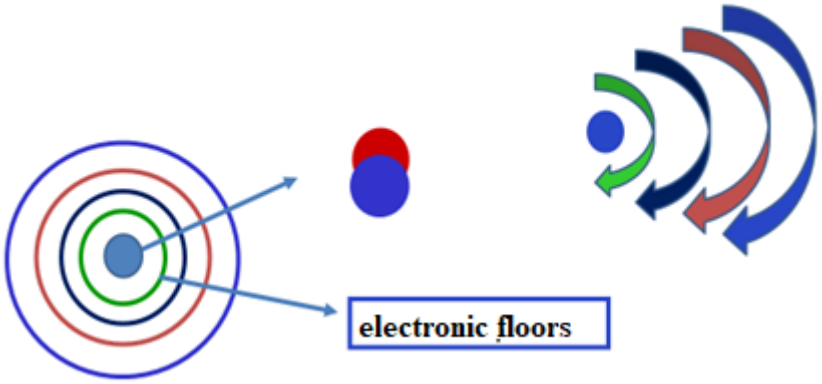
modern and powerful electron microscopes offer limited ability to see its structure directly. The structure of the atom has only been proposed and confirmed through chemical experiments and mathematical, quantum-chemical calculations. Therefore, the opportunity for students to see the atom's structure in a real state is limited. For explaining the electronic structure of the atom, we recommend using visual aids similar to those presented below[2].

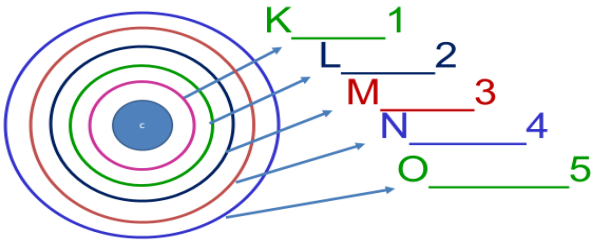
An electron moves at certain energy levels around the nucleus depending on the amount of its energy reserve and other reasons. The lower the energy of an electron, the closer it is to the nucleus. As the amount of energy increases, it moves further away from the nucleus.







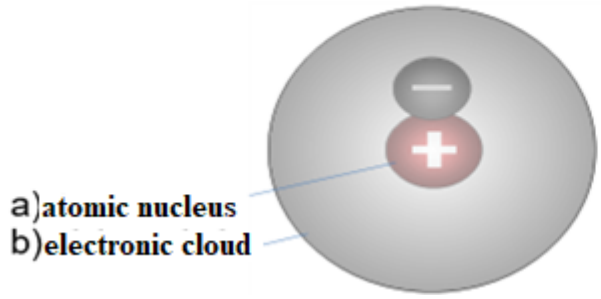




Energetic levels are denoted by the letter **n**. Their numerical values are 1, 2, 3, 4, 5, 6,... or they are expressed with the letters: **K, L, M, N, O, P, Q**

$N = 2n^2$

Expression by Numbers	**1**	**2**	**3**	**4**	**5**	**6**
Expression by Letters	**K**	**L**	**M**	**N**	**O**	**P**
Number of Electrons	**2**	**8**	**18**	**32**	**50**	**72**

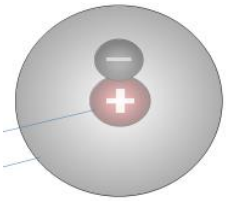


In an atom, the electron moves around the nucleus, forming a spherical cloud.

In this case, the electron is at a distance of 0.53×10^{-10} m from the nucleus.

Do you know? Electrons are arranged in an energy shell based on their properties?

A group of electrons that are close to each other in terms of energy form a specific energy shell.



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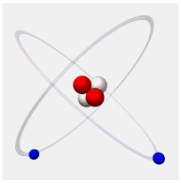
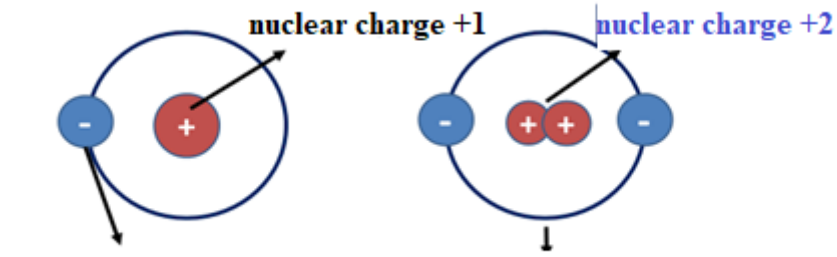
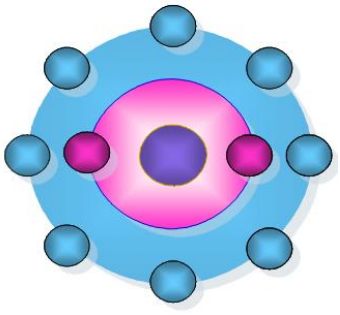


Geliy

1st LEVEL:



2 nd LEVEL:



Element belgisi	Yadro zaryadi	K	L
Li	(+3)	2 ē	1 ē
Be	(+4)	2 ē	2 ē
B	(+5)	2 ē	3 ē
C	(+6)	2 ē	4 ē
N	(+7)	2 ē	5 ē
O	(+8)	2 ē	6 ē
F	(+9)	2 ē	7 ē
Ne	(+10)	2 ē	8 ē

To reinforce the learned topic, one can use the **"Confirm"** or **"Joy of Knowledge"** methods.

"CONFIRM" method

Chemical symbol of an element	*Order number*	*Nuclear charge*	*K*	*L*	*M*
Na					
P					
Cl					

"Joy of Knowledge"

	Na	K	Ca	Mg	Li
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$					
$1s^2 2s^2 2p^6 3s^1$					
$1s^2 2s^1$					
$1s^2 2s^2 2p^6 3s^2$					
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$					

We recommended the use of non-standard tests to assess the effectiveness of interactive learning because the appropriate application of non-standard test tasks in the educational process allows for a fair and unbiased monitoring and evaluation of students' acquired knowledge, skills, and competencies. When preparing non-standard test tasks, content and form are of primary importance. Therefore, it is necessary to consider the principles of selecting the content of test tasks.

Examples of non-standard tests on the topic of the electronic structure of atoms:

1.If the 150th element were to be discovered, what would be the maximum number of electrons in its 5th sublevel?

Answer: ...

2.What is the maximum number of electrons in the 3rd sublevel of the 37th element? Answer: ...

3.If an element's electron configuration is 1s22s22p63s11*s*22*s*22*p*63*s*1, is it a metal?

a)Yes

b) No

4.Which of the following correctly represents the electron configuration of the 28th element:

1.$3d^9 4s^1 3d^9 4s^1$;

2.$3d^8 4s^2 3d^8 4s^2$;

3.$3d^6 4s^2 4p^2 3d^6 4s^2 4p^2$;

4.$3d^7 4s^3 3d^7 4s^3$?

1.For an element whose electron configuration ends with ...4s23d10...4*s*23*d*10, determine:

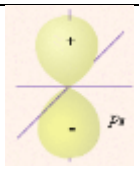
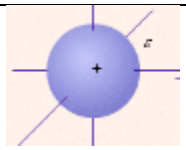
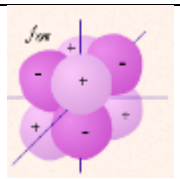
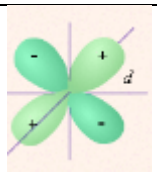
- Which period it belongs to,
- The number of electrons in its energy levels,
- The number of its valence electrons.

Answer: ...

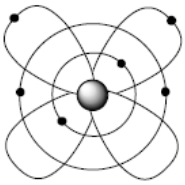
6. Determine the quantum numbers (n, l, ml, ms) of the valence electrons of a germanium atom.

n				
l				
m_l				
m_s				

7. Write the values corresponding to the following orbital quantum numbers (0,1,2,3)

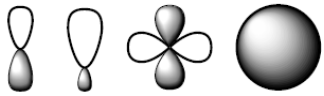
			

8. Which oxygen ion is represented in this figure?



A) O^{2-} B) O^{2+} C) O^{-} D) O^{+}

9. Indicate the s-1, p-2, and d-3 orbitals below.



a b c d

A) 1d, 2b, 3c B) 1d, 2a, 3b C) 1d, 2c, 3a D) 1d, 2a, 3c

10. X^{3+}, Y^{2-}, Z^{4-} The number of electrons in the ions is equal. If the number of protons of element Z is 32, determine the sum of the neutrons of X and Y.

A) 85 B) 72 C) 95 D) 105

In conclusion, it can be said that the use of interactive teaching methods in instructing the topic of atomic electron structure serves to enhance the effectiveness of education. In particular, methods such as "intellectual assault," visual demonstration, the "Confirm" or "Joy of Knowledge" method for the topic, and the use of non-standard tests to assess the mastery of the covered material have been proposed as effective strategies. Furthermore, if students are provided opportunities to work individually and in groups, and if various innovative technologies and game-based methods are utilized in lessons, their interest in the subject will increase, their thinking will broaden, they will strive to acquire more independent knowledge, and they will learn to collaborate. Organizing lessons in this manner not only improves students' academic performance but also helps the teacher to develop professionally, achieve better results, and manage time more effectively.

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