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## **INTEGRATED LESSONS IN CHEMICAL EDUCATION**

*The features of integrated lessons in the chemistry teaching process are described in this article. The opportunities of increasing the effectiveness of teaching chemistry are identified on the basis of the highlighted advantages of this lessons' type teaching. It is shown that an integrated lesson is a specially organized lesson, the purpose of which can be achieved only by combining knowledge from different subjects (biology, physics, mathematics, computer science). It is aimed at considering and solving a problem, allowing to achieve a perceptual, synthesized understanding of the subject under study by students, harmoniously combining the methods of various sciences, having a practical orientation*

*The article provides information that today in chemistry lessons, in addition to the classroom-specific form of organization of the educational process, it is advisable to use non-traditional forms of education, such as integrated lessons. It is shown that any components of the pedagogical process can be integrated in the lesson: goals, principles, content, methods and means of teaching. When, for example, the content is taken, any of its components can be distinguished for integration in it: concepts, laws, principles, definitions, signs, phenomena, hypotheses, events, facts, ideas, problems, etc. It is also possible to integrate such components of the content as intellectual and practical skills and abilities. These components from different disciplines, combined in one lesson, become system-forming, educational material is collected around them and brought into a new system.*

*Keywords: integrated lesson, integration, chemistry, technology, interdisciplinary approach, optimization of the learning process.*

## **Introduction**

The formation of a general system of students' knowledge about the real world, reflecting the interconnections of various forms of matter movement is one of the main educational functions of integrated lessons. The connections of chemistry with both the subjects of the scientific science and the humanities cycle are strengthened; knowledge transfer skills, their application and versatile comprehension are improved at the integrated lessons.

It is possible to single out the main elements of the education content, to provide the development of systemically important ideas, concepts and general scientific methods of educational activities, the possibility of the integrated application of knowledge from various subjects in the students' training activity during integrated lessons.

The integration of knowledge from different subjects can be done with the help of an integrated lesson. Integrated lesson system is a foundation of integrated learning

Conducting of integrated lessons helps to optimize the learning process, since they allow avoiding duplication of the same material in curricula and textbooks; use the technologies of problem and project learning (for example, drawing up interdisciplinary projects); rationally use time with its limit on the study, using ready-made content from a related or parallel discipline [1].

The practical significance of this article is that integrated teaching of chemistry at school can be used by teachers in teaching practice, with their help such qualities of students' knowledge as consistency, depth, awareness, flexibility is formed, and they also help to overcome the subject inertia of thinking and broaden pupils' outlook.

## **Materials and methods**

Theoretical research methods were used in this work, namely the analysis of pedagogical literature, synthesis, generalization, scientific research. Since integrated learning addresses a variety of interdisciplinary problems, this approach harmoniously combines a variety of teaching methods (teaching and learning methods) used at the interface of subjects: story and conversation, seminar and conference, observation and experience, comparison, analysis and synthesis, play.

## **Results and discussion**

For the effective training of integrated lessons, the following conditions are required [ 2]:

- correct definition of the lesson's theme, the object of study, careful selection of the lesson's content, its integrative resource;
- high professional qualities of teachers, providing creative integrative cooperation in the preparation of the lesson, during the lesson;

- inclusion of students' self-education in lesson preparation;
- use of various educational technologies: traditional (they are always necessary), project, interactive, informational, problem-based learning, in order to enhance the mental activity of students at all stages of the lesson;
- a thoughtful combination of individual and group forms of work

The need for integrated lessons was dictated by the fact that the material on the structure, properties and functions of many substances is duplicated with related disciplines [3, 4].

Consider some themes and content of the lessons (Table 1), which provide the formation of students' skills to establish and assimilate connections between knowledge from various courses, for example, chemistry and biology.

Table 1 – Integrated lessons on the relationship between chemistry and biology

	Themes	Content
1	Periodic table of chemical elements. Cell structure	The importance of calcium ions for a growing organism's formation
2	Calcium. Bone structure	To show the importance of bones for the human body; to prove the need for Ca salts for the formation of bones, the need for the Ca ions in the food of an adult, adolescent and newborn.
3	Metals. Muscle work	The value of Ca ions for muscle contraction, acceleration of ATP hydrolysis in the presence of calcium and potassium ions, as well as magnesium.
4	Iron. Blood	To show the value of the iron (II) ion in the hemoglobin composition.
5	Aggregate states of substances. Gases. Breath	To give the chemical characteristics of oxygen and carbon dioxide gases, show their importance for the body; to characterize gas exchange (pulmonary and tissular).
6	Carbon. Carbon compounds. The harm of smoking	To prove the harm of smoking, because in addition to nicotine, tobacco smoke contains: soot, carbon monoxide, hydrocyanic acid, etc. The effect of these substances on the human body.
7	Water. The value of water for the human body	To emphasize the role of water in biochemical processes.

Let's consider further the integrated lessons [5, 6] and show the connection between chemistry and physics. In the 8th grade, the theme «The structure of the atom» is studied. Students know a lot from physics: an atom consists of a positive charged nucleus and electrons. Electrons move around the nucleus at different distances and have different energy reserves.

Batteries are studied in physics, the electrolyte for which is sulfuric acid or potassium hydroxide. In medicine and in everyday life, a diluted solution of ammonia, called ammonia, is used, and in agriculture, a more concentrated solution is nitrogen fertilizer, which increases the yield – biology tells us about this. And physics adds a condition under which ammonia goes into a liquid state – increased pressure; with evaporation of liquid ammonia – strong cooling.

In the theme «Nitrogen and Phosphorus», the following task is useful: what industrially important substances can be obtained from air and water? «Nitrogen» means lifeless, and biology refutes this, arguing that nitrogen is an integral part of protein, and «life is a way of existence of protein bodies» (Friedrich Engels).

Any chemical task, equation, problem, dependence, determination of the structure of molecules can be solved only with the help of mathematical skills [7] and acquired logical techniques. In order to solve a chemical task, it is necessary to: determine what is required in the problem, write out the basic chemical formulas for solving the problem, and then use mathematical knowledge to solve chemical tasks.

The connection between chemistry and computer science can be observed every day, the Internet and various programs help students learn more about the current state of science, students are happy to share new information with the teacher. Students should be able to correctly design their reports and abstracts, and in the electronic version this material can be supplemented and processed, as well as the development of the information space [8] increases students' interest in new methods and forms of teaching.

Chemistry is directly related to history, because chemistry, as a science, has not been formed for a single millennium. Thus, any discovery, phenomenon had its date, its own scientist. The economic situation of a particular era influenced the development of chemistry, and often slowed down the most important discoveries

Consider the relationship between chemistry and biology and ecology [9]. Any biological process is based on chemical transformation. An example is the oxidation of glucose in the human body. The other side of the biological process is the final product that is obtained during this process. An example is the oxidation of alcohol in the human body. As a result, oxidation products such as aldehydes have a toxic effect on the body.

Students are first introduced to photosynthesis in biology; in chemistry, this acquaintance is confirmed by the equations of reactions. When studying hydrochloric acid, it must be noted that a lot of students already have known: gastric juice, the cause of heartburn, precautions when working with acids (also when working with caustic alkali) and initial care in case of damage by them.

A questionnaire to determine the effectiveness of the use of integrated tasks and lessons was conducted in teaching chemistry. The analysis showed that the use

of integrated tasks and lessons contributes to better assimilation of new material in the study of chemistry. The results are shown in Figure 1.

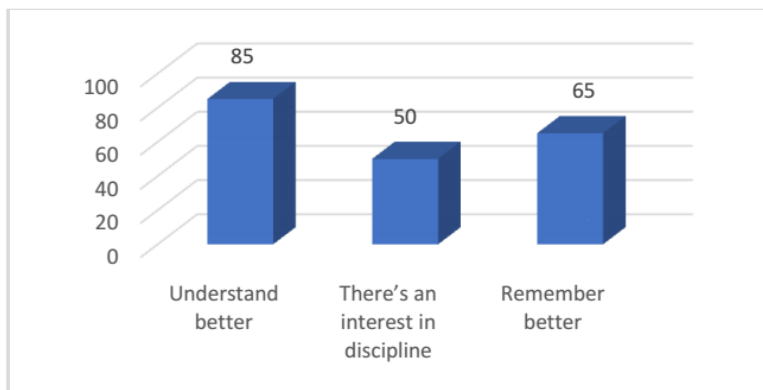


Figure 1 – The impact of the use of integrated tasks and lessons on the assimilation of new material

Among the advantages of integration in Chemistry lessons are the following:

- development of students' mental potential (stimulation to active cognition of the surrounding reality, to comprehend and find causal relationships, the development of communication skills, the formation of the ability to compare, generalize, draw conclusions);

- increasing the students' cognitive interest and motivation through non-standard exciting forms of integrated lessons conducting;

- the ability to reduce students' fatigue and overstrain by changing a variety of activities;

- an opportunity for self-realization, self-expression, creativity of the teacher [10].

### **Conclusion**

Establishing relationships between chemistry and related disciplines expands the amount of basic knowledge necessary for understanding and conscious assimilation of program material in chemistry, allows a person to better navigate and find the relationship of sciences that has disappeared over the past decade. Integration with those subjects that seem quite attractive to schoolchildren, allows you to successfully increase interest in chemistry and develop the motivation to study it. Integration with applied disciplines reveals the possibilities of practical application of the acquired chemical knowledge. Integration is a necessary condition for the modern educational process and its implementation is a transition to a new quality level of education.

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## **ХИМИЯНЫ ОҚЫТУ ҮДІРІСІНДЕГІ ИНТЕГРАЦИЯЛҒАН САБАҚТАР**

*Мақалада химияны оқыту үдірісіндегі біріктірілген сабақтардың ерекшеліктері сипатталған. Сабақтың осы түрін өткізудің ерекше артықшылықтарының негізінде химияны оқытудың тиімділігін арттыру мүмкіндіктері анықталды. Интеграцияланған сабақ – бұл арнайы ұйымдастырылған сабақ, оның мақсатына әртүрлі пәндерден (биология, физика, математика, информатика) білімді біріктіру арқылы қол жеткізуге болады, кез-келген мәселені қарастыруға және шешуге бағытталған, студенттердің зерттелетін мәселені тұтас, синтезделген қабылдауына қол жеткізуге мүмкіндік береді. Әр түрлі ғылымдардың әдістерін үйлестіретін, практикалық бағыты бар.*

*Мақалада бүгінгі таңда химия сабақтарында оқу процесін ұйымдастырудың сынып-сабағынан басқа, интеграцияланған сабақтар сияқты дәстүрлі емес оқыту формаларын қолданған жәон екендігі туралы мәліметтер келтірілген. Сабақта педагогикалық процесің кез-келген компоненттерін біріктіруге болатындығы көрсетілген: оқу мақсаттары, принциптері, мазмұны, әдістері мен құралдары. Мысалы, мазмұн алынған кезде, оның кез-келген компоненті оған интеграциялануы мүмкін: ұғымдар, заңдар, принциптер, анықтамалар, белгілер, құбылыстар, гипотезалар, оқиғалар, фактілер, идеялар, проблемалар және т.б. Сондай-ақ, зияткерлік және практикалық дағдылар мен дағдылар сияқты мазмұнды компоненттерді біріктіруге болады. Бір сабақта біріктірілген әртүрлі пәндердің бұл компоненттері жүйені құрайды, олардың айналасында Оқу материалы жиналып, жаңа жүйеге енгізіледі.*

*Кілтті сөздер: интеграцияланған сабақ, интеграция, химия, технология, пәнаралық тәсіл, оқу процесін оңтайландыру.*

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## **ИНТЕГРИРОВАННЫЕ УРОКИ В ПРОЦЕССЕ ОБУЧЕНИЯ ХИМИИ**

*В статье описываются особенности интегрированных уроков в процессе обучения химии. На основе выделенных преимуществ проведения такого вида уроков выявлены возможности повышения эффективности обучения химии. Показано, что интегрированный урок – это специально организованный урок, цель которого может быть достигнута лишь при объединении знаний из разных предметов (биологии, физики, математики, информатики), направленный на рассмотрение и решение какой-либо проблемы, позволяющий добиться целостного, синтезированного восприятия учащимися исследуемого вопроса, гармонично сочетающий в себе методы различных наук, имеющий практическую направленность.*

*В статье приведены сведения о том, что сегодня на уроках химии, кроме классно-урочной формы организации учебного процесса, целесообразно использовать нетрадиционные формы обучения, такие как интегрированные уроки. Показано, что интегрировать на уроке можно любые компоненты педагогического процесса: цели, принципы, содержание, методы и средства обучения. Когда берется, например, содержание, то для интегрирования в нем может выделяться любой его компонент: понятия, законы, принципы, определения, признаки, явления, гипотезы, события, факты, идеи, проблемы и т.д. Можно также интегрировать такие составляющие содержания, как интеллектуальные и практические навыки и умения. Эти компоненты из разных дисциплин, объединяемые в одном уроке, становятся системообразующими, вокруг них собирается и приводится в новую систему учебный материал.*

*Ключевые слова: интегрированный урок, интеграция, химия, технология, междисциплинарный подход, оптимизация процесса обучения.*

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