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# Integration of the Content of the Connection Between Education and Real Life in Teaching Chemistry with the Main Chemistry Course and Other Subjects

**Abstract**

My article emphasizes the importance of ensuring the connection of chemistry education with real life and explores how this principle develops students' ability to relate their knowledge to everyday life. It examines topics in the core chemistry curriculum through real-life examples, highlighting their practical applications and the formation of a broader knowledge system through integration with other disciplines. The article presents integrative approaches related to subjects such as mathematics, biology, geography, and physics, emphasizing how this method enhances students' critical thinking and motivation. Additionally, it discusses project-based learning. Teaching chemistry with real-life relevance enables students to better understand their environment and acquire practical knowledge.

***Keywords:*** *connection of education with real life, interrelations among natural sciences, ecological education, chemical experiments, environmental chemistry, project-based learning, active lesson model*

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# Kimyanın tədrisində təhsillə real həyat arasında əlaqənin məzmununun əsas kimya kursu və digər fənlər ilə inteqrasiyası

**Xülasə**

Məqaləm kimya təhsilinin real həyatla əlaqəsinin təmin edilməsinin vacibliyini vurğulayır və bu prinsipin tələbələrin öz biliklərini gündəlik həyatla əlaqələndirmək bacarığını necə inkişaf etdirdiyini araşdırır. O, əsas kimya kurikulumundakı mövzuları real həyat nümunələri vasitəsilə araşdırır, onların praktik tətbiqlərini və digər fənlərlə inteqrasiya yolu ilə daha geniş bilik sisteminin formalaşmasını vurğulayır. Məqalədə riyaziyyat, biologiya, coğrafiya və fizika kimi fənlərlə bağlı inteqrativ yanaşmalar təqdim edilir və bu metodun tələbələrin tənqidi təfəkküründü və motivasiyasını necə artırdığı vurğulanır. Bundan əlavə, layihə əsaslı öyrənməni müzakirə edir. Kimyanın real həyatla əlaqəli tədrisi tələbələrə ətraf mühiti daha yaxşı başa düşməyə və praktiki biliklər əldə etməyə imkan verir.

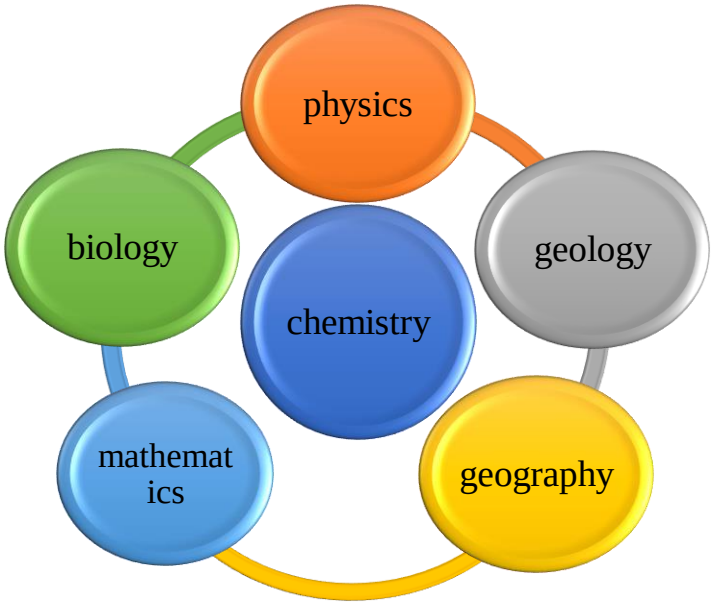
***Açar sözlər:*** *təhsilin real həyatla əlaqəsi, təbiət elmləri arasında qarşılıqlı əlaqə, ekoloji təhsil, kimyəvi təcrübələr, ekoloji kimya, layihə əsaslı təlim, aktiv dərs modeli*

## Introduction

Chemistry is a subject that serves as a key to understanding the processes occurring in the deeper layers of nature. However, the true marvel of chemistry lies in its integration with other sciences, permeating every aspect of life. There are strong connections between biology, such as energy production and photosynthesis at the cellular level, physics with the structure of atoms and molecules, mathematics with the precise calculation of chemical reactions, and geography with the balance of ecosystems. This integration provides students with the opportunity to realize how sciences complement each other and gain a deeper understanding. Establishing the connection of chemistry education with real life and integrating it with other subjects is an essential teaching approach. This helps students relate the theoretical knowledge they acquire to real-life situations and problems, thereby increasing their interest in chemistry.

**Research**

**1. Chemistry is a subject closely related to our lives.** To ensure this connection, we can use interdisciplinary integration in the teaching of chemistry. Integrating chemistry with other subjects allows students to relate various sciences to each other, fostering a deeper understanding and the development of scientific thinking. The integration of chemistry with subjects such as biology, physics, geography, mathematics, and geology makes teaching more effective and engaging. At the same time, it helps students understand that these sciences are interconnected in real life.



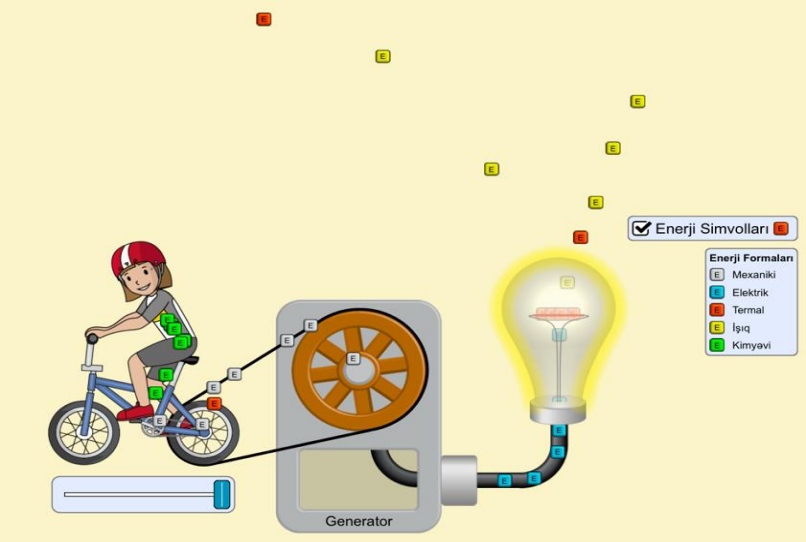

Below, I provide a more detailed explanation of these examples of integration:

**1. Integration with Biology:**

There are close connections between chemistry and biology, as many processes occurring in organisms are based on chemical reactions (chemical processes at the cellular level, photosynthesis and respiration, enzyme activity). The human body consists of organs, organs are made up of organelles, organelles are composed of macromolecules, macromolecules are formed from molecules, and molecules consist of atoms. To deeply understand living organisms and the inanimate substances around us, it is essential to know how all the chemical bonds that hold atoms together in molecules are formed. To understand how atoms bond together to form the molecules that make up living organisms, it is necessary to pay attention to their atomic structure (Alberts et al., 2014, pp. 53-54).

**2. Integration with Physics:**

As natural sciences, chemistry and physics share many similar concepts. Topics such as the structure of atoms and molecules, and energy and heat exchange ensure the close integration of these two disciplines.




(Structure of atoms and molecules, molecular structure and forces, thermodynamics and energy exchange) The interaction and convergence of these sciences have led to the emergence of fields like physical chemistry and chemical physics.

Although physical chemistry and chemical physics are not included as independent subjects in the secondary school curriculum, many concepts from these fields are incorporated into chemistry and physics lessons. This allows for the teaching of both subjects based on interdisciplinary connections (Əkbərov, Həsənli, 2022, s. 34-35). The field of physical chemistry known as thermodynamics deals with the study of energy transformations. At first glance, this field may seem unrelated to chemistry and biology. In fact, thermodynamics was initially developed by physicists and engineers studying the efficiency of steam engines. However, it has proven to be of great importance in both chemistry and biology. It not only explains the energy output of chemical reactions but also helps answer fundamental questions in biochemistry, such as how energy flows in biological cells and how large molecules assemble into complex structures like cells (Atkins & de Paula, 2014, p. 21).

3. Integration with mathematics:

Chemistry is closely related to mathematics because the analysis of many chemical processes and reactions requires mathematical calculations. These calculations allow a more accurate and analytical study of chemistry (calculation of quantities, percentages and concentrations of substances, samples of substances, etc.).

4. Integration with Geography:

There are also strong links between geography, science and chemistry because the chemical composition of soil, water, air and other natural resources is important for studying the natural environment.

5. Geology and integration:

Chemistry and geology are closely related in many fields because the composition, formation process and properties of structures, minerals and natural resources in the earth's crust are chemically related. It is explained by laws. The presence of rich natural resources in Azerbaijan makes it necessary to investigate the relationship between chemistry and geology. Regions of Azerbaijan rich in precious metals: Dashkasan (iron resources), Nakhchivan (salt and mineral deposits), Absheron (oil and gas), Gadabay (gold and copper), Zengilan and Lachin (many sprouts), etc.

These models of integration allow students to understand the interrelationships of objects and gain broader and deeper knowledge.

An active teaching model based on the interdisciplinary integration of chemistry allows students to study chemistry in depth by linking it with other sciences and interdisciplinary connections. It is an educational approach that ensures understanding of the subjects. Below I present an active lesson model based on the integration of chemistry with biology, physics, mathematics and geography.

Course subject: Photosynthesis and chemical reactions (integration with biology, physics, math and geography)

Course objectives:

- Chemistry: Study of the chemical reactions that occur in the process of photosynthesis.
- Biology: To understand the functional importance of the photosynthesis process in plants.


- Physics: The process of transmitting and absorbing the light energy required for photosynthesis.
- Mathematics: The equations of photosynthesis and the mathematical calculation of quantities of matter.
- Geography: The effects of photosynthesis on terrestrial ecosystems, plant habitats and climate relations.

Lesson plan

1. Motivational phase (5 minutes):
- Problem question: "Why are plants important in our lives and how do they produce energy?"
- The teacher encourages students to think by asking open questions: "How does the process of photosynthesis take place?" and "What substances are needed for photosynthesis?"
- Students discuss how photosynthesis affects our daily lives (e.g. food production, oxygen production).

2. Research phase (10-15 minutes):
- Dividing into groups: Students are divided into 4 groups and each group focuses on a different topic:
- Chemistry group's task: To study the chemical reactions that occur in the process of photosynthesis (formation of glucose and oxygen from water and carbon dioxide) and to write the equations of these reactions.
- Biology group task: To study the process of photosynthesis in plants at the organelle level (chloroplast) and its importance for the plant.
- Physics group task: To explain how light energy is needed for photosynthesis and how light waves are absorbed by chlorophyll.
- Math group task: Calculating the amounts of substances in photosynthesis equations, balancing the equations and calculating the mole ratios of substances.
- The task of the geography group: to study the impact of photosynthesis on climate and ecosystems, the relationship between vegetation density and photosynthetic efficiency in different geographical regions.

3. Presentation phase (15 minutes):
- After each group has completed their task, they share their findings with the other groups. For example:
- Chemistry group: Write the equation of photosynthesis and explain the process of converting water and carbon dioxide into glucose and oxygen.
- Biology group: Explains the biological function of photosynthesis, the structures in which it occurs in plants and how it is a source of energy for the plant body.
- Physics group: Explain the function of sunlight as an energy source and its absorption during photosynthesis.
- Math group: Balance the photosynthesis equation and calculate the molar amounts of substances involved in the reactions.
- Geography group: Discuss the relationship between vegetation density and photosynthetic efficiency in different regions and explain the role of photosynthesis in maintaining the ecological balance on earth.

4. Feedback and discussion (10 minutes):
- The teacher summarizes the lesson and discusses the results of each group again. Students express their opinions by asking questions.
- They discuss how each topic plays a role in the process of photosynthesis and how these sciences complement each other.

5. Project work (as homework):

- Project task: Students grow a small plant and observe its growth and the process of photosynthesis. They observe how important light, water and carbon dioxide are for plant growth and analyze the growth rate of the plant by measuring it. This project gives students the opportunity to learn the practical side of photosynthesis.

Lesson outcomes: Students understand the chemical, biological and ecological importance of photosynthesis. They learn the mathematical equilibrium of chemical reactions and begin to understand the physics processes related to light energy. Students understand and apply the important role photosynthesis plays in ecological balance and relate this knowledge to various natural and geographical systems. Students also develop environmental education. They understand the role of plants and nature in our lives. And mother nature takes care of

Based on interdisciplinary integration, this teaching model provides students with well-rounded and broad knowledge, enabling them to gain a deeper understanding of the natural sciences and appreciate interdisciplinary relationships.

2) In chemistry teaching, interdisciplinary integration as well as extra-disciplinary integration, i.e. linking education with life, makes the subjects more interesting and practical and helps students to better master the lesson.

1. Household chemistry:

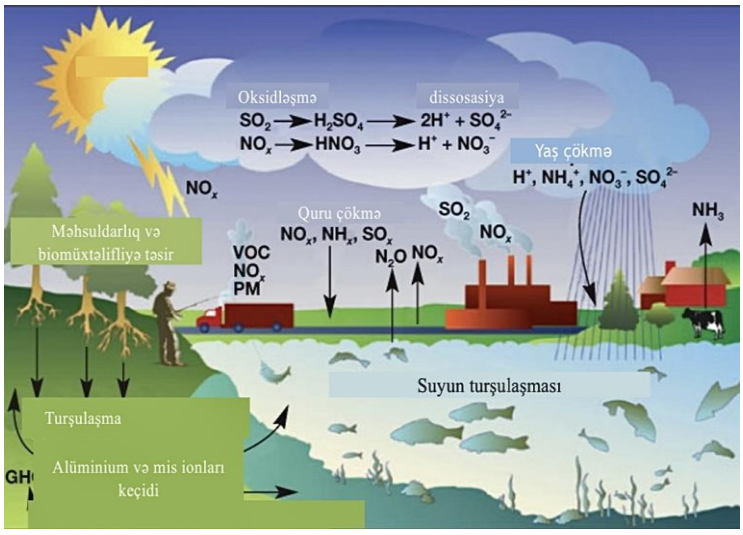
Household chemistry is concerned with the chemical composition and properties of products used in everyday life. Household items that students are familiar with can make chemistry teaching more lively and interesting:

- Cleaning agents: Household cleaning agents (e.g. washing powders, dishwashing detergents) are composed of a variety of chemicals.

- Food additives and preservatives: Preservatives, dyes and other additives used in the food products we consume are also chemicals.

2. Environmental chemistry:

Human activities play a significant role in the accumulation and release of waste from chemical and non-chemical industries into water and the atmosphere. During the 20th century, pollution caused by these activities severely disrupted the natural balance (Qurbanov, Tağıyev, Qurbanov, 2014, s. 1).




Environmental problems are still current today and the inclusion of these issues in chemistry education increases students' sense of responsibility towards the environment. A better understanding of environmental issues is possible through chemistry.

- Air pollution: The chemical composition of pollutants in the atmosphere (e.g. carbon dioxide, sulphur dioxide, nitrogen oxides) and their effects on the environment can be explained. For example, the chemical composition of acid rain, how this process occurs, and its effects on soil and water bodies can be examined comprehensively. Students can research global environmental problems and propose solutions.

3. Health care and medicinal chemistry:

Chemistry is widely used in health care and concepts in this field play a key role in the development of medicines and the explanation of their effects on the body.

Mechanism of action of drugs: Explaining how different drugs work strengthens the link between chemistry and pharmacology. Currently, supramolecular compounds are being studied. These compounds both exist in the human body and are used in drug synthesis.

Chemical reactions in the body: Chemical reactions in the human body, metabolic processes, the role of enzymes and energy exchange at the cellular level increase students' biological and chemical knowledge.

- Laboratory diagnostics: Chemical analysis is an integral part of diagnosis in medicine. Examples include the measurement of pH, glucose and cholesterol levels in the blood and the determination of these substances through chemical reactions.

By explaining these areas, students gain a deeper understanding of the important role chemistry plays in everyday life and in medicine, leading to the development of scientific thinking and an increased interest in the subject.

The active learning model, based on connecting chemistry to everyday life, aims to show students how chemistry knowledge can be applied in everyday life. This model increases students' interest in the subject, encourages them to think more and apply knowledge practically. Below is a model of an active lesson based on connecting chemistry to everyday life.

Lesson topic: Household chemistry: Chemical composition and action of cleaning products

Course objectives: To enable students to understand the mechanism of action of household cleaning products, to learn the effects of these substances on our health, to learn how to use cleaning products in an environmentally friendly and health-safe way.

In the motivation phase, the teacher can ask the students the following question: "How safe are the cleaning products we use at home? Which ingredients do they contain?"

Then the teacher implements the other phases of the active lesson using different teaching methods. Work at the end of the project (as homework):

- Project assignment: Students research the composition of cleaning products used in their families and analyze in writing the chemical effects of each product. They present environmentally safe alternatives and conduct a study on the use of environmentally friendly cleaning products in their families.

Lesson outcomes:

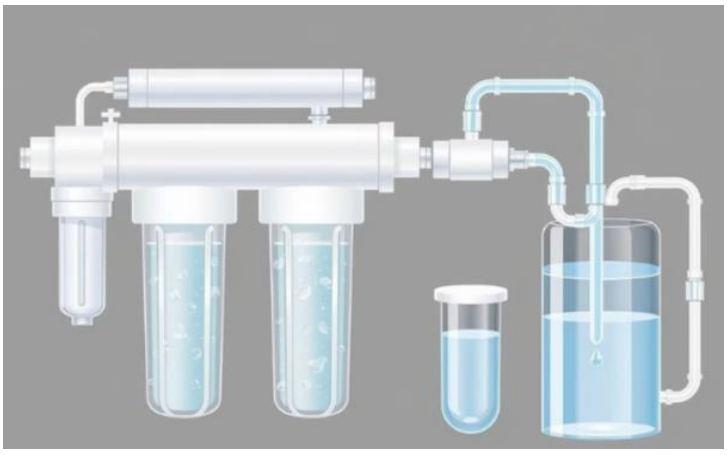
Students learn the mechanism of action of surfactants on dirt, gain a broader understanding of household chemistry and gain a better understanding of the composition and effects of chemicals they use in their daily lives. They will also learn how to avoid harmful chemicals and use more environmentally friendly products.

This active teaching model enables students to develop both their theoretical knowledge and practical skills by relating chemistry to everyday life.

3) Practical education and project-based learning (PBL) approach is a highly effective method for linking theoretical knowledge with real-life problems in chemistry courses and developing students' in-depth understanding skills. This approach shows students how to apply knowledge in practice rather than just memorizing it and encourages them to participate more actively in problem solving, research and group work (TAIM, 2024, s. 93).

1. Advantages of project-based learning: Increased motivation, Cooperation and teamwork, Ability to research and experiment, Creative thinking

2. Examples of project-based learning in chemistry:



Below are examples of project-based learning that can be used in chemistry courses: Water purification project, Composition of household cleaning products, Energy efficiency project, Making cosmetics

Making Environmentally Friendly Plastics - Polymers are large macromolecules composed of repeating molecular compounds. They are formed by addition and condensation polymeri-

zation reactions and are widely used in various industries. However, the impact of polymers on the environment is a serious problem because many plastic polymers decompose very slowly and remain in the natural environment for a long time. This causes pollution on earth, especially microplastics in the oceans. Therefore, the realization of this project will be very useful (Mortimer, 2013, p. 741).

3. Developing students' skills:

Project-based learning helps students develop various skills: Critical thinking, Research and information gathering, Problem solving, Presentation and communication skills:

4. Feedback and reflection:

During project-based learning students reflect not only on the theoretical knowledge but also on the results obtained during the implementation.

While using all these methods, students need to acquire emotional intelligence as well as academic intelligence (Hacıyeva, Əliyeva, 2024, p. 66). Every individual should take care of their environment. Global environmental problems are deepening every year. There are many reasons for this. Loss of biodiversity, climate change, invasive species and overuse, climate change caused by increases in carbon dioxide and other greenhouse gases in the atmosphere, sea level rise, extreme weather events and the impact of temperature changes on ecosystems. And. p. (Campbell, Reece, & Urry, 2020, p. 1330).

One global problem is excessive air pollution. There are many factors that cause this. Car engines release exhaust gases into the air and pollute the atmosphere. Catalytic converters can reduce these impurities. Catalytic converters help clean the air by converting carbon monoxide (CO), oxides of nitrogen (NOx) and unburned hydrocarbons into more harmless substances such as carbon dioxide ($CO_2$) and nitrogen ($N_2$)

Complaints of eye irritation from anthropogenically polluted air in Los Angeles were recorded as early as 1868. Characterized by reduced visibility, eye irritation, cracking of rubber and deterioration of materials, turbidity became a serious concern in the Los Angeles area (Manahan, 2017, p. 391). Photochemical Haze, NO2, O3 and. Peroxyacetyl Nitrate (PAN) due to solar radiation is a result of chemical reactions between air pollutants causing a creative phenomenon. For the first time, scientists have practically investigated the impact of air pollution on public health and proved a direct link between these two factors (Azərbaycan Memarlıq və İnşaat Universiteti (n.d.). Yer kürəsi iqliminin dəyişməsi: Müasir problemləri).

Nature can no longer maintain its natural balance. Therefore, it is our duty to protect nature. A number of projects are being implemented to protect nature, one of them, "Green chemistry", was created in the 1990s and aims to eliminate the impact of industrial waste at the beginning rather than afterwards. In other words, it is based on the principle of reducing or completely stopping pollution at its source. For this reason, green chemistry is also called "sustainable chemistry" or "environmental chemistry" (Junejo, 2023, p. 369).

Combining chemistry with other sciences expands students' knowledge and allows them to apply it in real life. Seeing how photosynthesis is not just a biological process, but a whole with chemical, physical and geographical aspects shows how integrated the sciences are. This teaching approach encourages the development of scientific thinking and provides a solid foundation for future scientists. The main purpose of applying the integration method is to move students away from mechanical memorization. Students learn differently. Research shows that most students have the ability to learn by touch. One of the most difficult topics for my students to memorize is how bases and acids change the color of an indicator. The teacher can teach children who are tactile learners to make indicators naturally (e.g. making indicators from red cabbage) and conduct experiments so that other children can see the colors live. In this way, students will easily remember the colors.

## Conclusion

The use of interdisciplinary, intradisciplinary and extradisciplinary integration in the process of teaching chemistry not only provides students with scientific knowledge, but also develops their practical and polytechnic skills. These connections provide integration of knowledge from different fields, help students to better understand real-world problems and apply a wide range of approaches to solve them (Abışov, Paşayeva, Ədilova, 2022, s. 58).

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