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THE RELATIONSHIP BETWEEN CHEMISTRY AND OTHER SCIENCES

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Abstract: This article explores the integration of sciences in education, focusing on the interdisciplinary connections in chemistry and other related disciplines. It highlights the importance of integrating various scientific fields to foster a holistic understanding of complex phenomena. The paper discusses the benefits of interdisciplinary approaches in education, such as promoting critical thinking, enhancing problem-solving skills, and fostering a deeper appreciation for the interconnectedness of scientific disciplines. Examples of integrated lessons and projects are provided to illustrate the practical application of interdisciplinary concepts in the classroom. Overall, the paper emphasizes the significance of interdisciplinary connections in enriching the educational experience and preparing students for future scientific endeavors.
Key words: Integration, interdisciplinary connections, chemistry, mathematics, interdisciplinary tasks, problem-solving tasks, skills development, scientific worldview, activation of thinking, cognitive interest, spatial representations, logical thinking, subject knowledge, skills, acquisition of new ways of activity.

Introduction: Currently, the issue of the quality of education has become one of the priorities. Alongside developing ways to optimize the learning process as a whole, there is a growing importance placed on researching the outcomes of this process. These outcomes should include key competencies. This means that the task of modern schooling is to develop in graduates the ability to independently create new knowledge and new ways of working, to perform a wide variety of cognitive tasks. The study of chemistry allows students to understand the essence of chemical processes occurring around us. To develop an interest in the subject, students need to be active participants in the learning process, not passive listeners. Cognitive activity is a socially significant quality of a personality; it is formed in organized and regulated educational activities by the teacher, and it is characterized by the desire for skill, mental tension, and the manifestation of volitional efforts in the process of acquiring knowledge.

Main part

Among the many modern approaches to teaching chemistry, one can highlight the application of interdisciplinary and intradisciplinary connections in explaining the material. Interdisciplinary and intradisciplinary integration contributes to the densification of the informational content of the content, expanding the heuristic and practical spheres of application of the knowledge and skills acquired in the learning process. Identifying interdisciplinary connections is one of the most difficult tasks. To do this, one needs not only knowledge of the content of programs and textbooks on other subjects but also a wide range of knowledge and creativity. Working in this direction, a teacher can develop a very important skill of transferring knowledge from one academic discipline to another, teach to apply knowledge in new conditions, and also form a notion of the integrity of the surrounding world.

To realize interdisciplinary connections, the following serve:

- interdisciplinary tasks;
- problem-solving tasks;
- conducting integrated lessons;

- conducting conferences;
- conducting seminars;
- extracurricular activities;
- research homework, etc.

The use of interdisciplinary tasks can lead to a significant improvement in the quality of education.

Interdisciplinary tasks are cognitive tasks that lead to the integration of subject tasks and subject skills, contributing to the mastering of integrative ways of solving problems through independent combination of known solution methods. The development and use of interdisciplinary tasks are based on the principles of scientificity, integration, and differentiation of integrity.

The methodological basis for the development and application of tasks with interdisciplinary content is competency and integrative approaches. Thus, they are based on the comparative analysis, synthesis, and generalization of students' knowledge and educational actions and should be aimed at forming in students key competencies.

For example, the use of interdisciplinary tasks with chemical-mathematical content contributes to the formation of students' integrative skills to conduct comparative analysis, establish cause-and-effect relationships, synthesize and generalize knowledge, model tasks, make predictions in the process of computational activities, solve problems in different ways; control the execution of the solution, use chemical and mathematical languages correctly.

When solving chemistry problems, students need mathematical skills to simplify and correctly conduct calculations of results, round numbers, calculate mass and volume fractions of components in mixtures, solve proportions, construct and solve linear equations, systems of equations, inequalities, etc. In the stage of systematizing and generalizing knowledge and skills, it is expedient to use the following tasks:

Task 1.

1. Determine the volume of a solution with a mass fraction of sodium hydroxide of 40.00% (ρ=1430 g/L) that should be taken to mix it with 200 mL of a solution containing 6.02% sodium hydroxide (ρ=1065 g/L) to obtain a solution containing more than 20% but less than 30% sodium hydroxide.

(Answer: more than 104 mL but less than 357 mL)

2. Two solutions containing p1 and p2 % of magnesium sulfate were taken. As a result of their mixing, a solution with a p%-content of the salt was obtained. The first solution was taken in m grams. Calculate the mass of the second solution.

(Answer:(p1m-pm)/(p-p2) grams)

When developing interdisciplinary tasks of a chemical-mathematical nature, it is important to identify the most general regularities, principles, and concepts to establish subject connections between them. It is also necessary to take into account:

- the topics and content of chemistry and mathematics lessons where these interdisciplinary tasks can be applied;
- the content of chemical and mathematical problems;
- types of interdisciplinary tasks;
- stages of the lesson where they should be used;
- levels of difficulty of interdisciplinary tasks.

Chemical-mathematical interdisciplinary tasks contribute to the activation of students' thinking, formation of spatial representations necessary for the study of natural and mathematical sciences, development of logical thinking and cognitive independence of students, increase of cognitive interest in the subjects of the natural and mathematical cycle. When performing chemical-mathematical interdisciplinary tasks, there is a deepening of subject knowledge and development of subject skills of students, consolidation and generalization of knowledge of basic concepts and regularities, which contributes to the strengthening and awareness of knowledge, formation of the basis of a scientific worldview, mastering new ways of activity.

Problem-solving tasks.

The use of problem-solving tasks not only reveals the role of chemical sciences in the development of individual crafts but also contributes to the deepening of knowledge not only in chemistry but also in biology, geography, physics, literature, history, and other sciences.

Examples:

1. Why do cucumbers grow curved?

(Cucumbers, resembling twisted peppers, grow in beds when plants lack nitrogen. This usually happens at the end of summer when the content of elements necessary for plant growth in the soil significantly decreases.)

Task: Write down the formulas of salts known as mineral nitrogen fertilizers.

Creative task:

Create an illustrated mini-guide "The Biological Role of Nitrogen in Plant Life."

2. Why does the yolk turn gray when boiled for a long time?

(The reason for this phenomenon is that the yolk contains many iron ions. Prolonged heat treatment causes the decomposition of some proteins with the release of hydrogen sulfide. A negligible amount of hydrogen sulfide is enough to form iron sulfide compounds of gray-black color.)

Task: Write down the formulas and names of two amino acids.

Creative task:

Select a series of experiments with egg proteins.

3. Why do we yawn in winter?

(The cold winter air is more rarefied and contains less oxygen than the body needs for activity. Blood becomes thicker, blood flow slows down, the load on the heart and blood vessels increases. This leads to fatigue, headaches caused by spasms of blood vessels, and yawning.)

Task: Draw a diagram "Composition of Air."

Creative task:

Prepare a report on "Oxygen Production in Industry."

Integrated lessons.

Integration is the process of achieving unity and integrity, consistency within a system based on the interdependence of individual specialized elements. The integration of natural scientific knowledge contributes to the development of systemic thinking, forms a comprehensive approach to solving a range of global problems, and determines the place of humans in the modern world. Integrated lessons can be conducted to demonstrate the interrelation of two disciplines, their role in forming a unified and holistic view of the surrounding world.

Themes for integrated lessons include:

- Integrated lesson of chemistry and geography: the object of study is oil;
- Integrated lesson of biology, chemistry, and social studies: the object of study is ethyl alcohol. "The influence of alcohol on the human body and the consequences of its consumption";
- "Physical phenomena in chemistry" (8th grade, chemistry, physics);
- "Factors influencing the rate of chemical reaction" (9th grade, chemistry, biology);
- "Proteins, their structure, properties, biological functions" (10th grade, chemistry, biology);
- "Chemistry of gases" (10th grade, chemistry, English);
- "Solving computational problems to determine the formulas of hydrocarbons through a system of equations" (10th grade, chemistry, algebra, informatics);
- "Chemical organization of the cell" (11th grade, chemistry, biology);
- "A.P.Borodin - a great composer and chemist" (11th grade, chemistry, music).

Conducting conferences and seminars, extracurricular activities:

Conducting conferences and seminars can be used as a form of organization in both lesson and extracurricular activities.

Examples:

- "Chemistry and the environment";
- "Chemistry and medicine";
- "Chemistry and nutrition";
- "Removing stains at home";
- "Chemical composition of cosmetic and hygiene products. Natural cosmetics";
- "Proteins: benefits and harm";
- "Fats: benefits and harm";

- "Fast food. Convenient but healthy?";
- "Vitamins. Synthetic vitamins" and others.

Chemistry has great didactic possibilities for the formation of thinking, logic, and intellectual skills (generalization, classification, systematization, establishment of cause-and-effect relationships, etc.). Chemical literacy is necessary in modern society at the household level, in medicine and healthcare, in organizing a healthy lifestyle, proper nutrition, and safety. Conferences and seminars can consider the following questions:

- Which compounds are classified as bioorganic and why are they so named?
- Excess of which vitamins and deficiency of which substances are characteristic of the population of our region?
- Ways to protect the human body from excess nitrates found in vegetables.
- Protecting the human body from the effects of heavy metals, radiation, poisoning by reagents.
- What foods should be eaten to lose weight?
- What are the dangers of collecting herbs, mushrooms, berries near highways?
- What are wastewater?
- What are freons? What is the danger of their use for the environment?

Not only in lessons, but also in seminar classes, it is necessary to use collective and group work of students. Group work has several advantages compared to traditional methods. The atmosphere of cooperation and mutual assistance prevailing in the lesson influences the development of interest in knowledge. The results of joint work are usually higher than when each student works separately.

Research homework assignments, project activities:

As practice shows, research tasks stimulate students to independent search for knowledge, contribute to the formation of experience in creative, research activities.

Examples:

1. Yeasts convert sucrose into monosaccharides using invertase. Write the equation for the corresponding chemical reaction. How to experimentally prove the action of invertase? Check at which temperature (+5, +35, +65°C) the efficiency of invertase action is higher.

2. Sympathetic ink from food products. Using the following liquids (of your choice): milk, lemon juice, apple juice, concentrated sugar solution, onion juice, make a inscription on a sheet of writing paper using a cotton swab. When the inscription dries, heat this sheet with an iron for several minutes. What happens to the inscription? Explain the observations.

Project activities should be organized when students already have a significant arsenal of knowledge, skills, and abilities, allowing them to demonstrate high activity and a certain degree of independence in the process of studying new material. If each student is involved in active creative activity, feels confident and free, then a situation of success naturally arises. In this case, cognitive interest and personal motivation contribute to better assimilation of knowledge.

In the process of performing research tasks and project activities, students master various ways of integrating information, learn to develop their own opinion based on the understanding of various experiences, ideas, and concepts, build conclusions and logical chains of evidence, express their thoughts clearly, confidently, and correctly to others.

Conclusions:

1. Implement interdisciplinary connections, considering the chemical content in conjunction with the content of other disciplines: biology, physics, mathematics, history, etc.
2. It is recommended to conduct integrated lessons.
3. Use various teaching methods in chemistry lessons, prepare interdisciplinary, problem-creative, and research tasks.
4. Organize project activities.
5. Conduct seminars and conferences.

In the process of establishing interdisciplinary connections, students deepen their understanding of processes occurring in the surrounding world, relate various sciences to each other, and show interest in their study.

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