

## Modeling in the Teaching of Chemistry: Directions for the Formation of Psychomotor Activity in Students, Modeling Methods

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### Abstract

Study in the article from the goals arising from its main purpose, the provisions reflected in the state standards, the competencies to be formed in students, the requirements of the chemistry curriculum for the content of chemistry teaching, the content lines that realize the general learning outcomes, especially modeling, the nature of the modeling content line, learning outcomes, the 3rd content of chemistry education from linear experiment and modeling, batch modeling with modeling techniques, computer simulations, modeling of chemical experiments, possibilities of using space diagrams, modeling we are talking about its status in modern textbooks and textbooks, as well as its focus on questions and assignments.

**Keywords:** modeling, observation, party, computer, simulation, thinking, spindle, sphere, process, balance, animation.

The Law of the Republic of Azerbaijan on Education The main goal of education is to evaluate initiatives and innovations that protect and develop national, moral and universal values, have a broad world viewable, theoretical and practical knowledge, modern-minded and competitive specialist personnel. The goal set at this time is to ensure the acquisition of systematized knowledge, skills and habits in students (Law of the Republic of Azerbaijan on Education, Baku, June 19, 2009).

Referring to the Law on Education, according to the State Standards of General Education in the Republic of Azerbaijan, changes in the content of chemistry are an important factor in order to achieve the formation and development of competences related to activity and thinking formed in students at the general education level (State Standards of General Education in the Republic of Azerbaijan, Baku 2020 ).

The content of chemistry education is fundamentally different from traditional education due to its humanistic and democratic approach. The new chemistry education program (curriculum) is fundamentally different from traditional educational documents due to its humanistic, democratic and integrative character, directly oriented to the formation of students as a personality. Its coverage of content standards, learning strategies, and assessment mechanisms makes it a comprehensive document. It is known that the content lines contained in the content of the chemistry curriculum serve to ensure the realization of the general learning outcomes of chemistry. These essential areas are matter and the material world, chemical phenomena, experimentation and modeling, chemistry and life. Each direction differs from each other in its content. If we pay attention to the content line of experiment and modeling, modeling the knowledge and skills obtained from the study of the structure and properties of substances through experiments, showing chemical reactions in practice, preparing three-dimensional models of molecules, crystal lattices, ensures the formation of practical habits in students, and the formation of the skills of applying theoretical information in practice. The content line of experiment and modeling leads to the development of spatial concepts in them. It becomes possible to interpret the acquired knowledge and skills more fully. Analysis of the qualitative and quantitative composition of substances and the foundation for conducting scientific-research work is created (Educational Program (Curriculum) on Chemistry for Secondary Schools of the Republic of Azerbaijan, Baku 2013. As a result of the hierarchical development of content standards for each class in this document, knowledge deepens and the field of activity expands. During modeling, along with the students' cognitive activity, their psychomotor activities also develop.

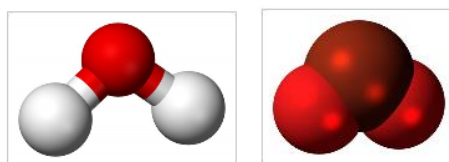
In chemistry teaching, modeling is a method used to make chemistry more understandable and to help students better understand abstract concepts. What is modeling? Modeling is a necessary component of content that represents chemical phenomena and structures through tangible objects or symbols and realizes the overall learning outcomes of chemistry education. Modeling of chemistry can be done in different ways. Some common modeling techniques are:

### Batch modeling method

In this method, spheres, rods or rods, plates, etc. are used to represent chemical compounds and reactions is used. Students can then show the structures of inorganic and organic compounds in molecular models, or use balance sticks and animations for reaction equations. (<https://gifer.com/en/9ujd>)

### Computer simulations

Using computer programs and software, it is possible to simulate the spatial structure of substances and chemical phenomena. In this method, students can visually examine reactions or chemical bonds at the molecular level. Such simulations allow analyzing complex systems and performing experiments virtually. This also includes molecular models. Molecular models are used to visualize the three-dimensional structures of chemical compounds. These models use small spheres and bond rods to represent atoms and bonds. This can help students understand the structures of organic molecules.

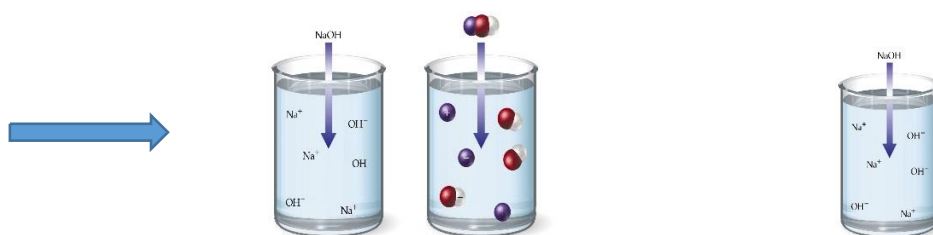


### Modeling Chemical Experiments

Conducting chemical experiments may involve some risks and costs. Therefore, computer modeling of some experiments can be used. For example, to model an acid-base neutralization reaction, you can draw pictures on paper or cardboard and show how the reaction proceeds. This process can be implemented in any presentation-oriented application on the computer. For example, the equation of the neutralization reaction of hydrochloric acid solution with sodium hydroxide can be conditionally shown by such models:



The experimental model of the process is as follows:

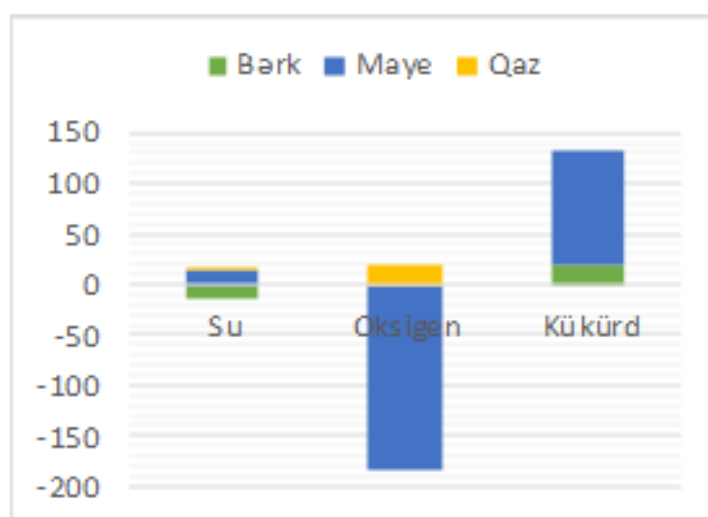
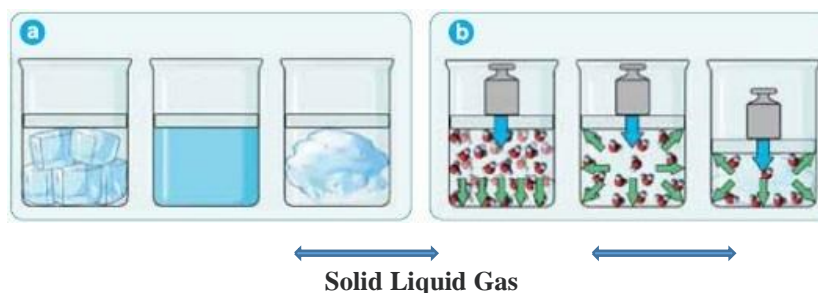


Modeling is a useful tool in teaching chemistry because it embodies abstract concepts and helps students use their visual, bodily kinesthetic intelligence. Modeling not only develops micro-skills in students, but also allows students to improve problem-solving skills and better understand concepts related to chemistry. Chemical reaction models are similar.

It is possible to show the equilibrium state of reactions and the formation of products with tools such as balance sticks or equation models used to represent chemical reactions. These models help students understand the law of conservation of mass, rates of chemical reactions, and the nature of chemical equilibria.

### Phase diagrams

Phase diagrams show the state of a compound that exists in different phases (solid, liquid, gas) at different temperatures and pressures. These diagrams help students understand how different phases and phase transitions occur.



### Electronic Structure Models

The electron shell model, used to visualize the electron configuration of an atom, helps students understand atomic structure. This model represents electron shells and subshells arranged around the nucleus of an atom.

### Ionic Crystal Models

These are models used to understand the crystal structures of ionic compounds. These models show how the positive and negative ions are arranged in an orderly manner and how the crystal structure is formed.

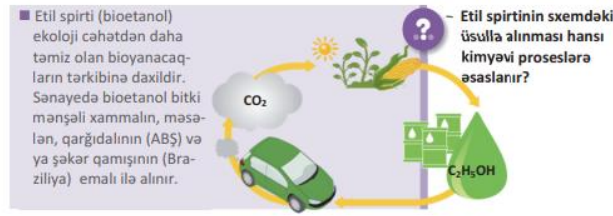
### Models of Spectroscopy

Spectroscopy is a technique that deals with the emission, absorption, or scattering of matter by means of light. Models used in this field show students how electromagnetic radiation of different wavelengths interact and provide information about molecular structure. These examples illustrate the different modeling techniques used in teaching chemistry. Teachers can use these models to help students better understand abstract concepts and provide an effective learning experience in chemistry education.

In the 7th and 11th grades of general education schools, there are ample opportunities for using modeling. Different types of modeling were used in the 7th grade textbook for easier mastering of topics such as methods of separation of mixtures, composition of substances, structure, atomic composition, structure, isotopes, relative atom, relative molecular mass, physical, chemical phenomena, chemical reactions, chemical equation.

In the 11th grade textbook, it is possible to find more perfect forms of modeling, both in the direction of learning the content of the subject, both in activity tasks and in self-assessment tasks. Let's look at examples:

Illustrative presentation of modeling in both the involvement and activity stages of ethanol acquisition increases students' motivation to learn.

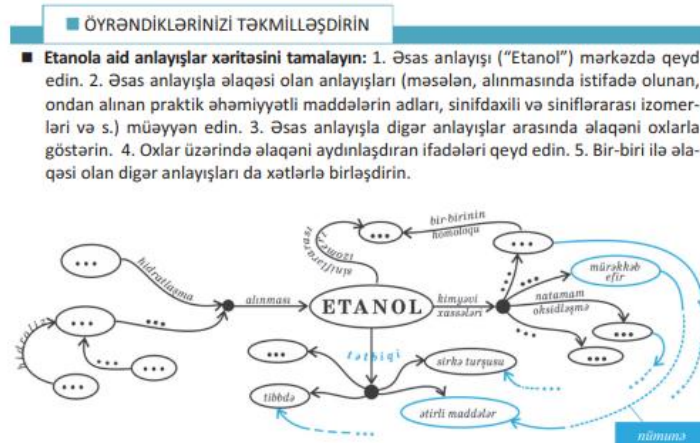


**Fəaliyyət • Etil spirtinin alınması**  
 Sxemdə etil spirtinin qlükozadan alınması prosesi göstərilmişdir. Sxemə əsasən X, Y, Z və K maddələrini müəyyənləşdirin və müvafiq reaksiyaların tənliklərini tərtib edin.

**Müzakirə edin:**  
 – Prosesin necə baş verdiyini izah edin.  
 – Nə üçün termometrin göstəricisi dəyişir?

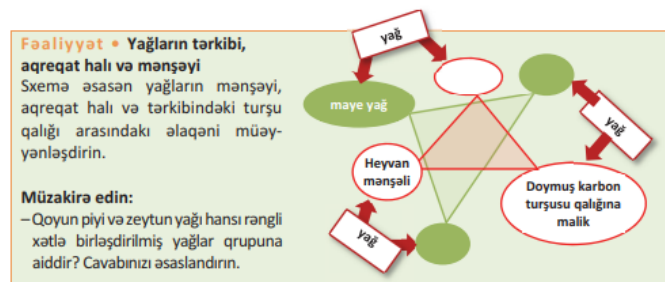
If you pay attention to the picture, the complete cycle of ethanol as an environmentally friendly fuel such as bioethanol is shown. If we focus on the other activity block, we will see that the modeling of the process of obtaining ethanol creates a learning environment.

Another example is the ethanol concept map model, which will improve students' generalization skills.



Through this map, students will have the opportunity to present what they have learned at a more advanced level.

If we pay attention to one more task example model, through this model critical thinking will be formed in students along with logical thinking.



In this way, such an activity and model serve to explore the content.

## Conclusion

In conclusion, we can say that the role of chemistry in the formation of competences in students is great. As a result of observational skills, chemistry, like a natural science, develops students' understanding, logical, critical and creative thinking is formed in them. At this time, students conduct experiments and observations to understand chemical laws and regularities in accordance with the learning outcomes of the modeling content line, prepare a presentation on the results, model molecules with complex structures, and chemical processes. At this time, they acquire both information and ICT skills according to the demand of the day. The use of different methods of modeling during the teaching of chemistry also leads to the increase of the professionalism of teachers, which is one of the provisions of the State Standards of General Education in the Republic of Azerbaijan: it is a point related to quality indicators of educators. The teaching of chemistry based on the student-oriented, personality-oriented, integrative character serves to address the demands and needs of the individual, society, and the state. Today, this demand is visible, tangible, etc. it is fundamentally different from traditional training in that it takes into account the real possibilities, but also the realities of the virtual world. In the textbooks and teaching aids, even the assignment of the tasks prepared by the Ministry of Education and Culture according to the models is also included in the work characteristics. It is also fundamentally different from traditional training as it takes into account the realities of the virtual world. In the textbooks and teaching aids, even the assignment of the tasks prepared by the Ministry of Education and Culture according to the models is also included in the work characteristics. It is also fundamentally different from traditional training as it takes into account the realities of the virtual world. In the textbooks and teaching aids, even the assignment of the tasks prepared by the Ministry of Education and Culture according to the models is also included in the work characteristics.

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