

**OPEN ACCESS**

SUBMITTED 30 July 2025

ACCEPTED 26 August 2025

PUBLISHED 28 September 2025

VOLUME Vol.05 Issue09 2025

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Methodology For Solving Heuristic Problems And Exercises In Biology Teaching

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Abstract: This article describes heuristic problems and exercises related to the field of biology, along with their types and solution methodologies. The significance of teaching biology in general secondary schools and its role in scientific and technological advancement is highlighted. The article provides information about the works of well-known scientists in the field of heuristic problem research, including Herbert A. Simon, John Holland, and others. It mentions the names of scholars who have contributed to the development of heuristic problems and methods in pedagogy. The essence of the heuristic approach is emphasized, and methods aimed at enhancing students' independent thinking abilities in the educational process are introduced, including the method of targeted problems, heuristic conversations, and techniques for posing and solving problems. Approaches by M.S. Modestov inspired by G.S. Altshuller's theory are presented as examples. The article is supplemented with knowledge that can be used in studying the theoretical and practical aspects of working with heuristic problems in biology education.

Keywords: Heuristic problems, algorithm, M.S. Modestov, Altshuller, educational-research problems, heuristic method.

Introduction: The importance of biology, taught in secondary schools, is determined by its place in the development of science, technology and industry, in everyday life. Teaching biology in secondary schools

is aimed at forming and developing the potential of students to apply biological knowledge in practice by generalizing their life ideas and practical activities. As a result of studying biology, students will gain knowledge

about the characteristics of living objects, methods of studying biology, Uzbek scientists who contributed to the development of biology, general concepts about the world of life: bacteria, fungi, plants and animals, general information about spore and seed plants, invertebrates and vertebrates, basic ecological concepts, food chains, nature protection, protected areas, and the "Red Book of Uzbekistan".

biology, by its content and essence, requires finding answers to a large number of problematic questions. In order to solve these problematic questions, it is important to organize heuristic activities.

METHOD

Heuristic problems and exercises from biology are tasks aimed at developing independent thinking of students, which include elements of research. This activity helps to develop students' inquisitiveness, analytical ability and logical thinking in teaching biology and allows to direct students to human capital.

Some notable individuals who have conducted scientific research on heuristics and algorithms include: Herbert A. Simon - Conducted research on heuristic approaches to decision-making and human bounded rationality. John Holland - Conducted research in the field of genetic algorithms and developed heuristic search methods. Stuart Russell and Peter Norvig - Known for their contributions to heuristic search algorithms and other artificial intelligence research in the field of artificial intelligence. Richard E. Korf - Conducted research on search algorithms, including heuristic search methods. These individuals have conducted research on a wide range of heuristics, from theoretical developments to their practical applications.

Some of the most famous foreign and Russian scientists who have conducted research on heuristic issues and exercises in the field of pedagogy are: These scientists have made a great contribution to the development of heuristic issues and methods in the field of pedagogy, and their research is aimed at improving the cognitive development of the educational process and increasing the ability of students to think independently. If the ability of students to think independently increases gradually in the discussion of the issue, if their thoughts become more complete and substantiated, and the teacher's activity becomes mainly the provision of necessary additional information and the general management of students' thinking, then working with research-based issues in biology will lead to effective results.

Various methods of problem solving have been developed in the fields of pedagogy, psychology and didactics. The heuristic method corresponding to the

modern educational paradigm is described in detail in the methodical literature, in which the teacher directs the students to "discover" the laws themselves and formulate definitions independently, instead of providing ready-made educational material. Types of this method include:

- Method of targeted problems;
- Heuristic conversations in problem solving;
- Set and solve problems;
- Summarize the solution method and make recommendations for similar problems.

In the process of solving problems, formal-logical analysis is used, which does not provide specific instructions for working on problems, but rather general directions. Modestov S.Yu. offers an interesting approach, which, inspired by G.S. Altshuller's Theory of Solving Inventive Ministries, combines problem-solving ideas with algorithmic and heuristic approaches.

Interesting approaches to solving educational and research problems in ecology and biology are offered by the creative groups of Anishenko L.N., Zaitsev D.N., and Bulavintseva L.I. In the 70s and 80s of the 20th century, E.P. Brunovt in his works proposed a sequence of operations for solving educational and research problems in biology: many teachers have developed and successfully used a system of logical reasoning to solve educational and research problems in biology.

First, the teacher introduces examples of solving the problem and explains the thinking algorithm; determines what is clear from the conditions of the problem and what needs to be explained; identifies existing information on the problem and new information needed to solve it.

Having considered various approaches, we believe that the use of traditional and "new" methods in solving educational and research problems leads to success. The process of solving any educational and research problem consists of a sequence of consistent actions:

Read and understand the condition of the problem.

Determining the biological content of the issue, understanding which phenomena are considered in it.

Briefly write down the problem statement (based on a specific algorithm).

Identify relevant concepts and information to help answer and identify their interrelationships.

If there is not enough information in the condition, remember, find, or read it.

Create a step-by-step solution plan.

Check that the proposed solution answers the question posed and that all information is taken into account.

The teacher should give the student a research-based problem that allows the student to use both his existing theoretical knowledge and skills and his undiscovered research skills in carrying out this research. If he clarifies his goals in the process of completing the task based on heuristic questions, the outcome of the work will change for the better.

For example: Ant communication methods. Given research: Students will study how ants in their homes and schools communicate with each other and how the effectiveness of this communication varies.

Heuristic questions that help in conducting research:

Question for the teacher: What approaches do you think are most effective for students to use in learning about ants' communication methods?

(Teacher Tip: Provide direction for researchers to determine whether ants use pheromones or communicate through touch, and which communication method is more effective. This information will provide insight into how ants form effective colonies.)

Questions for students (The following heuristic questions can be suggested to guide students in their study of ants' communication):

Questions before watching:

- What methods do you think are likely to be used to communicate between ants?
- In what situations do they communicate more?

Follow-up questions:

- How do ants approach each other? Do they communicate through familiar or unfamiliar signals?
- Are there any interactions in their movements?
- What does the movement of ants in a certain direction mean to other ants?

Questions to analyze:

- What communication methods have you identified between the ants you have observed?
- What purpose do you think ants' communication serves?
- How have you observed ants communicating with you (e.g., touch, chemical signals)?

General Thinking Questions:

- In your opinion, how are ants' communication methods similar to and different from those of other creatures?
- What new things did you learn from their interactions?

- What conclusions can you draw when comparing these communication methods with the communication of society or people?

These questions help students to improve their observation, to discover the types of communication and to understand their different ways of communication.

A biology teacher to use the heuristic method in the educational process, he must understand its essence and apply it in accordance with the content and didactic purpose of the subject being studied. The heuristic method is a method that requires the student to use his own independent thinking in the process of acquiring knowledge. In this process, the teacher does not directly provide ready-made knowledge to students, but creates an opportunity for students to draw conclusions through questions, experiments, and analysis.

According to the definition of A.V. Khutorskoy, heuristic education is a type of education, the purpose of which is to provide the student with the opportunity to independently form the specific meaning, goals and content of education, as well as its organization, diagnostics and understanding. In this process, the teacher purposefully formulates a problematic question, which is the main feature of the heuristic method, through which students' educational and cognitive activity, through this problematic question, includes elements of research, is directed to solving problem situations, draws rational assumptions and conclusions, develops thinking skills through a creative approach.

Heuristic problems and exercises used in teaching biology can be divided into the following types according to their content:

Heuristic problems and exercises in anatomical content.

2. Heuristic problems and exercises in morphological content.

3. Cytological heuristic problems and exercises.

Heuristic problems and exercises in osteological content.

5. Systematic heuristic problems and exercises.

6. Heuristic problems and exercises in ecological content.

Heuristic problems and exercises in physiological content.

8. Heuristic problems and exercises in genetic content.

9. Logical heuristic problems and exercises.

Problems related to the cellular structure of living organisms and the processes involved in them find their expression in the issues belonging to this group.

For example, determine and project what processes led to changes in the body of the ciliate-slipper relative to the amoeba.

Students have the opportunity to apply previously acquired knowledge to solve biological problems in a new, unexpected situation, and they think according to the following algorithms:

1. Comparative analysis of the structure of Amoeba and Infusoria.
2. Identifies similarities and differences in the structure of biological objects.
3. It compares the life processes that occur in these organisms.
4. The permanent presence of the infusoria-shoe body makes a conclusion about the causal connections of the changes that have occurred in the processes of digestion, excretion and movement.

In the process of solving biological problems, a problematic situation forces students to apply their existing knowledge and draw new conclusions.

Examples of heuristic problems and exercises in morphological content can be given as follows.

Why do plants growing in an oasis have large leaves while desert plants have small and thick leaves?

The following stages are important in the process of solving these issues by students:

1. Problem analysis: Students apply previously acquired knowledge about the morphological structure of plants to a new situation, comparing the leaves of plants growing in an oasis and a desert, and analyzing their similarities and differences.
2. Collecting information: Finds and observes the necessary information based on the herbarium of the leaves of plants growing in the oasis and desert.
3. Proposing a hypothesis: Based on the collected data, students express their opinions by thinking analytically.
4. Conclusion and generalization: A clear conclusion is made on the solution of the problem, that is, it is noted that the differences in the morphological structure of the leaves depend on the transpiration occurring in plants, which allows adaptation to the habitat in the process of evolution.

Based on the above-mentioned information, heuristic problems and exercises used in teaching biology develop students' independent thinking, logical analysis and creative approach as a verbal tool of active learning. Effective use of heuristic problems serves to deepen students' knowledge of biology and direct them to independent research.

CONCLUSION

Methodological approaches aimed at solving heuristic problems and exercises in biology teaching are very important. These approaches play an important role in developing students' independent thinking, analysis, and problem-solving abilities. The approaches of researchers such as Modestov S.Yu. and G.S. Altshuller are aimed at increasing students' knowledge and skills in biology using heuristic methods. In the process of teaching biology, the goal is to consolidate students' theoretical knowledge through practical activities and to interest them in research by introducing research elements. The use of heuristic methods in the modern education system ensures the cognitive development of students and forms their creative and analytical thinking skills. As a result, working with heuristic problems in biology teaching makes the learning process more effective and meaningful. By asking students heuristic questions that increase their independent thinking abilities in the educational process, they are directed to research and analysis in the process of learning. As the article emphasizes, students need to be able to apply their theoretical knowledge and develop their undiscovered abilities.

By clarifying each stage of the problem, students can consistently study the elements of research. The given problem of studying the communication methods of ants and designing processes in the infusoria-shoeworm allows students to apply their theoretical skills in practice. This approach not only strengthens the theoretical knowledge of students, but also develops their research qualities. The article shows that the introduction of heuristic and innovative methods into the educational process leads to successful results.

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