

IMPROVING THE METHODOLOGY OF USING STEAM TECHNOLOGY IN
TEACHING THE SECTION "GENETICS AND SELECTION IN BIOLOGY"
(BASED ON THE EXAMPLE OF GRADE 9)

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Abstract. *This dissertation examines the methods of effective use of STEAM technology in teaching the section "Genetics and selection" in biology in the 9th grade of comprehensive secondary schools. The dissertation interprets the main concepts of genetics - heredity, variability, genetic laws and methods of selection - in an integrated approach with STEAM (science, technology, engineering, art and mathematics) components. Methodological approaches, project developments, laboratory experiments and the possibilities of using mathematical models aimed at developing students' skills of critical thinking, observation and experimental analysis are described. Ways to achieve interdisciplinary integration through the introduction of innovative educational tools into the lesson process will also be considered. The dissertation contains methodological recommendations for biology teachers who want to introduce the STEAM approach into their pedagogical activities.*

Keywords: *genetics, selection, STEAM technology, biological education, 9th grade, interdisciplinary integration, methodology, experimental learning, heredity, variability, project approach, visual modeling, innovative lesson.*

Log in. The radical reforms taking place in the education system in the 21st century require students to move from passive memorization to active research. In particular, there is a growing need to introduce modern pedagogical technologies for the effective teaching of one of the most complex sections of biology - "Genetics and selection". An important role in this process is played by the integrated approach of STEAM technology (Science, Technology, Engineering, Arts, Mathematics).

creates a basis for a deeper understanding of biological concepts not only theoretically but also practically, figuratively and analytically. Especially in topics such as genetics, the acquisition of experimental knowledge, the representation of hereditary traits using models, the calculation of mathematical probabilities and the creation of visual projects encourage students to actively participate in the learning process. At the same time, it develops students' interdisciplinary thinking and enhances their research potential.

The article analyzes the methodological aspects, practical approaches and advantages of using STEAM technology in teaching the Genetics and Selection section of the 9th grade biology course to improve the effectiveness of the lesson.

In recent years, changes in technological processes have required the renewal of every stage of education. The use of modern technology, especially in subjects rich in complex concepts such as biology, helps students develop deep knowledge, research skills and

interdisciplinary integration. In this regard, the STEAM approach serves as an effective tool in teaching biology, especially when teaching the chapter "Genetics and Breeding" in grade 9. Genetics is a subject based on complex scientific concepts, and its teaching using traditional methods often results in students developing a superficial understanding of the subject. Thus, the STEAM methodology, developed based on the harmony of biological, technological, engineering, artistic and mathematical elements, fully meets the needs of modern education.

The 9th grade biology textbook analyzes the basic concepts of genetics - terms such as heredity, variability, gene, allele, dominant and recessive traits, genotype and phenotype. The selection section also covers methods for creating new varieties and breeds, mutations and hybridization, and biotechnological approaches.

Since the Genetics and Breeding section contains many scientific and abstract concepts, it can be difficult for students to fully understand and consciously assimilate them. First of all, understanding the conceptual foundations of terms such as gene, allele, and dominant-recessive traits can be difficult, especially if it is not based on visual and experimental knowledge. Students also have difficulty visualizing genetic combinations, i.e. how hereditary information is passed from parents to offspring. This makes it difficult to master the mathematical expression of Mendel's laws, the use of Punnett squares, and the calculation of probabilities. The lack of ability to analyze the mechanisms of change using real-life examples leads to superficial memorization of the topic. It is by effectively solving such problems that the STEAM approach transforms the student from a passive learner into an active researcher and creator.

STEAM technology is an innovative approach based on the integrated teaching of biology, technology, engineering, art and mathematics. This model is especially effective when studying the section of biology "Genetics and selection", as it allows for a comprehensive and practical approach to the topic. Thanks to the "Natural Science" component, students have the opportunity to practically observe biological laws, conduct experiments and draw conclusions. "Technology" will be enriched with interactive tools, including DNA models, genetic modeling and online experiments. Thanks to the "Engineering" approach, students will have the opportunity to create genetic combinations based on models and simulate selection processes step by step. Through "Art", biological knowledge is expressed visually: genetic trees, posters, infographics and drawings provide a deeper understanding of the topic. The "Mathematics" component provides a deeper understanding of probability analysis, relationships and probability calculations based on Mendel's laws.

The STEAM-based methodological approaches developed for the Department of Genetics and Breeding cover several areas. First, during laboratory training, students gain real experimental experience by extracting DNA from a banana. Also, practical classes aimed at identifying hereditary traits using family trees will be an effective example of integrating science and art. Second, with the help of complex mathematical problems, students calculate the ratios of phenotypes and genotypes using Punnett squares, which helps them understand Mendel's laws using specific numbers.

Third, using modeling and engineering, students create models of genetic combinations using Lego, play dough, or software. This allows them to independently design breeding processes, such as describing the steps involved in creating a new tomato variety.

Fourth , using a creative visual approach, students will present heredity and variability in the form of infographics or videos, and create leaflets about genetic diseases. This allows not only to understand the topic, but also to present it and consolidate it in the public consciousness.

Unlike traditional point assessments , it is aimed at identifying deeper skills of students. In particular, the main assessment criteria are the level of interdisciplinary thinking, creativity and visual representation skills , the ability to draw conclusions based on experience, the ability to critically analyze, and teamwork skills. This contributes to the formation of not only knowledge, but also practical skills in teaching biology.

| Evaluation criteria | Description |
|----------------------------|---|
| Interdisciplinary thinking | Harmonious application of biology, mathematics and technology |
| Creativity | Visual expressions, design developments |
| Experimental approach | Lab work, creating a model |
| Critical analysis | Analysis and conclusion on genetic cases |
| Cooperation | Teamwork, collaboration on projects |

Figure 1. Lesson evaluation and determination of results

Source: Developed by the author.

The Department of Genetics and Breeding is one of the fundamental and promising areas of biology. When studying these topics, STEAM technology can be used to connect knowledge with the student's life activities, direct him to independent thinking and an innovative approach. This methodology allows not only to integrate disciplines, but also to take into account the individual interests of students , preparing them for future research activities. The STEAM approach, especially when mastering complex topics such as genetics , increases student motivation and turns them into active participants and creative thinkers.

Conclusion. The Department of Genetics and Breeding is one of the most important and complex areas of biology, both theoretically and practically. Effective and meaningful teaching of these topics to students requires the teacher to use not only the traditional approach, but also modern, interdisciplinary and innovative methods. STEAM technology is a comprehensive approach that meets this need.

conducted using the STEAM approach not only ensure excellent assimilation of the subject, but also create the opportunity to prepare students for real life, help them in choosing a future career and increase their interest in science. Teaching genetics and selection based on STEAM is a relevant, effective and promising direction of teaching biology at the level of modern requirements.

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