University of Ss. Cyril and Methodius in Trnava
Námestie Jozefa Herdu 2
917 01 Trnava

# EDUCATIONAL OBJECTIVES AND OUTPUTS

**Part A: Information on the study programme**

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| **Faculty/Institute** | Faculty of Natural Sciences, University of Ss. Cyril and Methodius | | | |
| **Field of study** | 4. Biotechnology | | | |
| **Study programme** | Biotechnology | | | |
| **Level of study** | Bachelor | | | |
| **Academic degree** | ☒ Bc. | ☐ Mgr. | ☐ Ing. | ☐ PhD. |
| **Form of study** | ☒ full-time | | ☐ part-time | |
| **Language** | English | | | |
| **Place of education** | Faculty of Natural Science, University of Ss. Cyril and Methodius in Trnava | | | |

**Part B: Defining the objectives and outcomes of education in relation to the profile subjects of the study programme**

| **Educational objectives** | | **Educational objectives description** | | |
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| | | **Educational outcomes** | | |
| **Study semester** | **Profile subject** | **Acquired knowledge*** | **Acquired skills*** | **Acquired competencies and transferable competencies*** |
| **Semester 1** | Introduction to Biotechnology | **x** | | |
| | Basics of Biology for Biotechnologists | **x** | | |
| | Laboratory Exercise in Biology | | **x** | |
| | Basics of Biotechnological Processes and Equipment | | | **x** |
| **Semester 2** | Advanced Biology for Biotechnologists | **x** | | |
| | Laboratory Exercise in Advanced Biology | | **x** | |
| **Semester 3** | Balance Systems in Biotechnological Processes | | | **x** |
| | Principles of Molecular Biology | | | **x** |

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| | Laboratory Exercise in Molecular Biology | | **x** | |
| **Semester 4** | Agricultural Biotechnology | **x** | | |
| | Microbial Biotechnology | **x** | | |
| **Semester 5** | Enzymology | | | **x** |
| | Laboratory Exercise in Enzymology | | **x** | |
| | Methods and Techniques of Gene Manipulation | | | **x** |
| **Semester 6** | Enzyme Biotechnology | **x** | | |
| | Regulation and Biosafety of Biotechnology | | | **x** |
| | Bachelor Project | | | **x** |
| | Experimental Activity for Bachelor Thesis | | | **x** |

* Knowledge, skills, competencies, and transferable competencies are mentioned only in those profile subjects that lead to their acquisition. It is not necessary to list all types of educational outcomes for each profile subject, and conversely, if we get all outcomes with a profile subject, they are listed in each column.

The aim of studying in the bachelor study programme Biotechnology is the development of intellectual and creative abilities, practical skills of the student. During the three years of study, the student will gain knowledge and overview of biotechnology, the classification of biotechnology, its uses and applications in various sectors, pharmaceuticals and medicine, agriculture, food, environment, energy. It provides a basis for education in biotechnology subjects, which are already focused on specific uses and applications.

The graduate by completing the subject **Introduction to Biotechnology** will

- obtain the following knowledge and overview of biotechnology, the classification of biotechnology and its applications
- be able to explain the nature of biotechnological processes and the main components of these processes
- understand the wide range of applications of biotechnology in various industries, pharmaceutical and medical, agricultural, food, environmental, energy
- acquire knowledge for education in other biotechnology subjects that are already more focused on specific uses and applications.

After completing the subject **Basics of Biology for Biotechnologists**, the graduate will

- acquire basic knowledge of the biological aspects of the organization of life at the cellular level in terms of structure, function, development and evolution and practical significance,
- acquire a knowledge and terminological base, on the basis of which he/she will correctly understand the principles of not only the structure and composition, but especially the functional activity of pro- and eukaryotic cells and their subcellular structures,
- acquire the knowledge and logical skills which are the basis and prerequisite for understanding the content of the biology curriculum at the upper secondary level of education.

After completing the subject **Advanced Biology for Biotechnologists**, the graduate

- is able to make proper use of the knowledge and terminology base, which allows him/her to promptly orient himself/herself in superstructural biological, as well as non-biological subjects related to a certain aspect of living systems, their evolution, organization,

- can logically understand the nature and mechanisms of the functioning of living systems.

After successful completion of the subject **Basics of Biotechnological Processes and Equipment**, the graduate

- gains knowledge about basic processes in biotechnological production and about equipment used in the field of biotechnological production and
- gains knowledge that will enable him/her to better respond to the needs of production practice and more quickly integrate fully into the production process.

After successful completion of the **Enzymology** subject, the graduate

- is able to describe the basic structural and functional characteristics of enzymes and on their basis to apply a strategy for selecting a suitable enzyme for a specific application on an industrial scale and
- is able to calculate the need for a given enzyme for a given application and to calculate the effect of possible interactions of substances with inhibitory activity.

The graduate of the **Enzyme Biotechnology** subject

- will get acquainted with the production and finalization of enzymes in the form of active components used in various industrial applications, with the practical use of individual classes of enzymes in different areas of industrial practice with emphasis on their mechanism of action and forms of application in specific technological processes and
- will understand the possibilities of streamlining the processes catalyzed by these enzymes with the tools of molecular biology on the basis of the results of bioinformatics analyses.

After successful completion of the subject **Balance systems in biotechnological processes**, the student will

- gain knowledge related to balance systems in biotechnological processes and
- will acquire skills and competences in the preparation of material and energy balance, balance of a system with several components, without chemical reactions and with chemical reactions; in the definition of currents and their composition; in the design of a balance scheme and a balance table.

Graduate of the subject **Principles of Molecular Biology**

- acquires knowledge and understanding of basic molecular biological principles used in the field of research carried out in natural sciences and will be able to apply them competently in his/her further experimental activities and practice,
- is able to define the basic principles of molecular biology,
  theoretically be able to use them in their further laboratory practice,
- achieves an advanced level of knowledge in the field of molecular biology knowledge, approaches, methodologies and processes occurring at all levels of organisms,
- is able to define concepts, have an overview in the use of molecular biology knowledge,
- can explain and correctly use the knowledge acquired in the field of molecular biology,
- can select the correct and simplest procedures to achieve the correct result,
- is able to confront his/her procedures and, consequently, his/her findings in accordance with scientific databases dealing with the relevant issue,
- achieves competence in hypothesis generation, experimental design and experimental implementation in the field of molecular biology research,
- is able to confront the knowledge acquired with different groups of experts,
- is able to express criticism in a given situation,
- takes responsibility for using their knowledge in the right direction.

Graduates of the **Methods and Techniques of Gene Manipulation** subject will

- be able to define recombinant DNA, theoretically be able to prepare and use it in their future laboratory practice,
- achieve an advanced level of knowledge of approaches, methodologies and knowledge of DNA cloning, gene manipulation at all levels of organisms and be able to define the terms,
- have an overview of the use of molecular biological knowledge in the field of methods and techniques of gene manipulation,
- be able to explain and correctly use the acquired knowledge and relevant procedures in gene manipulation and

- be able to confront their procedures and subsequent findings in accordance with scientific databases dealing with the relevant issue.

After successful completion of the microbial biotechnology subject, the graduate

- will be able to describe the principles of the process and setup of the basic parts of biotechnological production and to describe the production of selected biotechnological products in industrial practice, which are prepared with the active participation of microorganisms, with an emphasis on the food and pharmaceutical industry.

By completing the subject of **Agricultural Biotechnology**, the graduate will

- gain knowledge and overview of biotechnologies used and applicable in agriculture, respectively in agriculture,
- know the spectrum of applications of biotechnology in agriculture, especially techniques to improve the parameters and characteristics of plants and animals used in agriculture,
- understand the principles of biotechnological processes and their application to plants and animals,
- gain knowledge of plants and animals themselves as producers of food, feed, raw materials, energy and services,
- be able to design laboratory experiments for the preparation of biotechnologically modified organisms for agriculture, and work in an area of agriculture in which biotechnological processes or biotechnologically modified plants and animals are used.

Upon successful completion of the **Regulation and Biosafety of Biotechnology** subject, the graduate will

- understand and gain knowledge of biotechnology from a biosafety perspective and of regulatory frameworks at national and international level and will be able to evaluate analyze, address and perform risk management of current biotechnology.

By completing laboratory exercises in different areas of the natural sciences such as biology, chemistry (general, inorganic, organic), enzymology or microbiology, the student will gain an overview of the basic methods used in laboratories, learn basic laboratory skills when working with living organisms or samples from living organisms, and learn how to manipulate laboratory instruments.

In the subject of **Laboratory Exercise in Biology,** the graduate is able to

- follow the teacher's instructions for safe work in the laboratory,
- apply basic knowledge and simple know-how in solving problems under the supervision of the teacher,
- follow the correct procedures for the preparation of solutions,
- work correctly with the microscope,
- perform simple proof reactions and micro- and macroscopic observations according to the procedure and
- describe observed phenomena and interpret simple conclusions under teacher supervision.

Within the **Laboratory Exercise in Advanced Biology** subject, the graduate is able to

- apply in the laboratory the basic knowledge for work in the biological laboratory,
- to use simple know-how in solving tasks in the laboratory under the supervision of the teacher, such as the correct preparation of solutions, simple separation methods, simple measurements and observations of observed phenomena,
- draw basic conclusions, using logical and creative thinking,
- choose the correct procedure for preparing solutions,
- carry out the steps of the reaction according to the procedure,
- use description and evaluation of the observed phenomenon and interpreting it correctly.

As part of the European Qualifications Framework, by completing **the Laboratory Exercise in Molecular Biology** subject, students will acquire the skills and abilities to follow instructions and plan their own experimental work, specifically basic laboratory skills for working in a biotechnology laboratory, working with DNA, RNA, proteins and recombinant molecules. Graduates can

- analyse data and present them as a basis for important decisions in further experimental practice, master all chemical calculations, unit conversions and acquire the skills that are a prerequisite for the successful implementation of the experimental part of the bachelor's and later master's thesis,
- routinely use laboratory instruments and correctly learn the principles of laboratory practice,
- use information databases and work with them in the context of relevant assignments,
- design and implement an experiment and can correctly evaluate the results obtained and discuss them with the relevant practice, respectively,
- can draw conclusions and correct procedures in relation to the assigned topic.

After completing the **Laboratory Exercise in Enzymology**, the student will

- learn to master the common procedures used to determine selected enzymes from the six groups of enzymes,
- be able to evaluate the influence of various factors on the activity of enzymes and also to determine the kinetic parameters,
- try out the basic procedures of working with enzymes, the output of the laboratory exercise will be the skill acquired during the semester in working with enzymes and the ability to determine the activity of a selected group of enzymes and evaluate the influence of selected factors on it,
- be able to follow the instructions and plan the experimental procedure, analyze the data obtained, master the basic calculations necessary in enzymology in appropriate programs, present their results in an appropriate form and compare with foreign literature.

In specialized thesis subjects such as **Bachelor Project** and **Experimental Activity for Bachelor Thesis**, the student

- develops and consolidates the habits of methodological discipline in the preparation of the thesis
- demonstrate knowledge and skills in literature search from primary and secondary sources
- demonstrate basic knowledge in the orientation of the problem addressed, as well as skills in writing scientific papers.

The result of individual subjects is a comprehensive dissertation within two years elaborated in the scope defined in the Higher Education Act of the Ministry of Education, Science, Research and Sport of the Slovak Republic. As a result of the education, the student acquires the ability to

- propose hypotheses,
- verify it with a suitably designed and constructed experiment or set of experiments
- evaluate the results and process them in the form of a thesis

The graduate can

- solve problems during the experimental activities within the bachelor thesis
- design appropriate procedures for modifying an experiment
- work independently in the laboratory
- communicate with experts within the scope of his/her thesis topic; and
- present his/her results to experts.

Prepared by: RNDr. Daniela Ondrejovič Chmelová, PhD.

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