Training Plan of the Doctoral School of Biology and Sport Biology

(03. November 2025.)

Abbreviations:
Doctoral Council of Sciences (abbreviation: DCS)

Doctoral School of Biology and Sport Biology (hereinafter: Doctoral School)

Council of the Doctoral School of Biology and Sport Biology (hereinafter: Council of the Doctoral School)

Training Plan and Rules Concerning Doctoral Programmes

(1) The Council of the Doctoral School prepares the Training Plan of the Doctoral School, which is approved by the DCS. The Council of the Doctoral School reviews the Training Plan regularly during each accreditation period in accordance with Level 8 of the Hungarian Qualifications Framework, submits the revised version to the DCS for approval, and, following approval, promptly arranges for the publication of the new version on the Doctoral School's website.

(2) During the preparation and revision process of the Training Plan, the Doctoral School solicits the opinions of external experts involved in the training, cooperating partners, and students, and takes these opinions into account during the review. These opinions are discussed at the annual meeting of the Doctoral School and may also be submitted in writing to the Council of the Doctoral School.

(3) The Doctoral School operates within the framework of the Training Plan, which defines the credits obtainable for specific activities. The mandatory courses announced by the Doctoral School are listed in Annex 1 of the Organisational and Operational Rules of the Doctoral School of Biology and Sport Biology, while the general catalogue of courses offered with variable availability across semesters can be found in Annex 8. The Training Plan specifies the compulsory courses and the credits obtainable through course participation and other academic activities, as follows:

TOTAL REQUIRED CREDITS: 240 (1 credit = 30 working hours)
Average credits to be completed per semester: 30 (900 hours)
Minimum credits to be obtained per semester: 18

I–IV semesters:

TEACHING (not mandatory)	16 credits
Weekly 1 hour + same amount of preparation = 1 credit (30 hours) Maximum: weekly 4 hours in total for 4 semesters	
COURSES	24–56 credits
Weekly 1 hour + completion of individual tasks = 2 credits (60 hours; compulsory minimum 24 credits) over 4 semesters. Courses not announced by the BDS may also be accepted with the consent of the Head of the Doctoral School.	
LITERATURE REVIEW	10 credits
Submission of a 10-page literature review by the end of semester II	
PREPARATION FOR REPORT AND COMPREHENSIVE EXAM	10 credits

To be completed at the end of semester IV
RESEARCH LAB max. 60 credits
Ongoing completion: maximum 15 credits may be accounted for in one semester.
Total (minimum): 120 credits

V–VIII semesters:
PRESENTATION AT PROFESSIONAL CONFERENCE 16 credits
480 hours for preparation for two professional conferences (additional credits may be accounted)
Only first-author presentations can be counted (8 credits/presentation)
PUBLICATIONS 32 credits
960 hours for preparing 2 required-level publications (additional credits may be accounted)
(16 credits/publication)
RESEARCH REPORT 20 credits
To be completed at the end of semester VI
RESEARCH LAB max. 80 credits
2400 hours (assuming 44 working weeks per year, over 2 years = 88 weeks) 20 hours/week
Ongoing completion: maximum 20 credits may be accounted for in one semester.
Total (minimum): 120 credits

General compulsory courses for all students of the Doctoral School

Compulsory courses for all students of the Doctoral School:

Scientific English I.	Lecturer: Dr. Róbert Gábriel
Biostatistics	Lecturer: Dr. Zoltán Csabai
History of Biology and its Philosophical Aspects	Lecturer: Dr. Gyula Hoffmann
Bioinformatics	Lecturer: Dr. Gábor Kemenesi
or	
Molecular Bases of Physical Activity	Lecturers: Dr. Márta Wilhelm, Dr. Tamás Atlasz, Dr. Éva Tékus, Dr. Márk Váczi

The further list of courses available in each semester changes continuously; the subjects listed in Annex 8 of the Organisational and Operational Rules of the Doctoral School of Biology and Sport Biology serve as a general guideline.

Course descriptions of compulsory courses

Course title	**Scientific English I.**
Instructor(s)(%):	Dr. Robert Gabriel (100/)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2 hrs/week
Credit:	3 credits
Description:	Understanding the use of English language in scintific context. Develoüpment of communication skillés of students, conference type communication in English
Topics:	Commentaries from, Science, Scientific American and és Nature Biology and envireon,ental science papers from National Geographic Translation and interpretation of scientifc papers selected by student (3 to 5 in a semester).

Course title	**Biostatistics**
Instructor (s) (%):	Zoltán Csabai (100%)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2 hours per week
Credit:	2
Description:	The aim of the course is to review fundamental statistical knowledge, present it in a unified framework, and deepen understanding of the principles and applications of various statistical methods.
Topics:	Basic concepts of research and experimental design, sampling and data collection methods, sampling schemes, determination of sample size and number of samples, experimental layouts. Fundamental statistical concepts, data types, scale types, dependent and independent variables, notable data distributions, standardization and data transformations. Parametric and non-parametric hypothesis tests, regression analysis, tests of independence, homogeneity, and goodness of fit. Fundamentals of statistical modeling (GLM, GLMM, GAM, and other models). Main characteristics of multivariate methods. Hierarchical and non-hierarchical classifications. Ordination methods (PCA, CCA, CoA, CCoA, PCoA, NMDS). Interpretation and presentation of the results of statistical analyses.

Course title	**Bioinformatics**
Instructor(s)(%):	Dr. Gábor Kemenesi (100%)
Course type (lecture/seminar/practice)	seminar

Total or weekly hours of the course	2x45 min per week
Credit:	3
Description:	Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data. In a narrow sense for many people it means nucleotide and protein sequence analysis. In some places "biotechnology" is also used instead of bioinformatics. Based on Biochemistry and Molecular Biology studies these lectures will introduce into the use of public data bases and internet tools for DNA and protein sequence analysis
Topics:	1. History of Bioinformatics. Prediction, query sequence, homology search and content analysis. Basic molecular biology for bioinformatics: the prokaryotic and eukaryotic gene, transcription, translation, the genetic code. 2. Nucleotide sequence databases (EMBL GenBank, DDBJ), protein sequence databases (SWISS-PROT, TrEMBL) The structure of database records. 3. Additional useful databases in the az ENTREZ system: PubMed, PubMedCentral, Books, EST, GSS, Genome, Structure, Taxonomy, PubChem Compounds. 4. Text base database searching, use of Boolean operators, the integrated database search, ENTREZ, SRS and DBGET/LinkDB 5. Gene finding programs, sequence motifs, use of ORF finder and eukaryotic gene prediction by GeneMark-HMM and FGENESH, detection of codon preference. 6. Analysis by sequence comparison, sequence homology: use of BLAST program family, evaluation of the results (expect value, similarity and identity, scoring matrix, low complexity). 7. Written exam I. 8. Analysis by sequence comparison, sequence homology: use of BLASTN and BLASTX for DNA sequence analysis. Pairwise sequence alignments and generation of the reverse complement DNA sequence. 9. Multiple alignment by ClustalO: detection of conserved DNA and protein motifs, use of multiple alignments for phylogenetic analysis, primer design and protein domein prediction. 10. Protein sequence analysis: motif and domain databases, the pattern and the PROSITE Pattern Database. Profiles and Pfam (Protein Families Database). Prediction of transmembrane domains and signal sequences: TOPCONS, Philius and SignalP. 11. DNA sequence determination. Evaluation of the sequencing results. Assembly of the subsequences into contigs. 12. Primer design for PCR reactions. The use of multiple alignment and Primer BLAST.

Course title	**Molecular basis of Physical activity**
Instructor(s)(%):	dr. Wilhelm Márta (40%), dr. Bock-Marquette Ildikó (10%), Fáskerti Gábor (10%), dr. Váczi Márk (10%), Csala Dávid (10%), Ádám Zoltán (10%), Tékus Éva (10%)
Course type (lecture/seminar/practice)	Lecture

Total or weekly hours of the course	20
Credit:	3
Description:	The course's objective is to elucidate the intricate molecular, biological, immunological, biomechanical, physiological and adaptive mechanisms, which manifest within the human body due to consistent physical activity. It provides a comprehensive examination of the molecular mechanisms and cascades influenced by training intensity and regularity, delving into both their advantages and disadvantages. Key topics covered: analyzing molecular patterns in blood and urine before and following exercise, exploring the components and composition of unconventional body fluids such as saliva and sweat, and investigating molecular alterations within the epithelial tissue. Additionally, the course encompasses proteomic, lipidomic measurements and miRNA patterns in various fitness-related samples.
Topics:	1, Stress, sport and immune functions 2, Molecular markers of fitness, wellness or overtraining (I-II) 3-4, Integration of performance enhancement, sport therapy and tissue regeneration I-II. 5, The effect of physical activity on salivary composition 6, Mechanism of the elastic energy storage and re-use in skeletal muscle: a magnificant nature of the muscle-tendon complex 7, Resistence exercise and miRNA profile 8,Molecular changes after regular physical activity among university students and seniors 9, Student presentations

Course descriptions of other available courses

Course title	**Introduction to Environment Impact Assessments and Conservation Plans**
Instructor(s)(%):	László Szemethy, PhD
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2 hours/week
Credit:	3
Description:	The aim of the course is to introduce students to the preparation of environment assessments, ecological impact assessments, management plans for protected areas and species conservation plans. After the class consultations, students prepare assignments independently on each topic using the suggested literature available on Teams and resources on the Internet. They prepare for the acquisition of basic data related to design, the evaluation of their practical suitability, and the design process. They practice cooperation and coordination with stakeholders in simulated negotiations.
Topics:	1. Assessment of the state of the environment, accessibility and applicability of survey methods, databases. 2. Strategic impact assessments, elements of environmental – ecological – impact assessment. 3. Structure and content of management plans for protected areas. 4. Structure and content of species conservation plans.

Course title	**Biomechanics**
Instructor(s)(%):	Dr. Márk Váczi (100%)
Course type (lecture/seminar/practice)	lecture
Total or weekly hours of the course	2 hours/week
Credit:	2
Description:	In the course, students will be introduced to the interdisciplinary nature of biomechanics. Using previous knowledge in the fields of biology, anatomy, and physiology they will understand the laws and mechanisms responsible for human movement. Acquiring two major topics: principles of mechanics, and the neuromechanical basis of muscle, students will understand the background of muscular force production and forces acting on human body during physical activity.
Topics:	1. Definition, development, importance, and application of biomechanics as an interdisciplinary science. Principles of motion. 2. Types of motions form mechanical aspects. Steady and unsteady motions. Straight and curved motions. 3. Definition of mechanics 1. Kinematical and dynamical parameters of motions. Displacement, time, and velocity. 4. Definition of mechanics 2. Velocity and acceleration. Kinematical parameters during rotary motions. Ways to measure kinematical parameters of motions.

	5. Definition of free fall. Horizontal, vertical, and oblique trajectory. 6. Principles of dynamics. Force as a vector quantity. Newton's laws and their applications in sport movements. 7. Definition of statics. Balance and stability. The leverage system in the human body. 8. Mechanical work, energy, power, pressure, and friction. Forces acting on human body in fluid. 9. Structure, function, and molecular contraction mechanism of skeletal muscle. The excitation-contraction coupling. 10. Muscle fiber and motor unit types. Motor unit recruitment principles. Electric activity and reflex mechanisms of muscle. 11. Mechanical aspects of skeletal muscle force production. Length-tension, force-velocity, torque, and elastic energy storage characteristics. 12. Skeletal muscle plasticity. Fatigue, microdamage, neural adaptation, hypertrophy, sarcopenia. 13. Laboratory tests in biomechanics. Dynamometry, force plate, EMG, motion analysis.

Course title	**The Role and Potential of Citizen Science in Biological and Environmental Research**
Instructor(s)(%):	Zoltán Csabai (100%)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2× 45 minutes per week (organized as a block course held in the last third of the semester), total of 24×45 minutes per semester
Credit:	2
Description:	Citizen science and community-based data collection are becoming increasingly popular bridges between the general public and the academic sphere. Beyond its undeniable role in science communication and public engagement, citizen science opens new horizons for researchers by enabling broader data collection, allowing for spatial or temporal coverage and/or data volumes that were previously inaccessible or difficult to finance. However, this can only be achieved if the project's structure, tools, and methodologies, as well as its outreach, marketing activities, and approaches to engaging and retaining participants make the project appealing and engaging for the wider public. At the same time, data collected through community participation can only provide reliable information and be treated as research data if they meet the expected scientific quality standards during both data collection and subsequent validation. The course provides an overview of the concepts and toolkit of citizen science, offers recommendations for the design and implementation of citizen science projects, and, through case studies, aims to guide interested students toward best practices.
Topics:	1. Definition, key concepts, types, approaches, and historical development of citizen science. 2. The role and significance of citizen science in the natural sciences, with special emphasis on biodiversity research and environmental data collection. Major national and international projects. 3. Participation and co-creation in citizen science. Fundamental principles and key elements in the design of citizen science data collection projects.

	4. Tools and methodologies in citizen science: offline and online approaches, applications of analog and digital tools. The potential use of machine learning and artificial intelligence in citizen science. 5. Data quality in citizen science: background information, training, supporting materials, principles of data collection protocols, expected data structures, validation, and issues of data quality and usability. 6. User acquisition, retention, engagement, and rewarding: applied strategies and their impact on the quantity and quality of the contributed data. 7. The role and importance of communication and dissemination in natural science–related projects: from design and marketing to scientifically sound content. 8. Learning, public education, social responsibility, awareness raising, and achieving positive environmental impacts through citizen science. 9. The role of innovation and networking in citizen science. Citizen science networks and platforms. 10. Ethical and legal aspects, and the potential impact on social processes as well as on economic and political decision-making mechanisms.

Course title	**Sustainability and biodiversity conservation**
Instructor(s)(%):	László Szemethy, PhD (100%)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2 hours/week
Credit:	3
Description:	The aim of the course is to familiarize students with the wide-ranging ecological, social, and economic interpretations and problems of sustainability; to understand the evolution from species protection to ecosystem services; to gain insight into the EU's biodiversity conservation and sustainability strategies, with a particular focus on the international agenda.
Topics:	1. What does sustainability mean? Ecological-social and economic approach. 2. Sustainability goals, strategies, programs. 3. How conservation biology differs from previous trends in nature conservation, the strengths and weaknesses of active and passive nature conservation. 4. Natural resources. The concept of sustainable use. Overconsumption and overuse. Ecological footprint, what is it good for and what is it not? 5. Analytical comparison of BD strategies. 6. Evaluation of the UN Sustainable Development Goals. 7. Monitoring and research. The importance of descriptive data, the reliability of databases. 8. Research: the importance of a holistic approach. Methodological development.

Course title	**Biosafety training course**
Instructor(s)(%):	Szabó Péter 10%; Leiner Krisztina 20%; Ábrahám Ágota 20%; Somogyi Balázs 20%; Kemenesi Gábor 30%
Course type (lecture/seminar/practice)	lecture and practice
Total or weekly hours of the course	2x45 min per week
Credit:	3
Description:	The primary goal of the Biosafety Training Course is to prepare professionals for safe and compliant work in high-containment laboratories through a combination of theoretical knowledge and hands-on practice. Participants gain a comprehensive understanding of biosafety levels, risk groups, relevant regulations, and international standards, which are essential for working with infectious agents. The training emphasizes core skills such as risk assessment, decontamination protocols, and the correct use and maintenance of personal protective equipment. It also offers practical experience in biosafety cabinet use and laboratory procedures in BSL-2 to BSL-4 environments, including simulations in positive pressure suits. Ultimately, the course strengthens global biosafety capacity and fosters preparedness for real-world biological risks and emergencies.
Topics:	1. RG and BSL categories, most important pathogens; International (EU) and Hungarian regulations; Overview of the international recommendations, handbook 2. Requirements for BSL category facilities (BSL-1/2); Concepts and principles of BSL-3 facilities; Concepts and principles of BSL-4 facilities 3. Risk Assessment and Risk management 4. Requirements, use and maintenance of the PPE; Material transfer, transport and packaging 5. Laboratory design and technical criteria; Basic principles in laboratory work - Biosafety cabinet 6. Decontamination methods and protocols; Basic principles in laboratory work (BSL-2) 7. Basic principles in laboratory work (BSL-3); Basic principles in laboratory work (BSL-4); Decontamination methods and protocols (BSL-3/4) 8. Field Biosafety 1: Field labs and sampling; Field Biosafety 2: Rapid response and civil protection 9. Pre-work procedures (BSL-2); Pre-work procedures (BSL-3); Pre-work procedures (BSL-4) 10. Biosafety Cabinet practice 11. PPE and work practice in BSL-2; PPE and work practice in BSL-3; PPE and work practice in BSL-4

Course title	**Principles and Applications of Flow Cytometry in Agricultural and Food Research**
Instructor(s)(%):	Árpád Czéh (100%)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2× 45 minutes per week (organized as a block course held in the last third of the semester), total of 26×45 minutes per semester
Credit:	3
Description:	The aim of the course is to provide students with comprehensive knowledge of the theoretical foundations, instrumental setup, and practical applications of flow cytometry, with particular emphasis on its role in agricultural and food research. In the first part of the course, students will learn about the main components of a flow cytometer — the fluidic system, optical components, and electronic/data processing unit — and their operating principles. The course will cover in detail the detection of individual cells and microparticles, the measurement of light scattering and fluorescence signals, as well as the processing and interpretation of the acquired data. The second part of the course focuses on the applications of flow cytometry in agricultural and food research. Through practical examples, students will explore the use of the method in various areas, including: ➢ Determination of ploidy level and cell cycle analysis in plant cells and tissues ➢ Assessment of the viability, activity, and stress response of microorganisms (bacteria, yeasts, algae) ➢ Applications in food safety and quality control, such as rapid detection of pathogens and monitoring of cell injury ➢ Cell-level monitoring of biotechnological processes (e.g., fermentation) The course includes theoretical lectures, demonstration-based practical sessions, and data evaluation exercises, facilitating an interdisciplinary understanding and application of the method. By the end of the course, PhD students will be able to: ➢ Understand the basic principles of flow cytometry, ➢ Interpret data obtained from measurements, ➢ Independently apply the technique in agricultural and food science research projects.
Topics:	1. Introduction to Flow Cytometry (History, significance, and interdisciplinary fields of application.) 2. Main Components of a Flow Cytometer I – Fluidic System (Principles of sample flow, hydrodynamic focusing, individual cell passage.) 3. Main Components of a Flow Cytometer II – Optical and Detection System (Function and role of lasers, lenses, filters, and photodetectors.) 4. Signal Processing and Data Acquisition (Electronic signal handling, digital data processing, interpretation of histograms and dot plots.) 5. Sample Preparation and Labeling Techniques (Fluorescent dyes, antibodies, methods for cell fixation and permeabilization.) 6. Cellular Analytical Parameters and Basic Measurements (Cell size, granularity, viability, and apoptosis detection.) 7. Data Evaluation and Statistical Analysis (Compensation, gating strategies, multiparametric data analysis.) 8. Analysis of Plant Cells (Determination of ploidy level, cell cycle analysis, evaluation of plant stress responses.) 9. Microorganisms and Biotechnological Applications (Measurement of yeast, bacterial, and algal activity and viability in fermentation systems.)

	10. Applications in Food Safety and Quality Control (Detection of pathogens, analysis of cellular contamination and oxidative stress in food samples.) 11. Innovative Directions and Technological Developments (Imaging flow cytometry, microfluidic systems, automation, artificial intelligence in data analysis.) 12. Student Project Presentations and Summary (Presentation of application plans related to individual research topics; course summary.)

Course title	**Forests of Europe**
Instructor(s)(%):	Ortmann-né Ajkai Adrienne 100%
Course type (lecture/seminar/practice)	practice
Total or weekly hours of the course	Total 26/semester, partly in field
Credit:	2
Description:	The course introduces the students to ecology, species composition, and geographical position of Europe"s forests. It deals also with issues of forest management, forest conservation, and ancient forests
Topics:	Forest types of Europe, main tree species, forest management and conservation, forest dynamics, forest reserves, ancient forests

Course title	**Read Nature Briefings**
Instructor(s)(%):	Ortmann-né Ajkai Adrienne 100%
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2/week
Credit:	2
Description:	Although research gets more and more specialized, but sciencist have to preserve a broad scale of interest, i.e. be aware of the most important scientific news outside of their specific research area. During this course students will be enabled to obtain this kind of awareness by reading and discussing papers of Nature, one of the most renowned scientific journals, based on it daily newsletter, Nature Briefing (https://www.nature.com/nature/articles?type=nature-briefing)
Topics:	Content: 1. Introduction, exploration of resources 2. Lecturer's presentation on a chosen paper Followings: Students' presentations on their chosen papers and discussion. Actual list of topics is formed by the participants. The quality of the selected papers is guaranteed by Nature journal.

Course title	**Best papers on biodiversity conservation**
Instructor(s)(%):	Ortmann-né Ajkai Adrienne 100%
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2/week
Credit:	2
Description:	Current issues of conservation biology based on up-to-date scientific papers
Topics:	1. Introduction to the course. Most important papers and searching methods. 2. Teacher-assisted search of publications on conservation biology 3. Student's presentations and discussion on conservation biology 4. Teacher-assisted search of publications on the ecosystem service approach 5. Student's presentations and discussion on the ecosystem service approach I 6. Student's presentations and discussion on the ecosystem service approach II 7. Teacher-assisted search of publications on species conservation 8. Student's presentations and discussion on species conservation 9. Teacher-assisted search of publications on habitat conservation 10. Student's presentations and discussion on habitat conservation 11. Teacher-assisted search of publications on habitat reconstruction and rehabilitation 12. Student's presentations and discussion on on habitat reconstruction and rehabilitation I 13. Student's presentations and discussion on on habitat reconstruction and rehabilitation II

Course title	**Stress, sport and immune system**
Instructor(s)(%):	dr.Wilhelm Márta
Course type (lecture/seminar/practice)	Lecture
Total or weekly hours of the course	16
Credit:	2
Description:	The aim of the course is to introduce students to the basics of stress theory and its interpretations, through a multidisciplinary approach. Based on this, the course describes immunological and physiological factors determining performance, utilizing modern scientific knowledge. Main topics covered during the course include: eustress, distress, the immunological and cardiovascular effects of stress, changes in white blood cell populations in response to acute and chronic physical exertion, sudden cardiac death, asthma triggered by exertion, and stress responses in the digestive system as a result of regular physical activity.
Topics:	1,The meaning and characteristics of the general adaptation syndrome 2. The concept and interpretation of the emergency reaction 3. The meaning and interpretation of Selye's fire alarm model 4. The biological interpretation of the stress response, eustress, distress, no stress

	5. Acute and chronic stress responses in the circulatory system due to physical activity 6. Acute and chronic changes in the immune system due to physical activity 7. Heat shock, its development in athletes and non-athletes 8. Stress effects on the digestive system in athletes requiring high endurance 9. Characteristics of exercise-induced asthma 10. The relationships between physical activity, the immune system, and psychological condition

Course title	**Introduction to Beekeeping**
Instructor(s)(%):	Marianna Kocsis (10%) Antalovics Máté (90%)
Course type (lecture/seminar/practice)	lecture
Total or weekly hours of the course	1× 45 minutes per week (organized as a block course held in the first half of the semester), total of 14×45 minutes per semester
Credit:	2
Description:	Students will learn about the development, history, current situation, and different types of beekeeping. It is important that students understand the importance of bees and beekeeping products, and gain insight into this beautiful profession. The role of bees as pollinators has become extremely significant today, and it is important that they understand their role in the ecosystem.
Topics:	1. Development and history of beekeeping 2. Biology of bees 3. Types of hives and their significance 4. Diseases of bees, significance of beekeeping pests 5. Market situation of beekeeping 6. Honey adulteration 7. Student presentations, summary

Course title	**Agricultural plant knowledge**
Instructor(s)(%):	Marianna Kocsis (10%) Antalovics Máté (90%)
Course type (lecture/seminar/practice)	lecture
Total or weekly hours of the course	1× 45 minutes per week (organized as a block course held in the second half of the semester), total of 14×45 minutes per semester
Credit:	2
Description:	The aim of the course is to provide students with a complete picture of the importance of the most important field crops, to learn the basics of possible farming methods. The aim is to gain insight into modern precision solutions and discuss issues of sustainable solutions.
Topics:	1. Farming methods 2. Wheat and its relatives 3. Corn cultivation 4. Oil and protein crop cultivation 5. Industrial crop production

	6. Precision solutions in agricultural crop production 7. Future issues in agriculture 8. Student presentations, summary

Course title	**Plant microtechniques**
Instructor(s)(%):	Marianna Kocsis (50%) Ágnes Farkas (50%)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2× 45 minutes per week (organized as a block course held in the second half of the semester), total of 26×45 minutes per semester
Credit:	2
Description:	The course focuses on the most frequently applied protocols of plant microtechniques, used to study various plant tissues and cells. Students will master the techniques listed below. Leaf surface casts, hand cross-sections, using histochemical stains. Leaf clearing. Fixing plant samples, embedding into paraplast and artificial resin. Preparing slides for light microscopic studies (using a microtome, various microscopic stains, mounting). Pollen preparations for morphological and viability studies. Using a digital camera connected to a microscope. Qualitative and quantitative evaluation of micrographs.
Topics:	1. Leaf clearing techniques 2. Conserving plant samples 3. Embedding of plant samples 4. Mounting of blocks 5. Sectioning of embedded samples with rotation microtome 6. Staining and mounting of sections 7. Qualitative and quantitative analysis of leaf cross sections with light microscopy 8. Staining and processing of vegetative plant parts for fluorescent microscopy 9. Taking microphotos, qualitative and quantitative analysis of micrographs 10. Processing of reproductive plant parts for fluorescent microscopy 11. Taking and analysing microphotos 12. Qualitative and quantitative analysis of micrographs 13. Summing up and evaluating results

Course title	**Scientific English II.**
Instructor(s)(%):	Dr. Robert Gabriel (100%)
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	2 hrs/week
Credit:	3 credits
Description:	Logics and vocabulary of scientific English in practice. Development of paper writing skills of students. Translation and interpretation of Hungarian scientific texts into English. Alternative solutions.

Topics:	Translation of Hungarian scientific texts to English independently. Discussion of the alternative solutions. Conference poster preparation and presentation in English (at least one).

Course title	**Instrumental Measurement Techniques in Sports Biology Research**
Instructor(s)(%):	Balázs Sebesi (80%), Tamás Atlasz PhD (20%)
Course type (lecture/seminar/practice)	practice
Total or weekly hours of the course	1×45 minutes per week (organized as a block course held in the last third of the semester), total of 12×45 minutes per semester
Credit:	3
Description:	The goal of this course is to provide students with a comprehensive understanding of contemporary measurement methodologies employed in sports biology research and to develop their ability to apply these techniques in practice. Throughout the course, students will acquire the methodological knowledge and practical competencies necessary to design, conduct, and critically evaluate experimental investigations independently. Practical training will introduce participants to key approaches such as isokinetic dynamometry, sensor- and video-based motion analysis, and electromyography (EMG) for the assessment of muscle activity, alongside additional methods for examining human performance capacity and movement patterns. At the end of the course, students will be proficient in the autonomous application of these techniques within sports biology research context.
Topics:	1. Introduction to sport-biological measurement techniques. Overview of the course, objectives, and content. Introduction to measurement principles and key methodological approaches in sport biology. 2. Principles of measurement reliability and validity. Measurement errors, calibration, and data reliability. Ethical considerations in sport-biological measurements, research permissions, and data management. 3. Theoretical foundations of strength measurement and isokinetic dynamometry. Components of muscular strength, objectives of isokinetic testing, measurement setups, and interpretation of parameters. 4. Practical application of isokinetic dynamometry. Individual practical measurements by participants: warm-up, equipment setup, test protocols, data collection, and basic evaluation. 5. Sensor-based motion analysis. Accelerometers, gyroscopes, and inertial measurement technologies. Application examples in sports biology and movement assessment. 6. Video-based motion analysis. Camera systems, determination of kinematic parameters, and fundamentals of image processing. 7. Practical motion analysis. Video recording, use of reference markers, analysis of angular velocity, acceleration, and movement patterns. 8. Theoretical foundations of electromyography (EMG). Physiological background of muscle activity, differences between surface and needle EMG, signal acquisition and filtering. 9. Practical EMG measurement. Electrode placement, measurement protocols, signal processing, and quantification of muscle activation.

	10. Integration of complex measurement protocols. Combined analysis of strength, motion, and EMG data. Synchronization, data processing issues, and possible solutions. 11. Data processing, visualization, and basic statistical analysis. Graphical and numerical processing of sport-biological data, error analysis, and interpretation of fundamental statistical indicators. 12. Presentation of individual measurements and course summary. Short presentations of student-led measurements, discussion of experiences, and evaluation of the applicability of the methods learned.

Course title	**Adapted Exercise Physiology**
Instructor(s)(%):	
Course type (lecture/seminar/practice)	seminar
Total or weekly hours of the course	22
Credit:	2
Description:	The aim of the course to show students those conventional and modern fitness testing techniques and methods, which help to analyze the fitness level, physical performance of a person. With the aid of a properly planned and performed exercise test the further performance improving strategies can be personalized and more successful. The most important topics: Measurement of heart rate, blood pressure in field test and in laboratories with modern techniques and devices. Analyzing heart rate data and changes. Measuring and analyzing aerobic capacity in field test and in laboratories with complex spiro-ergometric techniques. Blood saliva and urine sample analyzation in relation to measured physiological changes.
Topics:	1, Understanding aerobic and anaerobic capacity 2, Blood pH, blood lactate measurement, importance of blood lactate level in training and performance 3, Maximal oxygen uptake, measurement, relevance in training and improvement of VO_2max, Estimation of VO_2max 4, Capilarization of muscles, metabolism of muscle cells, mitochondria (structure, function, numbers in cells) 5, Field tests measuring aerobic capacity, the health of the cardiovascular and pulmonary system (step tests, walking tests) 6, Sport testers measuring heart rate changes in rest and exercise (Polar watches etc.) 7, Spiro-ergometry, protocols and collecting data (Bruce- Astrand, Ramp-, walking protocols) 8, Estimating the efficiency of training using different measurement strategies taken into account the different age groups 9, Elderly (physiological and hormonal status, motor performance, fitness testing. The possible training methods and their efficiency 10, Body fat percentage. Measurement, estimation. Health, fitness and body composition. Body fat percentage and health in different age groups 11, PPT presentation from scientific papers describing the health and fitness of the human population all around the World (student's presentations)