

**University of Debrecen  
Faculty of Science and Technology  
Institute of Biology and Ecology**

**BIOLOGY BSC PROGRAM**

**2024**

## TABLE OF CONTENTS

<b>DEAN'S WELCOME</b> .....	3
<b>UNIVERSITY OF DEBRECEN</b> .....	4
<b>FACULTY OF SCIENCE AND TECHNOLOGY</b> .....	5
<b>DEPARTMENTS OF INSTITUTE OF BIOLOGY AND ECOLOGY</b> .....	6
<b>ACADEMIC CALENDAR</b> .....	7
<b>THE BIOLOGY BACHELOR PROGRAM</b> .....	8
<b>Information about the Program</b> .....	8
<b>Completion of the BSc Program</b> .....	11
The Credit System .....	11
Curriculum of Biology BSc .....	12
Work and Fire Safety Course .....	16
Physical Education .....	16
Pre-degree certification .....	16
Thesis .....	16
Final Exam .....	17
<b>Diploma</b> .....	18
<b>Course Descriptions of Biology BSc Program</b> .....	19

## **DEAN'S WELCOME**

Welcome to the Faculty of Science and Technology!

This is an exciting time for you, and I encourage you to take advantage of all that the Faculty of Science and Technology UD offers you during your bachelor's or master's studies. I hope that your time here will be both academically productive and personally rewarding

Being a regional centre for research, development and innovation, our Faculty has always regarded training highly qualified professionals as a priority. Since the establishment of the Faculty in 1949, we have traditionally been teaching and working in all aspects of Science and have been preparing students for the challenges of teaching. Our internationally renowned research teams guarantee that all students gain a high quality of expertise and knowledge. Students can also take part in research and development work, guided by professors with vast international experience.

While proud of our traditions, we seek continuous improvement, keeping in tune with the challenges of the modern age. To meet our region's demand for professionals, we offer engineering courses with a strong scientific basis, thus expanding our training spectrum in the field of technology. Recently, we successfully re-introduced dual training programmes in our constantly evolving engineering courses.

We are committed to providing our students with valuable knowledge and professional work experience, so that they can enter the job market with competitive degrees. To ensure this, we maintain a close relationship with the most important companies in our extended region. The basis for our network of industrial relationships are in our off-site departments at various different companies, through which market participants - future employers - are also involved in the development and training of our students.

Prof. dr. Ferenc Kun

Dean

# UNIVERSITY OF DEBRECEN

**Date of foundation:** 1912 Hungarian Royal University of Sciences, 2000 University of Debrecen

**Legal predecessors:** Debrecen University of Agricultural Sciences; Debrecen Medical University; Wargha István College of Education, Hajdúböszörmény; Kossuth Lajos University of Arts and Sciences

**Legal status of the University of Debrecen:** state university

**Founder of the University of Debrecen:** Hungarian State Parliament

**Supervisory body of the University of Debrecen:** Ministry of Education

**Number of Faculties at the University of Debrecen:** 13

Faculty of Agricultural and Food Sciences and Environmental Management

Faculty of Child and Special Needs Education

Faculty of Dentistry

Faculty of Economics and Business

Faculty of Engineering

Faculty of Health

Faculty of Humanities

Faculty of Informatics

Faculty of Law

Faculty of Medicine

Faculty of Music

Faculty of Pharmacy

Faculty of Science and Technology

**Number of students at the University of Debrecen:** 30,899

**Full time teachers of the University of Debrecen:** 1,597

210 full university professors and 1,262 lecturers with a PhD.

## FACULTY OF SCIENCE AND TECHNOLOGY

The Faculty of Science and Technology is currently one of the largest faculties of the University of Debrecen with about 2,500 students and more than 200 staff members. The Faculty has got 6 institutes: Institute of Biology and Ecology, Institute of Biotechnology, Institute of Chemistry, Institute of Earth Sciences, Institute of Physics and Institute of Mathematics. The Faculty has a very wide scope of education dominated by science and technology (12 Bachelor programs and 14 Master programs), additionally it has a significant variety of teachers' training programs. Our teaching activities are based on a strong academic and industrial background, where highly qualified teachers with a scientific degree involve students in research and development projects as part of their curriculum. We are proud of our scientific excellence and of the application-oriented teaching programs with a strong industrial support. The number of international students of our faculty is continuously growing (currently ~760 students). The attractiveness of our education is indicated by the popularity of the Faculty in terms of incoming Erasmus students, as well.

### THE ORGANIZATIONAL STRUCTURE OF THE FACULTY

Dean: Prof. Dr. Ferenc Kun, Full Professor  
E-mail: [tkdekan@science.unideb.hu](mailto:tkdekan@science.unideb.hu)

Vice Dean for Educational Affairs: Prof. Dr. Gábor Kozma, Full Professor  
E-mail: [kozma.gabor@science.unideb.hu](mailto:kozma.gabor@science.unideb.hu)

Vice Dean for Scientific Affairs: Prof. Dr. Sándor Kéki, Full Professor  
E-mail: [keki.sandor@science.unideb.hu](mailto:keki.sandor@science.unideb.hu)

Consultant on External Relationships: Prof. Dr. Attila Bérczes, Full Professor  
E-mail: [berczesa@science.unideb.hu](mailto:berczesa@science.unideb.hu)

Consultant on Talent Management Programme: Prof. dr. Tibor Magura, Full Professor  
E-mail: [magura.tibor@science.unideb.hu](mailto:magura.tibor@science.unideb.hu)

Dean's Office  
Head of Dean's Office: Mrs. Katalin Kozma-Tóth  
E-mail: [toth.katalin@science.unideb.hu](mailto:toth.katalin@science.unideb.hu)

English Program Officer: Mrs. Alexandra Csatóry  
Address: 4032 Egyetem tér 1., Chemistry Building, A/101, E-mail: [acsatory@science.unideb.hu](mailto:acsatory@science.unideb.hu)

## DEPARTMENTS OF INSTITUTE OF BIOLOGY AND ECOLOGY

### Department of Botany

4032 Debrecen, Egyetem tér 1, Life Science Building

Head of department	Position	E-mail	room
Mr. Prof. Dr. Gábor Vasas, PhD, habil, DSc	University Professor, Head of Department	vasas.gabor@science.unideb.hu	LFS 1.506

### Department of Ecology

4032 Debrecen, Egyetem tér 1, Ecology Building

Head of department	Position	E-mail	room
Mr. Prof. Dr. Tibor Magura, PhD, habil, DSc	University Professor, Head of Department	magura.tibor@science.unideb.hu	Ecol. Building 104

### Department of Evolutionary Zoology and Human Biology

4032 Debrecen, Egyetem tér 1, Life Science Building

Head of department	Position	E-mail	room
Mr. Prof. Dr. Zoltán Barta, PhD, habil, DSc	University Professor, Head of Department. Head of Institute	barta.zoltan@science.unideb.hu	LFS 1.206

### Department of Hydrobiology

4032 Debrecen, Egyetem tér 1, Ecology Building

Head of department	Position	E-mail	room
Mr. Dr. István Grigorszky, PhD, habil,	Associate Professor, Head of Department	grigorszky.istvan@science.unideb.hu	Ecol. Building 023

## ACADEMIC CALENDAR

General structure of the academic semester (2 semesters/year):

Study period	1 <sup>st</sup> week	Registration*	1 week
	2 <sup>nd</sup> – 15 <sup>th</sup> week	Teaching period	14 weeks
Exam period	directly after the study period	Exams	7 weeks

\*Usually, registration is scheduled for the first week of September in the fall semester, and for the first week of February in the spring semester.

For further information, please check the following link:

[https://www.edu.unideb.hu/tartalom/downloads/University\\_Calendars\\_2024\\_25/University\\_calendar\\_2024-2025-Faculty\\_of\\_Science\\_and\\_Technology.pdf](https://www.edu.unideb.hu/tartalom/downloads/University_Calendars_2024_25/University_calendar_2024-2025-Faculty_of_Science_and_Technology.pdf)

# THE BIOLOGY BACHELOR PROGRAM

## Information about the Program

Name of BSc Program:	Biology BSc Program
Specialization available:	
Field, branch:	Science
Qualification:	Biology
Mode of attendance:	Full-time
Faculty, Institute:	Faculty of Science and Technology Institute of Biology and Ecology
Program coordinators:	Dr. Viktor Oláh, Associate Professor Dr. Jácint Tökölyi, Associate Professor
Student adviser:	Dr. István Gyulai, Assistant Professor
Duration:	6 semesters
ECTS Credits:	180

### Objectives of the BSc program:

Our aim is to provide students with basic knowledge in the most important biological fields, to attain skills in fundamental methods of laboratory and applied biology and acquaint them with the most important biological processes at the molecular, cell, individual and supraindividual level. The Biology BSc program covers a broad range of biological science including the most important concepts in modern biology; the levels of biological organization; the fundamental principles of structure and function and the development of ecosystems. The Institute of Biology and Ecology at the University of Debrecen has about 40 staff members, a third of whom are professors and associate professors with fluent English, established educational and research experience and regular research publications. The institute is well equipped and has an almost complete new Life Sciences library with more than 20000 books and about 200 journals in biology and ecology. Our libraries also enjoy the technical support and database of the National University Library of Debrecen. The institute is located in the two newest buildings of the Faculty of Science: the Life Sciences Building and the Ecological Building, with well equipped, spacious and computerized lecture rooms and laboratories.



## **Professional competences to be acquired**

### **A Biologist:**

#### **a) Knowledge:**

- He/she has a high level of knowledge about the living systems both above and below organism level. Able to apply, organise and develop this knowledge further.
- He/she knows the methods applied in modern field, laboratory and industrial biology.
- He/she knows and is able to apply the terminology and knowledge of the different areas of biology (cell biology, ecology, environmental and nature protection, microbiology, immunology, physiology, animal behaviour, genetics, evolutionary biology, biotechnology, structural biology, syntetic biology, botany and zoology).
- He/she knows the connections between the different biological disciplines and understands the importance of multidisciplinary approaches.
- He/she knows the theoretical and historical aspects of evolution of life on Earth and is able to argue scientifically for this view.
- He/she knows the possibility of applications of modern biological methods, recognises the importance of the development of new methodology and contributes to this development.
- He/she has usable knowledge of natural sciences.
- He/she senses and understands problems of the society which are rooted in biology.

#### **b) Abilities:**

- He/she is able to recognise the connections between different areas of science.
- He/she is able to recognise patterns in social processes related to nature and living organisms.
- He/she is able to carry out scientific research projects and produce (with appropriate supervision) new scientific results.
- He/she is able to use research methods and tools, plan and carry out investigations, interpret and present results of such investigations, learn and develop new methods.
- He/she is able to be an interdisciplinary thinker, build collaborations and coordinate division of labour between members of staff.
- He/she is able to think and act to achieve high level of quality control.
- He/she is able to manage, analyse and interpret scientific data.
- He/she has and develops skills for precise measurements.
- He/she is able to present and defend his/her views and perform well on job interviews.
- He/she is able to present his/her results and views in biology at a high level both in oral and written form.
- He/she joins the national and international scientific community and is able to communicate his/her results at a high level.
- He/she is able to work in a sustainable way.

#### **c) Attitude:**

- He/she aims to know and understand the interactions amongst humans and nature, the structure, function and evolution of humans and other organisms.
- He/she aims at expressing a responsible point of view about humans and nature, explain their relations for the widest possible audience, and positively influence the public view on biology according to the latest scientific findings.
- He/she sets an example by his/her behaviour concerning environment and nature. He/she acts to push environmental and nature conservation further.
- He/she follows and makes others to follow the ethics of scientific research.

- He/she spread the results of science in an active way even in the media, he/she is able to defend his/her views against pseudoscientific attacks.
- He/she works both in the field and laboratory in a sustainable way and sets examples in this way for others.
- He/she is open to learn new theories and experimental results and is eager to collaborate with others. He/she aims to develop his/her knowledge and set new research directions.
- He/she is committed to do high quality work, to improve his/her own and his/her fellows' knowledge and career.
- He/she is open to develop research consultancy services and spin-offs.
- He/she is open to continuously learn and collaborate with other groups. He/she actively seeks the possibility for personal and professional development and actively helps the flow of information.

**d) Autonomy and responsibility:**

- He/she has the ability to lead small research groups.
- He/she expresses his/her point of view responsibly in professional and non-professional circles about biological research, ethical and bioethical questions.
- He/she puts a great emphasis on work safety under all conditions.
- He/she has the self-determination to organise the work of small groups, and takes responsibility for this.
- He/she knows the legal conditions for safe work. He/she stands on his/her own and his/her fellows' interests at different forums and suggests changes to improve work conditions.
- He/she obtains work experience and helps others to work efficiently.
- He/she determinately builds his/her own career and helps others in doing so.

## **Completion of the BSc Program**

### *The Credit System*

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes: statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).

ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programs and student achievement. ECTS in no way regulates the content, structure and/or equivalence of study programs.

Regarding each major, the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, subject-related subjects and differentiated field-specific subjects.

During the program students have to complete a total amount of 180 credit points. It means approximately 30 credits per semester. The curriculum contains the list of subjects (with credit points) and the recommended order of completing subjects which takes into account the prerequisite(s) of each subject. You can find the recommended list of subjects/semesters in chapter “Guideline”.

Curriculum for Biology BSc students											
Abbreviations: E, oral or written examination; P, practical, S, seminar											
Module	Subject Lecturer	Code	Prerequisite	Hours/week in semesters (Lecture+Seminar+Lab practice)						Type of exami- nation	Credit point
				1	2	3	4	5	6		
Module I.	<b>Basic Information I.</b> Dr. Viktor Oláh, Dr. Jácint Tökölyi	TTBBG1000_ EN		0+1+0						S	1
	<b>Safety</b> Dr. György Deák	TTKBE0711_ EN		2+0+0						E	3
	<b>Basic environmental science</b> Dr. Sándor Alex Nagy	TTEBE0040_ EN		1+0+0						E	1
	<b>Fundamentals of Biomathematics</b> Dr. András Bazsó	TTMBE0801_ EN		2+0+0						E	3
	<b>Fundamentals of Biomathematics practice</b> Dr. András Bazsó	TTMBG0801_ EN		0+2+0						P	2
	<b>Biostatistics</b> Dr. Béla Tóthmérész	TTBBE1001_ EN					2+0+0			E	3
	<b>Biostatistics seminar</b> Dr. Béla Tóthmérész	TTBBG1001_ EN					0+2+0			S	3
	<b>Chemical Basis of Biology</b> Dr. János Kerégyártó, Dr. Sándor Kun	TTBBE1005_ EN			2+0+0					E	2
	<b>Chemical Basis of Biology</b> Dr. János Kerégyártó, Dr. Teréz Barna	TTBBG2035_ EN			0+0+2					P	3
	<b>Introduction to chemistry</b> Dr. Katalin Várnagy	TTKBE0141_ EN		2+0+0						E	3
	<b>Introduction to chemistry</b> Dr. Petra Herman	TTKBL0141_ EN	TTKBE0141_ EN		0+0+2					P	2
	<b>Sampling, sample treatment, analytical tests</b> Dr. Edina Baranyai	TTKBE0514_ EN	TTKBE0141_ EN		1+0+0					E	1
	<b>Sampling, sample treatment, analytical tests</b> Dr. Edina Baranyai, Dr. István Gyulai	TTKBL0514_ EN	TTKBL0141_ EN				0+0+4			P	4
	<b>Basic Geology</b> Dr. Péter Rózsa	TTGBG5103_ EN		0+2+0						S	2
	<b>Fundamentals of biology</b> Dr. Ibolya Revákné Markóczy	TTBBE1010_ EN		2+0+0						E	3
<b>Evolutionary biology</b> Dr. Ádám Lendvai	TTBBE0004_ EN		2+0+0						E	2	
				<b>11+5+0</b>	<b>3+0+4</b>	<b>0+0+4</b>	<b>2+2+4</b>			<b>36</b>	
Module II.	<b>Plant taxonomy</b> Dr. Gábor Matus	TTBBE2005_ EN		2+0+0						E	3
	<b>Plant taxonomy</b> Dr. Gábor Matus	TTBBL2005_ EN			0+2+0					P	2
	<b>Zoology I.</b> Dr. András Tartally	TTBBE2010_ EN			2+0+0					E	2
	<b>Zoology II.</b> Dr. Jácint Tökölyi	TTBBE2015_ EN				2+0+0				E	2
	<b>Animal taxonomy I.</b> Dr. András Tartally	TTBBL2020_ EN				0+0+2				P	3

	<b>Animal taxonomy II.</b> Dr. András Tartally	TTBBL2025_ EN					0+0+2			P	3
	<b>Basic Ecology</b> Dr. Béla Tóthmérész	TTBBE3045_ EN			2+0+0					E	3
	<b>Basic Ecology seminar</b> Dr. Béla Tóthmérész, Dr. Tibor Magura, Dr. Edina Kundrát-Simon, Dr. Péter Török, Dr. Dávid Nagy, Dr. Edina Tóth-Szabó, Dr. Roland Horváth	TTBBG3045_ EN			0+2+0					S	3
	<b>Biodiversity</b> Dr. Béla Tóthmérész	TTBBE3050_ EN				2+0+0				E	3
	<b>Biodiversity seminar</b> Dr. Edina Kundrát-Simon	TTBBG3050_ EN				0+2+0				S	3
	<b>Hydrobiology</b> Dr. Sándor Alex Nagy, Dr. István Grigorszky	TTBBE2065_ EN				2+0+0				E	3
	<b>Hydrobiology practice</b> Dr. István Bácsi, Dr. Csaba Berta, Dr. István Gyulai	TTBBL2065_ EN				0+1+2				P	4
	<b>Ecological examination methods</b> Dr. Péter Török	TTBBE3055_ EN							1+0+0	E	2
	<b>Ecological examination methods practice</b> Dr. Edina Kundrát-Simon	TTBBG3055_ EN							0+2+0	S	3
	<b>Population Genetics</b> Dr. Nikoletta Nagy	TTBBE3060_ EN	TTBBE3020_ EN					2+0+0		E	2
	<b>Population Genetics practice</b> Dr. Nikoletta Nagy	TTBBG3060_ EN	TTBBE3020_ EN					0+2+0		P	1
	<b>Biogeography</b> Dr. Attila V. Molnár	TTBBE3065_ EN							2+0+0	E	3
	<b>Environmental and Nature protection</b> Dr. István Gyulai, Dr. Csaba Berta	TTBBE3070_ EN						2+0+0		E	3
	<b>Environmental and Nature protection seminar</b> Dr. István Gyulai, Dr. Csaba Berta	TTBBG3070_ EN						0+2+0		P	2
	<b>Animal Behaviour</b> Dr. Zoltán Barta	TTBBE3075_ EN				3+0+0				E	4
	<b>Field practicals</b> Dr. Gábor Matus	TTBBG2055_ EN					*			P	2
					2+0+0	4+4+0	9+3+4	0+0+2	4+4+0	3+2+0	58
<b>Module III.</b>	<b>Plant anatomy</b> Dr. Csaba Máthé, Dr. Márta Hamvas	TTBBE2001_ EN			2+0+0					E	3
	<b>Plant anatomy lab.</b> Dr. Márta Hamvas, Dr. Csaba Máthé	TTBBL2001_ EN			0+0+2					P	2
	<b>Animal anatomy</b> Dr. Brigitta Csernus	TTBBL2030_ EN				0+0+2				P	3
	<b>Biochemistry</b> Dr. János Kerékgyártó	TTBBE2036_ EN				2+0+0				E	2
	<b>Biochemistry seminar</b> Dr. János Kerékgyártó	TTBBG2036_ EN				0+1+0				S	1
	<b>Bioinformatics</b> Dr. Mátyás Sipiczki	TTBBE2060_ EN					1+0+0			E	2
	<b>Bioinformatics</b> Dr. Hajnalka Csoma	TTBBG2060_ EN						0+2+0		P	2
	<b>Cell biology</b> Dr. Gábor Szemán-Nagy	TTBBE2045_ EN				2+0+0				E	3

	<b>Cell biology seminar</b> Dr. Gábor Szemán-Nagy	TTBBG2045_ EN				0+2+0				P	2
	<b>Animal physiology I.</b> Dr. Gábor Szemán-Nagy	TTBBE3001_ EN					2+0+0			E	3
	<b>Animal physiology I. seminar</b> Dr. Gábor Szemán-Nagy	TTBBG3001_ EN						0+2+0		S	3
	<b>Plant physiology I.</b> Dr. Csaba Máthé	TTBBE3010_ EN					2+0+0			E	3
	<b>Plant physiology I. lab</b> Dr. Viktor Oláh	TTBBL3010_ EN					0+0+2			P	2
	<b>Plant physiology II.</b> Dr. Csaba Máthé	TTBBG3015_ EN						0+2+0		S	3
	<b>Genetics</b> Dr. Gyula Batta	TTBBE3020_ EN			2+0+0					E	3
	<b>Molecular biology</b> Dr. Ida Miklós Gálné	TTBBE3025_ EN					2+0+0			E	3
	<b>General microbiology and mycology</b> Dr. Valter Péter Pfyegler	TTBBE3030_ EN			2+0+0					E	3
	<b>Biotechnology</b> Dr. Éva Leiter	TTBBE3035_ EN				2+0+0				E	3
					<b>2+0+2</b>	<b>8+1+2</b>	<b>3+2+0</b>	<b>6+2+2</b>	<b>0+4+0</b>		<b>46</b>
<b>Module IV: Elective subjects 21 Credits</b>	<b>Soil Science</b> Dr. Viktor Oláh	TTBBE4001_ EN						1+1+0		E	3
	<b>Plant ecophysiology</b> Dr. Viktor Oláh, Dr. Ilona Mészáros	TTBBG4005_ EN							0+2+0	S	3
	<b>Paleolimnology and Aquatic Biomonitoring</b> Dr. Istvan Gyulai	TTBBG4010_ EN			1+1+0					E	3
	<b>Toxicology and ecotoxicology</b> Dr. Edina Kunderát-Simon	TTBBG4015_ EN						2+0+0		E	3
	<b>Medical plant products</b> Dr. Gábor Vasas	TTBBG4020_ EN							2+0+0	E	3
	<b>Histology of medical plants seminar</b> Dr. Márta Hamvas	TTBBG4025_ EN						0+1+0		S	2
	<b>Animal Ecology</b> Dr. Edina Kunderát-Simon, Dr. Roland Horváth	TTBBE4030_ EN							2+0+0	E	3
	<b>Caseworks in Hydrobiology</b> Dr. László Antal	TTBBG4035_ EN						0+1+0		S	2
	<b>Biochemistry II.</b> Dr. Teréz Barna	TTBBE2040_ EN						2+0+0		E	2
	<b>Fundamentals of physics</b> Dr. Balázs Ujvári	TTFBE2101							2+1+0	E,P	4
	<b>Techniques of image formation</b> Dr. Gábor Szemán-Nagy	TTBBE4040_ EN							2+0+0	E	3
	<b>Sustainability and current environmental issues</b> Dr. Viktor Oláh	TTBBG4045_ EN						1+1+0		E	3
	<b>Plant Biochemistry and Molecular Biology</b> Dr. Ilona Mészáros	TTBBE4050_ EN							2+0+0	E	3
	<b>Methods in Molecular Biology lab</b> Dr. Gyula Batta	TTBBG2042_ EN	TTBBE3025_ EN TTBBE3020_ EN						0+2+0	E	2
<b>Microbial Ecology</b> Dr. Jácint Tökölyi	TTBBE0506						0+1+2		P	2	

	<b>Cell cultures and cell preparation techniques</b> Dr. Gábor Szemán-Nagy	TBBE0230-A					2+0+0			E	3
	<b>Cell cultures and cell preparation techniques practice</b> Dr. Gábor Szemán-Nagy	TBBL0230-A					0+0+2			P	2
	<b>Animal physiology and cell biology lab</b> Dr. Gábor Szemán-Nagy	TTBBL3005_ EN	TTBBE3001_ EN					0+0+4		P	4
<b>Module V.</b>	<b>Free optional subjects</b>										<b>9</b>
<b>Module VI.</b>	<b>Thesis I.</b>	TTBBG0001_ EN					*				<b>2</b>
	<b>Thesis II.</b>	TTBBG0010_ EN						*			<b>3</b>
	<b>Thesis III.</b>	TTBBG0020_ EN							*		<b>5</b>
											<b>10</b>
<b>Number of ECTS credits:</b>											<b>180</b>

### *Work and Fire Safety Course*

According to the Rules and Regulations of University of Debrecen each student has to complete the online course for work and fire safety. Registration for the course and completion are mandatory for graduation. For MSc students, the course is only necessary if their BSc diploma has been awarded outside of the University of Debrecen.

Registration in the Neptun system by the subject: MUNKAVEDELEM

Students have to read an online material until the end to get the signature on Neptun for the completion of the course. The link of the online course is available on webpage of the Faculty.

### *Physical Education*

According to the Rules and Regulations of University of Debrecen each student has to fulfil at least two semesters of Physical Education during his/her Bachelor's training. Our University offers a wide range of facilities to carry them out. Further information is available from the Sport Centre of the University, its website is: <http://sportsci.unideb.hu>.

### *Pre-degree Certification*

A pre-degree certificate is issued by the Faculty after completion of the bachelor's (BSc) program. The pre-degree certificate can be issued if the student (1) has successfully completed the study and exam requirements as set out in the curriculum, (2) the requirements relating to Physical Education as set out in Section 10 in Rules and Regulations– with the exception of preparing thesis – and (3) gained the necessary credit points (180). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtain the pre-degree certificate can submit their theses and take the final exam.

### *Thesis*

The thesis is based on an independent project work summarizing research by the student conducted under the supervision of a university professor. It serves to prove that students are able to collect and interpret literature information related to a specific problem and solve biological problems through data collection, analysis and interpretation. The topic of the thesis has to be selected in the 4th semester at the latest, however, students may join any research activity at the departments earlier. Thesis courses have to be completed in semesters 4, 5 and 6 with the total credit points of 10. The minimum length of the thesis is 15-20 typewritten pages, composed with A/4 paper size, 2.5 cm margins, 12 points Times New Roman letter size and type, and 1.5 spacing, respectively. The following chapters need to be included: Title page, Table of Contents; Introduction and review of literature; Objectives; Materials and Methods;



Results; Discussion; Summary; Acknowledgements; Bibliography. The literature review should cover a very minimum of 10 scientific articles (a scientific article is a piece of literature that is indexed in the scientific databases Web of Science, PubMed or Scopus). There are no further formal requirements, but the supervisor may make additional recommendations specific to the particular field of study.

### *Final Exam*

(a) requirements for admission to the final examination;

Registration for the Final Exam requires that the student has already obtained the required 180 credits and submitted his/her thesis.

(b) final examination;

At the final exam the obtained knowledge is evaluated in an oral exam using topics covering the core material. Defending the thesis is part of the final exam in the form of a short presentation of the results summarized in the thesis work. Calculation of exam results is based on the Rules and Regulations. The final exam has to be taken in front of the Final Exam Board. If a candidate does not pass his/her final exam by the termination of his/her student status, he/she can take the final exam after the termination of the student status on any of the final exam days of subsequent academic years according to existing requirements on the rules of the final exam.

#### Final Exam Board

The Board chair and members are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair and in case of his/her absence or indisposition the vice-chair who will be called upon, as well. The board consists of – besides the chair – at least two members (one of them is an external expert), and questioners as required. The mandate of a Final Examination Board lasts for one year.

#### Repeating a failed Final Exam

If any part of the final exam is failed it can be repeated according to the rules and regulations. A final exam can be retaken in the forthcoming final exam period (typically the next semester). A repeated final exam can be taken twice on each subject.

## Diploma

The diploma is an official document decorated with the coat of arms of Hungary which testifies the successful completion of studies in the Biology Bachelor Program. It contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the rector's (or vice-rector's) original signature and the seal of HEI. The University keeps a record of the diplomas issued.

In Biology Bachelor Program the diploma grade is calculated as the average grade of the results of the followings:

- Weighted average of the overall studies at the program (A)
- Average of grades of the thesis and its defense given by the Final Exam Board (B)
- Average of the grades received at the Final Exam for the two subjects (C)

Diploma grade =  $(A + B + C)/3$

Classification of the award on the bases of the calculated average:

Excellent	4.81 – 5.00
Very good	4.51 – 4.80
Good	3.51 – 4.50
Satisfactory	2.51 – 3.50
Pass	2.00 – 2.50

## Course Descriptions of Biology BSc Program

<b>Title of course:</b> Safety <b>Code:</b> TTKBE0711_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - preparation for the tests: 62 hours Total: 90 hours	
<b>Year, semester:</b> 4 <sup>th</sup> year, 1 <sup>th</sup> semester	
<b>Its prerequisite(s):</b> TTKBE1112_EN	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
<ul style="list-style-type: none"> <li>-General safety rules.</li> <li>- Describing major accidents and causes.</li> <li>- Poisoning, noise.</li> <li>- Inerting of chemical vessels.</li> <li>- Hazards of electricity (Static electricity, Direct current and alternating current)</li> <li>- Dangers of chemical reactions.</li> <li>- Safety valves, regulation of pressure, solutions in case of emergency.</li> </ul>	
<b>Literature</b>	
<p><i>Recommended:</i></p> <ol style="list-style-type: none"> <li>1. D. A. Crowl, J.F. Louvar: Chemical Process Safety, Pearson, Boston, USA (2011)</li> <li>2. Roger L. Bauer: Safety and Health for Engineers, Wiley Interscience, New York (2005)</li> <li>3. Richard J. Lewis ed.: Sax's Dangerous properties of Industrial Materials, John Wiley (2005)</li> <li>4. C. D. Classen, Caserett and Doull's Toxicology, McGraw-Hill, New York (2008)</li> </ol>	
<b>Schedule:</b>	
<p><i>1<sup>st</sup> week</i> General and basic security rules. Definition of accident, near-miss (quasi-accident) and first aid. Can we learn from accidents that have not happened?</p> <p><i>2<sup>nd</sup> week</i> Accident statistics, industry comparison. Conclusions from the figures.</p> <p><i>3<sup>rd</sup> week</i> Some major accidents are described, for example: in Bhopal, India (1984), Seveso, Italy (1976), Red Sludge (Red Mud) Disaster, Kolontar, Hungary (2010). Discussion of the possible causes of accidents.</p> <p><i>4<sup>th</sup> week</i> Intoxications. Exposure and elimination of toxic substances to the body. Basic principles of toxicology. Definition of LD50. Cross effects of toxic substances, antidotes. Methanol poisoning.</p>	

*5<sup>th</sup> week*

Definition and classification of noise. Effect of the frequency and power of the noise. Dangers and diseases caused by noise. Work in a noisy workplace.

*6<sup>th</sup> week*

Purpose and implementation of inerting. Nitrogen-Purging, Vacuum, Pressure, Combination and Siphon Method. Advantages disadvantages. Simplification of a simple oxygen concentration calculation method..

*7<sup>th</sup> week*

Dangers of static electricity. Prevention of the formation of static electricity. The dust explosion. Electrical hazards. The role of insulation, earthing, residual current device (fi-relay) and fuse in the prevention of accidents

*8<sup>th</sup> week*

Dangers of chemical reaction. Run-away reaction and possible causes. Exothermic and/or gas producing reactions. Pyrophoric, peroxide-forming, reacting with water, highly oxidizing, self-reactive, impact-sensitive, heat-decomposing materials and their dangers.

*9<sup>th</sup> week*

Types of safety valves and their operation. Multiple protection. Comparison of safety valves, advantages and disadvantages.

*10<sup>th</sup> week*

Removal of excess pressure in case of danger. Technical solutions. Protective devices and their use.

*11<sup>th</sup> week*

Identification of hazards (environmental and safety). Solution options. Explosion limits of gas mixtures. Options for security protection.

*12<sup>th</sup> week*

Watching educational videos on safety. Learn the GHS pictograms and safety signs.

*13<sup>th</sup> week*

Consultation.

*14<sup>th</sup> week*

Test for a recommended grade.

**Requirements:**

Attendance at lectures is recommended, but not compulsory.

The course ends with test for a recommended grade. (This test is not compulsory!) The minimum requirement for the test is 50%. The grade is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-80	satisfactory (3)
81-90	good (4)
91-100	excellent (5)

The students can retake the test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. György Deák, associate professor, PhD

**Lecturer:** Dr. György Deák, associate professor, PhD

<b>Title of course:</b> Basic Environmental Sciences <b>Code:</b> TTTBE0040_EN	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 16 hours Total: 30 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
What we call Environmental sciences. Natural values of the Earth, conservation of biodiversity. Effects of invasive species. Protection of habitats, prevention of species extinction. Short term and long term monitoring systems. Biomonitoring and MAB (Man and Biosphere programme). Fluvial and human transformed landscapes.	
<b>Literature</b>	
<i>Compulsory:</i> H. Frances (2005): Global Environmental Issues. John Wiley & Sons, USA ISBN: 978-0-470-09395-5 M. K. Wali, F. Evrendilek, M. S. Fennessy (2009): The Environment: Science, Issues, and Solutions. CRC Press ISBN: 9780849373879 J.M. Fryxell, A. R. E. Sinclair, G. Caughley (2014): Wildlife Ecology, Conservation, and Management. Wiley-Blackwell ISBN: 978-1-118-29106-1	
<b>Schedule:</b> <i>1<sup>st</sup> week</i> Main parts of Environmental Sciences, objects of Environmental Sciences <i>2<sup>nd</sup> week</i> Levels of living world. <i>3<sup>rd</sup> week</i> Basis of monitoring and biomonitoring systems <i>4<sup>th</sup> week</i> Levels of Ecology, ecological methods in environmental sciences <i>5<sup>th</sup> week</i> Ecological impacts of invasive plant and animal species in a changing world <i>6<sup>th</sup> week</i> Role of small habitat islands in human transformed landscapes – nature conservation, cultural andecosystem services <i>7<sup>th</sup> week</i> Biodiversity	

<p>8<sup>th</sup> week Indication 9<sup>th</sup> week The world in maps 10<sup>th</sup> week Rivers – fluival geomorfology 11<sup>th</sup> week Sustainable development – World Conferences 12<sup>th</sup> week Ecological footprint 13<sup>th</sup> week Man and Biosphere program 14<sup>th</sup> week Consultation or exam.</p>
<p><b>Requirements:</b> - <i>for a signature</i> Attendance at lectures is recommended, but not compulsory.  - <i>for a grade</i> The course ends in an written examination. 2 (Pass) grade: 50% of the maximum points available. If the score of any test is below 50%, students can take a retake test.  - <i>an offered grade:</i> There are at least two tests during the semester, and the offered grade is the average of them.</p>
<p><b>Person responsible for course:</b> Dr. Sándor Alex Nagy, associate professor, PhD</p>
<p><b>Lecturer:</b> Dr. István Gyulai, assistant professor, PhD</p>

<p><b>Title of course:</b> Basics of Mathematics and Informatics <b>Code:</b> TTMBE0801_EN</p>	<p><b>ECTS Credit points:</b> 2</p>
<p><b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -</p>	
<p><b>Evaluation:</b> exam</p>	
<p><b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 32 hours Total: 60 hours</p>	
<p><b>Year, semester:</b> 1<sup>st</sup> year, 1<sup>st</sup> semester</p>	
<p><b>Its prerequisite(s):</b> -</p>	
<p><b>Further courses built on it:</b></p>	
<p><b>Topics of course</b></p>	

Systems of linear equations. Basics of set theory, relations, functions. Continuous functions, limits of functions. Differentiability of function, differential calculus, analysis of differentiable functions. Indefinite integrals, rules of integration, Riemann-integral. Applications of integration. Differential equations. Basics of combinatorics. Introduction to probability theory, classical probability model, conditional probability, law of total probability. Random variables, distribution of random variables, discrete distributions, absolutely continuous distributions. Basic concepts of statistics, basic methods for statistical analysis.

### Literature

#### *Compulsory:*

George B. Thomas, Maurice D. Weir, Joel Hass, Frank R. Giordano. Thomas's Calculus, 11th ed. Addison-Wesley, 2004.

#### *Recommended:*

Yeagers, Edward K., Herod, James V., Shonkweiler, Ronald W. An Introduction to the Mathematics of Biology: with Computer Algebra Models. Birkhauser, Boston, 1996.

### Schedule:

#### *1<sup>st</sup> week*

Matrices, elementary matrix transformations, upper triangular matrices. Systems of linear equations, equivalent transformations of systems of linear equations. Gaussian elimination.

#### *2<sup>nd</sup> week*

Relations, domain and range of relations. Inverse relations, composition of relations. Equivalence relations, ordering relations. Functions, domain and range of functions. Inverse functions, composite functions. Elementary functions.

#### *3<sup>rd</sup> week*

Continuity of functions, continuity of elementary functions, operations and continuity of functions. Limits of functions. Limit at infinity, infinity as limit of a function. The connection between limit and continuity, limit and operations, and limit and ordering. Limits of composite functions.

#### *4<sup>th</sup> week*

The notion of differential quotient and derivative function. Geometric interpretation of the differential quotient. Connection between differentiability and continuity. Derivatives of elementary functions. Rules of differentiation.

#### *5<sup>th</sup> week*

Monotonicity of functions: necessary condition for monotonicity, necessary and sufficient condition for monotonicity. Extremal points, necessary condition of extremal points, sufficient condition of extremal points, general condition of extremal points. Analysis of differentiable functions. The L'Hospital rule.

#### *6<sup>th</sup> week*

Primitive function, indefinite integral. Basic integrals. Linearity of the integral. Partial integration, integration by substitution.

#### *7<sup>th</sup> week*

Darboux-sums, the notion of Riemann-integral of a function. Linearity of the Riemann-integral. Additivity of the Riemann-integral over intervals. The integral, as the function of the upper limit. The Newton-Leibnitz formula. Partial Riemann-integration, Riemann-integration by substitution.

#### *8<sup>th</sup> week*

Computing of area and arc length. Computing the area of the surface and the volume of solids of revolution.

#### *9<sup>th</sup> week*

The concept of differential equation. Differential equations of first order. Elementary types of differential equations: separable equations, linear differential equations of first order, exact differential equations.

*10<sup>th</sup> week*

Permutations, permutations with repetitions. Variations, variations with repetition. Combinations, combinations by repetition. Binomial coefficients, the binomial theorem.

*11<sup>th</sup> week*

Sample space, events, operations with events. Statistical explanation of the concept of probability. Probability space. Finite probability spaces. Classical probability space. Conditional probability, law of total probability. Bayes theorem. Independent events.

*12<sup>th</sup> week*

Discrete random variables, distribution of discrete random variables. Joint distribution. Independence. Expectation. Standard deviation. The most common discrete distributions.

*13<sup>th</sup> week*

Absolutely continuous random variable. Cumulative distribution function, probability density function. Expectation. Standard deviation. Most common absolutely continuous distributions.

*14<sup>th</sup> week*

Sample. Empirical distribution function. Sample mean, sample variance, sample mode, sample median, quantile.

**Requirements:**

*- for a signature*

If the student fails the course TTMBG0801\_EN, then the signature is automatically denied.

*- for a grade*

The course ends in written examination, although it is possible to request an oral examination. The grade is given according to the following table:

<b>Total Score (%)</b>	<b>Grade</b>
0 – 50	fail (1)
51 – 60	pass (2)
61 – 75	satisfactory (3)
74 – 85	good (4)
86 – 100	excellent (5)

*-an offered grade:*

It is possible to obtain an offered grade on the basis of two written test during the semester. The grade is given according to the following table:

<b>Total Score (%)</b>	<b>Grade</b>
0 – 50	fail (1)
51 – 60	pass (2)
61 – 75	satisfactory (3)
74 – 85	good (4)
86 – 100	excellent (5)

**Person responsible for course:** Prof. Dr. Attila Bérczes, university professor, DSc

**Lecturer:** Prof. Dr. Attila Bérczes, university professor, DSc

**Title of course:**Basics of mathematics and informatics

**ECTS Credit points:** 3



<b>Code:</b> TTMBG0801_EN	
<b>Type of teaching, contact hours</b>	
<ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: 2 hours/week</li> <li>- laboratory: -</li> </ul>	
<b>Evaluation:</b> mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b>	
<ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: 28 hours</li> <li>- laboratory: -</li> <li>- home assignment: -</li> <li>- preparation for the exam: 62 hours</li> </ul> <p>Total: 90 hours</p>	
<b>Year, semester:</b> 1 <sup>st</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b>	
<b>Topics of course</b>	
Systems of linear equations. Basics of set theory, relations, functions. Continuous functions, limits of functions. Differentiability of function, differential calculus, analysis of differentiable functions. Indefinite integrals, rules of integration, Riemann-integral. Applications of integration. Differential equations. Basics of combinatorics. Introduction to probability theory, classical probability model, conditional probability, law of total probability. Random variables, distribution of random variables, discrete distributions, absolutely continuous distributions. Basic concepts of statistics, basic methods for statistical analysis.	
<b>Literature</b>	
<p><i>Compulsory:</i> George B. Thomas, Maurice D. Weir, Joel Hass, Frank R. Giordano. Thomas's Calculus, 11th ed. Addison-Wesley, 2004.</p> <p><i>Recommended:</i> Yeagers, Edward K., Herod, James V., Shonkweiler, Ronald W. An Introduction to the Mathematics of Biology: with Computer Algebra Models. Birkhauser, Boston, 1996.</p>	
<b>Schedule:</b>	
<i>1<sup>st</sup> week</i>	
Exercises concerning matrices, elementary matrix transformations. Solving systems of linear equations by Gaussian elimination.	
<i>2<sup>nd</sup> week</i>	
Exercises concerning relations, domain and range of relations, inverse relations, composition of relations, equivalence relations, ordering relations. Exercises concerning functions (do-main and range, inverse functions, composite functions).	
<i>3<sup>rd</sup> week</i>	
Exercises concerning continuity of functions, and limits of functions (simple limits, limit at infinity, infinity as limit of a function).	
<i>4<sup>th</sup> week</i>	

Exercises concerning the derivative of functions.

*5<sup>th</sup> week*

Exercises concerning monotonicity of functions, extremal values of functions and the L'Hospital rule. Complete analysis of functions.

*6<sup>th</sup> week*

Exercises concerning primitive function, indefinite integral, partial integration, integration by substitution.

*7<sup>th</sup> week*

Exercises concerning Riemann-integrals, the Newton-Leibnitz formula, partial Riemann-integration and Riemann-integration by substitution.

*8<sup>th</sup> week*

Exercises concerning computing of area and arc length, and computing the area of the surface and the volume of solids of revolution.

*9<sup>th</sup> week*

Solving differential equations of special type (homogeneous, separable, linear, exact).

*10<sup>th</sup> week*

Solving basic exercises in combinatorics.

*11<sup>th</sup> week*

Solving exercises based on the classical probability model, conditional probability, law of total probability, Bayes theorem.

*12<sup>th</sup> week*

Exercises concerning discrete random variables.

*13<sup>th</sup> week*

Exercises concerning absolutely continuous random variables.

*14<sup>th</sup> week*

Solving basic exercises in the field of statistics.

**Requirements:**

*- for a signature*

Attendance of classes are compulsory with the possibility of missing at most three classes during the semester. In case of further absences, a medical certificate needs to be presented, otherwise the signature is denied.

*- for a grade*

The course is evaluated on the basis of two written tests during the end of the semester. The grade is given according to the following table:

<b>Total Score (%)</b>	<b>Grade</b>
0 – 50	fail (1)
51 – 60	pass (2)
61 – 75	satisfactory (3)
76 – 85	good (4)
86 – 100	excellent (5)

If a student fails to pass at first attempt, then a retake of the tests is possible.

*- an offered grade:*

It is not possible to obtain an offered grade in this course.

**Person responsible for course:** Prof. Dr. Attila Bérczes, university professor, DSc

**Lecturer:** Prof. Dr. Attila Bérczes, university professor, DSc

<b>Title of course:</b> Introduction to Chemistry <b>Code:</b> TTKBE0141_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam:62 hours Total: 90 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> TTKBL0141_EN, Introduction to Chemistry (Parallel registration for both courses is required)	
<b>Topics of course</b> History and development of chemistry and its relation to other natural sciences. Basic definitions in chemistry: atoms, molecules, elements, compounds, mixtures, chemical symbols, chemical formulas, molar mass, chemical equations, the classification of chemical reactions. Development of atomic and molecular theory. The structure of atom. Basics of radioactivity. Discovery of the periodic table and periodically changing properties. Introduction to quantum chemistry. Primary and secondary chemical bonds. Description of gaseous, liquid and solid states of matter. Phase changes. Chemical equilibrium. Acid-base theories. Basics of thermochemistry, reaction kinetics and electrochemistry.	
<b>Literature</b> <i>Compulsory:</i> - John McMurry – Robert C. Fay: Chemistry, 7th ed., Prentice Hall ISBN: 0321943171. - Darrell D. Ebbing: General Chemistry, 9th ed. Belmont, CA, ISBN: 1-4390-4982-9 - James E. Brady, Gerard E. Humiston:General chemistry: principles and structure, 3rd ed., New York, Wiley,ISBN: 0471808164	
<b>Schedule:</b> <i>1<sup>st</sup> week</i> Classification of natural sciences, history and development of chemistry. The concept of chemical change. The SI system of units, the most important physical quantities and units. Conservation of mass and energy. The law of definite proportions, the law of multiple proportions, law of combining gas volumes, Avogadro's law. Dalton's atomic theory. Relative atomic and molecular weights. Amount of substance and the definition of mole. Notations for elements and compounds, symbol, empirical formula, molecular formula. <i>2<sup>nd</sup> week</i>	

Valency and oxidation number. Oxidation number in inorganic compounds. Types of chemical reactions. Experimental background of the atomic theory, discovery of the nucleus. Discovery and basic properties of subatomic particles (electron, proton, neutron). Isotopes.

*3<sup>rd</sup> week*

Types and properties of radioactive radiation. Laws of radioactive decay, decay series. Medical and other practical importance of radioactive isotopes. The mass defect. Einstein's equation on mass-energy equivalence. Nuclear energy, nuclear fission and fusion. The Bohr model of the atom. Characteristics of electromagnetic radiation.

*4<sup>th</sup> week*

The dual nature of matter. Heisenberg's uncertainty principle. Schrödinger's equation and its application for the hydrogen atom. Quantum numbers and their importance. The shape of atomic orbitals. Principles of the periodic table.

*5<sup>th</sup> week*

Electronegativity, ionization energy, electron affinity, atomic and ionic radii and their change across the periodic table. The ionic bond. Calculation of the lattice energy. Metallic bonding.

*6<sup>th</sup> week*

The covalent bond. Basic characteristics of the molecular orbital (MO) theory and its application for diatomic molecules. The valence shell electron pair repulsion (VSEPR) model. The shape of molecules, bond angles, bond orders. Polarity of covalent bonds, polar and nonpolar molecules.

*7<sup>th</sup> week*

Intermolecular forces. London forces, dipole-dipole interaction. Hydrogen bond and its importance in inorganic and organic chemistry. General characterization of molecular, ionic, metallic, and network atomic solids.

*8<sup>th</sup> week*

Classification and structure of chemical systems. General characterization of different states of matter. Gas laws: Boyle's law, Charles's law, the ideal gas law. Gas mixtures, partial pressure. General characterization of liquids, surface tension, viscosity. General characterization and classification of solids. Changes of state: melting, freezing, evaporation, condensation, sublimation.

*9<sup>th</sup> week*

Classification of multicomponent systems, properties of solutions and mixtures. Solubility and units of concentration. Vapor pressure, freezing and boiling point of solutions. Osmosis pressure. Determination of molecular weight. Phase diagrams, critical temperature and pressure. Thermodynamic temperature.

*10<sup>th</sup> week*

Basics of thermochemistry. Heat of reaction, Hess's law. The importance of heat of formation. Heat of reaction and bond energies. The direction of spontaneous chemical reactions: internal energy, enthalpy, free energy and entropy.

*11<sup>th</sup> week*

Dependence of reaction rates on concentrations and the temperature. Order of reactions. Activation energy. Catalysts, homogeneous and heterogeneous catalytic reactions. The equilibrium condition and the equilibrium constant. Possibilities to shift the composition of equilibria. Le Chatelier's principle.

*12<sup>th</sup> week*

Solubility equilibria, solubility product. Temperature dependence of solubility. Different theories of acid-base reactions (Arrhenius, Brønsted, Lewis). Characterization of aqueous

solutions, electrolytic dissociation. Strength of acids and bases. Dissociation constant and degree of dissociation.

*13<sup>th</sup> week*

Self-ionization of water. Ionic product of water. The definition and calculation of pH. Amphoteric substances. Buffer solutions and acid-base indicators. Acid-base properties of salts. Complex ion equilibria.

*14<sup>th</sup> week*

Basics of electrochemistry. Galvanic cells and the concept of electrode potential. Standard electrode potentials, oxidizing and reducing agents. Quantitative laws of electrolysis. Galvanic cells and batteries.

**Requirements:**

*-for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*-for a grade*

The course ends in an **examination**. The result of the examination determines the final grade.

The minimum requirement for the examination is 50%. Based on the score of the exam, the grade is given according to the following table:

Score	Grade
0-49	fail (1)
50-62	pass (2)
63-75	satisfactory (3)
76-87	good (4)
88-100	excellent (5)

In case of failure, students can take retake exam(s) in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gábor Bellér, assistant professor, PhD

**Lecturer:** Dr. Gábor Bellér, assistant professor, PhD

**Title of course:** Sampling, Sample treatment and Analytical tests  
**Code:** TTKBE0514\_EN

**ECTS Credit points:** 1

**Type of teaching, contact hours**

- lecture: 1 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 16 hours

Total: 30 hours

<b>Year, semester:</b> 1 <sup>st</sup> year, 2 <sup>nd</sup> semester
<b>Its prerequisite(s):</b>
<b>Further courses built on it:</b>
<b>Topics of course</b>
The aim of the course is to introduce the sampling methods generally applied in environmental chemistry. The most important techniques for sampling soil, sediment, surface and underground water, gases, biotic and abiotic biological indicators, biological tissues and fluids, rocks and metal alloys will be discussed. All the relevant and most important pre-treatment techniques will be overviewed which are necessary to get rid of the matrix components prior to the quantitative and qualitative determination of organic and inorganic analytes (such as extraction and dilution techniques, atmospheric and microwave digestion, acidic and basic reactions under high pressure etc.). Sampling and sample pre-treatment methods will be discussed which are used for speciation analysis, for organometallic compounds and biomolecules.
<b>Literature</b>
<i>Compulsory:</i> - Fundamentals of environmental sampling and analysis by Chunlong Zhang (ISBN: 978-0-471-71097-4)
<i>Recommended:</i> - N.T. Crosby, I. Patel: General principles of good sampling practice, RSC, 1995 - S. Mitra: Sample Preparation Techniques in Analytical Chemistry, Wiley, 2003. - Sampling for Environmental Data Generation; P. Grieco and R. Trattner, SciTech Publishers, Matawan, NJ 1990. - <a href="https://web.njit.edu/~kebbekus/analysis/SAMPLING.htm">https://web.njit.edu/~kebbekus/analysis/SAMPLING.htm</a>
<b>Schedule:</b> The lecture will be held in the first half of the semester, 2 hours/week
<i>1<sup>st</sup> week</i> The grouping of environmental samples, sample types. The thematic classification of the most commonly measured components from environmental samples. The basic rules of sampling and the general description of sampling techniques.
<i>2<sup>nd</sup> week</i> General statistical aspects of sampling. Liquid sampling: surface and underground water, rivers and streams. Solid sampling of metals, alloys and rocks. General guidelines, homogenization methods.
<i>3<sup>rd</sup> week</i> Sampling from gases at atmospheric and high pressure. Direct sampling of solid materials from gaseous substances: aerosols and particulate matter (PM 10, PM 2.5). Adsorption and absorption techniques to selectively gain compounds from gaseous state, gas filtration. Sampling of soil, sediment and biological tissues.
<i>4<sup>th</sup> week</i> Introduction to basic sample pre-treatment methods: homogenisation and drying of solid substances, circumstances affecting the solubility of the analyte. Storage, preservation and dissolving methods. Extraction techniques.
<i>5<sup>th</sup> week</i> Reactions to eliminate the matrix and mobilize the compounds to be determined: dry and wet digestion methods, ignition, digestion at atmospheric pressure, microwave assisted sample pre-treatment. Digestion under acidic and basic conditions, most commonly applied reagents and pieces of equipment.
<i>6<sup>th</sup> week</i>

General introduction to the sampling and sample pre-treatment carried out for speciation analysis and organometallic substances, as well as biomolecules. Elemental speciation.

7<sup>th</sup> week

Sample preparation of biological indicators and biological tissues, fluids. Exact examples of a complex sampling and sample pre-treatment process, discussing the steps of tasks to be carried out. Review and consultation possibility.

**Requirements:**

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory. However, students attending 5 out of the 7 occasions will have the opportunity to write a written test after the last lecture: if it is successful **a grade will be offered** in the electronic system which can be accepted or denied by the student.

- *for a grade*

The course ends in an **examination**. The students will either successfully fulfil the requirements to write the written test for an offered grade or take an oral exam in the examination period.

The minimum requirement for the passing mark in the written test and the examination respectively is 50%. For the written test to gain the offered grade the following table will be applied to calculate the result:

Score	Grade
0-49	fail (1)
50-65	pass (2)
66-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of the written test is below 50, students can take the oral exam in the examination period which is the same for those students not visiting the lectures regularly. The exam is in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

- *for an offered grade*

Please see above highlighted with bold characters.

**Person responsible for course:** Dr. Edina Baranyai, assistant professor, PhD

**Lecturer:** Dr. Edina Baranyai, assistant professor, PhD

Dr. Gábor Bellér, assistant professor, PhD

**Title of course:** Sampling, Sample treatment and analytical tests  
**Code:** TTKBL0514\_EN

**ECTS Credit points:** 4

**Type of teaching, contact hours**

- lecture: -
- practice: -
- laboratory: 4 hours/week

**Evaluation:** mid-semester grade based on laboratory manual and written test

**Workload (estimated), divided into contact hours:**

- lecture: -
- practice: -

<ul style="list-style-type: none"> <li>- laboratory: 56 hours</li> <li>- home assignment: 64 hours</li> <li>- preparation for the exam: -</li> </ul> <p>Total: 120 hours</p>
<b>Year, semester:</b> 1 <sup>st</sup> year, 2 <sup>nd</sup> semester
<b>Its prerequisite(s):</b> ?
<b>Further courses built on it:</b> ?
<b>Topics of course</b>
<p>During the laboratory practice, the complex environmental assessment of a fishing lake will be carried out. Taken plant, water, soil and sediment samples will be analysed with the studied methods for the most important inorganic contaminants: chemical oxygen demand, cations and anions affecting halobity, dissolved oxygen, oxygen saturation, pH, conductivity, elemental composition. Both on site techniques, as well as classical and instrumental methods will be applied.</p>
<b>Literature</b>
<p><i>Compulsory:</i></p> <ul style="list-style-type: none"> <li>- Fundamentals of environmental sampling and analysis by Chunlong Zhang (ISBN: 978-0-471-71097-4)</li> <li>- University syllabus of environmental analysis (available at the Department's home page of inorg.unideb.hu)</li> </ul> <p><i>Recommended:</i></p> <ul style="list-style-type: none"> <li>- Sampling for Environmental Data Generation; P. Grieco and R. Trattner, SciTech Publishers, Matawan, NJ 1990.</li> <li>- <a href="https://web.njit.edu/~kebbekus/analysis/SAMPLING.htm">https://web.njit.edu/~kebbekus/analysis/SAMPLING.htm</a></li> </ul>
<p><b>Schedule:</b>The third occasion will be a whole day (8 hours) of sampling at a fishing lake which therefore equals with two practical occasions (2*4 hours).</p> <p><i>1<sup>st</sup> week</i></p> <p>Introduction to the general laboratory safety rules highlighting the safety considerations of on-site field study. Overview of the laboratory and on-site pieces of equipment and instruments.</p> <p><i>2<sup>nd</sup> week</i></p> <p>Introduction to the fishing lake to be sampled. The sample types to be taken and the compounds to be measured will be discussed, the analytical methods to be applied for the quantitative analysis will be chosen. Students will build up the sampling plan, make a map, indicate the sampling points and collect all the sampling tools from the laboratory which will be necessary to carry out the sampling and on-site measurements.</p> <p><i>3<sup>rd</sup> week (2* 4 hours)</i></p> <p>A full day trip to the fishing lake where the collection of surface water, sediment, soil and plant samples will be carried out. On site measurements of water pH and electric conductivity, temperature, preservation of samples for elemental analysis as well as the titration for dissolved oxygen and chemical oxygen demand will be carried out. Samples will be then taken to the laboratory for further measurements.</p> <p><i>4<sup>th</sup> week</i></p> <p>Determination of cation (macro and micro elements) concentration of the surface water samples by microwave plasma atomic emission spectrometry (MP-AES). Dilution of standard solutions and calibration required for the quantitative measurements.</p> <p><i>5<sup>th</sup> week</i></p>



Determination of the anion concentration affecting halobity from surface water samples by classical analytical and instrumental methods: carbonate and hydrogen carbonate ion by acid-base titration, chloride ion by argentometric titration and sulphate ion by spectrophotometric analysis.

*6<sup>th</sup> week*

Grinding and drying of soil samples, homogenization. Determination of the moisture content and organic matter content of soil samples and preparing them for elemental analysis by microwave assisted wet digestion at elevated pressure.

*7<sup>th</sup> week*

The elemental analysis of soil samples by microwave plasma atomic emission spectrometry (MP-AES). Dilution of standard solutions and calibration required for the quantitative measurements.

*8<sup>th</sup> week*

Grinding and drying of plant samples, homogenization. Determination of the moisture content of plant samples and preparing them for elemental analysis by conventional wet digestion at atmospheric pressure.

*9<sup>th</sup> week*

The elemental analysis of plant samples by microwave plasma atomic emission spectrometry (MP-AES). Dilution of standard solutions and calibration required for the quantitative measurements.

*10<sup>th</sup> week*

Cutting, grinding and drying of sediment samples, homogenization. Determination of the moisture content and organic matter content of sediment samples and preparing them for elemental analysis by microwave assisted wet digestion at elevated pressure.

*11<sup>th</sup> week*

The elemental analysis of sediment samples by microwave plasma atomic emission spectrometry (MP-AES). Dilution of standard solutions and calibration required for the quantitative measurements.

*12<sup>th</sup> week*

Evaluation of the gained results – calculating the final concentration results from the primer data of samples.

*13<sup>th</sup> week*

Written test regarding the field and laboratory work of sampling, sample pre-treatment and analysis of important environmental factors. Discussion of statistical analysis for the final evaluation and interpretation of the gained data. Finishing the laboratory manuals to be handled in. Washing up all the sample containers and pieces of equipment.

**Requirements:**

*- for a signature*

Attendance at **both the field study and laboratory practices are obligatory**. Maximum one occasion can be missed but only along with a medical certificate. The written test must be above 20% to get a signature, otherwise the student will receive a signature denied and must take the course again in the next semester.

*- for a grade*

The course ends in a written test. The minimum requirement for the passing mark in the written test is 50%. For calculating the grade of the test the following table will be applied:

Score	Grade
0-49	fail (1)
50-65	pass (2)
66-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of the written test is below 50, students can take one final exam in the examination period, which will be similar to the written test. The exam is in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Students will also handle in an electronic laboratory manual interpreting the overall results of the complex environmental assessment of the fishing lake. Grade will be given to this laboratory manual as well.

Final grade will be formed by taking the average of the results of the written test (or exam) and the laboratory manual.

*-for an offered grade*

no grade will be offered

**Person responsible for course:** Dr. Edina Baranyai, assistant professor, PhD

**Lecturer:** Dr. Edina Baranyai, assistant professor, PhD

Dr. István Gyulai, assistant professor, PhD

<b>Title of course:</b> Basic Geology <b>Code:</b> TTGBG5103_EN	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: - - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice: 28 hours - laboratory: - - home assignment: 32 hours - preparation for the exam: - Total: 60 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
The aim of the course is to introduce the basic of geological sciences to the students. During the course basics of crystallography (unit cells, crystal system, main types of crystal lattices, principal physical features), mineralogy (main rock-forming minerals and mineral raw materials) and petrography (system and nomenclature, main igneous, sedimentary and metamorphic rock types) will be discussed. In the second half of the course the basic fields and principles of physical geology are discussed including global tectonics, lithostratigraphy and biostratigraphy. The most important events of the history of the Earth are also discussed from the Archaic to present times.	
<b>Literature</b>	

*Compulsory:*

- K.W. Hamblin – E.H. Christiansen: Earth's dynamic system (10th edition). Prentice Hall, ISBN 978-0131420663

- Z. Püspöki (ed): Chapter from Geology. Kossuth University Press, Debrecen, 2005.

- T.H. Torsvik – L.R.M. Cocks: Earth history and palaeogeography – Cambridge University Press, 2016

*Recommended:*

- A. Bishop – A. Wolley – W. Hamilton: Guide to minerals, rocks and fossils. Firefly Pocket Series, 2005. ISBN 1-55407-054-6

**Schedule:**

1<sup>st</sup> week

Definition of crystals, minerals, rocks. The concept and types of unit cell. Crystal system (triclinic, monoclinic, orthorhombic, tetragonal, trigonal, hexagonal, cubic).

2<sup>nd</sup> week

Crystal lattices, ionic lattices, covalent bonding lattices, metallic bonding lattices. Basic physical features of crystals (hardness, optical features).

3<sup>rd</sup> week

Test 1

4<sup>th</sup> week

Chemical and genetic system of minerals. Native element minerals; sulphides; oxides and hydroxides; silicates; sulphates; phosphates; carbonates, nitrates and borates; halogenides; organic minerals.

5<sup>th</sup> week

Nomenclature and system of rocks. Main types of igneous, sedimentary and metamorphic rocks.

6<sup>th</sup> week

Test 2

7<sup>th</sup> week

CONSULTATION WEEK

8<sup>th</sup> week

The interior structure of the Earth. Plate tectonics and structural geology. Diverging and converging plates and the processes along their margins. Rifting and mid-oceanic ridges.

9<sup>th</sup> week

Most important processes of subduction and the structure and development of volcanic island-arc systems. Orogenesis and the formation of cratons. Magma generation zones, the formation of igneous rocks in the different stages of plate tectonics.

The basic fields of stratigraphy (lithostratigraphy, biostratigraphy, chronostratigraphy).

10<sup>th</sup> week

The principles of stratigraphy (uniformitarianism, actualism, horizontality, deposition). Dollo's law, Walther's facies principles. The chronostratigraphic chart, relative and absolute age determination methods.

11<sup>th</sup> week

Test 3.

12<sup>th</sup> week

History of the Earth in general. Detailed history of the Earth over the Precambrian (formation of the crust together with the initiation of plate tectonic processes, formation and composition of the primary and the ancient atmosphere, occurrence of life and its early development, increasing earth crust via plate tectonic processes). Development of flora and fauna in the Palaeozoic. Plants and animals invading dry terrains.

13<sup>th</sup> week

Development of the crust, the flora and fauna over the Mesozoic and the Cenozoic. Alpine orogenic cycle, focusing on the formation of Europe. Dominant plants and animals in the Mesozoic. Development of microfauna in Mesozoic and early Cenozoic marine environments. History of mammals over the Mesozoic and Cenozoic.

14<sup>th</sup> week

Test 4

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are four tests: the first in the 3<sup>rd</sup>, the second in the 6<sup>th</sup>, the third in the 11<sup>th</sup> and the fourth one in the 14<sup>th</sup> week. Students have to sit for the tests

*- for a grade*

The practice grade is calculated as an average of the results of the four tests.

The minimum requirement for each test is 50%. The grade is given according to the following table:

Score	Grade
0-49	fail (1)
50-64	pass (2)
65-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Péter Rózsa, associate professor, PhD

**Lecturer:** Dr. Péter Rózsa, associate professor, PhD;  
Dr. Richard William McIntosh, assistant professor, PhD

**Title of course:** Fundamentals of Biology

**ECTS Credit points:** 3

<b>Code:</b> TTBBE1010_EN	
<b>Type of teaching, contact hours</b>	
<ul style="list-style-type: none"> <li>- lecture: 2 hours/week</li> <li>- practice: -</li> <li>- laboratory: -</li> </ul>	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b>	
<ul style="list-style-type: none"> <li>- lecture: 28 hours</li> <li>- practice: -</li> <li>- laboratory: -</li> <li>- home assignment: 62 hours</li> <li>- preparation for the exam: -</li> </ul> <p>Total: 90 hours</p>	
<b>Year, semester:</b> 1 <sup>st</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):-</b>	
<b>Further courses built on it:-</b>	
<b>Topics of course</b>	
<p>Concept of Biology. Criteria of Life. Fundamentals of Taxonomy. Tree of Life. Levels of Organization. Concept of the cell. Comparison of procaryote and eucaryote cell. The endosymbiosis theory. Comparison animal and plant cell. Biogenic and abiogenic component in living organism. Biogenic elements. Water and its biological importance. Osmosis and diffusion. Colloid systems. Biological importance of lipids. Carbohydrates and its biological importance. Amino acids. Structure and function of proteins. Nucleotides. Nucleic acids. Structure and function of DNA. Chromosomes. Concept and types of mutation. Mutagenics. Types of RNA in cell. Metabolism in cell. Enzymes as biocatalyzers. Place and process of photosynthesis in cell. Biosynthesis of nucleic acids. Genetic code. Central dogma of molecular biology. Genes. Gene regulation. Protein synthesis. Carbohydrate catabolism. Cytoplasm. Membranes in cell. Membrane transport in cell. Nucleus and centrosome. Cell cycle. Mitosis and meiosis.</p>	
<b>Literature</b>	
<p><i>Compulsory:</i></p> <ul style="list-style-type: none"> <li>- Sedava, D., Hillis, D. M., Heller, H. C., Berenbaum, M. R. (2012): Life. The Science of Biology. Sinauer Associates, Sunderland, USA.</li> </ul> <p><i>Recommended:</i></p> <ul style="list-style-type: none"> <li>- Ville, C. A., Martin, C. E., Berg, L. R., Davis P. W. (2008): Biology. Saunders College Publishing, Philadelphia</li> </ul>	
<b>Schedule:</b>	
<p><i>1<sup>st</sup> week</i></p> <p>Concept of Biology. Criteria of Life.</p> <p><i>2<sup>nd</sup> week</i></p> <p>Levels of Organization</p> <p><i>3<sup>rd</sup> week</i></p> <p>Fundamentals of Taxonomy. Tree of Life</p> <p><i>4<sup>th</sup> week</i></p>	

The endosymbiosis theory. Comparison animal and plant cell.

*5<sup>th</sup> week*

Concept of the cell. Comparison of procaryote and eucaryote cell.

*6<sup>th</sup> week*

Biogenic and abiogenic component in living organism. Biogenic elements. Water and its biological importance.

*7<sup>th</sup> week*

Osmosis and diffusion. Colloid systems.

*8<sup>th</sup> week*

Biological importance of lipids.

Carbohydrates and its biological importance..

*9<sup>th</sup> week*

Amino acids. Structure and function of proteins.

*10<sup>th</sup> week*

Nucleotides.

Nuklein acids. Structure and function of DNA. Chromosomes.

*11<sup>th</sup> week*

Concept and types of mutation. Mutagenics. Types of RNA in cell.

*12<sup>th</sup> week*

Metbolism in cell. Enzymes as byocatalyzers. Place and process of photosynthesis in cell. Carbohydrate catabolism.

*13<sup>th</sup> week*

Biosynthesis of nucleic acids. Genetic code. Central dogma of molecular biology.

Genes. Gene regulation. Protein synthesis.

*14<sup>th</sup> week* Cytoplasm. Membranes in cell. Membrane tarnsport in cell. Nucleus and citocentrum. Cell cycle. Mitosis and meiosis.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

*- for a grade*

The course ends in awritten (essay with ten question) **examination** (colloquium). Based on the average of the grades of the designing questions, the exam grade is calculated as an average of them:

- the average grade of the ten designing tasks
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tasks separately, the grade for the essay and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any essay is below 60, students can take a retake tessay in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:*

it may be offered for students if the average grade of written examination is at least satisfactory (3) The offered grade is the average of them.

**Person responsible for course:** Dr. Ibolya Markóczi Revák associate professor, PhD

**Lecturer:**Dr. Ibolya Markóczi Revák, associate professor, PhD

<b>Title of course:</b> Evolutionary Biology <b>Code:</b> TTBBE0004_EN	<b>ECTS Credit points:</b> 2
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: 32 hours - preparation for the exam: - Total: 60 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):-</b>	
<b>Further courses built on it:-</b>	
<b>Topics of course</b> The course is designed to provide an introduction to one of the comprehensive and foundational areas of biological sciences. Evolutionary biology is intrinsically linked to almost any branch of biology, so knowledge of evolutionary fundamentals is of great help in navigating the most diverse areas of biology. The aim of the course is to arouse the interest of students, to extend their biological thinking to the evolutionary peculiarities of the development of biological systems.	
<b>Literature</b> S. Freeman & J.C. Herron. Evolutionary Analysis. 4th ed. 2007. ISBN: 032167703X Mark Ridley: Evolution. 2nd Edition. Blackwell Scientific. 1996. ISBN: 0-86542-495-0 D. L. Hartl: A primer of population genetics. 3 ed. Sinauer Associates, Sunderland, 2000. ISBN: 0 87893 304 2	
<b>Schedule</b> I. The historical development of evolution as a discipline and theory. II. The principles of evolution by natural selection, the four postulates of Darwin, and the definition of evolution. The mechanism of natural selection, evolutionary patterns. Molecular, structural and fossil evidence for evolution. III. Mechanisms of evolution: mutation, selection, genetic drift, migration; the basics of population genetics. Elementary evolutionary processes at the population level. Genetic	





## Literature

### *Compulsory:*

- P. Gergely (2014): Organic and bioorganic chemistry for medical students, Debrecen University Press, ISBN 9789633181478

### *Recommended:*

- F. A. Carey (2000): Organic Chemistry, McGraw-Hill (2000), 2016. ISBN 0-07-290501-8

- P. Gergely (2014): Introduction to bioinorganic chemistry for medical students, Debrecen University Press, ISBN 9789633180105

## Course objective/intended learning outcomes

### **a) Knowledge**

- He/she knows the basic principles and terms of organic chemistry.
- He/she knows the industrially and biologically important compounds, their structures, physical and chemical properties.
- He/she can use the obtained knowledge in the course of their biochemistry studies.

### **b) Abilities**

- He/she is able to apply the obtained knowledge to solve simple problems of organic chemistry.
- He/she is able to understand the basic concepts behind news in the media concerning chemistry related research.
- He/she is able to express an opinion on chemistry related topics.

### **c) Attitude**

- He/she is open to learn and use the new methods of bioorganic chemistry.
- He/she is open to self-education.
- He/she aspires to understand and reveal concepts and correlations.
- He/she is committed, inquisitive and motivated.

### **d) Autonomy and responsibility**

He/she is cooperative, responsible and open-minded.

He/she is ready to deal with chemistry related problems alone and in a team as well.

He/she feels responsibility for other people's work during research and cooperative studies.

He/she feels it is their duty to take responsibility and participate actively in a team's work to achieve the goals they aim for.

## Schedule:

### *1<sup>st</sup> week*

Introduction. Relationship of organic chemistry with biochemistry and molecular biology. Carbon-carbon bonds. Allotropic forms of carbon. Carbon-heteroatom bonds. Classification of organic compounds. Electron distribution in organic compounds. Chemical reactions in organic chemistry.

### *2<sup>nd</sup> week*

Hydrocarbons. Saturated hydrocarbons (alkanes). Saturated cyclic hydrocarbons (cycloalkanes). Chemical reactions of saturated hydrocarbons. Unsaturated hydrocarbons (alkenes and alkynes). Nomenclature. Constitutional and geometric isomers. The conformation. Radical substitution reactions. Reactions of the carbon-carbon double bond. Conjugated polyenes. Structure and bonding of acetylene. Isoprenes and terpenes.

### *3<sup>rd</sup> week*

Aromatic compounds. Structure and bonding of benzene. Aromaticity. Isomerism of aromatic compounds. Groups derived from aromatic structures. Overview of aromatic compounds. Benzene and its homologues. Aromatic heterocycles with five and six membered rings. Chemical reactions of aromatic compounds. Electrophilic aromatic substitution. Substituent effects in electrophilic aromatic substitution. Organic halogen compounds. Synthesis and reactions of organic halogen compounds. Nucleophilic substitution and elimination reactions. Important halogenated compounds.

*4<sup>th</sup> week*

Alcohols and phenols. Classification of alcohols and phenols. Physical properties of alcohols and phenols. Hydrogen bonding. Synthesis and chemical properties of alcohols and phenols. Important alcohols and phenols. Synthesis, properties and important representatives of ethers.

*5<sup>th</sup> week*

Sulfur containing organic compounds: thiols and thioethers. Aldehydes and ketones. Nomenclature, physical properties and synthesis of aldehydes and ketones. Reactions of the carbonyl group. Nucleophilic additions, condensations, oxidation and reduction reactions. Keto and enol tautomers, aldol addition and condensation. Important aldehydes and ketones. Quinones.

*6<sup>th</sup> week*

Nitrogen-containing organic compounds. Physical properties and synthesis of amines. Chemical properties of amines: basicity and reactions. Aliphatic and aromatic amines. Biologically important amines.

*7<sup>th</sup> week*

Carboxylic acids. Nomenclature and physical properties. Preparation and chemical properties of carboxylic acids. Important mono- and dicarboxylic acids. Natural hydroxy- and oxocarboxylic acids. Carboxylic acid derivatives. Synthesis and hydrolysis of esters. Saponification and deacylation. Thioesters. Carboxylic acid anhydrides, acyl halides and amides. Derivatives of carbonic acid.

*8<sup>th</sup> week*

Mid-term test (topics of weeks 1-7).

*9<sup>th</sup> week*

Stereochemistry. Symmetry of simple carbon compounds. Properties of chiral compounds. Central chirality. Properties of enantiomers. Optical activity. Absolute and relative configurations. Molecules with more than one stereocenters. Separation of enantiomers.

*10<sup>th</sup> week*

Amino acids. Structure and classification of amino acids. Acid-base behaviour of amino acids. Reactions of amino acids. Peptides and proteins. The peptide bond. General properties and classification of proteins. Structure of proteins (primary, secondary, tertiary and quaternary).

*11<sup>th</sup> week*

Carbohydrates 1. Monosaccharides. Aldoses and ketoses. The cyclic structure of monosaccharides (hemiacetal, anomers, pyranose and furanose forms, epimers). Conformations of monosaccharides. Glycosides. Common monosaccharides.

*12<sup>th</sup> week*

Carbohydrates 2. Reducing and non-reducing disaccharides. Structure of important disaccharides. Oligosaccharides and polysaccharides.

13<sup>th</sup> week

Lipids. Classes of lipids. Biological functions of lipids. Fats, oils, glycerophospholipids. The structure of biological membranes. Nucleosides, nucleotides and polynucleotides. Chemical structure of DNA and RNA.

14<sup>th</sup> week

End-term test (topics of weeks 9-13).

**Requirements:**

Attending the lectures is recommended but not compulsory.

There are two mandatory written tests during the semester according to the schedule. The average score of the two tests is calculated, and the offered grade is given according to the following table:

Score	Grade
0-49	fail (1)
50-60	pass (2)
61-74	satisfactory (3)
75-87	good (4)
88-100	excellent (5)

**Examination**

Students may accept the offered grade based on the results of the mid-term and end-term test, otherwise the course ends in a written exam. The grade is given according to the table above.

**Person responsible for the course:** Dr. János Kerékgyártó, senior research fellow

**Lecturer:** Dr. Sándor Kun, research fellow

**Title of course:** Chemical Basis of Biology  
**Code:** TTBBG2035\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture:-
- practice:-
- laboratory: 2 hours/week

**Evaluation:** practical exam

**Workload (estimated), divided into contact hours:**

- lecture: -
- practice: -
- laboratory: 28 hours
- home assignment: 14 hours
- preparation for the exam: 14 hours

Total: 56 hours

**Year, semester:** 1<sup>st</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):-**

<b>Further courses built on it:-</b>
<b>Topics of course</b>
The students will acquire the basics of organic chemistry and will get acquainted with the structure and properties of biological macromolecules and their building blocks.
<b>Literature</b>
<p><i>Compulsory:</i></p> <p>- Switzer, R. and Garrity L.: Experimental biochemistry. Theory and exercises in fundamental methods, Third edition ; W.H. Freeman and Company New park; (1999) ISBN: 0-7167-3300-5 (EAN: 9780716733003)</p> <p><i>Recommended:</i></p> <p>- F. A. Carey (2000): Organic Chemistry, McGraw-Hill (2000), 2016. ISBN 0-07-290501-8</p> <p>- P. Gergely (2014): Organic and bioorganic chemistry for medical students, Debrecen University Press, ISBN 9789633181478</p>
<b>Course objective/intended learning outcomes</b>
<p><b>a) Knowledge</b></p> <ul style="list-style-type: none"> <li>- He/she knows the basic principles and terms of organic chemistry.</li> <li>- He/she knows the industrially and biologically important compounds, their structures, physical and chemical properties.</li> <li>- He/she can use the obtained knowledge in the course of their biochemistry studies.</li> </ul> <p><b>b) Abilities</b></p> <ul style="list-style-type: none"> <li>- He/she is able to apply the obtained knowledge to solve simple problems of organic chemistry.</li> <li>- He/she is able to understand the basic concepts behind news in the media concerning chemistry related research.</li> <li>- He/she is able to express an opinion on chemistry related topics.</li> </ul> <p><b>c) Attitude</b></p> <ul style="list-style-type: none"> <li>- He/she is open to learn and use the new methods of bioorganic chemistry.</li> <li>- He/she is open to self-education.</li> <li>- He/she aspires to understand and reveal concepts and correlations.</li> <li>- He/she is committed, inquisitive and motivated.</li> </ul> <p><b>d) Autonomy and responsibility</b></p> <p>He/she is cooperative, responsible and open-minded.</p> <p>He/she is ready to deal with chemistry related problems alone and in a team as well.</p> <p>He/she feels responsibility for other people's work during research and cooperative studies.</p> <p>He/she feels it is their duty to take responsibility and participate actively in a team's work to achieve the goals they aim for.</p>
<p><b>Schedule:</b></p> <p><i>1<sup>st</sup> week</i></p> <p><b>Laboratory techniques and safety instructions.</b></p> <p><i>2<sup>nd</sup> week</i></p> <p><b>Amino acids, peptides, proteins seminar. Amino acids. The structure and the classification of amino acids. Stereochemistry. Chemical reactions of amino acids. Peptides and proteins. Primary, secondary, tertiary, quaternary structures. Test reactions.</b></p> <hr/> <p><i>3<sup>rd</sup> week</i></p> <p><b>Amino acids, peptides, proteins practice.</b> Chemical tests of proteins and amino acids: Biuret test, Xanthoproteic test, Millon's test. Thin-layer chromatography of amino acids.</p>

4<sup>th</sup> week

**Amino acids, peptides, proteins practice.** Chemical tests of proteins and amino acids: ninhydrin test, sulfur test, heavy-metal ions test. Protein coagulation tests: effect of heat, alcohol, nitric acid.

5<sup>th</sup> week

**Purification of proteins practice.** Dialysis, gel-filtration chromatography. Quantitative determination of proteins by means of photometry.

6<sup>th</sup> week

**Carbohydrates seminar.** Carbohydrates. Monosaccharides, aldoses, ketoses, pentoses, hexoses. Stereochemistry of carbohydrates. Ring structure of monosaccharides. Conformation of pyranose and furanose rings.

7<sup>th</sup> week

**Carbohydrates practice.** Characterization reactions of carbohydrates: Molisch test, Bial's test, Seliwanoff's test. Thin-layer chromatography of carbohydrates.

8<sup>th</sup> week

**Carbohydrates seminar.** Disaccharides, reducing and nonreducing disaccharides. Polysaccharides.

9<sup>th</sup> week

**Carbohydrates practice.** Investigation of reducing and nonreducing disaccharides and starch. Fehling's test, hydrolysis test.

10<sup>th</sup> week

**Vitamines seminar.** Biological and chemical properties of water and fat soluble vitamins. The structure and reducing properties of vitamin C.

11<sup>th</sup> week

**Vitamines practice.** Quantitative determination of vitamin C content of juices and plant samples.

12<sup>th</sup> week

**Nucleotides, Nucleic acids seminar.** Structures of nucleotides, nucleic acids.

13<sup>th</sup> week

**Nucleotides, Nucleic acids practice.** Experiments with RNA. Hydrolysis of yeast RNA. Test reactions for building units of RNA. Quantitative determination of phosphorus content by means of photometry.

14<sup>th</sup> week

*Semester closing papers*

### Requirements:

- for a signature

Participation at practice classes is **compulsory**. A student must attend the practice classes and may not miss during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. In case of further absences, a medical certificate needs to be presented.

- for a grade

The course ends in practical test. The minimum requirement for the end-term tests respectively is 60%. The grade for the tests is given according to the following table:

Score

Grade

0-49	fail (1)
50-60	pass (2)
61-74	satisfactory (3)
75-87	good (4)
88-100	excellent (5)
<b>Person responsible for the course:</b> Dr. János Kerékgyártó, senior research fellow	
<b>Lecturer:</b> Dr. János Kerékgyártó, senior research fellow, Dr. Teréz Barna, associate professor	

<b>Title of course: Biostatistics</b> <b>Code:</b> TTBBE1001_EN	<b>ECTS Credit points: 2+1</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: 1 hours/week - laboratory: 0 hours/week	
<b>Evaluation: practical grade</b>	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: 14 hours - laboratory: 0 hours - home assignment: 28 hours - preparation for the exam: 30 hours Total: 100 hours	
<b>Year, semester:</b> 1st year, 1 st semester	
<b>Its prerequisite(s):</b> Course objective/intended learning outcomes a) knowledge - Has a designer and management level knowledge on the theories, paradigm, ideas and principles of environmental sciences. - Has the basic knowledge about biology, physics, geological sciences, chemistry, mathematics and informatics which is necessary for an effective work in the field of such a multi-disciplinary science as environmental sciences. - Has knowledge on the possibilities regarding the utilisation and protection of resources from spheres on the Earth's surface or near to the Earth's surface. - Has knowledge on the spatial relations of the environmental processes on micro-, meso- and macro-region level. - Has a knowledge and a critical approach regarding the effects of medical, judicial and safety regulations on the environment and on the society. - Has a knowledge on the management level solutions for problems occurring in the fields of environmental protection, nature conservation, industrial, medical and self-government.	

b) ability

- Able to critically evaluate theories and principles in the light of the changing natural environment and social environment.
- Through multidisciplinary thinking, able to understand the direct and indirect relationships of environmental science using the information available from the subdisciplines of environmental science.
- Able to recognise and identify the properties of the materials and phenomena involved in environmental science, and able to characterise them by the measures of environmental science both in the nm and km size range, both in space and time.
- Able to work independently as a designer, manager and expert in workplaces dealing with scientific research in environment and nature conservation. Able to work effectively in workplaces adapting the results of environmental sciences such as research institutes and administration.
- Able to engage in the tasks of industry, agriculture and forestry, water, health, and local government.
- Able to independently solve tasks requiring environmental education in nature and environment.
- Able to design and implement environmental impact assessments and evaluate the results in accordance with domestic and EU requirements and standards.
- Has a wide range of problem-solving skills set by environmental problems.
- Able to interpret articles in a foreign language, which are related to the field of environmental science and able to process them on an independently elaborated basis.

c) attitude

- Positively interested in continuative education in environmental science.
- Makes efforts to reach the widest possible understanding of processes in the spheres located on the Earth's surface or near its surface.
- Make efforts to get acquainted with the new achievements of the disciplines of environmental science and to synthesize them.
- Has the necessary abilities for designing, conducting and evaluating practical activities related to the examination of each sphere.
- Make efforts to carry out its tasks related to environmental problems in co-operation with his/hers colleagues, taking into account their professional opinion.
- Make efforts to develop co-operation with representatives of other scientific fields in environmental studies.
- Sensitive to the environmental and natural problems and crises both on a local and global scale.
- Environmental awareness, love of nature, and commitment to the sustainable development guide and shape his/hers lifestyle and actions.

d) autonomy and responsibility

- By his/hers initiatory and decision-making ability, personal responsibility he/she is able for a constructive co-operation in teamwork, even for managing teams.
- Takes responsibility for his/hers decisions regarding environmental issues.
- During professional activities, he/she studies with responsibility the environmental risks of anthropogenic processes and according to his best knowledge, directs the necessary actions to reduce them.
- He/she can independently evaluate the professional literature related to any field of environmental science, even in a foreign language.

- Independently carries out practical research tasks related to any field of the environment and takes responsibility for them.
- Can carry out independent planning, management and expert tasks in workplaces for scientific research in environmental sciences, in research and development institutes and in the administration of environmental sciences.

**Further courses built on it:**

**Topics of course**

A comprehensive introduction to probability, probability distributions, sampling distributions, basic techniques of statistical inference, analysis of variance, linear regression, inference for categorical variables, and nonparametric statistics. This course is designed to teach the students about a variety of mathematical methods which are used in modelling through their application to solving hydrobiological problems. In the practical part of the course students learn the methods of mathematical methods of data processing and planning of experiment.

**Literature**

Venables, W. N. and Ripley, B. D. 2003: Modern Applied Statistics with S. 4th edition. Springer, New York.

**Cox D.R., Donnelly C.A. (2011): Principles of Applied Statistics Cambridge University Press**

**Wasserman L. (2004): All of Statistics: A Concise Course in Statistical Inference, Springer;**

**Course objective/intended learning outcomes**

A comprehensive introduction to probability, probability distributions, sampling distributions, basic techniques of statistical inference, analysis of variance, linear regression, inference for categorical variables, and nonparametric statistics. This course is designed to teach the students about a variety of mathematical methods which are used in modelling through their application to solving hydrobiological problems. In the practical part of the course students learn the methods of mathematical methods of data processing and planning of experiment.

**Schedule:**

*1st week Introduction to the course*

*2nd week Basics of model building in science.*

*3rd week Introduction to the programming languages, with special reference to R programming language and environment.*

*4th week Basics of data management.*



*5th week Graphical methods in descriptive statistics.*

*6th week Basic statistics; statistical distributions*

*7th week Exam*

*8th week Sampling, design of experiments.*

*9th week Regression analyses.*

*10th week Analysis of variance (ANOVA).*

*11th week . General linear models and generalized linear models.*

*12th week. Multivariate methods: classification.*

*13th week. Multivariate methods: ordination.*

*14th week Exam*

**Requirements:**

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session.

**Person responsible for course: Dr. Béla Tóthmérész**

**Lecturer: Dr. Béla Tóthmérész**

**Title of course:** Plant anatomy  
**Code:** TTBBE2001\_EN, TTBBL2001\_EN

**ECTS Credit points: 2+4**

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: 3 hours/week

**Evaluation:** examination + mid-semester grade for laboratory classes

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: 42 hours
- home assignment: 54 hours
- preparation for the exam: 54 hours

Total: 180 hours

**Year, semester:** 1<sup>st</sup> year, 1<sup>st</sup> semester

**Its prerequisite(s):** -

**Further courses built on it:** Plant Physiology

**Topics of course**

**Regarding lectures:**

The course involves chapters from plant cell biology, discussing the characteristic plant cell compartments such as plastids, cell wall and vacuoles. It presents the cell types of different plant tissues. It involves the anatomy of primary organs and the study of the secondary tissues in roots and trunks (emphasizing the importance of secondary xylem and phloem) as well. Morphology elicits the amazing diversity of structures and forms of plants. Beside the above topics, the course is guiding students through the life cycles and the different reproduction forms in the kingdom of plants. Emphasis is placed on evolutionary trends and on the fact that all plant structures are the result of the natural selection.

**Regarding laboratory practice:**

During the practicals the students study plant cell structures, tissues, and their appearance and arrangement in the different organs by light microscopy. Different forms of plant organs are studied by taking typical plants representing different evolutionary complexity.

All these experimental approaches serve the better understanding of the topics of the lectures.

### Literature

#### *Compulsory:*

- Mauseth, J., D. 2003/2010: Botany, An introduction to plant biology, Saunders College Publishing, Philadelphia Fort Worth Chicago San Francisco Montreal Toronto London Sydney Tokyo.

- Peterson, R.L., Peterson, C.A., Melville, L.H. 2008: Teaching plant anatomy through creative laboratory exercises. NRC Press, Ottawa/ON

#### *Recommended:*

- Beck, C.B. 2005/2010: Plant structure and development. CUP, Cambridge, UK

- Cutler, D.F., Botha, T., Stevenson, D.W. 2008: Plant anatomy-an applied approach. Malden, MA., USA

### Schedule:

*1<sup>st</sup> week* **Lecture (L):** Survey of the topics discussed during the semester. What is a plant? Life cycles in the plant kingdom.

**Laboratory (Lab):** Basic methods in the study of plant morphology and anatomy- a survey.

*2<sup>nd</sup> week* **L:** Life cycles in Gymnosperms and Angiosperms.

**Lab:** Leaf, stem and root morphology.

*3<sup>rd</sup> week* **L:** Reproductive structures in flowering plants: the flower.

**Lab:** Flower morphology.

*4<sup>th</sup> week* **L:** Reproductive structures in flowering plants: the fruit and seed.

**Lab:** Fruit, seed and seedling morphology.

*5<sup>th</sup> week* **L:** General features of eukaryotic and among them, plant cells.

**Lab:** Students will learn microscope usage.

*6<sup>th</sup> week* **L:** The plastid system of plants. Types of chloroplasts. Structure and functions of chloroplasts.

**Lab:** Examination of chloroplasts, chromoplasts and etioplasts as well as of pigmented vacuoles.

*7<sup>th</sup> week* **L:** The plant cell wall: formation, structure and functions.

**Lab:** Microscopic examination of the types of plant cell wall thickening I.

*8<sup>th</sup> week* **L:** The vacuolar system in plants: biogenesis, structure of tonoplasts and functions.

**Lab:** Microscopic examination of the types of plant cell wall thickening II.

*9<sup>th</sup> week* **L:** Types of plant tissues: a survey. The meristematic tissue: characterization of its cells, types of meristems.

**Lab:** Microscopic examination of different meristematic tissues.

**10<sup>th</sup> weekL:** Primary differentiated tissues. Epidermal tissues: types of epidermis and their cell types. Ground tissues: types, with special emphasis on assimilatory and mechanical tissues. Vascular tissues: types- the xylem and phloem, structure and functioning of the vessel elements and sieve tubes.

**Lab:** Microscopic examination of several characteristic cells of epidermal, ground and vascular tissues.

**11<sup>th</sup> weekL:** Primary and secondary structure of root.

**Lab:** Microscopic examination of primary root structures of dicots and monocots as well as several characteristic secondary structures of dicots (e.g. in *Taraxacum officinale*).

**12<sup>th</sup> weekL:** Primary and secondary structure of stem.

**Lab:** Microscopic examination of primary stem structures of dicots and monocots as well as several characteristic secondary structures of dicots (e.g. in *Aristolochia*, *Sambucus* and *Tilia*).

**13<sup>th</sup> weekL:** Types of leaves according to their structure and their histology. Structure-function relationships in leaves.

**Lab:** Microscopic examination of characteristic dorsiventral and homogenous leaves as well as of the characteristic leaf structure in Gymnosperms (*Pinus*).

**14<sup>th</sup> weekL/Lab:** Discussion/survey of the topics treated on lectures and laboratory classes.

#### **Requirements:**

-for a signature

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

-for a grade

The course ends in an **examination** in case of the lecture. As for **laboratory classes**, there will be three tests during the semester and the mark for laboratory classes will be the average of these tests and the activity of the student as recorded in their notebooks.

The minimum requirement for both the examination and laboratory grade is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:*

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

**Person responsible for course:** Dr. Márta M-Hamvas, associate professor, PhD,  
Dr. Csaba Máthé, associate professor, PhD

**Lecturer:** Dr. Csaba Máthé, associate professor, PhD

<b>Title of course:</b> Plant Taxonomy lecture <b>Code:</b> TTBBE2005_EN	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 62 hours Total: 90 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
Topic, basic terms and history of Plant Taxonomy. Serial Endosymbiont Theory (SET). Origin and taxonomy of significant divisions of algae (Cyanobacteria, Glaucocystophytes, Rhodophyta, Heterokontophyta, Haptophyta, Cryptophyta, Dinophyta, Euglenozoa, Chlorarachniophytes and Chlorophyta), of bryophytes (Anthocerotophyta, Hepaticophyta, Bryophyta), of ferns and allies (Lycopodiophyta, Monilophyta) and of gymnosperms (Cycadophyta, Ginkgoaceae, Gnetales and Coniferophyta). Molecular cladistics of major angiosperm taxa (paleoherb, monocot, eudicot). Evolutionary links and practical significance of the most important orders and families of angiosperms.	
<b>Literature</b>	
<i>Compulsory:</i> APG 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants : APG II. <i>Bot. Journal of the Linnean Society</i> 141: 399-436.	

**Schedule:**

*1<sup>st</sup> week* Delineation of the term's schedule. A brief history of plant taxonomy (plant systematics) (folk systems, taxonomists of the antiquity, Middle Ages: scolastics, doctrine of signatures, herbals, taxonomists of the modern history, artificial taxonomic systems: Linnaeus and followers, natural systems after Linnaeus, evolutionary systems, numerical taxonomy, morphological cladistics, molecular cladistics).

*2<sup>nd</sup> week* Topic and basic terms of plant systematics (taxonomy, hierarchic classification, identification, binominal nomenclature, taxon, descriptio, diagnosis, concept of priority, synonymy, homonymy, tautonymy, type (typus), holotype, isotype, *International Code of Botanical Nomenclature*, artificial vs. natural systems, sources of taxonomic information (citotaxonomy, hybridisation, mechanisms of isolation, concept of species and subspecies, polytypic species, autofertility, pieces of geobotanical information).

*3<sup>rd</sup> week* Origin of the eucaryotic cell, SET. Algae I. (Cyanobacteria, Glaucophyta, Rhodophyta, Heterokontophyta and Haptophyta).

*4<sup>th</sup> week* Algae II. (Cryptophyta, Dinophyta, Euglenophyta, Chlorarachniophyta, Chlorophyta and some of its significant classes as Chloro-, Ulvo-, Cladophoro-, Zygnemato- and Charophyceae)

*5<sup>th</sup> week* Taxonomic position of lichens and bryophytes. Evolutionary links among bryophyte divisions (Anthocerophyta, Hepaticophyta, Bryophyta). Their morphology and diversity.

*6<sup>th</sup> week* Origin of Polysporangiophytes (interpolation and transformation theory), their diversification (telome and enation theories), challenges and solutions: morphological and functional consequences of land life. Major fossile taxa among ferns and fern allies Taxonomic position of their extant taxa (Lycopodiophyta: Lycopodiales, Isoetales, Selaginellales, Monilophyta: Ophioglossopsida, Psilopsida, Equisetopsida, Marattiopsida, Polypodiopsida).

*7<sup>th</sup> week* Origin and phylogenetic links of gymnosperms. Selected fossile taxa (Progymnospermopsida, Pteridospermales, Glossopterale) and extant representatives in Cycadophyta (*Zamia*, *Cycas*), Ginkgophyta (*Ginkgo*), Gnetophyta (*Gnetum*, *Ephedra*, *Welwitschia*) and in Coniferophyta: *Cordaites*, *Wolzia*; Pinaceae. Araucariaceae, Podocarpaceae, Sciadopityaceae, Cephalotaxaceae, Taxaceae, Cupressaceae). Morphological traits, diversity, evolutionary and practical significance. Mid-term consultation, discussion of test examples.

*8<sup>th</sup> week* Evolutionary age and origin of angiosperms, some selected fossile taxa of angiosperms (Pteridospermales: *Sanmiguelia*, *Furcula*, *Caytonia*, *Umkomasia*, *Pteruchus*, ancient angiosperms: *Ficophyllum*, *Acaciaephyllum*, *Archaeofructus*, *Caloda*, *Lesqueria*, *Archaeanthus*). Recent assessment of the 'monocot' and 'dicot' concept (paleoherb, monocot, eudicot). The paleoherb clade (Amborellales, Nymphaeales, Austrobaileyales, Ceratophyllales, Chloranthales, Magnoliales, Laurales, Canellales, Piperales).

*9<sup>th</sup> week* Evolutionary position of the monocot clade and that of the commelinid subclade. Morphological and biochemical synapomorphies. Acorales, Alismatales, Dioscoreales, Pandanales, Liliales, Asparagales, Arecales, Zingiberales/Commelinales, Poales.

*10<sup>th</sup> week* Basal eudicot and basal core eudicot clades. Basal eudicots (Ranunculales, Proteales). Basal core eudicots (Gunnerales, Dilleniales, Caryophyllales, Santalales, Saxifragales, Vitales)

*11<sup>th</sup> week* The rosid clade. Basal orders of rosids (Geraniales, Myrtales). Eurosid I. = fabid clade (first orders) (Zygophyllales, Malpighiales, Oxalidales, Fabales, Rosales).

*12<sup>th</sup> week* Eurosid I. = fabid clade (second group of orders) (Cucurbitales, Fagales), eurosid II. – malvid clade (Brassicales, Malvales, Sapindales).

*13<sup>th</sup> week* Morphological synapomorphies of the asterid clade. Basal orders of the asterids (Cornales, Ericales). The euasterid I. = lamiid clade with late sympetaly (Garryales, Gentianales, Boraginales, Lamiales, Solanales)

*14<sup>th</sup> week* The euasterid II. – campanulid clade with early sympetaly (Aquifoliales, Apiales, Dipsacales, Asterales). Incertae sedis (Balanophoraceae, Rafflesiaceae). Review of exam requirements, demonstration and discussion of a full test example.

**Requirements:**

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

No test during the semester but there is mid-term discussion (7<sup>th</sup> week) which includes consultation possibility of test examples in topics covered till that time.

- *for a grade*

The course ends in an **examination**.

The minimum requirement for the test is 50%. Based on the score of the exam test the grade for the examination is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-69	satisfactory (3)
70-79	good (4)
80-100	excellent (5)

**Person responsible for course:** Dr. Matus Gábor, associate professor, PhD

**Lecturer:** Dr. Matus Gábor, associate professor, PhD

**Title of course:** Plant Taxonomy practical  
**Code:** TTBBL2005\_EN

**ECTS Credit points: 2**

**Type of teaching, contact hours**

- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:**

**Workload (estimated), divided into contact hours:**

- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 62 hours
- preparation for the exam: -

Total: 90 hours

**Year, semester:** 1<sup>st</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):** Plant Taxonomy lecture, Plant Anatomy practical and lecture

**Further courses built on it:** -

## Topics of course

The aim of the course is to get an overview on the diversity of selected taxonomical groups of plants. Our goal is to get a clear morphological delimitation of some significant natural plant families in angiosperms and some higher ranked taxa in other divisions. Selection of taxa includes both representatives of the Central European flora and those of the students' home country. A total of ca. 400 taxa will be covered in form of independent data collection and seminar discussion. Learning the critical usage of electronic as well as printed sources is also aimed. This knowledge enables students to conduct activities that require a basic level of practical taxonomic knowledge. A set of sources which help students to improve this knowledge is also discussed.

## Literature

### *Recommended in print:*

Király, G. et al. (eds.) (2009, 2011) New Hungarian Herbal The vascular plants of Hungary. Identification key. Illustrations (Új magyar fűvészkönyv. Magyarország hajtásos növényei.) I.-II. Aggteleki Nemzeti Park Igazgatóság, Jósvafő pp. 675.

### *Recommended sites:*

<http://www.mobot.org>

<http://www.efloras.org> (recently updated regions include North America, China, Chile, Nepal and several other regions for selected taxa).

<http://www.tropicos.org/>

<http://ec.europa.eu/environment/nature/conservation/species/redlist/plants/acknowledgements.htm>

<http://www.hlasek.com>

<http://caliban.mpiz-koeln.mpg.de/thome/index.html>

## Schedule:

*1<sup>st</sup> week* Requirements and way of presentations discussed. Review of recommended literature in print and on the web. Native and cultivated gymnosperms in Central Europe.

*2<sup>nd</sup> week* Gymnosperms native and cultivated to the students' home countries. Ferns and fern allies in Central Europe. Visit to the herbarium (Soó and Siroki collections of DE, Department of Botany).

*3<sup>rd</sup> week* Ferns and fern allies in the students' home countries. Woody flora in Central Europe.

*4<sup>th</sup> week* Woody species in the students' home countries. Poaceae in Central Europe.

*5<sup>th</sup> week* Poaceae in the students' home countries. Cyperaceae, Juncaceae, Sparganiaceae and Typhaceae in Central Europe.

*6<sup>th</sup> week* Cyperaceae, Juncaceae, Sparganiaceae, Typhaceae in the students' home countries. Nymphaeaceae, Aristolochiaceae, Magnoliaceae, Ranunculaceae and Papaveraceae in Central Europe.

*7<sup>th</sup> week* Nymphaeaceae, Aristolochiaceae, Magnoliaceae, Ranunculaceae and Papaveraceae in the students' home countries. Completion of missing or delayed presentations.

*8<sup>th</sup> week* Discussion on presentations in first half of term. Crassulaceae, Saxifragaceae, Haloragaceae, Grossulariaceae, Rosaceae in Central Europe.

*9<sup>th</sup> week* Crassulaceae, Saxifragaceae, Haloragaceae, Grossulariaceae, Rosaceae in the students' home countries. Fabaceae (incl. Mimosaceae, Caesalpiniaceae) in Central Europe.



*10<sup>th</sup> week* Fabaceae (incl. Mimosaceae, Caesalpiniaceae) in the students' home countries. Asclepiadaceae, Apocynaceae, Lamiaceae, Lentibulariaceae, Orobanchaceae, Plantaginaceae, Scrophulariaceae, Solanaceae, Convolvulaceae and Boraginaceae in Central Europe.

*11<sup>th</sup> week* Asclepiadaceae, Apocynaceae, Lamiaceae, Lentibulariaceae, Orobanchaceae, Plantaginaceae, Scrophulariaceae, Solanaceae, Convolvulaceae and Boraginaceae in the students' home countries. Plumbaginaceae, Polygonaceae, Caryophyllaceae, Amaranthaceae, Phytolaccaceae, Portulacaceae, Euphorbiaceae, Hypericaceae, Violaceae, Cannabaceae, Urticaceae, Cucurbitaceae, Brassicaceae, Resedaceae, Cistaceae, Malvaceae in Central Europe.

*12<sup>th</sup> week* Plumbaginaceae, Polygonaceae, Caryophyllaceae, Amaranthaceae, Phytolaccaceae, Portulacaceae, Euphorbiaceae, Hypericaceae, Violaceae, Cannabaceae, Urticaceae, Cucurbitaceae, Brassicaceae, Resedaceae, Cistaceae, Malvaceae in the students' home countries. Euasterid II. (Lorathaceae, Viscaceae, Primulaceae, Ericaceae, Campanulaceae, Asteraceae) in Central Europe.

*13<sup>th</sup> week* Euasterid II. in the students' home countries. Visit to the Botanic Garden of the Debrecen University.

*14<sup>th</sup> week* Completion of missing or delayed presentations. Closing remarks and discussion on marks.

### **Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor.

Each students have to **submit 7 presentations in a term** which practically means that every student has to compile a presentation in every second week and in every practical half of the students is going to give a presentation in front of his/her fellow students. Attendance of practice classes when a given student has not a presentation is also compulsory.

Presentations in a each topic should include five species native to or cultivated in the student's home country. It should cover the taxonomic position, morphology, habitat preference, conservational and practical significance of selected species. Species selection is free within the formerly designated taxonomic group. It should be prepared and submitted via e-mail at least 24 hours before the beginning of the next practice. Preferred formats for the presentation are *ppt* (not *pptx*) and *pdf*.

*- for a grade*

The minimum requirement for each submission material is 50%. Based on the average of submitted presentation the mark is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-69	satisfactory (3)
70-79	good (4)
80-100	excellent (5)

If the score of any test is below 50, students can take a retake test two times during the term in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gábor Matus, associate professor, PhD

**Lecturer:** Dr. Gábor Matus, associate professor, PhD

**Title of course:** Zoology I  
**Code:** TTBBE2010\_EN

**ECTS Credit points: 2**

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
  - practice: -
  - laboratory: -
    - home assignment: 32 hours
  - preparation for the exam: -
- Total: 60 hours

**Year, semester:** 1<sup>st</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):**

**Further courses built on it:**

**Topics of course**

Introduction to the taxonomy, ontogeny, phylogeny and anatomy of Porifera, Placozoa, Cnidaria, Ctenophora, Acoelomorpha, Lophotrochozoa and Ecdysozoa.

**Literature**

*Recommended:*

R. C., Brusca, W., Moore & M., Schuster: Invertebrates. Massachusetts, Sinauer Associated. Inc, Publishers, 2016

**Schedule:**

*1<sup>st</sup> week*

General introduction to the taxonomy, ontogeny, phylogeny, physiology and anatomy of animals

*2<sup>nd</sup> week*

Protista

*3<sup>rd</sup> week*

Parazoa, Porifera

*4<sup>th</sup> week*

Placozoa, Cnidaria, Ctenophora

*5<sup>th</sup> week*

Acoelomorpha, Lophotrochozoa, Gnathostomulida, Cycliophora, Gastrotricha, Acanthocephala, Rotifera

6<sup>th</sup> week

Platyhelminthes, Mesozoa, Entoprocta, Bryozoa, Phoronozoa, Brachiozoa

7<sup>th</sup> week

Nemertea, Mollusca, Annelida, Sipunculida

8<sup>th</sup> week

Ecdysozoa (except for Arthropoda)

9<sup>th</sup> week

General introduction to Arthropoda

10<sup>th</sup> week

Trilobita, Chelicerata

11<sup>th</sup> week

Myriapoda

12<sup>th</sup> week

Crustacea I: Remipedia, Cephalocarida, Branchiopoda, Maxillopoda, Ostracoda

13<sup>th</sup> week

Crustacea II: Malacostraca

14<sup>th</sup> week

Insecta

**Requirements:**

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

Grade based on written examination at the end of the semester.

**Person responsible for course:** Dr. András Tartally, associate professor

**Lecturer:** Dr. Jácint Tökölyi, associate professor,

Dr. Edit Juhász, senior lecturer,

Dr. András Tartally, associate professor.

**Title of course:** Animal Anatomy

**Code:** TTBBBL2030\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture: 2 hours/week

- practice: -

- laboratory: -

**Evaluation:** mid-semester tests

**Workload (estimated), divided into contact hours:**

- lecture:

- practice: -

<p>- laboratory: 28 hours  - home assignment: 32 hours  - preparation for the exam: -  Total: 60 hours</p>
<p><b>Year, semester:</b> 1<sup>st</sup> year, 2<sup>nd</sup> semester</p>
<p><b>Its prerequisite(s):</b></p>
<p><b>Further courses built on it:</b></p>
<p><b>Topics of course</b></p> <p>The students will learn the fundamentals of anatomy, the inter-multi- and transdisciplinary nature of anatomy, the basic concepts of anatomy, as well as the general and global questions and problems of anatomy, as well as the connection between science policy and practical activity in anatomy within the framework of the practical classes of animal anatomy. The students will be prepared for the critical processing of problems and phenomena within the scope of biology.</p>
<p><b>Literature</b></p> <p><i>Recommended:</i></p> <p>R. C., Brusca, W., Moore &amp; M., Schuster: Invertebrates. Massachusetts, Sinauer Associated. Inc, Publishers, 2016</p>
<p><b>Schedule:</b></p> <ol style="list-style-type: none"> <li>1. week: Application of the terminology of anatomy, systems of anatomical planes. The most important anatomical abbreviations. Protozoa (<i>Protista</i>) showing animal behavioural properties. Organizational structure (reproduction, nutrition) of the Giant amoeba (<i>Amoeba proteus</i>) and the Paramecium (<i>Paramecium caudatum</i>).</li> <li>2. week: Sponges (<i>Porifera</i>) as animals with pseudo-tissues and <i>Cnidaria</i> as the first ancient representatives of animals true tissues. The common hydra (<i>Hydra vulgaris</i>). The life functionalities of the three types of sponges (Ascon, Sycon, Leucon).</li> <li>3. week: Introduction to flatworms (<i>Plathyhelminthes</i>), mourning planaria (<i>Planaria lugubris</i>). The nematode (<i>Nematoda</i>) group. Pig roundworm (<i>Ascaris suum</i>). Its organizational structure, evolutionary significance.</li> <li>4. week: Segmented worms (<i>Annelida</i>) and the common earthworms (<i>Lumbricus terrestris</i>). Leeches (<i>Hirudinea</i>) and body structure of the medical leech (<i>Hirudo medicinalis</i>). The practical importance of both species, their ecological functions.</li> <li>5. week: Mollusca (<i>Mollusca</i>) and mussels (<i>Bivalvia</i>). Body structures of the snails (<i>Gastropoda</i>) and mussels (<i>Bivalvia</i>). and their ecological roles.</li> </ol>

6. week: Arthropods (*Arthropoda*). Insects (*Insecta*), the organizational structure of a cockroach species. The economic importance as a forest pests and population decline in specific areas in Europe and Hungary.
7. week: The importance of vertebrates as the most complex organisms among animals. The importance of fishes (*Pisces*). Carps (*Cypriniformes*): body structure, integument, digestive system, circulatory system, excretory system, reproductive system, nervous system and sensory organs.
8. week: The skeletal system of fish. The structure and role of the skull, the vertebral column and the ligaments.
9. week: Amphibians (*Amphibia*, tailless amphibians (*Anura*). The integument, digestive system, respiratory system, urogenital system, circulatory system, nervous system and sensory organs of the edible frog (*Rana esculenta*).
10. week: The skeletal system of amphibians. The cranium, spinal column, girdle, limbs. Muscular system.
11. week: The body structure of birds (*Aves*), focusing on galliforms (*Galliformes*). The body structure, plumage, feather types of the domestic fowl (*Gallus domesticus*). The digestive system, the respiratory system, the circulatory system, the reproductive system, the urinary system. The structural elements and role of the egg. The nervous system and the senses. The skeletal system of birds. The skull, spinal column, ribs, sternum, shoulder girdle and pelvic girdle. System of free limbs.
12. week: Body structure of mammals (*Mammalia*). The organizational structure of Rodents (*Rodentia*) and of the albino rat (*Epimys norvegicus var albino*). Alimentary canal, excretory system, reproductive organs, nervous system, sensory organs. The skeletal system of mammals, the structure of the axial skeleton and the limb skeleton (Appendicular skeleton). Structure, parts and characteristics of the viscerocranium and the brain skull (Neurocranium).

**Requirements:**

- for a grade

Grade based on mid-semester tests.

**Person responsible for course:** Dr. Edit Juhász, senior lecturer

**Lecturer:** Dr. Edit Juhász, senior lecturer

**Title of course:**Zoology II

**Code:** TTBBE2015\_EN

**ECTS Credit points:** 2

<p><b>Type of teaching, contact hours</b></p> <ul style="list-style-type: none"> <li>- lecture: 2 hours/week</li> <li>- practice: -</li> <li>- laboratory: -</li> </ul>
<p><b>Evaluation:</b> exam</p>
<p><b>Workload (estimated), divided into contact hours:</b></p> <ul style="list-style-type: none"> <li>- lecture: 28 hours</li> <li>- practice: -</li> <li>- laboratory: -</li> <li>- home assignment: 32 hours</li> <li>- preparation for the exam: -</li> </ul> <p>Total: 60 hours</p>
<p><b>Year, semester:</b> 2<sup>nd</sup> year, 1<sup>st</sup> semester</p>
<p><b>Its prerequisite(s):</b> TTBBE2010_EN</p>
<p><b>Further courses built on it:</b> -</p>
<p><b>Topics of course</b></p> <p>Introduction to Deuterostomes. Echinoderms. Hemichordates. Chordates: Urochordates, Cephalochordates and Vertebrates. General characterization of vertebrates. Agnathans. Cartilaginous fishes. Ray-finned fishes. Sarcopterygians and the origin of tetrapods. Amphibians and adaptations to land. General characterization of amniotes. Sauropsida I: turtles (Testudines). Snakes and lizards (Lepidosauria). Sauropsida II: crocodiles and alligators (Crocodylia). Radiation of mesozoic diapsids. Birds (Aves): evolution, diversity and characterization; Mammals (Mammalia): evolution, diversity and characterization.</p>
<p><b>Literature</b></p> <p><i>Recommended:</i></p> <p>F. Harvey Pough, Christine M. Janis, John B. Heiser: Vertebrate Life, Pearson Education, 2013.</p>
<p><b>Schedule:</b></p> <p><i>1<sup>st</sup> week</i> Introduction to Deuterostomes. Echinoderms. Hemichordates</p> <p><i>2<sup>nd</sup> week</i> Chordates: Urochordates, Cephalochordates and Vertebrates.</p> <p><i>3<sup>rd</sup> week</i> General characterization of vertebrates. Agnathans.</p> <p><i>4<sup>th</sup> week</i> Cartilaginous fishes.</p> <p><i>5<sup>th</sup> week</i> Ray-finned fishes.</p> <p><i>6<sup>th</sup> week</i> Sarcopterygians and the origin of tetrapods.</p> <p><i>7<sup>th</sup> week</i> Amphibians and adaptations to land.</p>

*8<sup>th</sup> week*

General characterization of amniotes. Sauropsida I: turtles (Testudines).

*9<sup>th</sup> week*

Snakes and lizards (Lepidosauria).

*10<sup>th</sup> week*

Sauropsida II: crocodiles and alligators (Crocodylia). Radiation of mesozoic diapsids.

*11<sup>th</sup> week*

Birds (Aves): their evolutionary origins

*12<sup>th</sup> week*

Birds (Aves): their diversity and characterization;

*13<sup>th</sup> week*

Mammals (Mammalia): their evolutionary origins.

*14<sup>th</sup> week*

Mammals (Mammalia): their diversity and characterization.

**Requirements:**

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

- *for a grade*

Grade based on written examination at the end of the semester.

**Person responsible for course:** Dr. Jácint Tökölyi

**Lecturer:** Dr. Jácint Tökölyi

**Title of course:** Animal taxonomy I

**Code:** TTBBL2020\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture: -

- practice: 2 hours/week

- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**

- lecture: -

- practice: 28 hours

- laboratory: -

- home assignment: 62 hours

- preparation for the exam: -

Total: 90 hours

**Year, semester:** 2<sup>nd</sup> year, 1<sup>st</sup> semester

**Its prerequisite(s):**

**Further courses built on it:**

<b>Topics of course</b>
Introduction to the zootaxonomy, the knowledge and identification of the practically most important groups and species of: Crustacea, Myriapoda, Chelicerata and Hexapoda.
<b>Literature</b>
<i>Recommended:</i> The up-to-date taxonomic keys of the certain groups (given at the course).
<p><b>Schedule:</b></p> <p><i>1<sup>st</sup> week</i> Crustacea</p> <p><i>2<sup>nd</sup> week</i> Myriapoda</p> <p><i>3<sup>rd</sup> week</i> Chelicerata</p> <p><i>4<sup>th</sup> week</i> Parainsecta, Blattodea, Mantodea, Orthoptera, Dermaptera, Phasmatodea</p> <p><i>5<sup>th</sup> week</i> Embiodoptera, Zoraptera, Psocoptera, Hemiptera, Phthiraptera</p> <p><i>6<sup>th</sup> week</i> Coleoptera I</p> <p><i>7<sup>th</sup> week</i> Coleoptera II, Strepsiptera</p> <p><i>8<sup>th</sup> week</i> Odonata, Ephemeroptera, Plecoptera, Neuropteroidea, Mecoptera, Trichoptera, Thysanoptera, Megaloptera</p> <p><i>9<sup>th</sup> week</i> Lepidoptera I</p> <p><i>10<sup>th</sup> week</i> Lepidoptera II</p> <p><i>11<sup>th</sup> week</i> Hymenoptera I</p> <p><i>12<sup>th</sup> week</i> Hymenoptera II</p> <p><i>13<sup>th</sup> week</i> Diptera I</p> <p><i>14<sup>th</sup> week</i> Diptera II, Siphonaptera</p>
<p><b>Requirements:</b></p> <p><i>- for a signature</i></p> <p>Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence.</p>



- for a grade

During the semester there will be tests week-by-week. Students have to sit for the tests. The minimum requirement for each of the tests is 60%. The grade is calculated as an average of the tests. The grade for the tests is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

**Person responsible for course:** Dr. András Tartally, senior lecturer, PhD

**Lecturer:** Dr. András Tartally, senior lecturer, PhD

**Title of course:** Animal taxonomy II  
**Code:** TTBBL2025\_EN

**ECTS Credit points: 3**

**Type of teaching, contact hours**

- lecture: -
- practice: 2 hours/week
- laboratory: -

**Evaluation:** mid-semester grade

**Workload (estimated), divided into contact hours:**

- lecture: -
  - practice: 28 hours
  - laboratory: -
  - home assignment: 62 hours
  - preparation for the exam: -
- Total: 90 hours

**Year, semester:** 2<sup>nd</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):**

**Further courses built on it:**

**Topics of course**

Introduction to the zootaxonomy, the knowledge and identification of the practically most important groups and species of: Porifera, Cnidaria, Platyhelminthes, Nemertinea, Nematoda, Nematomorpha, Rotatoria, Annelida, Mollusca, Pisces, Amphibia, „Reptilia”, „Aves” and Mammalia.

**Literature**

*Recommended:*

The up-to-date taxonomic keys of the certain groups (given at the course).

**Schedule:**

*1<sup>st</sup> week*

Porifera, Cnidaria, Platyhelminthes

*2<sup>nd</sup> week*

Nemertinea, Nematoda, Nematomorpha

*3<sup>rd</sup> week*

Rotatoria, Annelida

*4<sup>th</sup> week*

Mollusca

*5<sup>th</sup> week*

Pisces I

*6<sup>th</sup> week*

Pisces II

*7<sup>th</sup> week*

Amphibia I

*8<sup>th</sup> week*

Amphibia II

*9<sup>th</sup> week*

„Reptilia” I

*10<sup>th</sup> week*

„Reptilia” II

*11<sup>th</sup> week*

„Aves” I

*12<sup>th</sup> week*

„Aves” II

*13<sup>th</sup> week*

Mammalia I

*14<sup>th</sup> week*

Mammalia II

**Requirements:**

*- for a signature*

Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student cannot make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence.

*- for a grade*

During the semester there will be tests week-by-week. Students have to sit for the tests. The minimum requirement for each of the tests is 60%. The grade is calculated as an average of the tests. The grade for the tests is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

**Person responsible for course:** Dr. András Tartally, senior lecturer, PhD

**Lecturer:** Dr. András Tartally, senior lecturer, PhD

**Title of course:** Cell biology  
**Code:** TTBBE2045\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: shared with the TTBBL3001-EN

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment:
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester:** 1<sup>st</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):** -

**Further courses built on it:** -

**Topics of course**

The series of lectures are based on the topics of cellular structure and function. It reviews the theories describing the abiotic origin of life. After that it deals with the cellular membrane systems, compartmentalisation, transport processes and describes the properties of cellular organs on the morphological and molecular level. The lectures are strongly focusing on the explanation of basic cellbiological principles and terminology to gain massive fundamentals for the upcoming courses.

**Literature**

*Compulsory:*

- Gerald Karp: Cell Biology, 6th.Ed. John Wiley and Sons, 2010

*Recommended literature will be given on every lecture, and can be accessed online.*

**Schedule:**

*1<sup>st</sup> week*

**General properties of the living systems**

Cellular-theory, Chemoton-model, abiogenesis, chemical evolution, ribozymes, molecules of information

*2<sup>nd</sup> week*

**Cellular membranes**

Composition and formation of cellular and endomembrane systems.

*3<sup>rd</sup> week*

**Cellular membrane transport**

Transport systems and transport energetics.

*4<sup>th</sup> week*

**Prokaryotic and eukaryotic cells**

Functional and morphological comparison of pro- and eukaryotic cells.

5<sup>th</sup> week

**Cytoskeleton and motorproteins**

Cellular dynamics and involved proteins.

6<sup>th</sup> week

**Vesicular systems and lysosomes**

Vesicular processes and transport.

7<sup>th</sup> week

**1. Midterm exam**

8<sup>th</sup> week

**Biology of the cellular organelles**

Basic function and morphology of the cellular organelles.

9<sup>th</sup> week

**Mitochondrial function and energy metabolism**

Basic cellular metabolism and bioenergetics.

10<sup>th</sup> week

**Cellular signalling pathways**

Signal transduction, receptors and ligands, second messengers.

11<sup>th</sup> week

**The nucleus**

Nuclear structure and functions, chromatin structure.

12<sup>th</sup> week

**Cell-cycle regulation and pathology**

Normal and pathological processes involved in the regulation of cell-cycle.

13<sup>th</sup> week

**Cellular experimental and investigation methods**

Basic methods in cell-biology.

14<sup>th</sup> week

**2. Midterm exam**

**Requirements:**

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

During the semester there are two tests: mid-term tests in the 8<sup>th</sup> week and in the 15<sup>th</sup> week. Students have to sit for the tests.

- for a grade

Based on the grades of the mid-term tests, the final grade is calculated as an average of them. The course ends in an **examination if mid-term test results are not reaching 60% each.**

The minimum requirement for the mid-term and examination test respectively is 60%. Based on the score of the tests separately, the grade for the tests **or** the examination is given according to the following table:

Score	Grade
0-59	fail (1)

60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)
<p>If the score of <b>exam</b> test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.</p> <p><i>-an offered grade:</i> it may be offered for students if the average grade of the two mid-termtest is at least pass (2) and the mid-term tests reach 60% each.</p>	
<p><b>Person responsible for course:</b> Dr. Szemán-Nagy Gábor, senior lecturer, PhD</p>	
<p><b>Lecturer:</b> Dr. Szemán-Nagy Gábor, senior lecturer, PhD</p>	

<p><b>Title of course:</b> Cell biology <b>Code:</b> TTBBG2045_EN</p>	<p><b>ECTS Credit points:</b> 2</p>
<p><b>Type of teaching, contact hours</b></p> <ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: 2 hours/week</li> <li>- laboratory: shared with the TTBBL3001-EN</li> </ul>	
<p><b>Evaluation:</b> mid-semester grade</p>	
<p><b>Workload (estimated), divided into contact hours:</b></p> <ul style="list-style-type: none"> <li>- lecture: 28 hours</li> <li>- practice: -</li> <li>- laboratory: -</li> <li>- home assignment: 32 hours</li> <li>- preparation for the exam: -</li> </ul> <p>Total: 60 hours</p>	
<p><b>Year, semester:</b> 1<sup>st</sup> year, 2<sup>nd</sup> semester</p>	
<p><b>Its prerequisite(s):</b> -</p>	
<p><b>Further courses built on it:</b> -</p>	
<p><b>Topics of course</b></p> <p>The series of lectures are based on the topics of cellular structure and function. It reviews the theories describing the abiotic origin of life. After that it deals with the cellular membrane systems, compartmentalisation, transport processes and describes the properties of cellular organs on the morphological and molecular level. The lectures are strongly focusing on the explanation of basic cellbiological principles and terminology to gain massive fundamentals for the upcoming courses.</p>	
<p><b>Literature</b></p> <p><i>Compulsory:</i> - Gerald Karp: Cell Biology, 6th.Ed. John Wiley and Sons, 2010 <i>Recommended literature will be given on every lecture, and can be accessed online.</i></p>	
<p><b>Schedule:</b></p>	

*1<sup>st</sup> week*

**General properties of the living systems**

Cellular-theory, Chemoton-model, abiogenesis, chemical evolution, ribozymes, molecules of information

*2<sup>nd</sup> week*

**Cellular membranes**

Composition and formation of cellular and endomembrane systems.

*3<sup>rd</sup> week*

**Cellular membrane transport**

Transport systems and transport energetics.

*4<sup>th</sup> week*

**Prokaryotic and eukaryotic cells**

Functional and morphological comparison of pro- and eukaryotic cells.

*5<sup>th</sup> week*

**Cytoskeleton and motorproteins**

Cellular dynamics and involved proteins.

*6<sup>th</sup> week*

**Vesicular systems and lysosomes**

Vesicular processes and transport.

*7<sup>th</sup> week*

**1. Midterm exam**

*8<sup>th</sup> week*

**Biology of the cellular organelles**

Basic function and morphology of the cellular organelles.

*9<sup>th</sup> week*

**Mitochondrial function and energy metabolism**

Basic cellular metabolism and bioenergetics.

*10<sup>th</sup> week*

**Cellular signalling pathways**

Signal transduction, receptors and ligands, second messengers.

*11<sup>th</sup> week*

**The nucleus**

Nuclear structure and functions, chromatin structure.

*12<sup>th</sup> week*

**Cell-cycle regulation and pathology**

Normal and pathological processes involved in the regulation of cell-cycle.

*13<sup>th</sup> week*

**Cellular experimental and investigation methods**

Basic methods in cell-biology.

*14<sup>th</sup> week*

**2. Midterm exam**

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory. A Power Point presentation (10 relevant slide) about a selected topic.

During the semester there are two tests: mid-term tests in the 8<sup>th</sup> week and in the 15<sup>th</sup> week. Students have to sit for the tests.

*- for a grade*

Based on the grades of the mid-term tests, the final grade is calculated as an average of them. The course ends in an **examination if mid-term test results are not reaching 60% each.**

The minimum requirement for the mid-term and examination test respectively is 60%. Based on the score of the tests separately, the grade for the tests **or** the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of **exam** test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:*

it may be offered for students if the average grade of the two mid-term test is at least pass (2) and the mid-term tests reach 60% each.

**Person responsible for course:** Dr. Szemán-Nagy Gábor, senior lecturer, PhD

**Lecturer:** Dr. Szemán-Nagy Gábor, senior lecturer, PhD

<b>Title of course:</b> Bioinformatics <b>Code:</b> TTBBE2060_EN	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hour/week - seminar: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - seminar: - - laboratory: - - home assignment: - - preparation for the exam: 46 hours Total: 60 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	

**Further courses built on it: -**

**Topics of course**

Introduction to bioinformatics. The course includes: a general introduction, methods of genome sequencing, genome projects, sequence assemblers, structural and functional annotation of genome sequences, cluster analysis, basic principles of molecular phylogenetics, phenetics and cladistics, distance-based and character-based strategies, UPGMA and WPGMA, neighbor-joining analysis, maximum parsimony analysis, maximum likelihood analysis and Bayesian methods

**Literature**

*Recommended:*

Barnes M.R. and Gray, I.C.: Bioinformatics for Geneticists, Wiley, Chichester, 2013

**Schedule:**

*1<sup>st</sup> week*

Introduction to bioinformatics

*2<sup>nd</sup> week*

Methods of genome sequencing and the genome projects

*3<sup>rd</sup> week*

Sequence assemblers

*4<sup>th</sup> week*

Structural and functional annotation of genome sequences.

*5<sup>th</sup> week*

Cluster analysis

*6<sup>th</sup> week*

Basic principles of molecular phylogenetics

*7<sup>th</sup> week*

Phenetics and cladistics

*8<sup>th</sup> week*

Distance-based and character-based strategies

*9<sup>th</sup> week*

PGMA methods: UPGMA and WPGMA

*10<sup>th</sup> week*

Neighbor-joining analysis

*11<sup>th</sup> week*

Maximum parsimony analysis

*12<sup>th</sup> week*

Maximum likelihood analysis

*13<sup>th</sup> week*

Bayesian methods

*14<sup>th</sup> week*

End-of-semester consultation

**Requirements:**

Attendance at lectures is recommended, but not compulsory.



Attendance at seminars is compulsory.  
 During the semester, there are two tests: in the 6<sup>th</sup> week and in the 10<sup>th</sup> week. Students have to sit for the tests but the results of the tests are not taken into consideration at the end-of-semester examination.  
 Semester ends with examination and signature.

Examination (lectures):

The end-of-semester examination is based on the lectures, no additional reading is required. The students answer questions in the standard assay form. No time limit is set for writing the answers. Each answer is evaluated individually using the standard five-grade system. The final examination grade is the average of the individual grades. If necessary, students can also be examined orally.

Signature (seminar):

Signature is given for the attendance at seminars. More than three absences are not permitted.

**Person responsible for course:** Prof. Dr. Matyas Sipiczki, emeritus professor, DSc

**Lecturer:** Prof. Dr. Matyas Sipiczki, emeritus professor, DSc

<b>Title of course:</b> Bioinformatics <b>Code:</b> TTBBG2060_EN	<b>ECTS Credit points:</b> 2
<b>Type of teaching, contact hours</b> - lecture: - - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> practical exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice: 28 hours in blocks - laboratory: - - home assignment: 32 hours - preparation for the exam: - Total: 60 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):-</b>	
<b>Further courses built on it:-</b>	
<b>Topics of course</b> Finding scientific journals, citations: Pubmed, Medline, Scopus, Agricola. Getting to know NCBI. Genetic diseases in humans and animals: OMIM, OMIA. Database of Hazardous Substances: NCBI-TOXNET. Identification of DNA and Protein Sequences: ENTREZ, ENSEMBL, GeneDB, Yeastgenome, Pombase Databases. Sequence analysis: Protein and DNA BLAST, pairwise alignment, multiple alignment and phylogenetic trees. Learn about the Treeview program. Design and control of PCR primers. Restriction digestions, restriction endonucleases. Learn about bioinformatics.org.	

**Literature**

*Compulsory:-*  
*Recommended:-*

**Requirements:**

*-for a signature*

Participation at practice classes is **compulsory**. A student must attend the practice classes and may not miss during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. In case of further absences, a medical certificate needs to be presented.

Students are allowed to bring and use their own notebook computer.

*- for a grade*

The course ends in practical test.

The minimum requirement for the end-term tests respectively is 60%. The grade for the tests is given according to the following table:

Score	Grade
0-9	fail (1)
10-11	pass (2)
12-13	satisfactory (3)
14-15	good (4)
16-17	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:-*

**Person responsible for course:** Dr. Hajnalka Csoma, assistant professor, PhD

**Lecturer:** Dr. Hajnalka Csoma, assistant professor, PhD

**Title of course:** Animal physiology I  
**Code:** TTBBE3001\_EN

**ECTS Credit points: 3**

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester:** 2<sup>nd</sup> year, 2<sup>nd</sup> semester

<b>Its prerequisite(s):</b>
<b>Further courses built on it:</b> TTBBG3001_EN
<b>Topics of course</b>
<p>To provide the students with the necessary amount of knowledge (both theoretical and practical) which allows them to fully understand the physiological activity of the animal and human body and the most important regulatory mechanisms governing its function.</p> <p>Topics: Homeostasis. Extra- and intracellular fluids. Buffer systems of body. Oxygen transfer. Clotting. Physiology of blood, heart, circulatory, respiratory and alimentary systems. Hormonal and neural regulation of circulatory, respiratory and alimentary systems.</p>
<b>Literature</b>
<p><i>Compulsory:</i>  Knut Schmidt-Nielsen: Animal physiology, Cambridge University Press, 1997.  Eckert: Animal physiology. Mechanisms and adaptations. W.H. Freeman and Company, 1998.  Christopher D. Moyes, Patricia M. Schulte: Principles of animal physiology. Pearson Education Inc. 2008.</p>
<b>Schedule:</b>
<p><i>1<sup>st</sup> week</i> Homeostasis. Extra- and intracellular fluids. Fluid compartments of body. Special extracellular fluids. Transports across cellular membrane</p> <p><i>2<sup>nd</sup> week</i> Blood circulation systems: open and closed circulation. Types of heart pumps. Fish, Amphibia, Reptile circulation systems. Arteriosus and venous pressure in standing and prone positions. Birds and Mammals circulatory systems.</p> <p><i>3<sup>rd</sup> week</i> Circulatory systems. Flow of fluid between capillaries and cells. Blood supply of organs. Different parts of blood vessels. Main arteries and veins of organs. Circulatory systems of fetus and newborn</p> <p><i>4<sup>th</sup> week</i> Function of heart. Histological and physiological characteristics of cardiac muscle. Pulmonary and systemic circuit. Coronary artery. Adaptation to high altitudes. Conducting pathway of heart. Cardiac adaptation. Chronotropic, dromotropic, inotropic and bathmotropic effects on heart. Hormonal and neuronal regulation of heart.</p> <p><i>5<sup>th</sup> week</i> Oxygen transport. The structure and oxygen equilibrium curve of hemoglobin and myoglobin. Oxygen affinity depending of Hb to temperature, pH and 2,3-bisphosphoglycerate. CO affinity to Hb. Methemoglobin. Blood clotting. Extrinsic and intrinsic way. Coagulation factor. Fibrin network formation, effect of thrombin in blood clotting. Fibrinolysis.</p> <p><i>6<sup>th</sup> week</i> <b>Mid-term test.</b> Homeostasis, evolution of circulatory system, parts of heart and regulation of movement of heart. Blood cells, oxygen carrying of blood. Mechanism of coagulation.</p> <p><i>7<sup>th</sup> week</i> Mechanics of respiration. Upper and lower part of respiratory system. Lung volumes and capacities. Disorders of pulmonary gas exchange. Gas exchange across surface of alveoli, role of surface tension. Respiratory movements and their regulation. Respiration in air, water: gill, lung, trachea. Dissolving and diffusion of gases in water. Gas exchange and flow of water across gill. Diffuse and ventilation lung. Respiratory movements. Regulation of respiratory.</p>

*8<sup>th</sup> week* Energy metabolism, nutrition, thermal regulation. Nutrient: carbohydrates, lipids, proteins. Liquid nutrients. Parasites, symbiotic nutrition. Thermal equilibrium, centre and periphery temperature, fever.

*9<sup>th</sup> week* Digestion. Gut motoric and secretory locomotions. Comparison of different animal groups based on their nutrition and digestion methods.

*10<sup>th</sup> week* The human stomach and digestive organs of gastrointestinal tract. Digestive enzymes. Function of pancreas. Regulation of enzyme production.

*11<sup>th</sup> week* Transport. Surfaces for transport of nutrients. Function of liver. Production of bile, its composition and function.

*12<sup>th</sup> week* The three main mechanisms of locomotion (amoeboid, ciliary, muscle). Smooth, cardiac and striated muscle. Molecular mechanism of muscle contraction.

*13<sup>th</sup> week* Discussion of the topics treated on lectures.

*14<sup>th</sup> week 2. End-term test.* Types and regulation of respiration. Types and regulation of digestion. Types of muscles and locomotion; mechanisms of muscle contraction.

### **Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Students have to **submit all the two designing tasks** as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test in the 6<sup>th</sup> week and the end-term test in the 14<sup>th</sup> week. Students have to sit for the tests

*- for a grade*

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*- an offered grade:*

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

<b>Person responsible for course:</b> Dr. Szemán-Nagy Gábor, associate professor, PhD	
<b>Lecturer:</b> Dr. Szemán-Nagy Gábor, associate professor, PhD	
<b>Title of course:</b> Animal physiology I <b>Code:</b> TTBBG3001_EN	<b>ECTS Credit points:</b> 2
<b>Type of teaching, contact hours</b> - lecture:- - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice:28 hours - laboratory: - - home assignment: 32 hours - preparation for the exam: - Total: 60 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it:</b> TTBBG3001_EN	
<b>Topics of course</b> To provide the students with the necessary amount of knowledge (both theoretical and practical) which allows them to fully understand the physiological activity of the animal and human body and the most important regulatory mechanisms governing its function. Topics: Homeostasis. Extra- and intracellular fluids. Buffer systems of body. Oxygen transfer. Clotting. Physiology of blood, heart, circulatory, respiratory and alimentary systems. Hormonal and neural regulation of circulatory, respiratory and alimentary systems.	
<b>Literature</b> <i>Compulsory:</i> Knut Schmidt-Nielsen: Animal physiology, Cambridge University Press, 1997. Eckert: Animal physiology. Mechanisms and adaptations. W.H. Freeman and Company, 1998. Christopher D. Moyes, Patricia M. Schulte: Principles of animal physiology.Pearson Education In c. 2008.	
<b>Schedule:</b> <i>1<sup>st</sup> week</i> Homeostasis. Extra- and intracellular fluids. Fluid compartments of body. Special extracellular fluids. Transports across cellular membrane  <i>2<sup>nd</sup> week</i> Blood circulation systems: open and closed circulation. Types of heart pumps. Fish, Amphibia, Reptile circulation systems. Arteriosus and venous pressure in standing and prone positions. Birds and Mammals circulatory systems.	

*3<sup>rd</sup> week* Circulatory systems. Flow of fluid between capillaries and cells. Blood supply of organs. Different parts of blood vessels. Main arteries and veins of organs. Circulatory systems of fetus and newborn

*4<sup>th</sup> week* Function of heart. Histological and physiological characteristics of cardiac muscle. Pulmonary and systemic circuit. Coronary artery. Adaptation to high altitudes. Conducting pathway of heart. Cardiac adaptation. Chronotropic, dromotropic, inotropic and bathmotropic effects on heart. Hormonal and neuronal regulation of heart.

*5<sup>th</sup> week* Oxygen transport. The structure and oxygen equilibrium curve of hemoglobin and myoglobin. Oxygen affinity depending of Hb to temperature, pH and 2,3-bisphosphoglycerate. CO affinity to Hb. Methemoglobin. Blood clotting. Extrinsic and intrinsic way. Coagulation factor. Fibrin network formation, effect of thrombin in blood clotting. Fibrinolysis.

*6<sup>th</sup> week* **Mid-term test.** Homeostasis, evolution of circulatory system, parts of heart and regulation of movement of heart. Blood cells, oxygen carrying of blood. Mechanism of coagulation.

*7<sup>th</sup> week* Mechanics of respiration. Upper and lower part of respiratory system. Lung volumes and capacities. Disorders of pulmonary gas exchange. Gas exchange across surface of alveoli, role of surface tension. Respiratory movements and their regulation. Respiration in air, water: gill, lung, trachea. Dissolving and diffusion of gases in water. Gas exchange and flow of water across gill. Diffuse and ventilation lung. Respiratory movements. Regulation of respiratory.

*8<sup>th</sup> week* Energy metabolism, nutrition, thermal regulation. Nutrient: carbohydrates, lipids, proteins. Liquid nutrients. Parasites, symbiotic nutrition. Thermal equilibrium, centre and periphery temperature, fever.

*9<sup>th</sup> week* Digestion. Gut motoric and secretory locomotions. Comparison of different animal groups based on their nutrition and digestion methods.

*10<sup>th</sup> week* The human stomach and digestive organs of gastrointestinal tract. Digestive enzymes. Function of pancreas. Regulation of enzyme production.

*11<sup>th</sup> week* Transport. Surfaces for transport of nutrients. Function of liver. Production of bile, its composition and function.

*12<sup>th</sup> week* The three main mechanisms of locomotion (amoeboid, ciliary, muscle). Smooth, cardiac and striated muscle. Molecular mechanism of muscle contraction.

*13<sup>th</sup> week* Discussion of the topics treated on lectures.

*14<sup>th</sup> week* **2. End-term test.** Types and regulation of respiration. Types and regulation of digestion. Types of muscles and locomotion; mechanisms of muscle contraction.

**Requirements:**

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

Students have to **submit all the two designing tasks** as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test in the 6<sup>th</sup> week and the end-term test in the 14<sup>th</sup> week. Students have to sit for the tests

- *for a grade*

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-*an offered grade:*

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

**Person responsible for course:** Dr. Szemán-Nagy Gábor, associate professor, PhD

**Lecturer:** Dr. Szemán-Nagy Gábor, associate professor, PhD

**Title of course:** Plant Physiology I

**Code:** TTBBE3010\_EN, TTBL3010\_EN

**ECTS Credit points:**  
**3+0+2**

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice:
- laboratory: 2 hours/week

**Evaluation:** exam, mid-semester grade

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice:
- laboratory: 28 hours
- home assignment: 52 hours
- preparation for the exam: 42 hours

Total: 150 hours

**Year, semester:** 2<sup>nd</sup> year, 1<sup>st</sup> semester

**Its prerequisite(s):** Plant anatomy

**Further courses built on it:** -

**Topics of course**

Plant metabolism and plant development. Plant water relations, water uptake, transport and processes of plant water budget. Utilization of light energy in photosynthesis. Carbon fixation pathways and photorespiration. Translocation in the phloem. Processes of carbohydrate breakdown. Assimilation of mineral nutrients with main focus on processes of nitrogen and sulphur assimilation. Photoreceptors and light control of plant developments. Growth regulation and role of phytohormones. Responses of plants to environmental stresses. Basic experimental methods in studying metabolism and development of plants.

## Literature

### *Compulsory:*

- Jones R, Ougham H, Thomas H, Waaland S, eds. (2013) The molecular life of plants. Wiley-Blackwell

### *Recommended:*

- Buchanan BB, Gruissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASP Books.

- Taiz L, Zeiger E (2010): Plant Physiology. (5th edition). Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts.

## Schedule:

### *1<sup>st</sup> week*

Water balance of plants I. Structure and properties of water molecule. Definitions of chemical potential, and water potential. Water potential of plant cells, water potential and its components (solute potential, pressure potential, matrix potential). Physical laws of water movement: diffusion, osmosis, bulk flow. Water uptake by cells, water movements across cell membranes.

### *2<sup>nd</sup> week*

Water balance of plants II. Water movements in soil-plant-atmosphere continuum. Structural properties of organs and tissues involved in water balance. Active and passive pathways of water absorption by roots. Phenomenon of „root pressure“. Water movements in roots, ways of short-term movements. Water transport in the xylem. Cohesion-tension theory of water transport in the xylem. Water loss from leaves. Guttation and transpiration. Regulation of transpiration, role of stomatal control. Movements of stomata.

### *3<sup>rd</sup> week*

Mineral nutrition. Definition of nutrient. Essential and non-essential elements. Mineral deficiencies and plant metabolism disorders. Excess mineral elements and metabolism disorders. Techniques used in mineral nutrition studies. Soil properties influencing the availability of mineral nutrients. Role of mycorrhizal fungi in nutrient uptake by roots.

### *4<sup>th</sup> week*

Photosynthesis in higher plants. Light reactions I.

Solar radiation and photosynthetically active radiation. Photosynthetic pigments: chemical characteristics and absorption spectra of main pigment groups. Organization of photosynthetic apparatus: chloroplast structure, main protein complexes involved in light reactions and their localization in the thylakoid membrane system. Organisation of photosystem I and II: light harvesting antennas and reaction centres.

### *5<sup>th</sup> week*

Photosynthesis in higher plants. Light reactions II. Electron transport in the chloroplast. Water oxidation by PSII. Electron flow through the cytochrome  $b_6/f$  complex and the related proton transport through the thylakoid membrane. Role of plastocyanin in the electron transport between PSII and PSI. NADPH formation by PSI. ATP synthesis in the chloroplast. Cyclic electron flow. Repair and photoprotection of photosynthetic apparatus.

### *6<sup>th</sup> week*



Carbon reactions of photosynthesis I. The Calvin-Benson Cycle ( $C_3$   $CO_2$  fixation pathway): carboxylation, reduction and regeneration stages. The key enzyme: ribulose 1,5 bisphosphate carboxylase and oxygenase. The  $C_2$  oxidative photosynthetic carbon cycle. Role of photorespiration during stress. Regulation of  $C_3$  cycle.

*7<sup>th</sup> week*

Carbon reactions of photosynthesis. Inorganic carbon-concentrating mechanisms. The  $C_4$  carbon cycle and special leaf anatomy. Single cell  $C_4$ (SCC<sub>4</sub>) carbon fixation. Crassulacean acid metabolism (CAM). Synthesis of starch and sucrose. Photosynthetic responses to environmental factors.

*8<sup>th</sup> week*

Translocation in the phloem. Composition of phloem sap. The pressure-flow model of phloem transport. Phloem loading in source tissues: symplastic and apoplastic pathways. Phloem unloading processes at sink tissues.

*9<sup>th</sup> week*

Nitrogen assimilation I. Biological nitrogen fixation: nodule formation, nitrogenase enzyme complex, transported nitrogen compounds. Nitrate assimilation, key enzymes and processes: nitrate reductase and nitrite reductase. Ammonium assimilation: enzymes involved in conversion of ammonium into amino acids. Sulphur assimilation: processes involved in sulphate assimilation. Connection between photosynthesis, nitrate assimilation and sulphate assimilation.

*10<sup>th</sup> week*

Respiration and lipid metabolism. Reserved carbohydrates in plants and their breakdown processes to monomers. Glycolysis: alternative glycolytic reactions in plants. The citric acid cycle and its unique properties in plant cells. Mitochondrial electron transport and ATP synthesis. The oxidative pentose phosphate pathway. Lipid metabolism. Function of lipids in plants. Stored lipids: conversion into carbohydrates during germination.

*11<sup>th</sup> week*

Light perception and transduction: role of photoreceptors. Phytochromes and photomorphogenesis. Physiological responses to blue light and ultraviolet radiation. Role of cryptochromes, phototropins, Zeit-lupe receptors.

*12<sup>th</sup> week*

Plant growth and development I. External and internal growth regulating factors. General considerations: phytohormones have similarities and dissimilarities from animal hormones. Auxins and cytokinins.

*13<sup>th</sup> week*

Plant growth and development II. Gibberellins, abscisic acid, ethylene, brassinostreoids, strigolactones, jasmonate, salicylic acid.

*14<sup>th</sup> week*

Plants in changing environment. Carbon balance of plants and environmental stress. Responses of plants to environmental stresses: excess light, drought, flooding, salinity, heavy metals.

**Requirements:**

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory.

Students are required to read the experimental protocols and understand the tasks during each practice class.

In case of laboratory class there are tests from experimental issues of every main course topic during the semester.

*-for a grade in case of the lecture:*

The course ends in an **examination**.

*-for a grade in case of the practice class:*

The result of tests and teacher's evaluation of participation in the experimental work are involved.

The minimum requirement for both the examination and laboratory grade is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:*

it may be offered for students if the average grade of the designing tasks is at least satisfactory (3)

**Person responsible for course:** Dr. Máthé Csaba, associate professor, PhD

**Lecturer:** Dr. Máthé Csaba associate professor, PhD

Dr. Mészáros Ilona, associate professor, PhD

Dr. Surányi Gyula assistant professor, PhD

**Title of course:**Genetics

**Code:** TTBBE3020\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester:** 1<sup>st</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):** -

**Further courses built on it:?**

**Topics of course**

The series of lectures are based on the topics of classical and molecular genetics. It reviews the discovery of DNA, RNA and protein as genetic material. We will discuss DNA replication and the repair mechanisms of DNA. Chromatin and chromosome structures will be reviewed during classes, but also chromosomal aberrations. We will discuss gene expression and its regulation on DNA and chromatin level. In regard of gene expression also genetic code and mutations will be discussed. Basics of mitotic and meiotic cell division will be reviewed. Mendelian genetics will follow after: principles of Mendel, different types of inheritances. We will then continue the course with sex determination and sex-linked inheritances of different organisms. We will end the lecture course with the basics of meiotic and non-meiotic recombination events.

### **Literature**

#### *Compulsory:*

- List of keywords sent out. Lecture materials sent out. Lecture notes taken during classes.

#### *Recommended:*

- Daniel L. Hartl: Essential Genetics, 6<sup>th</sup> edition; ISBN-13: 978-1449686888

- Jocelyn E Crebs et. al.: Lewin's Genes XII; ISBN-1: 978-1284104493

### **Schedule:**

*1<sup>st</sup> week: Introduction: genetics as a science field; historical overview. The nature of genetic material. DNA and RNA as genetic material. Prions.*

*2<sup>nd</sup> week: Structure of DNA. Superhelicity of DNA. The organization of prokaryotic genome.*

*3<sup>rd</sup> week: DNA organisation of eukaryotes: chromatin structures – euchromatin and heterochromatin. Basics of epigenetics.*

*4<sup>th</sup> week: Structure of chromosomes. Telomere and telomerase. Chromosome sets – euploidy and aneuploidy. Human chromosomal aberrations. Prenatal diagnostics.*

*5<sup>th</sup> week: DNA replication mechanisms. Polymerase chain reaction (PCR). DNA repair mechanisms.*

*6<sup>th</sup> week: The mitotic cell division and its significance. Nondisjunction and its significance.*

*7<sup>th</sup> week: The first step of gene expression: transcription in prokaryotes and eukaryotes.*

*8<sup>th</sup> week: Regulation of transcription. Posttranscriptional modifications.*

*9<sup>th</sup> week: The second step of gene expression: translation and the genetic code. The change of genetic code – mutations.*

*10<sup>th</sup> week: Meiotic cell division, recombination. Life cycles. The generation of human gametes.*

*11<sup>th</sup> week: Laws of Mendel. Mendelian inheritance – dominant and recessive autosomal inheritances.*

*12<sup>th</sup> week: Nonmendelian inheritances. Multifactorial inheritance.*

*13<sup>th</sup> week: Sex determination and sex linked inheritances.*

14<sup>th</sup> week: Meiotic recombination and its use in genetic mapping. Somatic recombination.

**Requirements:**

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

The course ends in an **examination**. Exam is taken in exam period. It is primarily in written form, composed of A and B part. A part is composed of “true or false” questions and keywords, and 70 % must be reached. B part is composed of single choice, multiple choice tests, figures, fill in tests, long and short essays. Grade will be given based on the B part, but A part must be passed.

Score	Grade
0-49	fail (1)
50-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If required oral exams can be taken.

**Person responsible for course:** Dr. Gyula Batta, senior lecturer, PhD

**Lecturer:** Dr. Gyula Batta, senior lecturer, PhD

<b>Title of course:</b> Molecular biology <b>Code:</b> TTBBE3025_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - preparation for the exam:62 hours Total: 90 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 4 <sup>th</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	

Review of basic concepts, such as genome, gene, chromosome, DNA, RNA etc. Structure of DNA, DNA extraction and purification methods. Gel electrophoresis. Pulsed field gel electrophoresis. Restriction enzymes in molecular biology and their application. Vectors for recombinant technology: plasmid and viral vectors, cosmids, artificial chromosomes, cloning and expression vectors. PCR methods. Gene expression, central dogma, cDNA synthesis. Cloning of genes. Ligation. Transformation. DNA sequencing methods. Genome sequencing of model organisms, human genome project and its results. DNA libraries. Southern-blot hybridisation. Studying of gene expression: quantitative PCR, microarray methods.

### Literature

RJ Reece: Analysis of Genes and Genomes , Wiley and Sons Ltd ISBN:0-470-84379-9

### Schedule:

#### *1<sup>st</sup> week*

Introduction. Review of basic concepts, such as genome, gene, chromosome, DNA, RNA etc.

#### *2<sup>nd</sup> week*

Structure of DNA, DNA extraction and purification methods.

#### *3<sup>rd</sup> week*

Gel electrophoresis. Pulsed field gel electrophoresis.

#### *4<sup>th</sup> week*

Restriction enzymes in molecular biology and their application.

#### *5<sup>th</sup> week*

Vectors for recombinant technology. Plasmid and viral vectors, cosmids, artificial chromosomes, cloning and expression vectors.

#### *6<sup>th</sup> week*

PCR methods.

#### *7<sup>th</sup> week*

Gene expression, central dogma, cDNA synthesis.

#### *8<sup>th</sup> week*

Cloning of genes. Ligation. Transformation.

#### *9<sup>th</sup> week*

DNA sequencing methods.

#### *10<sup>th</sup> week*

Genome sequencing of model organisms, human genome project and its results.

#### *11<sup>th</sup> week*

DNA libraries. Southern hybridisation.

*12<sup>th</sup> week*

Studying of gene expression: quantitative PCR, microarray methods.

*13<sup>th</sup> week*

Consultation.

*14<sup>th</sup> week*

Essay writing.

**Requirements:**

Attendance at **lectures** is recommended, but not compulsory. The course ends with **exam**.

The minimum requirement for the exam is 50%.

<b>Score</b>	<b>Grade</b>
under 50%	fail (1)
50-63%	pass (2)
64-76%	satisfactory (3)
77-89%	good (4)
90-100%	excellent (5)

If the score of the exam is below 50%, students can take further exams according to the EDUCATION AND EXAM RULES.

**Person responsible for course:** Dr. Ida Miklós, associate professor, PhD

**Lecturer:** Dr. Ida Miklós, associate professor, PhD

**Title of course:** General Microbiology and Mycology  
**Code:** TTBBE3030\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture: 2 hours/week
- practice: -
- laboratory: -

**Evaluation:** exam

**Workload (estimated), divided into contact hours:**

- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 62 hours

Total: 90 hours

**Year, semester:** 1<sup>st</sup> year, 2<sup>nd</sup> semester

**Its prerequisite(s):** -

**Further courses built on it:** -

## Topics of course

The history of microbiology. The domain of Bacteria. The domains Archaea and Eukarya. Microbial taxonomy. The phyla of Archaea. The phyla of Bacteria: Deinococcus-Thermus, Chloroflexi, Chlorobi, Cyanobacteria, Chlamydiae, Spirochetes, Bacteroidetes, Proteobacteria, Firmicutes and Actinobacteria. Basics of virology, virus types. Plant, animal viruses and bacteriophages. Prions and plasmids. Eukaryote diversity. Taxonomy of true fungi and fungal-like organisms. Phyla of true fungi. Symbiosis: microbes as symbionts. Pathogenic microbes. Virulence factors. Antibacterial drugs. Medical protozoology. Basics of mycology. Fungal life cycles. The most important species of biotechnologically or medically important fungal species. Secondary metabolites of fungi. Plant parasitic fungi. Fungi as symbiotic organisms. Sporulation and spore dispersion. Medical mycology.

## Literature

### *Compulsory:*

Handout slides of the course.

### *Recommended:*

Willey, J., Sherwood, L., Woolverton, C. J.: Prescott's Microbiology, 9th Edition, McGraw-Hill Education, 2014

Cavalier-Smith, T.: Megaphylogeny, cell body plans, adaptive zones: causes and timing of eukaryote basal radiations. *J. Eukaryot. Microbiol.* 56, 26-33, 2009

Adl, S.M. et al.: The revised classification of eukaryotes. *J. Eukaryot. Microbiol.* 59, 429-514, 2012

## Schedule:

*1<sup>st</sup> week* Introduction. The history of microbiology. Main methods and termini of microbiology. The microbiome of the planet Earth and its roles in the history of life. General features of microbes.

*2<sup>nd</sup> week* The growth curve of microbes. Environmental conditions and their effects on microbes. The characteristic features of Bacteria. The size, morphology and subcellular anatomy of prokaryotes. The bacterial cell wall. Antibiotics.

*3<sup>rd</sup> week* Primary nutritional groups of organisms. Bacterial locomotion. Endospores. The characteristic features of Archaea. Archaeal cell walls and membranes. Eukaryotic cell organelles. Eukaryotic locomotion. Mitosis and meiosis, eukaryotic life cycles and spores.

*4<sup>th</sup> week* Microbial taxonomy. The evolution of the three domains. Bacterial tree of life. Archaeal phyla. Methanogenic archaea.

*5<sup>th</sup> week* Symbiosis and parasitism in the domain Bacteria. Virulence of bacteria and immune activity against pathogens. Microbiome. Deinococci and Gram-negative prokaryotes. Introduction for the phyla Chloroflexi, Chlorobi, Cyanobacteria, Chlamydiae, Spirochaetes and Bacteroidetes

*6<sup>th</sup> week* Proteobacteria. Alpha-, Beta-, Gamma-, Delta- and Epsilonproteobacteria and their most important species.

*7<sup>th</sup> week* Gram-positive bacteria with low G+C content. The phylum Firmicutes. Tenericutes. Mollicutes, Clostridia, Bacilli. The importance of biofilms. The human microbiome. High G+C Gram-positive bacteria. Phylum Actinobacteria, Actinomycetales, Actinomycineae, Micrococcineae, Corynebacterineae, Micromonosporineae, Propionibacterineae, Streptomycineae, Streptosporangineae, Frankineae. Bifidobacteriales. Immunisation against microbes.

*8<sup>th</sup> week* Viruses: their characteristic features, morphology. DNA and RNA virus taxonomic groups. Bacteriophages. Plant viruses, viroids. Animal and human viruses.

*9<sup>th</sup> week* Plasmids of bacteria and yeasts. Prions. The taxa of Eukaryota. Medically important "protozoa".

*10<sup>th</sup> week* General mycology. The subject of mycology, the life cycles and anatomy of fungi. Taxonomy of fungi. The hypha and the fungal organelles.

*11<sup>th</sup> week* Fungal like organisms, slime moulds, Chytrids, Cryptomycota, Blastocladiomycota and "Zygomycota". Glomerulomycota and endomycorrhizae. Important species and genera.

*12<sup>th</sup> week* The sac fungi. The Ascomycota classes. Ascus and ascoma types. Conidia and conidiomas, conidiogenesis. Taphrinomycotina, Saccharomycotina, Pezizomycotina (Pezizomycetes, Sordariomycetes, Leotiomycetes, Eurotiomycetes, Dothideomycetes and Orbiliomycetes classes). Yeast as a polyphyletic group. Dimorphic growth. Ascomyota from industrial and medical perspectives. The most important species of the phylum.

*13<sup>th</sup> week* The Basidiomycota. Basidiospore formation, basidiocarps. Pucciniomycotina, Ustilaginomycotina and Agaricomycotina (Tremellomycetes and Agaricomycetes). Human mycoses and their treatments.

*14<sup>th</sup> week* Fungi in ecosystems. The fungal spores and their dispersion. Symbiosis between bacteria/fungi and plants and animals. Lichens. Plant pathogenic microbes. Nutrition of fungi. Mycoparasitism.

*15<sup>th</sup> week* Consultation.

**Requirements:**

- *for a signature*

Attendance of **9 of 15 lectures (60%)** is compulsory.

- *for a grade*

The course ends in an **examination**.

The minimum requirement for examination is 60%. The grade for the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

- *an offered grade:*

it may be offered for students if they take an optional written exam before the first week of the exam period.

**Person responsible for course:** Dr. Valter Péter Pfliegler, assistant professor, PhD

**Lecturer:** Dr. Valter Péter Pfliegler, assistant professor, PhD

**Title of course:** Biotechnology

**ECTS Credit points:** 3



<b>Code:</b> TTBBE3035_EN	
<b>Type of teaching, contact hours</b>	
<ul style="list-style-type: none"> <li>- lecture: 2 hours/week</li> <li>- practice:</li> <li>- laboratory: -</li> </ul>	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b>	
<ul style="list-style-type: none"> <li>- lecture: 28 hours</li> <li>- practice:-</li> <li>- laboratory: -</li> <li>- home assignment:-</li> <li>- preparation for the exam: 62 hours</li> </ul> <p>Total: 90 hours</p>	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
<p>The series of lectures are based on the topics of biotechnology: food and beverage biotechnology, recombinant enzymes, gene technology, cells as synthetic factories, viruses, antibodies and vaccines, environmental biotechnology, green biotechnology, embryos, clones and transgenic animals, stem cells, analytical biotechnology and the human genome, biosafety, public perception of biotechnology.</p>	
<b>Literature</b>	
<p><i>Compulsory:</i> -Reinhard Renneberg: Biotechnology for Beginners, Elsevier, ISBN: 978-0-12-373581-2</p>	
<b>Schedule:</b>	
<i>1<sup>st</sup> week</i>	
Introduction. The history of biotechnology. Biotechnology: an interdisciplinary pursuit.	
<i>2<sup>nd</sup> week</i>	
Substrates for biotechnology. Natural raw materials. Availability of by-products. Chemical and petrochemical feedstock. Raw materials and the future of biotechnology.	
<i>3<sup>rd</sup> week</i>	
Bioprocess/fermentation technology. The bioreactor. Media design for fermentation processes. Solid-substrate fermentation. Scale-up. Microbial, mammalian and plant cell cultures. Dowsntream processing.	
<i>4<sup>th</sup> week</i>	
White biotechnology. Cells as synthetic factories. Production of primer and secondary metabolites, like $\beta$ -lactames, streptomycin, cyclosporin A, statines andsteroides.	
<i>5<sup>th</sup> week</i>	
Enzymes. Enzymes for detergents. Immobilized enzymes. Biosensors. Protein engineering and <i>in vitro</i> evolution.	
<i>6<sup>th</sup> week:</i>	

Food and beverage biotechnology. Alcoholic and lactic fermentation. Sweeteners. Beer and wine production. Functional foods. Vegetable and legume fermentations. Enzymes, additives and food processing.

*7<sup>th</sup> week:*

Green biotechnology. SCP. Mycoprotein. SCP from algae and wastes.

*8<sup>th</sup> week:*

Environmental biotechnology. Sewage water treatment. Biogas. Composting. Bioremediation. Silent mining. Microbes and the geological environment. Biodegradable plastics. Clean technologies.

*9<sup>th</sup> week:*

Biological fuel generation. Bioethanol and biogas from biomass. Biodiesel and biohydrogen.

*10<sup>th</sup> week:*

Genetics and biotechnology. Protoplast and cell-fusion technologies. Genetic engineering. Green biotechnology. Plant breeding. Transgenic plants. Heterologous protein expression in bacteria, plants, yeasts and mammalian cells. Recombinant insulin and somatostatin production.

*11<sup>th</sup> week:*

Agricultural biotechnology. Plant biotechnology. GM plants. Biocontrol. Biological insecticides. „Gene farming“. Animal biotechnology. Dolly. Xenotransplantation. *In vitro* fertilization. Embryos, clones and transgenic animals. Artificial insemination. Embryo transfer.

*12<sup>th</sup> week:*

Biotechnology and medicine. Viruses and vaccines. Live and attenuated vaccines. Recombinant vaccines. Polyclonal, monoclonal and recombinant antibodies. Phage display. Myocardial infarction and anticoagulants. Recombinant EPO, Factor VIII. Stem cells. Gene therapy. RNA interference.

*13<sup>th</sup> week:*

Analytical biotechnology. Biosensors. Diagnostic tests. Immunological pregnancy tests. AIDS tests. The Human Genome. Pharmacogenomics. DNA Chips. Proteomics.

*14<sup>th</sup> week:*

Protection of biotechnological inventions. Patent protection. Trade secrets. Safety in biotechnology. Concepts of hazard and risk. Problems of organism pathogenicity. Biowarfare and bioterrorism.

Public perception of biotechnology. Genetic modification and food uses. The applications of human genetic research.

**Requirements:**

*- for a grade*

The course ends in an **examination**.

The minimum requirement for the examination respectively is 60%. The grade for the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

**Person responsible for course:** Dr. Éva Leiter, senior lecturer, PhD

**Lecturer:** Dr. Éva Leiter, senior lecturer, PhD

<b>Title of course:</b> Basic Ecology seminar <b>Code:</b> TTBBG3045_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> - lecture: - - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice: 28 hours - laboratory: - - home assignment: 62 hours - preparation for the exam: - Total: 90 hours	
<b>Year, semester:</b> 1st year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b> The role of global ecological studies in nature conservation. The effects of urbanization on terrestrial and aquatic ecosystems. The global effect of urbanization on carabid assemblages. Introduction to restoration ecology, methods of conservational grassland management. Planning of restoration ecological management practices. The most common methods used in grassland restoration: spontaneous succession, seed sowing and hay transfer. The basics of seed bank ecology, seed bank studies. The relationship between vegetation and seed bank. Environmental analytical methods in ecology. The most common sampling methods used in animal ecology. The significance and applicability of spiders in comparative ecological studies. The conservational role, species composition and spatial structure of saline and loess grasslands. The role of micro-relief in the maintenance of small-scale habitat diversity. The use of remote sensing for studying vegetation pattern. The biodiversity protecting role of habitat islands in agricultural landscapes. Ecological processes and mechanisms in forest edges. The nature conservational problems of invasive species. Organic agriculture and biodiversity of agro-ecosystems.	
<b>Literature</b> <i>Compulsory:-</i> <i>Recommended:</i> - M. Begon, J. L. Harper, C. R. Townsend (1990): Ecology, Blackwall, Oxford. ISBN-13: 978-0632038015	
<b>Schedule:</b> <i>1<sup>st</sup> week</i> Processes and principles in urban ecology.  <i>2<sup>nd</sup> week</i> The effects of urbanization and anthropogenic influences on terrestrial and aquatic ecosystems.	

*3<sup>rd</sup> week* Introduction to restoration ecology, the methods of conservational grassland management. Basic terms of restoration ecology. Restoration, rehabilitation, creation, recultivation. Stability, resistance, resiliency. The planning of management practices in restoration ecology. The most common methods used in grassland restoration: spontaneous succession, sowing and hay transfer.

*4<sup>th</sup> week* Classic and dynamic biogeography models: the unified neutral theory of biogeography and biodiversity (Hubbel's neutral theory).

*5<sup>th</sup> week* Models and role of modelling in ecology. Computer simulation experiments.

*6<sup>th</sup> week* The basics of seed bank ecology, seed bank studies. The relationship between vegetation and seed bank. Seed bank, vertical and horizontal seed bank profile. Density of seed bank. Viability of seeds. Types of seed banks. The significance of seed bank studies. A case study.

*7<sup>th</sup> week* Environmental analytical methods in ecology. The role of chemical analytics in environmental protection. The steps of analytical processes. Sampling methods. Types of sample preparation. Methods for the determination of the composition of solutions. Analytical projects in the Department.

*8<sup>th</sup> week* The significance and applicability of spiders in comparative ecological studies. The most common sampling methods in arachnology. Protected species. Hunting strategies.

*9<sup>th</sup> week* Effects of grazing and urbanization on spider assemblages.

*10<sup>th</sup> week* The conservational role, species composition and spatial structure of saline and loess grasslands. The role of micro-relief in the maintenance of small-scale habitat diversity. The use of remote sensing for studying vegetation pattern.

*11<sup>th</sup> week* The role of cultural sites in nature conservation. The biodiversity conservation role of habitat islands in agricultural landscapes. Kurgans as habitats, and their significance in maintaining grassland biodiversity.

*12<sup>th</sup> week* Ecological processes and mechanisms in forest edges.

*13<sup>th</sup> week* Invasive species. Biological invasion, the chances of the establishment of invasive species. The strategies of invasive species. The nature conservational problems of invasive species.

*14<sup>th</sup> week* Organic agriculture and biodiversity of agroecosystems. The role of cover crop in organic agriculture and in maintaining agrobiodiversity. A case study.

**Requirements:**

*- for a signature*

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct

doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

*- for a grade*

- The course ends in a **term mark**.

The following grades are possible for the written and oral parts of the presentation:

Grade  
 fail (1)  
 pass (2)  
 satisfactory (3)  
 good (4)  
 excellent (5)

**Person responsible for course:** Dr. Roland Horváth, senior lecturer, PhD,  
 Dr. Orsolya Deák-Valkó, senior lecturer, PhD,  
 Dr. Balázs Deák, senior lecturer, PhD

**Lecturer:** Dr. Roland Horváth, senior lecturer, PhD  
 Dr. Orsolya Deák-Valkó, senior lecturer, PhD,  
 Dr. Balázs Deák, senior lecturer, PhD,  
 Prof. Dr. Péter Török, university professor, DSc,  
 Dr. Edina Kundrať-Simon, associate professor, PhD  
 Prof. Dr. Béla Tóthmérész, university professor, DSc  
 Prof. Dr. Tibor Magura, university professor, DSc

<b>Title of course:</b> Biodiversity seminar <b>Code:</b> TTBBG3050_EN	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: - - practice:2hours/week - laboratory:-	
<b>Evaluation:</b> exam, mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice:28hours - laboratory: - - home assignment: 62 hours - preparation for the exam: - Total: 90 hours	
<b>Year, semester:</b> 2nd year, 1st semester	
<b>Its prerequisite(s):-</b>	
<b>Further courses built on it:-</b>	
<b>Topics of course</b>	

The course provides a practical knowledge on the application possibilities of statistical methods regarding the measurements of biodiversity.

### **Literature**

- Magurran, A.E. and McGill, B.J. 2011: Biological Diversity: Frontiers in Measurement and Assessment. Oxford University Press ISBN: 0199580677
- Clark, J.S. and Gelfand, A. 2006: Hierarchical Modelling for the Environmental Sciences: Statistical Methods and Applications. Oxford University Press. ISBN: 9780198569671

### **Schedule:**

*1<sup>st</sup> week Introduction to the course*

*2<sup>nd</sup> week Statistical measures for calculating biodiversity I.*

*3<sup>rd</sup> week Statistical measures for calculating biodiversity II.*

*4<sup>th</sup> week Review of classical statistical methods.*

*5<sup>th</sup> week Species number and species richness, saturation of species richness.*

*6<sup>th</sup> week Dynamics of species richness*

*7<sup>th</sup> week: Mid-term test*

*8<sup>th</sup> week Diversity measures I*

*9<sup>th</sup> week Diversity measures II*

*10<sup>th</sup> week Simpson and Shannon diversity*

*11<sup>th</sup> week Calculation of RTS diversity*

*12<sup>th</sup> week Entropy*

*13<sup>th</sup> week Calculation of diversity by the Rényi functions*

*14<sup>th</sup> week End-term test*

### **Requirements:**

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the tests is at least satisfactory. The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

**Person responsible for course:** Dr. Deák Balázs, assistant professor, PhD;

**Lecturer:** Dr. BalázsDeák, assistant professor, PhD;

Dr. Orsolya Deák-Valkó, assistant professor, PhD

Dr Edina Kunderát-Simon, associate professor, PhD

<b>Title of course:</b> Ecological examination methods <b>Code:</b> TTBBE3055_EN	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 46 hours Total: 60 hours	
<b>Year, semester:</b> 3rd year, 2nd semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
The course introduce the students the basics of research planning, experimental research and elementary statistics and data capture. It provides essential knowledge in the most important field methods of data collection. The course focus on methods frequently used in environmental	

assessment and evaluation focusing on essential sampling methods of vegetation coverage and height, biomass, soil seed bank, and the sampling of water plants, algae and animal communities. The course introduces the theory of trait-based ecosystem analyses, provides information on trait measurements and analyses, and provides an essential guideline for trait-based ecosystem engineering and ecological strategies based analyses.

**Literature**

- Gordon A. Fox, Simonetta Negrete-Yankelevich, Vinicio J. Sosa (eds.) (2015): Ecological Statistics – Contemporary theory and application. Oxford University Press, Oxford.
- Moore PD and Chapman SB (1986): Methods in plant ecology. Blackwell Scientific Publications, Oxford.
- Martin Kent, Paddy Cooker (1995): Vegetation description and analysis – A practical approach. Wiley, Chichester.

**Schedule:**

- 1<sup>st</sup> week* Introduction to the course
- 2<sup>nd</sup> week* Field sampling and design of experiments
- 3<sup>rd</sup> week* Elementary statistics and data analysis I
- 4<sup>th</sup> week* Elementary statistics and data analysis II
- 5<sup>th</sup> week* Sampling of terrestrial plant communities I
- 6<sup>th</sup> week* Sampling of terrestrial plant communities II.
- 7<sup>th</sup> week* Sampling of terrestrial plant communities III.
- 8<sup>th</sup> week:* Mid-term test
- 9<sup>th</sup> week* Sampling in freshwater communities I
- 10<sup>th</sup> week* Sampling in freshwater communities II
- 11<sup>th</sup> week* Sampling in animal communities I
- 12<sup>th</sup> week* Sampling in animal communities II
- 13<sup>th</sup> week* Sampling in animal communities III
- 14<sup>th</sup> week* End-term test

**Requirements:**

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.



During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

**Person responsible for course:** Prof. Dr. Péter Török, university professor, DSc.

**Lecturer:** Prof. Dr. Péter Török, university professor, PhD, DSc.

Dr. Balázs Deák, assistant professor, PhD

Dr. Orsolya Valkó, assistant professor, PhD

Dr. Roland Horváth, assistant professor, Ph.D.

<b>Title of course:</b> Ecological examination methods practice <b>Code:</b> TTBBG3055_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> - lecture: - - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice: 28 hours - laboratory: - - home assignment: 62 hours - preparation for the exam: - Total: 90 hours	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	

**Topics of course**

The course provides practical knowledge on the basic ecological examination methods focusing on botany and zoology. The students get information on selection of the proper methodology, ways of sample preparation, and evaluation of field data.

**Literature**

*Compulsory:-*

*Recommended:*

- M. Begon, J. L. Harper, C. R. Townsend (1990): Ecology, Blackwall, Oxford. ISBN-13: 978-0632038015

- Harper, J. L. 1977: Population Biology of Plants, Academic Press, London, pp. 829

**Schedule:**

*1<sup>st</sup> week Introduction to the course*

*2<sup>nd</sup> week Botanical surveys, coenological methods*

*3<sup>rd</sup> week Botanical surveys, species area relations*

*4<sup>th</sup> week Estimation of biomass production, field methods, sample sorting*

*5<sup>th</sup> week Sampling of the seed bank, sample preparation, germination in greenhouse*

*6<sup>th</sup> week Sampling connected to seed dispersal*

*7<sup>th</sup> week Mid-term test*

*8<sup>th</sup> week Sampling of Orthopterans and True Bugs*

*9<sup>th</sup> week Sampling of Lepidopterans*

*10<sup>th</sup> week Sampling of Amphibians*

*11<sup>th</sup> week Sampling of Reptilians*

*12<sup>th</sup> week Monitoring of bird species*

*13<sup>th</sup> week Sampling of small mammals*

*14<sup>th</sup> week End-term test*

**Requirements:**

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the tests is at least satisfactory. The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

**Person responsible for course:** Dr. Orsolya Deák-Valkó, senior lecturer, PhD

Dr. Balázs Deák, senior lecturer, PhD

**Lecturer:** Dr. Roland Horváth, senior lecturer, PhD,

Dr. Orsolya Deák-Valkó, senior lecturer, PhD

Dr. Balázs Deák, senior lecturer, PhD

<b>Title of course:</b> Population genetics, Population genetics seminar <b>Code:</b> TTBBE3060_EN, TTBBG3060_EN	<b>ECTS Credit points:</b> 2+1
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - seminar: 2 hour/week - laboratory: -	
<b>Evaluation:</b> exam, mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: 28 hours - laboratory: - - home assignment: 12 hours - preparation for the exam: 22 hours Total: 90 hours	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):-</b>	
<b>Further courses built on it:-</b>	

### Topics of course

The history of evolutionary biology. Genetic introduction. Genetic variation in natural populations, molecular methods to estimate it. The Hardy-Weinberg equilibrium. The source of genetic variation: mutation. Types of preferentiality in mating. Inbreeding. Genetic drift, bottle neck and founder effect. Selection: types, fitness, allele frequency changes during different types of selection. Elementary quantitative genetics. Genetic differentiation and migration. Different species concepts. Speciation. Coevolution. The evolution of biosphere. Adaptive radiations and mass extinctions.

The topics of the seminar: Calculation of allele frequencies. Statistical test of the Hardy-Weinberg equilibrium. Calculation of allele frequencies in case of dominance. Calculation of allele frequencies at X linked loci. Calculation of the inbreeding coefficient. genotype frequencies in inbred populations. calculation of fitness components and net fitness. Allele frequencies in overdominant selection.

### Literature

#### *Compulsory:*

- Futuyma, D.J. 2005. *Evolution*. Sinauer Associates Inc., Sunderland, ISBN 0-87893-187-2.

#### *Recommended:*

- Hedrick, P.W. 1985. *Genetics of populations*. Jones and Bartlet Publishers, Boston ISBN 0-86720-011-1

- Ridley, M. 1996. *Evolution*. Blackwell Science, Cambridge ISBN 0-86542-495-0

### Schedule:

*1<sup>st</sup> week:* Introduction to Evolutionary biology. A historical background.

*2<sup>nd</sup> week:* Genetic variation in natural populations. Molecular methods to analyse genetic variation.

*3<sup>rd</sup> week:* The Haerdy Weinberg principle.

*4<sup>th</sup> week:* The evolutionary significance of mutation.

*5<sup>th</sup> week:* Types of preferentiality in mating. Inbreeding.

*6<sup>th</sup> week:* Genetic drift. Bottle neck and founder effect.

*7<sup>th</sup> week:* Types of selection. Allele frequency changes under selection.

*8<sup>th</sup> week:* Elementary quantitative genetics.

*9<sup>th</sup> week:* Genetic differentiation.

*10<sup>th</sup> week:* Migration models.

*11<sup>th</sup> week:* Species concepts. Reproductive isolation. Basic types of speciation.

*12<sup>th</sup> week:* Coevolution.

*13<sup>th</sup> week:* The evolution of the biosphere.

*14<sup>th</sup> week:* Adaptive radiations and mass extinctions. Adaptive radiations and mass extinctions

**Requirements:**

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

Participation at **seminars** is compulsory. A student must attend the seminars and may not miss more than once during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at seminars will be recorded by the leader.

- for a grade

The course ends by an **examination: one test for the seminars and one for the lectures**. The grades of both tests are calculated on the basis of the results of the tests.

**Person responsible for course:** Dr. Nikoletta Nagy, assistant professor, PhD

**Lecturer:** Dr. Nikoletta Nagy, assistant professor, PhD

<b>Title of course:</b> Biogeography <b>Code:</b> TTBBE3065_EN	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - seminar: - - laboratory: –	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: – - laboratory: - - home assignment: - - preparation for the exam: 62 hours Total: 90 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b> Subject, history and methodology of biogeography. Tectonics. Phylogenetical biogeography. Analitical and regional biogeography: regional biogeography of large biocycles. Distribution and colonisation. Characteristics of distribution area. Filogeography and its practical importance. Climatic characteristics, vegetation- and fauna history, and evolutionary dynamics. of the Quarter. Regionality and evolutionary history of bioms. Phytogeography: flora and vegetation. Zonality, succession and klimax. Floristic elements. Relicts and endemisms. Vegetation zones of planet Earth.- Rainforests, subtropical areas. Grasslands of the temperate zones. Forest-steppes. Broadleaf and needleleaf forests. Arctic and mountain territories. Vegetation of Hungary and Pannonian Basin and its floristic division. Zoogeography. Animals of Pannonian Basin.	
<b>Literature</b>	
<i>Compulsory:</i>	

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*Recommended:*

Udvardy, M. D. (1969). Dynamic zoogeography. – Van Nostrand Reinhold Company  
Brown, D. (2009). Biogeography. – Sinauer Associates.

**Schedule:**

1st week: Basic principles of biogeography, historical aspects.  
2nd week: Climatic trends.  
3rd week: Continental drift.  
4th week: Distribution: types, effectiveness,  
5th week: Colonization.  
6th week: Island biogeography.  
7th week: Analytical and regional biogeography.  
8th week: Climatic characteristics, vegetation- and fauna history, and evolutionary dynamics. of the Quarter.  
9th week: Regionality and evolutionary history of bioms.  
10th week: Phytogeography: flora and vegetation. Zonality, succession and klimax. Floristic elements..  
11th week: Phytogeography: Relicts and endemisms. Vegetation zones of planet Earth..  
12th week: Zoogeography.  
13th week: Modern methods in biogeography.  
14th week: Molecular phylogeography and its practical importance.

**Requirements:**

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

During the semester there is a test: the end-term test in the 15<sup>th</sup> week. Students have to sit for the tests

- *for a grade*

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 50%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-49	fail (1)
50-59	pass (2)
60-69	satisfactory (3)
70-79	good (4)
80-100	excellent (5)

If the score of the is below 50, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

- *an offered grade:*

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

**Person responsible for course:** Prof. Dr. Attila Molnár, university professor, DSc

**Lecturer:** Prof. Dr. Attila Molnár V., university professor, DSc,  
 Dr. Gábor Sramko, senior research fellow, PhD  
 Dr. András Tartally, senior lecturer, PhD

<b>Title of course:</b> Environmental and nature protection <b>Code:</b> TTBBE3070_EN	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 62 hours Total: 90 hours	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b> The emergence of an environmental crisis. The main environmental problems: overpopulation, global warming, soil degradation, deforestation. Problems with energy production, conditions of water supply, waste and its environmental hazard. Natural values of the Earth, conservation of biodiversity. Protection of habitats, prevention of species extinction. Activities of nature conservation.	
<b>Literature</b> <i>Compulsory:</i> H. Frances (2005): Global Environmental Issues. John Wiley & Sons, USA ISBN: 978-0-470-09395-5 M. K. Wali, F. Evrendilek, M. S. Fennessy (2009): The Environment: Science, Issues, and Solutions. CRC Press ISBN: 9780849373879 J.M. Fryxell, A. R. E. Sinclair, G. Caughley (2014): Wildlife Ecology, Conservation, and Management. Wiley-Blackwell ISBN: 978-1-118-29106-1	
<b>Schedule:</b> <i>1<sup>st</sup> week</i> The main environmental problems. The development of environmental protection. <i>2<sup>nd</sup> week</i> Nature protection. The regulation and system of nature conservation. Types of nature protected areas. <i>3<sup>rd</sup> week</i>	

The methods of conservation. Legal instruments to protect nature. International conventions for nature conservation.

*4<sup>th</sup> week*

The largest national parks of the world.

*5<sup>th</sup> week*

The demographic processes of the world. Population indicators. Characteristics of the population of developed and developing countries.

*6<sup>th</sup> week*

The development of energy supply. The benefits and disadvantages of fossil and renewable energy sources and their use.

*7<sup>th</sup> week*

Environmental risks of nuclear energy and its use.

*8<sup>th</sup> week*

Water resources on Earth. Problems with drinking water supply. Types of wastewater, basics of wastewater treatment.

*9<sup>th</sup> week*

Concept and types of waste. Waste management (recovery, disposal).

*10<sup>th</sup> week*

Harmful environmental impacts on soil: soil contamination, soil degradation, secondary salinisation.

*11<sup>th</sup> week*

Air pollutants and their effects: smog formation, climate change, reduction of stratospheric ozone, acidification of the environment.

*12<sup>th</sup> week*

Forest-related problems: forest degradation, deforestation. The environmental role of forests.

*13<sup>th</sup> week*

The impacts of environmental change on the individual and on society.

*14<sup>th</sup> week*

Consultation or exam.

**Requirements:**

*- for a signature*

Attendance at lectures is recommended, but not compulsory.

*- for a grade*

The course ends in a written examination. 2 (Pass) grade: 50% of the maximum points available. If the score of any test is below 50%, students can take a retake test.

*- an offered grade:*

There are at least two tests during the semester, and the offered grade is the average of them.

**Person responsible for course:** Kaszáné Dr. Kiss Magdolna, assistant professor, PhD

**Lecturer:** Kaszáné Dr. Kiss Magdolna, assistant professor, PhD

Dr. Simon Edina, associate professor, PhD

Dr. Gyulai István, assistant professor, PhD

**Title of course:** Environmental and nature protection

**Code:** TTBBG3070\_EN

**ECTS Credit points: 2**



<p><b>Type of teaching, contact hours</b></p> <ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: 2 hours/week</li> <li>- laboratory: -</li> </ul>
<p><b>Evaluation:</b> exam</p>
<p><b>Workload (estimated), divided into contact hours:</b></p> <ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: 28 hours</li> <li>- laboratory: -</li> <li>- home assignment: 32 hours</li> <li>- preparation for the exam: -</li> </ul> <p>Total: 60 hours</p>
<p><b>Year, semester:</b> 3<sup>rd</sup> year, 1<sup>st</sup> semester</p>
<p><b>Its prerequisite(s):</b> -</p>
<p><b>Further courses built on it:</b> -</p>
<p><b>Topics of course</b></p> <p>Knowing the environmental problems in detail. Investigating changes in the environment. The methods and significance of environmental monitoring. Monitoring of biodiversity. Bioindication.</p>
<p><b>Literature</b></p> <p><i>Compulsory:</i>  M.J. Groom, G.K. Meffe, C.R. Carrol (2006): Principles of Conservation Biology. Sinauer Associates, Inc.  ISBN: 0-87893-518-5  H. Frances (2005): Global Environmental Issues. John Wiley &amp; Sons, USA  ISBN: 978-0-470-09395-5  M. K. Wali, F. Evrendilek, M. S. Fennessy (2009): The Environment: Science, Issues, and Solutions. CRC Press ISBN: 9780849373879</p>
<p><b>Schedule:</b></p> <p><i>1<sup>st</sup> week</i>  Global situation of biodiversity.</p> <p><i>2<sup>nd</sup> week</i>  Analysis of the consequences of climate change.</p> <p><i>3<sup>rd</sup> week</i>  Acid rain and its effects on the environment.</p> <p><i>4<sup>th</sup> week</i>  <i>Water supplies and the extreme flow regimes.</i></p> <p><i>5<sup>th</sup> week</i>  The problem of decreasing the wetland extension.</p> <p><i>6<sup>th</sup> week</i>  The impact of urbanization on the wildlife</p> <p><i>7<sup>th</sup> week</i>  Consultation about the previous topics.</p>

*8<sup>th</sup> week*

The concept, purpose, object and means of environmental monitoring. Elements of the monitor systems.

*9<sup>th</sup> week*

Features of monitor databases, data processing, and analysis of trends.

*10<sup>th</sup> week*

Definition and types of sampling.

*11<sup>th</sup> week*

Anthropogenic impacts: pollution of soil, water and air, the need for risk assessment and remediation.

*12<sup>th</sup> week*

The concept and general criteria for biomonitoring. The task of biomonitoring and its perspectives in environmental and nature conservation.

*13<sup>th</sup> week*

The concept of bioindication, living organisms that indicate and measure environmental pollution.

*14<sup>th</sup> week*

Consultation.

**Requirements:**

*- for a signature*

Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. In case of further absences, a medical certificate needs to be presented.

*- for a grade*

The practice ends with submitting a term paper.

**Person responsible for course:** Kaszáné Dr. Kiss Magdolna, assistant professor, PhD

**Lecturer:** Kaszáné Dr. Kiss Magdolna, assistant professor, PhD

Dr. Edina Simon assistant professor, PhD

Dr István Gyulai, assistant professor, PhD

<b>Title of course:</b> Animal Behaviour <b>Code:</b> TTBBE3075_EN	<b>ECTS Credit points: 4</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - seminar: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - seminar: - - laboratory: - - home assignment: -	

- preparation for the exam: 78 hours Total: 120 hours
<b>Year, semester:</b> 3 <sup>rd</sup> year, 1 <sup>st</sup> semester
<b>Its prerequisite(s):</b>
<b>Further courses built on it: -</b>
<b>Topics of course</b>
The aim of the course is threefold. First, to shed light on the huge diversity of animal behaviour. Second, to introduce the within-individual (e.g. genetic, physiological, psychological) mechanisms responsible to generate this diversity. Third, to highlight those evolutionary processes shaping this diversity.
<b>Literature</b>
<i>Compulsory:</i>
<i>Recommended:</i>
<ul style="list-style-type: none"> <li>- Dawkins, R. 1976, The selfish gene. OUP.</li> <li>- Alcock, J. 2009. Animal behaviour: An evolutionary approach. Sinauer Press.</li> <li>- Danchin, E., Giraldeau, L.-A., Cezily, F., 2008. Behavioural Ecology. OUP</li> </ul>
<b>Schedule:</b>
<i>1<sup>st</sup> week</i> Definition of animal behaviour. Tinbergen's four questions. The history of animal behaviour research.
<i>2<sup>nd</sup> week</i> The units of behaviour. Control of behaviour. Stimuli, decision making and motivation.
<i>3<sup>rd</sup> week</i> Ontogeny of behaviour. Nature or nurture?
<i>4<sup>th</sup> week</i> Genetic effects, the genetic dissection of behaviour.
<i>5<sup>th</sup> week</i> Environmental effects: maturation, hormones, early experiences, developmental homeostases, play and imprinting.
<i>6<sup>th</sup> week</i> Learning: types of learning, animal intelligence and its evolution.
<i>7<sup>th</sup> week</i> Natural selection and adaptation. Units of selection: gene, individual, group and kin selection.
<i>8<sup>th</sup> week</i> Basic models in behavioural ecology I: optimal foraging.
<i>9<sup>th</sup> week</i> Basic models in behavioural ecology II: evolutionary game theory.
<i>10<sup>th</sup> week</i> Animal communication: definition, evolution, ritualisation, design of signals, honest signals. Bees' dance language.
<i>11<sup>th</sup> week</i> Sexual reproduction: costs and benefits. Evolution of anisogamy and primary sex ratio.
<i>12<sup>th</sup> week</i>

Sexual selection: intra- and intersexual selection, alternative mating tactics, mate choice.

*13<sup>th</sup> week*

Mating systems: monogamy, polygyny, polyandry. Parental care.

*14<sup>th</sup> week*

Social behaviour: costs and benefits. Animal societies, eusociality.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **seminar classes** is compulsory. A student must attend the seminars and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any seminar with another group. Attendance at seminar classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed seminar classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class. On the seminar the students collect videos from the web and analyse them. They summarise their results in a short talk presented in the front of the class.

During the semester there is one test at the end of term. Students have to sit for the test

*- for a grade*

The course ends in an **examination**. The exam grade is given as the result of the examination. The exam consists of the definitions of five concepts of ethology and two short essays of topics in animal behaviour. To pass the exam the student must correctly define at least three concepts and reach a minimal grade of 2 for both essays.

If the students fail on the exam, they can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Prof. Dr. Zoltán Barta, university professor, DSc

**Lecturer:** Prof. Dr. Zoltán Barta, university professor, DSc

<b>Title of course:</b> Soil science <b>Code:</b> TTBBE4001_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> - lecture: - - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> mid-semester grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice: 28 hours - laboratory: -	

<p>- home assignment: 62 hours  - preparation for the exam: -  Total: 90 hours</p>
<p><b>Year, semester:</b> 3<sup>rd</sup>year, 1<sup>st</sup>semester</p>
<p><b>Its prerequisite(s):</b></p>
<p><b>Further courses built on it: -</b></p>
<p><b>Topics of course</b></p> <p>The series of lectures gives an overview of soil formation and the physical, chemical and biological properties of soils. The students learn the basic characteristics of different soil types, and how soil formation connects with the vegetation and climatic factors. The students also learn the effects of anthropogenic activities recently threatening soils worldwide. The course provides basic knowledge for botany, nature conservation, environmental protection and agricultural studies. During the seminars the students elaborate on, present and discuss a topic of their choice pertaining basic or applied aspects of soil science.</p>
<p><b>Literature</b></p> <p><i>Compulsory:-</i></p> <p><i>Recommended:</i></p> <ul style="list-style-type: none"> <li>- Blaskó L. 2008: Soil Science. University of Debrecen, <i>Centre for Agricultural and Applied Economic Sciences</i>. <a href="http://www.tankonyvtar.hu">www.tankonyvtar.hu</a></li> <li>- Kátai J. 2013: Applied Soil Science. University of Debrecen. <a href="http://www.tankonyvtar.hu">www.tankonyvtar.hu</a></li> </ul>
<p><b>Schedule:</b></p> <p><i>1<sup>st</sup> week</i></p> <p>The study area of soil science. Basic abiotic and biotic components of soils. Solid, liquid and gaseous phases. The structure of soil: soil profile and soil layers.</p> <p><i>2<sup>nd</sup> week</i></p> <p>The substrates for soil formation: parental rocks and types of minerals. Primary and secondary minerals in soils. Structure, water and ion absorption of clay minerals and their role in soil formation and functioning.</p> <p><i>3<sup>rd</sup> week</i></p> <p>Abiotic and biotic processes in soil formation: Physical and chemical weathering, biological processes. The transport of products: leaching, eluviation, illuviation, chelation. Podzolization, laterization, calcification, salinization, gleying.</p> <p><i>4<sup>th</sup> week</i></p> <p>The organic components of soils: The edaphon and the significance of its different groups in soil processes. Decomposition of organic materials, humification, groups and properties of humic components. The distribution of humic compounds in the soil profile and their role in the nutrient cycles, water relations and thermal properties of soils.</p> <p><i>5<sup>th</sup> week</i></p> <p>The role of soil colloids: Inorganic and organic colloids in soils. Surface reactions: electric double layer, permanent and pH-dependent charges, ion- and water adsorption, ion exchange, protolytic reactions. The effects of soluble salts on soil properties. Soil pH, acidic and alkaline soils. The effect of soil pH on other soil processes and on the edaphon. Buffering capacity and components of soils.</p> <p><i>6<sup>th</sup> week</i></p>

Redox reactions in soils: redox reactions, reducing and oxidizing agents in soils. The dependence of redox potential on aeration. The effects of redox potential on biotic reactions in soils.

*7<sup>th</sup> week*

Nutrient cycles in soils: The role of the soil in the biogeochemical cycles. The mobilization and immobilization of nutrients. N-, P-, S-cycles in soils. The dynamics and effects of basic cations (K, Na, Mg, Ca) in soils. The dynamics of micronutrients.

*8<sup>th</sup> week*

Physical properties of soils: soil particles, soil aggregates and the pore space. Water relations, aeration, heat balance.

*9<sup>th</sup> week*

Soil geography: the effects of the climate and vegetation on soil formation and soil properties. Edaphic zones on Earth.

*10<sup>th</sup> week*

Genetic and diagnostic soil classification. The World Reference Base for Soil Resources.

*11<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*12<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*13<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*14<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **seminars** is compulsory. A student may not miss more than one of the four seminars. In case a student does so, the subject will not be signed and the student must repeat the course. In case of more than one missed seminars a medical certificate needs to be presented. Being late is equivalent with an absence. Active participation is evaluated by the teacher in every seminar class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Each student has to prepare a brief review (~5 pages) on a selected topic and give a short presentation (~15 min) during the seminar classes based on his/her review. The chosen topics will be discussed at the seminars and the reviews will be evaluated by the lecturer. In order to get the signature the reviews must reach at least sufficient level.

*- for a grade*

The course ends with a **written exam**.

The minimum requirement due to pass the written exam is 50%. The grade for the exam is given according to the following table:

Score	Grade
0-50	fail (1)
51-62	pass (2)
63-75	satisfactory (3)
76-87	good (4)
88-100	excellent (5)

The final grade is calculated as an average of the seminar grade and the exam grade, respectively. If the score of the exam is below 50%, students can retake the test in line with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Viktor Oláh assistant professor, PhD

**Lecturer:** Dr. Viktor Oláh assistant professor, PhD

<b>Title of course:</b> Toxicology and ecotoxicology <b>Code:</b> TTBBG4015_EN	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 62 hours Total: 90 hours	
<b>Year, semester:</b> 3rd year, 1st semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
The aim of the course to introduce the toxicology, the effect of toxic metals and analysis methods in toxicology. The course give knowledge about metal toxicants in air, water and soil; metabolism, absorption, distribution and elimination of toxicants; environmental risk assessment and analytical methods in toxicology.	
<b>Literature</b>	
- Hodgson E (2004) A textbook of modern toxicology. John Wiley and Sons. Online ISBN: 9780471646778 - Nikinmaa M (2014) An introduction to Aquatic Toxicology. Elsevier. eBook ISBN: 9780124115811	
<b>Schedule:</b>	
<i>1<sup>st</sup> week</i> Introduction to the course	
<i>2<sup>nd</sup> week</i> History of toxicology	
<i>3<sup>rd</sup> week</i> Classification of metals, essential, non-essential, toxic and non-toxic metals	

4<sup>th</sup> week Source and effect of cadmium

5<sup>th</sup> week Source and effect of lead

6<sup>th</sup> week Source and effect of copper

7<sup>th</sup> week: Source and effect of zinc

8<sup>th</sup> week Source and effect of mercury

9<sup>th</sup> week Source and effect of nickel

10<sup>th</sup> week Mid-term test

11<sup>th</sup> week Toxicology tests for metals with animal

12<sup>th</sup> week Toxicology tests for metals with plants

13<sup>th</sup> week Methods for analysis of metals

14<sup>th</sup> week End-term test

**Requirements:**

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.



- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

**Person responsible for course:** Dr. Edina-Kundrát-Simon, associate professor, PhD

**Lecturer:**Dr. Edina-Kundrát-Simon, associate professor, PhD

<b>Title of course:</b> Animal Ecology <b>Code:</b> TTBBG4030_EN	<b>ECTS Credit points:</b> 3
<b>Type of teaching, contact hours</b> <ul style="list-style-type: none"><li>- lecture: 2 hours/week</li><li>- practice: -</li><li>- laboratory: -</li></ul>	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> <ul style="list-style-type: none"><li>- lecture: 28 hours</li><li>- practice:</li><li>- laboratory: -</li><li>- home assignment: -</li><li>- preparation for the exam: 62 hours</li></ul> Total: 90 hours	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
The aim of the course is to introduce the ecology, the animal ecology field and laboratory methods. The course gives knowledge and analysis about the effect of temperature, lights, radiation and salt content on animal population, and gives knowledge about predation, parasitism, symbiosis and mutualism, decomposers and detritivores, intra and interspecific competition.	
<b>Literature</b>	
Begon M, Harper JL, Townsend CR. Ecology. From Individuals to Ecosystems. Blackwell Scientific Publications, Oxford, 1986. Molles MC. Ecology: Concepts and Applications. 7th Edition. McGraw-Hill Education. 2016	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction of the course.  <i>2<sup>nd</sup> week</i> Effect of temperature	

3<sup>rd</sup> week Effect of light, and radiation

4<sup>th</sup> week Effect of salt content and chemical composition of environment

5<sup>th</sup> week Predation

6<sup>th</sup> week Parasitism

7<sup>th</sup> week Symbiosis and mutualism

8<sup>th</sup> week Decomposers and detritivores

9<sup>th</sup> week Intraspecific competition

10<sup>th</sup> week Interspecific competition

11<sup>th</sup> week Method of the soil and water collection

12<sup>th</sup> week Method of analysis of soil and water important physical and chemical parameters

13<sup>th</sup> week Visual, acoustic, trapping and other collection method

14<sup>th</sup> week End-term test

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to **submit all the two designing tasks** as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test in the 8<sup>th</sup> week and the end-term test in the 15<sup>th</sup> week. Students have to sit for the tests

*- for a grade*

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

*-an offered grade:*

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

**Person responsible for course:** Dr. Edina-Kundrát-Simon, associate professor, PhD, habil

**Lecturer:** Dr. Edina-Kundrát-Simon, associate professor, PhD, habil

<b>Title of course:</b> Biochemistry II <b>Code:</b> TTBBE2040_EN	<b>ECTS Credit points:</b> 2
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: - - laboratory: - - home assignment: - preparation for the exam: 46 hours Total: 60 hours	

<b>Year, semester:</b> 2 <sup>nd</sup> year, 2 <sup>nd</sup> semester
<b>Its prerequisite(s):</b> Biochemistry I
<b>Further courses built on it:</b> -
<b>Topics of course</b>
The lectures describe the main features of protein structure, deal with the thermodynamic and kinetic background of enzyme catalyzed reactions, give an insight into the different strategies of controlling the enzyme activities. Nucleotide metabolism is also covered in details: <i>de novo</i> biosynthetic and salvage pathways, the formation of deoxyribonucleotides as well as the routes of the nucleotide degradation.
<b>Literature</b>
<i>Compulsory:</i> The lecture notes <i>Recommended:</i> Berg J.M., Tymoczky J.L., Gatto G.J. and Styer L.: Biochemistry (W. H. Freeman; Eighth edition, 2015), ISBN-13: 978-1464126109 Nelson D.L., Cox M.M.: Lehninger Principles of Biochemistry (W. H. Freeman Sixth edition, 2012) ISBN-13: 978-14234146 Voet D. and Voet J.: Biochemistry (Wiley, Fourth edition, 2010) ISBN-13: 978-0470570951
<b>Schedule:</b>
<i>1<sup>st</sup> week</i> Structural feature of amino acids. Characteristics of peptide bonds, rotation angles of C( $\alpha$ ), Ramachandran plot; Protein secondary structures; Forces and interactions in polypeptide chains; Supersecondary structures and protein domains.
<i>2<sup>nd</sup> week</i> Structural classification of proteins. Fibrous proteins: $\alpha$ -keratin, fibroin and the structure of collagen fibrils. Anfinsen's experiment and Levinthal's paradox. Protein folding and chaperons. Protein misfolding.
<i>3<sup>rd</sup> week</i> Thermodynamics of enzyme catalyzed reactions. Models explaining substrate specificities. Characteristics of enzyme catalyzed reactions. Enzyme classifications. Factors influencing enzyme activity: temperature and pH.
<i>4<sup>th</sup> week</i> Kinetic model of enzyme catalyzed reaction by Michaelis and Menten. The rate equation and the interpretation of the kinetic parameters. The efficiency of the enzymatic catalyses. Linearization of the Michaelis–Menten equation.
<i>5<sup>th</sup> week</i> Reversible inhibition of enzyme activity in a competitive, uncompetitive and noncompetitive manner. Inactivation of enzyme activity - mechanism of penicillin action.
<i>6<sup>th</sup> week</i> The Modifying protein function. Allosteric regulation. The models of cooperativity, characteristics of allosteric regulation.
<i>7<sup>th</sup> week</i> Reversible covalent modification. The phosphorylation. The regulation of muscle and liver glycogen phosphorylases. Modifying protein function by small regulatory protein (calmodulin).
<i>8<sup>th</sup> week</i> Limited proteolysis - zymogen activation. Pancreatic zymogens, the proteolytic cascade. The structural features of chymotrypsin active site and the catalytic steps of serine proteases. Protein protease inhibitors.
<i>9<sup>th</sup> week</i> Nucleotide Metabolism. The building blocks, the structures and the nomenclature of nucleotides. The biological function of nucleotides. The source of the nucleotide pool.

*10<sup>th</sup> week*

Pyrimidin *de novo* biosynthesis

The origin of the atoms of the pyrimidine rings. The formation of carbamoyl phosphate, the features of carbamoyl phosphate synthetase II (domain function and metabolic channel) and its regulation in eukaryotes.

*11<sup>th</sup> week*

The function and localisation of CAD and UMP synthase, the multienzyme complex in mammals. The regulatory points of prokaryotic and eukaryotic pyrimidin *de novo* biosynthesis. The interconversion of nucleoside mono- di- and triphosphates. The synthesis of CTP.

*12<sup>th</sup> week*

Purin *de novo* biosynthesis. Origin of the ring atoms in purin. The regulation of the committed step of purin *de novo* biosynthesis. The features and the role of tetrahydrofolate in nucleotide biosynthesis. The branch point of purin *de novo* synthesis and the allosteric control to balance of AMP and GMP synthesis.

*13<sup>th</sup> week*

Salvage pathway of purin and pyrimidine biosynthesis. Deoxyribonucleotides biosynthesis: the structure, the mechanism and the regulation of ribonucleotide reductase.

*14<sup>th</sup> week*

Biosynthesis of thymidylate, the role of dihydrofolate reductase. Degradation of purin nucleotides, urate and gout. Degradation of pyrimidine nucleotides.

**Requirements:**

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

- *for a grade*

The course ends in an **examination**.

The grade for the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of examination is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Terez Barna, assistant professor, PhD

**Lecturer:** Dr. Terez Barna, assistant professor, PhD

**Title of course:** Sustainability and current environmental issues

**Code:** TTBBG4045\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**

- lecture: 1 hours/week
- practice: 1 hours/week
- laboratory: -

**Evaluation:** midterm + final exam + seminar work

**Workload (estimated), divided into contact hours:**

<ul style="list-style-type: none"> <li>- lecture: 14 hours</li> <li>- practice: 14 hours</li> <li>- laboratory: -</li> <li>- home assignment: 10 hours</li> <li>- preparation for the exam: 30 hours</li> </ul> <p>Total: 68 hours</p>
<b>Year, semester:</b> 1 <sup>st</sup> year, 2 <sup>nd</sup> semester (suggested)
<b>Its prerequisite(s):</b>
<b>Further courses built on it: -</b>
<b>Topics of course</b>
<p>The course gives an overview of the background, rise and interactions of the current global environmental, demographic and social problems, and possible ways of their alleviation. The students learn the evolution of mankind's attitude towards its surroundings, the current issues of the globalized society and economy, and the components of the worldwide escalating humanitarian and ecological crisis. The students learn the concept of sustainable development and the pitfalls and constraints of transforming the current societal and economic paradigm. The course also reviews the currently applied indices of the social and economic progress, the alternative proxies to measure environmental sustainability and human welfare, and the recently elaborated environmental economics approaches to meet sustainability.</p> <p>During the seminars the students present and discuss a selected topic of their choice, concerning their home regions'/countries' relevant environmental issues or good practices/projects in the field of sustainability.</p>
<b>Literature</b>
<p><i>Compulsory:</i> -</p> <p><i>Recommended:-</i></p>
<b>Course objective/intended learning outcomes</b>
<p><b>a) Knowledge</b></p> <ul style="list-style-type: none"> <li>- He/she knows the background, development and interactions of the current issues of the globalized society and economy.</li> <li>- He/she knows the fundamental social, economic and environmental principles and concepts to understand the current environmental and social problems and to interpret the basic concept of sustainability.</li> </ul> <p><b>b) Abilities</b></p> <ul style="list-style-type: none"> <li>- He/she is able to apply the most important terminology and theories of environmental and social sciences in connection with completing relevant tasks.</li> <li>- He/she is able to interpret, put into context and apply new information pertaining the environment, economy and society when completing relevant tasks.</li> </ul> <p><b>c) Attitude</b></p> <ul style="list-style-type: none"> <li>- He/she is eager to learn about the processes of the natural environment and the effects of anthropogenic activities.</li> <li>- He/she is open to gather new and environmentally relevant information and to use it in his/her profession.</li> <li>- He/she performs environmentally conscious attitude both in his/her professional and private actions.</li> </ul> <p><b>d) Autonomy and responsibility</b></p>

- He/she makes decisions in complex and unexpected cases based on his/her professional knowledge.
- He/she is capable of considering complex, fundamental questions from his/her professional field and elaborating them on the basis of the given sources.
- He/she is able to cooperate with professionals from the fields of biology, agriculture, environmental science and social sciences.

**Schedule:**

*1<sup>st</sup> week*

The history and development of mankind's attitude towards the natural environment and its resources. The globalized economy and society and the rise of the global social and ecological crisis.

*2<sup>nd</sup> week*

Major components of the worldwide social and ecological crisis 1: Limited natural resources (natural ecosystems and genetic diversity, arable lands, freshwater, food production, non-renewable resources, e.g. fossil fuels and minerals)

*3<sup>rd</sup> week*

Major components of the worldwide social and ecological crisis 2: Limited natural sinks (air pollution: ozone depleting chemicals, greenhouse gases and climate change, smog; water pollution: eutrophication, petrochemicals, detergents, heavy metals, forever chemicals, plastics and microplastics; soil pollution, electronic waste, noise and light pollution)

*4<sup>th</sup> week*

Major components of the worldwide social and ecological crisis 3: Social aspects (overpopulation, urbanization, demographic trends, poverty, inequality, malnourishment and obesity, sanitary, contagions and further health issues)

*5<sup>th</sup> week*

The history of environmentalism (the raising awareness, international conferences and agreements, the impact of civil movements and NGOs)

*6<sup>th</sup> week*

The limits of growth and the interpretation of critical transitions and alternative stable states. Technological, economic and social constraints of the paradigm shift and the tragedy of the commons. The concept of sustainable development.

*7<sup>th</sup> week*

Demographic and economic indices. How to measure sustainability and human welfare? Social and economic proxies and indices to assess the environmental impact and sustainability.

*8<sup>th</sup> week*

Environmental economics: Society-level approaches, e.g. sharing economy, non-growth economy, circular economy. Policy-level approaches, e.g. command and control instruments, pollution quotas and tradeable emission, ecosystem services. Company-level approaches, e.g. PESTEL-analysis, clean production strategies, product life cycle assessment, green marketing

*9<sup>th</sup> week*

consultation

*10<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*11<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*12<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*13<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

*14<sup>th</sup> week*

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

**Requirements:**

*- for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **seminars** is compulsory. A student may not miss more than two of the five seminars. In case a student does so, the subject will not be signed and the student must repeat the course. In case of more than two missed seminars an official certificate needs to be presented. Being late is equivalent with absence. Active participation is evaluated by the teacher in every seminar class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

The students -alone or in small groups with up to 5 people- have to prepare a brief seminar project essay (~5 pages) on a selected topic concerning their home region's/country's relevant environmental issues or good practices/projects in the field of sustainability; and also to give a short presentation (~10 min) during the seminar classes based on their seminar projects. The chosen topics will be discussed at the seminars and the reviews will be evaluated by the lecturer. In order to get the signature the seminar projects must reach at least sufficient level.

*- for a grade*

The course ends with a **written exam**.

The minimum requirement due to pass the written exam is 50%. The grade for the exam is given according to the following table:

Score	Grade
0-50	fail (1)
51-62	pass (2)
63-75	satisfactory (3)
76-87	good (4)
88-100	excellent (5)

The final grade is calculated as an average of the seminar grade and the exam grade, respectively.

If the score of the exam is below 50%, students can retake the test in line with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Viktor Oláh associate professor, PhD

**Lecturer:** Viktor Oláh associate professor, PhD

**Title of course:** Plant ecophysiology  
**Code:** TTBBG4005\_EN

**ECTS Credit points:** 3

**Type of teaching, contact hours**



<ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: 2 hours/week</li> <li>- laboratory: -</li> </ul>
<b>Evaluation:</b> exam + seminar work
<b>Workload (estimated), divided into contact hours:</b> <ul style="list-style-type: none"> <li>- lecture: 20</li> <li>- practice: 8 hours</li> <li>- laboratory: -</li> <li>- home assignment: 20 hours</li> <li>- preparation for the exam: 30 hours</li> </ul> Total: 78 hours
<b>Year, semester:</b> 3 <sup>rd</sup> year, 2 <sup>nd</sup> semester
<b>Its prerequisite(s):</b>
<b>Further courses built on it:</b> -
<b>Topics of course</b> <p>The series of lectures gives an overview of plant environmental responses and the relationship between the environmental factors and physiological processes constraining the distribution of plants. The students learn the physiological effects of environmental extremes and anthropogenic activities and also the physiological, anatomical and morphological adaption mechanisms of plants to these factors. They also learn the potential application of this knowledge in the fields of nature conservation, environmental protection and agriculture. During the seminars the students elaborate on, present and discuss a topic of their choice in the field of plant ecophysiology. The subject provides basic knowledge for studies in the fields of ecology and environmental protection.</p>
<b>Literature</b> <p><i>Compulsory:</i> -</p> <p><i>Recommended:</i></p> <ul style="list-style-type: none"> <li>- Lambers, H., Chapin III, F.S., Pons, L.T. 1998: Plant Physiological Ecology. Springer. New York-Berlin-Heidelberg.</li> <li>- Schultze, E., D., Beck, E., Müller-Hohenstein, K. 2005: Plant Ecology. Springer-Verlag. New York-Berlin-Heidelberg.</li> </ul>
<b>Course objective/intended learning outcomes</b> <p><b>a) Knowledge</b></p> <ul style="list-style-type: none"> <li>- He/she knows the fundamental principles and concepts of plant ecology and ecophysiology.</li> <li>- He/she knows the effects of environmental factors on plant physiological processes and productivity.</li> <li>- He/she knows the basic ecological strategies of plants and the fundamental physiological, anatomical and morphological adaption mechanisms to the environmental factors.</li> </ul> <p><b>b) Abilities</b></p> <ul style="list-style-type: none"> <li>- He/she is able to apply the most important terminology and theories of plant ecology and ecophysiology when completing relevant tasks.</li> <li>- He/she is able to interpret, put into context and apply new information regarding plant ecology and ecophysiology when completing relevant tasks.</li> </ul> <p><b>c) Attitude</b></p> <ul style="list-style-type: none"> <li>- He/she is eager to learn about processes of the natural environment and the effects of anthropogenic activities.</li> </ul>

- He/she is open to gather new and environmentally relevant information and to use it in his/her profession.

- He/she performs environmentally conscious attitude both in his/her professional and private actions.

**d) Autonomy and responsibility**

- He/she makes decisions in complex and unexpected cases based on his/her professional knowledge.

- He/she is capable of considering complex, fundamental questions from his/her professional field and elaborating them on the basis of the given sources.

- He/she is able to cooperate with professionals from the fields of ecology, botany and agriculture.

**Schedule:**

*1<sup>st</sup> week*

**The adaption of plants to their environment:** the field of interest and core questions of plant ecophysiology. Relationships between the environmental resources, physiological tolerance and distribution of plants. Time-scales, reversibility and mechanisms of plant adaption.

*2<sup>nd</sup> week*

**The plants and their environment:** disturbance, suboptimum and stress. Synergism, additivity and antagonism of various stressors. The characteristics of different ecological strategies: the r- and K-, and the C-S-R strategists, respectively.

*3<sup>rd</sup> week*

**The carbon balance and the productivity of plants:** carbon balance and carbon allocation, growth analyses. Productivity and ecophysiology of plants at extreme habitats.

*4<sup>th</sup> week*

**The photosynthesis of plants and its dependence on environmental factors:** light responses, light intensity and spectral distribution along light gradients in terrestrial and aquatic habitats. Light adaption and acclimation. The photosynthesis and water relations of plants: deciduous and evergreen strategies; C<sub>3</sub>, C<sub>4</sub> and CAM strategies and their habitat preferences.

*5<sup>th</sup> week*

**Adaption to water deficiency:** soil water reserves and the regulatory mechanisms of water balance in plants. Physiological, anatomical and morphological adaption to soil water deficiency: poikilohydric and homoiohydric plants; glycophytes, halophytes and xerophytes.

*6<sup>th</sup> week*

**Adaption to temperature extremities:** the physiological effects of ambient temperature. Cold stress and freezing. Heat stress. Physiological, anatomical and morphological adaption to temperature extremities.

*7<sup>th</sup> week*

**The mineral nutrition of plants:** environmental factors affecting the availability of mineral nutrients. The role of the plant microbiome (mycorrhiza, N-fixing symbionts). Productivity of different habitats and the limiting factors. The adaption of plants to different soil types. The adaption of plants to oligotrophic habitats.

*8<sup>th</sup> week*

**The biotic stressors and secondary metabolism of plants:** plant-plant interactions and allelopathy, plant defence mechanisms against pathogens and herbivory.

*9<sup>th</sup> week*

**Anthropogenic stressors I.:** the physiological effects of heavy metals and plant tolerance mechanisms. The practical application of heavy metal tolerance and hyperaccumulation.

10<sup>th</sup> week

**Anthropogenic stressors II.:** the physiological and ecological effects of air pollutants. Xenobiotics, basic herbicide modes of action and herbicide tolerance mechanisms.

11<sup>th</sup> week

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

12<sup>th</sup> week

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

13<sup>th</sup> week

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

14<sup>th</sup> week

Seminar: presentation and discussion of students' projects elaborated on a chosen topic.

**Requirements:**

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **seminars** is compulsory. A student may not miss more than one of the four seminars. In case a student does so, the subject will not be signed and the student must repeat the course. In case of more than one missed seminars a medical certificate needs to be presented. Being late is equivalent with an absence. Active participation is evaluated by the teacher in every seminar class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Each student has to prepare a brief review (~5 pages) on a selected topic and give a short presentation (~15 min) during the seminar classes based on his/her review. The chosen topics will be discussed at the seminars and the reviews will be evaluated by the lecturer. In order to get the signature the reviews must reach at least sufficient level.

- *for a grade*

The course ends with a **written exam**.

The minimum requirement due to pass the written exam is 50%. The grade for the exam is given according to the following table:

Score	Grade
0-50	fail (1)
51-62	pass (2)
63-75	satisfactory (3)
76-87	good (4)
88-100	excellent (5)

The final grade is calculated as an average of the seminar grade and the exam grade, respectively.

If the score of the exam is below 50%, students can retake the test in line with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Viktor Oláh associate professor, PhD

**Lecturers:** Viktor Oláh associate professor, PhD, Ilona Mészáros associate professor, PhD

**Title of course:** Methods in Molecular Biology lab

**ECTS Credit Points:** 2

<b>Code:</b> TTBBG2042_EN	
<b>Type of teaching, contact hours</b>	
- lecture: - - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> written test	
<b>Workload (estimated), divided into contact hours:</b>	
- lecture: - - practice: - - laboratory: 28 hours - home assignment: - - preparation for the exam: 30 hours Total: 58 hours	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b>	
Genetics - TTBBE3020_EN (lecture) Methods in Molecular Biology - TTBBE3025_EN (lecture)	
<b>Further courses built on it:</b> -	
<b>Topics of course:</b>	
Basic molecular biology methods for biology students	
<b>Literature</b>	
<i>Compulsory: Department teaching aid – lab manual</i> <i>Genetics lecture and Methods in Molecular biology lecture materials</i>	
<i>Recommended:</i> <ul style="list-style-type: none"> <li>• Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick: Lewin's GENES XII 12th Edition (2018) ISBN 9781284104493</li> <li>• Daniel L. Hartl: Essential genetics and genomics 7th edition (2018) ISBN 9781284152685</li> </ul>	

**Course objective/intended learning outcomes**

## a) knowledge:

- possesses the necessary natural scientific knowledge in the field of Molecular Biology and relevance for BSc level studies and employment
- the student learns about the basics of molecular biology methods
- knows the most important keywords in molecular biology and genetics

## b) abilities:

- understands the basics concepts of molecular biology and genetics and the connection between these
- is able to improve the knowledge on its own
- is able to work by instructions and plan and carry out basic molecular biology experiments in a laboratory
- understands the news related to molecular biology and genetics in media and can form an opinion by the knowledge gained
- is able to cooperate with workers of different scientific fields

## c) attitude:

- be dedicated to improving and gaining new knowledge by entering master's level and/or other vocational educations
- aim for understanding and unfolding connections
- be dedicated, curious and motivated
- value the variability of life and show respect towards it, and protect it

## d) autonomy and responsibility:

- cooperative, responsible, and open-minded
- performs the analysis of biological problems either alone or in team
- in the cooperative gaining of knowledge and research, feels responsible towards other people's work too

**Schedule:**

- Introduction – basic information about Molecular biology methods and their importance in science, biotechnology and medicine
- Safety instructions – basic instructions regarding safety of person, equipment and samples
- General instructions – learning the use of pipettes, centrifuges, etc.
- Microscopy of fission yeast and mammalian cells – transmission and fluorescence microscopic analysis of different cells
- Isolation of plasmid DNA from E. coli – plasmids are basic vectors which will be used for cloning
- Isolation of genomic DNA from fission yeast – genomic DNA will be isolated for later use for PCR
- Isolation of total RNA from fission yeast – RNA will be used for cDNA synthesis
- Gel electrophoresis of nucleic acids – required for confirming successful DNA and RNA isolation
- PCR – polymerase chain reaction of a fission yeast gene for cloning purpose
- Restriction digestion – plasmid vector and PCR amplicon double digestion
- Ligation – joining of the digested PCR product and plasmid
- Transformation of bacteria – transforming E. coli with the ligation products and
- Transformation of fission yeast by electroporation – previously generated plasmid will be used for fission yeast transformation
- cDNA synthesis – previously isolated RNA will be used for reverse transcriptase reaction
- Quantitative Real-Time PCR – qPCR reaction will be carried out to simulate a infection

Person responsible for course: Dr. Gyula Gábor Batta, assistant professor, PhD

Lecturers: Dr. Gyula Gábor Batta, assistant professor, PhD

<b>Title of course:</b> Cell cultures and cell preparation techniques <b>Code:</b> TBBE0230-A	<b>ECTS Credit Points: 3</b>
<b>Type of teaching, contact hours</b> <ul style="list-style-type: none"><li>- lecture: 2 hours/week</li><li>- practice: -</li><li>- laboratory: -</li></ul>	
<b>Evaluation:</b> written test	
<b>Workload (estimated), divided into contact hours:</b> <ul style="list-style-type: none"><li>- lecture: 28 hours</li><li>- practice: -</li><li>- laboratory: -</li><li>- home assignment: 20 hours</li><li>- preparation for the exam: 30 hours</li></ul> Total: 78 hours	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it: -</b>	
<b>Course description:</b> In this course students survey the theoretical principles of cellular and histological examination techniques, concentrating on the newest results of researches and examination methods.	
<b>Literature:</b>	
<b>Course objective/intended learning outcomes:</b>	
<b>Schedule:</b>	
Person responsible for course: Dr. Gábor Szemán-Nagy, associate professor, PhD	
Lecturers: Dr. Gábor Szemán-Nagy, associate professor, PhD	

<b>Title of course:</b> Cell cultures and cell preparation techniques <b>Code:</b> TBBE0230-A	<b>ECTS Credit Points: 2</b>
<b>Type of teaching, contact hours</b> <ul style="list-style-type: none"><li>- lecture: -</li><li>- practice: 2 hours/week</li><li>- laboratory: -</li></ul>	
<b>Evaluation:</b> written test	
<b>Workload (estimated), divided into contact hours:</b> <ul style="list-style-type: none"><li>- lecture: -</li></ul>	

<ul style="list-style-type: none"> <li>- practice: -</li> <li>- laboratory: 28 hours</li> <li>- home assignment: -</li> <li>- preparation for the exam: 30 hours</li> </ul> <p>Total: 58 hours</p>	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it:</b> -	
<b>Course description:</b> In this course students survey the theoretical principles of cellular and histological examination techniques, concentrating on the newest results of researches and examination methods.	
<b>Literature:</b>	
<b>Course objective/intended learning outcomes:</b>	
<b>Schedule:</b>	
Person responsible for course: Dr. Gábor Szemán-Nagy, associate professor, PhD	
Lecturers: Dr. Gábor Szemán-Nagy, associate professor, PhD	
<b>Title of course:</b> Animal physiology and cell biology lab <b>Code:</b> TTBBBL3005_EN	<b>ECTS Credit Points: 4</b>
<b>Type of teaching, contact hours</b> <ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: -</li> <li>- laboratory: 4 hours/week</li> </ul>	
<b>Evaluation:</b> written test	
<b>Workload (estimated), divided into contact hours:</b> <ul style="list-style-type: none"> <li>- lecture: -</li> <li>- practice: -</li> <li>- laboratory: 64 hours</li> <li>- home assignment: 20 hours</li> <li>- preparation for the exam: 20 hours</li> </ul> <p>Total: 104 hours</p>	
<b>Year, semester:</b> 3 <sup>rd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it:</b> -	
<b>Course description:</b> To give an insight into classical and modern methods of physiology and how these methods work. To get sufficient practical and theoretical knowledge to plan and execute your own experiments.	

<b>Literature:</b> Course notes
<b>Course objective/intended learning outcomes:</b>
<b>Schedule:</b> Characterization of the properties of blood: hematocrit, haemoglobin content, determination of bleeding time, coagulation time, blood group, Rh group, blood- stain. Analysis of cellular components of blood, the osmotic properties of blood, staining blood smear, determining the number of red blood cells. Blood circulation and studies on heart: the circulatory system of amphibians, in situ heart of the frog, registration of the spontaneous function of the blood. Stannius ligature. Electrocardiographic examination of the human heart. Measuring blood pressure. Pletismography. Computer simulated examinations. General characteristics of feeding. Fermentative properties of the human saliva. Protein digestion with pepsin extraction. Investigating the kidney: components of urine, computer simulation. Hormonal experiments: gravidity test, hormones influencing blood sugar level. Physiological experiments related to vision (blind spot, optical errors, colour-blindness, visual field), voice (audiometry), sensation of touch, pressure. Experiments on nerve, muscle and sensation using frog nerve-muscle preparation. Simulation of nerve action potential.
Person responsible for course: Dr. Gábor Szemán-Nagy, associate professor, PhD
Lecturers: Dr. Gábor Szemán-Nagy, associate professor, PhD

<b>Title of course:</b> Microbial Ecology <b>Code:</b> TTBBE0506	<b>ECTS Credit Points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: - - seminar: 1 hours/week - laboratory practice: 2 hours/week	
<b>Evaluation:</b> lab report	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - seminar: 14 hours - laboratory practice: 28 hours - home assignment: 8 hours - preparation for the exam: - Total: 50 hours	
<b>Year, semester:</b> 2 <sup>rd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it: -</b>	
<b>Course description:</b>	



Hands-on course aiming to give an introduction into the methodology of bacterial culturing, the estimation of bacterial loads and identification of bacterial types. Furthermore, students will test ecological hypotheses with their samples, analyze and interpret their data.

**Literature:**

Course notes

**Course objective/intended learning outcomes:**

**Schedule:**

- Sample collection for experiments (we will work with aquatic bacteria)
- Preparation of agar plates for culturing bacteria
- Serial dilution and spreading samples on agar plates
- Estimating the number of colony-forming units (CFUs) and bacterial diversity from agar plates
- Data digitalization & analysis using R software; interpretation of results
- Taxonomic identification of bacterial colonies: Gram staining
- Taxonomic identification of bacterial colonies: Oxidase, catalase & motility tests
- Journal article discussion and design of a simple ecological experiment
- A simple ecological experiment: the role of temperature in bacterial growth and diversity in water samples – agar plate preparation
- Spreading of samples on agar plates
- Estimating CFUs and bacterial diversity
- Data digitalization & analysis using R software
- Interpretation & discussion of results
- Generating final report

Person responsible for course: Dr. Jácint Tökölyi, associate professor

Lecturers: Dr. Jácint Tökölyi, associate professor