

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

**BIOLOGY MSC PROGRAM**

**2022**

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## **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 included 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

**Number of Faculties at the University of Debrecen:** 14

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 Public Health

Faculty of Science and Technology

**Number of students at the University of Debrecen:** 29,954

**Full time teachers of the University of Debrecen:** 1,557

197 full university professors and 1,224 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 3000 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 (11 Bachelor programs and 13 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 student 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 ~770 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: [ttkdekan@science.unideb.hu](mailto:ttkdekan@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  
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Consultant on External Relationships: Prof. Dr. Attila Bérczes, Full Professor  
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Consultant on Talent Management Programme: Prof. dr. Tibor Magura, Full Professor  
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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: Mr. Imre Varga – Applied Mathematics (MSc), Chemical Engineering (BSc/MSc), Chemistry (BSc/MSc), Earth Sciences (BSc), Electrical Engineering (BSc), Geography (BSc/MSc), Mathematics (BSc), Physics (BSc), Physicist (MSc), International Foundation Year,  
Address: 4032 Egyetem tér 1., Chemistry Building, A/101  
E-mail: [vargaimre@unideb.hu](mailto:vargaimre@unideb.hu)

English Program Officer: Mrs. Szilvia Gyulainé Szemerédi – Biochemical Engineering (BSc), Biology (BSc/MSc), Environmental Science (MSc), Hidrobiology Water Quality Management (MSc)  
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E-mail: [szemeredi.szilvia@science.unideb.hu](mailto:szemeredi.szilvia@science.unideb.hu)

## PARTICIPATING DEPARTMENTS OF THE INSTITUTE OF BIOLOGY AND ECOLOGY

**Department of Botany** (home page: <https://biology.unideb.hu/bemutakozas-novenytani-tanszek>)  
4032 Debrecen, Egyetem tér 1, Life Sciences Building

Name	Position	E-mail	room
Dr. Márta Hamvas, PhD, habil	Associate professor	hamvas.marta@science.unideb.hu	1.501
Dr. János Kerékgyártó, PhD	Senior researcher	kerekgyarto.janos@science.unideb.hu	1.511
Dr. Csaba Máthé, PhD, habil	Associate professor	mathe.csaba@science.unideb.hu	1.501
Dr. Viktor Oláh, PhD, habil	Assistant professor	olah.viktor@science.unideb.hu	1.504
Dr. Gábor Sramkó, PhD	Postdoctoral researcher	sramko.gabor@science.unideb.hu	1.502
Dr. Gyula Surányi, PhD	Assistant professor	suranyi.gyula@science.unideb.hu	1.511

**Department of Ecology** (home page: <http://ecology.science.unideb.hu/>)  
4032 Debrecen, Egyetem tér 1, Ecology Building

Name	Position	E-mail	room
Prof. Dr. Béla Tóthmérész, PhD, habil, DSc	Professor	tothmeresz.bela@science.unideb.hu	112
Dr. Edina Simon- Kundrát, PhD, habil	Associate professor	simon.edina@science.unideb.hu	017
Prof. Dr. Péter Török, PhD, habil, DSc	Professor	torok.peter@science.unideb.hu	019
Dr. Roland Horváth, PhD	Assistant professor	horvath.roland@science.unideb.hu	003

**Department of Evolutionary Zoology and Human Biology** (home page: <http://http://zoology.unideb.hu/home/>)  
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Name	Position	E-mail	room
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Dr. Miklós Bán, PhD	Assistant professor	ban.miklos@science.unideb.hu	1.203
Dr. Edit Juhász, PhD	Assistant professor	juhasz.edit@science.unideb.hu	1.204
Dr. Ádám Zoltán Lendvai, PhD, habil.	Associate professor	lendvai.adam@science.unideb.hu	1.207
Dr. Zoltán Németh, PhD	Assistant professor	nemethzoltan@science.unideb.hu	1.201
Dr. Katalin Pecsenye, PhD, habil., DSc	Associate professor emeritus	pecsenye.katalin@science.unideb.hu	1.204
Dr. Jácint Tökölyi, PhD, habil.	Associate professor	tokolyi.jacint@science.unideb.hu	1.202

## PARTICIPATING DEPARTMENT OF THE INSTITUTE OF BIOTECHNOLOGY

**Department of Biochemical Engineering** (home page: [https://  
https://biotechnologia.unideb.hu/hu/bemutakozas-biomernoki-tanszek/](https://https://biotechnologia.unideb.hu/hu/bemutakozas-biomernoki-tanszek/))

**4032 Debrecen, Egyetem tér 1, Chemistry Building**

Name	Position	E-mail	room
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**Department of Genetics and Applied Microbiology** (home page: <https://biotechnologia.unideb.hu/>)

**4032 Debrecen, Egyetem tér 1, Life Sciences Building**

Name	Position	E-mail	room
Dr. Ida Miklós, PhD, habil	Associate professor, Head of Department	miklos.ida@science.unideb.hu	2.503
Dr. Zsuzsa Antunovics, PhD	Assistant professor	antunovics.zsuzsa@science.unideb.hu	2.502
Dr. Teréz Barna, PhD	Assistant professor	barna.terez@science.unideb.hu	D-207/208 lab (Chemistry Bld)
Dr. Gyula Batta, PhD	Assistant professor	batta.gyula.ifj@science.unideb.hu	2.501
Dr. Hajnalka Csoma, PhD	Assistant professor	csoma.hajnalka@science.unideb.hu	2.501
Prof., Dr. Mátyás Sipiczki, PhD, habil, DSc	Professor emeritus	lipovy@gmx.com	2022/2023 lab

## 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\\_2022\\_23/University\\_calendar\\_2022-2023-Faculty\\_of\\_Science\\_and\\_Technology.pdf](https://www.edu.unideb.hu/tartalom/downloads/University_Calendars_2022_23/University_calendar_2022-2023-Faculty_of_Science_and_Technology.pdf)

# THE BIOLOGY MASTER PROGRAM

## Information about the Program

Name of MSc Program:	Biology MSc Program
Specialization available:	-
Field, branch:	Science
Qualification:	Biologist
Mode of attendance:	Full-time
Faculty, Institute:	Faculty of Science and Technology Institute of Biology and Ecology
Program coordinator:	Prof. dr. Zoltán Barta, professor dr. Zoltán Németh, assistant professor
Duration:	4 semesters
ECTS Credits:	120

### Objectives of the MSc program:

The aim of the Biology MSc program is to train professional scientists who have deep insight into biological processes. Relying on strong biological, evolutionary and ecological knowledge, graduates of the program are able to understand complex natural phenomena and to develop applied science-based solutions to problems in their respective fields.

### Professional competences to be acquired

#### Biologist:

##### a) Knowledge:

- He/she has a high level of knowledge about the living systems both at the 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, synthetic 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 relationships 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 their 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 relations among humans and nature, the structure, function and evolution of humans and other organisms.
- He/she aims to express 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 knowingly builds his/her own career and helps others to do so.

## **Completion of the MSc 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 120 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 “Model Curriculum of Biology MSc Program”. Students holding BSc degrees in non-biology disciplines may be required to complete additional courses from the Biology BSc curriculum as a condition of their acceptance into and completion of the Biology MSc program.

## Model Curriculum of the Biology MSc Program

Knowledge elements, courses and instructors	Semesters				ECTS credit points	evaluation
	1.	2.	3.	4.		
	total contact hours, type of course (l – lecture, s – seminar, p – practice)					
<b>Competences of the core material</b>						
<i>Theoretical foundations module</i>						
1. Biomathematics <i>Dr. Béla Tóthmérész</i>	28 s				2	exam, midsemester grade
2. Bioinformatics <i>Dr. Mátyás Sipiczki</i>	28 s				2	exam, midsemester grade
3. Biological chemistry <i>Dr. János Kerékgyártó, László Kalmár</i>		28 l			2	final exam
4. Cell biology <i>Dr. Csaba Máthé</i>			28 l		2	final exam
5. Molecular and synthetic biology <i>Dr. Ida Miklós</i>				28 s	2	exam, midsemester grade
6. Genetics <i>Dr. Hajnalka Csoma</i>	28 l				2	final exam
<i>Core materials module I („Biology below the level of the organism”)</i>						
1. Physiology, regulatory biology and immunology <i>Dr. Zoltán Németh, Dr. Ádám Lendvai</i>			42 l		3	final exam
2. Plant biology <i>Dr. Csaba Máthé</i>		42 l			3	final exam
3. Microbiology / Microbial physiology <i>Dr. Levente Karaffa</i>				42 l	3	final exam

<b>Core materials module II („Biology at and above the level of the organism”)</b>						
4. Zoology, ethology <i>Dr. Zoltán Németh</i>	42 l				3	final exam
5. Evolutionary biology <i>Dr. Jácint Tökölyi</i>			42 l		3	final exam
6. Ecology <i>Dr. Béla Tóthmérész</i>	42 l				3	final exam
7. Nature conservation and environmental protection <i>Dr. Béla Tóthmérész, Dr. Péter Török</i>		42 l			3	final exam
8. Scientific communication <i>Dr. Török Péter</i>		42 s			3	exam, midsemester grade
<b>Total credits for core courses</b>	<b>12</b>	<b>11</b>	<b>8</b>	<b>5</b>	<b>36</b>	
<b>Competences of specialized expertise</b>						
<b>Genetics</b>						
1. Developmental genetics <i>Dr. Mátyás Sipiczki</i>				14 l	1	final exam
2. Gene manipulation and basic genomics <i>Dr. Zsuzsa Antunovics</i>		28 s			2	exam, midsemester grade
3. Cell cycle and epigenetics seminar <i>Dr. Gyula Batta</i>			28 s		2	exam, midsemester grade
4. Bioregulation and proteomics <i>Dr. Teréz Barna</i>	14 l				1	final exam
<b>Plant biology</b>						
1. Plant cell and developmental biology <i>Dr. Csaba Máthé</i>		42 l 28 p			3 2	final exam, midsemester grade
2. Plant genetics and biotechnology <i>Dr. Gyula Surányi, Dr. Márta Hamvas, Dr. Csaba Máthé, Dr. Viktor Oláh</i>			28 l 28 s		2 2	final exam, midsemester grade

3. Plant molecular taxonomy <i>Dr. Gábor Sramkó</i>			28 l 28 p		2 2	final exam, midsemester grade
<b>Ecology</b>						
1. Conservation biology <i>Dr. Béla Tóthmérész, Dr. Péter Török</i>		14 l 28 s			1 2	final exam, midsemester grade
2. Plant ecology <i>Dr. Péter Török</i>		14 l 28 s			1 2	final exam, midsemester grade
3. Animal ecology <i>Dr. Edina Simon, Dr. Roland Horváth</i>	14 l 28 s				1 2	final exam, midsemester grade
<b>Project management</b>						
1. Biometry <i>Dr. Jácint Tökölyi</i>	42 p				3	exam, midsemester grade
2. Research planning <i>Dr. Ádám Lendvai</i>		28 p			2	exam, midsemester grade
3. Field practical <i>Dr. Miklós Bán</i>			42 p		3	exam, midsemester grade
4. Project evaluation and review <i>Dr. Ádám Lendvai</i>			28 p		2	exam, midsemester grade
<b>Zoology</b>						
1. Animal populations <i>Dr. Zoltán Barta</i>		14 l 14 p			1 1	final exam, midsemester grade
2. Animal behaviour <i>Dr. Zoltán Németh</i>		14 l 14 p			1 1	final exam, midsemester grade
3. Life history evolution <i>Dr. Ádám Lendvai</i>		42 s			3	exam, midsemester grade

4. Conservation genetics <i>Dr. Katalin Pecsénye</i> <i>Dr. Edit Juhász</i>				14 l 28 s	1 2	final exam, midsemester grade
<b>Total credits for specialized courses</b>	<b>7</b>	<b>22</b>	<b>15</b>	<b>4</b>	<b>48</b>	
<b>Thesis</b>			<b>210 p / 15 cr</b>	<b>210 p / 15 cr</b>	<b>30</b>	practical grade, state exam
<b>Elective courses</b>	in any semester during the graduate program				<b>6</b>	
<b>Total credits</b>	<b>19</b>	<b>33</b>	<b>23</b>	<b>9</b>	<b>120</b>	

### *Work and Fire Safety Course*

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if 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 a student has to complete Physical Education courses at least in one semester during his/her Master's training. Our University offers a wide range of facilities to complete them.

### *Pre-degree Certification*

A pre-degree certificate is issued by the Faculty after completion of the master's (MSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education, the internship (mandatory) – with the exception of preparing thesis – and gained the necessary credit points (120). 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 obtained the pre-degree certificate can submit the thesis and take the final exam.

## *Thesis*

A Thesis is the written communication of the research project the student carries out throughout their studies. By completing this task, the student demonstrates his/her ability, under the guidance of their supervisor, to design, execute, and prepare a report of a research project while using the scientific literature. By submitting and defending a thesis a biologist student certifies that he/she is capable to apply the acquired knowledge in practice and to summarize the completed work and its results in a professional way, to solve the tasks related to his/her topic creatively and to complete an independent professional work.

The requirements of the thesis content, the general aspects of evaluation and the number of credits assigned to the thesis are determined by the requirements of the program. In the Biology MSc Program the total credits assigned to the thesis are 30.

A thesis can be submitted only if it is supported and approved both by the internal supervisor and the external referee. If a thesis is evaluated with a fail mark by the referee and the department the student is not allowed to take the final exam and is expected to prepare a new or modified thesis. The student has to be informed about this decision and the conditions of resubmission.

## *Final Exam*

Students who obtained the pre-degree certificate will finish their studies by taking the final exam of the Biology master program. A final exam is the evaluation of the knowledge and skills acquired during the studies. The candidate has to certify that he/she is able to apply the obtained knowledge in practice. A final exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. A final exam has to be taken in front of the Committee. If a candidate does not pass his/her final exam until the termination of his/her student status, he/she can take his/her final exam after the termination of the student status on any of the final exam days of the relevant academic year according to existing rules of the state exam.

The Final Exam consists of 3 parts on the basis of its curriculum:

According to the prerequisites of taking a state exam:

- completing all the subjects offered from semester 1 to 4 in the model curriculum, obtaining at least 120 credits according to the curriculum;

- preparing and submitting the thesis (2 semesters, 30 credits).

The final exam (oral exam):

Subjects:

- The core materials of the final exam (T1; T2)
- Materials related to the specialized courses (T3)
- Grade for the thesis (D1) and grade for the thesis defence (D2)

Calculation of final exam grade (SE) according to this formula:

$$SE = (T1+T2+T3+D1+D2)/5$$

The requirements of the oral part of the final exam, the agenda of the topics with the indication of their literature are announced by the department during the final week of the study period the latest. The oral part of the final exam is evaluated on a five-point scale by the Final Exam Board. The final grade for the exam will be decided on by voting in a closed meeting after the state exam. In case of equal votes, the committee chair will take the decision. Final exam results will be announced by the committee chair.

#### *Retaking a failed Final exam*

If any parts of the final exam are evaluated with a fail mark, according to the existing rules of the university, it can be retaken. The next final exam period is the soonest that a new state exam is allowed. If a thesis is evaluated with a solid fail mark by the supervisor and the referee, the graduate is not allowed to take a final exam and a new thesis has to be written. A final exam can be retaken twice on each topic.

#### *Final exam board*

Committee chair and members of the committee 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. The committee consists of – besides the chair – at least two members. The mandate of a Final Examination Board lasts for one year.

## Diploma

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Earth Sciences 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 Master 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 State 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 the Biology MSc Program

<b>Title of course: Biomathematics</b> <b>Code: TTBMG0100_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 2 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> practical grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 42 hours - laboratory: 0 hours - home assignment: 28 hours - preparation for the exam: 30 hours Total: 90 hours	
<b>Year, semester:</b> 1st year, 1 st semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
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.	
<b>Literature</b>	
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;	
<b>Schedule:</b>	
<i>1st week: Practical basic knowledge to the course</i>	
<i>2nd week: Techniques and tools of model building in science.</i>	
<i>3rd week: Basic usage of the R environment and programming language.</i>	
<i>4th week: Basic methods of data management.</i>	

*5th week: Practical usage of graphical methods in descriptive statistics.*

*6th week: Basic statistics and statistical distributions of real data*

*7th week: Exam*

*8th week: Sampling, design of experiments.*

*9th week: Analysis of variance (ANOVA) and regression analyses based on R.*

*10th week: General linear models and generalized linear models in R.*

*11th week: Models of population dynamics and their implementation in R*

*12th week: Discrete and continuous models, chaotic dynamics and their programming in R.*

*13th week: Multispecies communities and diversity. R packages to calculate these methods.*

*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, professor, DSc

**Lecturer:** Dr. Béla Tóthmérész, professor, DSc

<b>Title of course: Bioinformatics</b> <b>Code: TTBMG0105_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: - - seminar: 2 hour/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - seminar: 28 hours - laboratory: - - home assignment: - - preparation for the exam: variable Total: 28 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>	
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	
<b>Literature</b>	
<i>Recommended:</i> Barnes M.R. and Gray, I.C.: Bioinformatics for Geneticists, Wiley, Chichester, 2013	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to bioinformatics <i>2<sup>nd</sup> week:</i> Methods of genome sequencing and the genome projects <i>3<sup>rd</sup> week:</i> Sequence assemblers <i>4<sup>th</sup> week:</i> Structural and functional annotation of genome sequences. <i>5<sup>th</sup> week:</i> Cluster analysis <i>6<sup>th</sup> week:</i> Basic principles of molecular phylogenetics <i>7<sup>th</sup> week:</i> Phenetics and cladistics <i>8<sup>th</sup> week:</i> Distance-based and character-based strategies <i>9<sup>th</sup> week:</i> PGMA methods: UPGMA and WPGMA <i>10<sup>th</sup> week:</i> Neighbor-joining analysis <i>11<sup>th</sup> week:</i> Maximum parsimony analysis <i>12<sup>th</sup> week:</i> Maximum likelihood analysis <i>13<sup>th</sup> week:</i> Bayesion methods <i>14<sup>th</sup> week:</i> 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 essay 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:** Dr. Mátyás Sipiczki DSc, professor emeritus

**Lecturer:** Dr. Mátyás Sipiczki DSc, professor emeritus

<b>Title of course: Biological chemistry</b> <b>Code: TTBME0115_EN</b>	<b>ECTS Credit points: 2</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: 28 hours - preparation for the exam: 40 hours Total: 96 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 give students a basic knowledge of bio-organic chemistry. Molecular design of life: properties and biological functions of amino acids, peptides, proteins, carbohydrates, nucleic acids, lipids. Biological membranes.	
<b>Literature</b> <i>Compulsory:</i> - P. Gergely, Organic and bioorganic chemistry for medical students, University of Debrecen, 2004.  <i>Recommended:</i> - A. L. Ternay, Jr. Contemporary Organic Chemistry, W. B. Saunders Co., 1979. - Lubert Stryer, Biochemistry, W. H. Freeman and Company, New York, 2002, ISBN 1-7167-4684-0.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to biological chemistry. Molecular design of life. Macromolecules of living organisms.  <i>2<sup>nd</sup> week:</i> Amino acids. Genetically coded and rare amino acids. Characteristics of the amino and carboxyl groups.  <i>3<sup>rd</sup> week:</i> Peptides and proteins. Primary, secondary, tertiary, quaternary structures. Levels of structure in protein architecture. Biological functions of proteins.  <i>4<sup>th</sup> week:</i> Determination of peptide and protein structures. Electrophoreses, ultracentrifugation, chromatography. Edman degradation.  <i>5<sup>th</sup> week:</i> Purification and analysis of proteins. Gel electrophoreses, gel-filtration chromatography, dialysis. Determination of molecular weights of proteins.	

*6<sup>th</sup> week:* Synthesis of peptides. The Merrifield solid-phase peptide synthesis. Protecting groups.

*7<sup>th</sup> week:* The mid-term test.

*8<sup>th</sup> week:* Carbohydrates. Characteristics of the oxo-compounds and alcohols. Biological roles of carbohydrates. Monosaccharides, aldoses, ketoses, pentoses, hexoses. Stereochemistry of carbohydrates. Ring structure of monosaccharides. Conformation of pyranose and furanose rings.

*9<sup>th</sup> week:* Oligosaccharides, polysaccharides. Glycoconjugates. Structure of glycolipids and glycoproteins occurring in cell membranes. Cell surface glycans mediate uncountable biological events such as viral and bacterial infection, tumorigenesis, immune response and receptor-mediated signaling processes.

*10<sup>th</sup> week:* Chemical reactions of carbohydrates. Preparation of esters, ethers, acetals, oxidation, reduction. Protecting groups in carbohydrate chemistry. Synthesis of glycosides and oligosaccharides.

*11<sup>th</sup> week:* Lipids. Classification of lipids. Saponifiable and non-saponifiable lipids. Membrane lipids: phospholipids, glycolipids, cholesterol. Biological membranes.

*12<sup>th</sup> week:* Nucleic acids. The structure of DNA and RNA. The Watson-Crick DNA double helix. Circular and supercoiled DNA. The biological role of RNA.

*13<sup>th</sup> week:* Other, biologically important organic compounds.

*14<sup>th</sup> week:* The end-term tests.

### **Requirements:**

*- for a signature*

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

During the semester there are two tests: the mid-term test in the 7<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. János Kerékgyártó, senior research fellow, CSc, PhD

**Lecturer:** Dr. János Kerékgyártó, senior research fellow, CSc, PhD

<b>Title of course: Cell biology</b> <b>Code: TTBME0120_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> examination	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 40 hours Total: 68 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> Cell Biology (BSc level)	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
The cell as the basic unit for the structure and functioning of living organisms, is highly complex and dynamic. The principal aim of this course is to show the mechanisms of those complex interactions that characterize pro- and eukaryotic cells (focusing on eukaryotes) that will result in functioning of the cell as a whole.	
<b>Literature</b>	
<i>Compulsory:</i> - Alberts, B. et al. (Eds.) (2008, 2010, 2013): Molecular biology of the cell/Essential Cell Biology. Garland Science/ Taylor and Francis Group  <i>Recommended:</i> - Buchanan BB, Gruissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASPB Books.	
<b>Schedule:</b>  <i>1<sup>st</sup> week:</i> General informations. Introduction into the main topics of cell biology that will be discussed during the semester.  <i>2<sup>nd</sup> week:</i> A survey of the topics discussed on the Cell Biology/ BSc course: the prokaryotic and eukaryotic/ fungal, plant, animal-human cell. Discussion of the topics presented at the lecture.  <i>3<sup>rd</sup> week:</i> Dynamics of subcellular structures, the role of cytoskeleton and endomembranes in intracellular movement. Discussion of the topics presented at the lecture. Modern techniques related to the study of intracellular dynamics.  <i>4<sup>th</sup> week:</i> Gene expression in the context of cell functioning, the coordinated functioning of nuclear and extranuclear genomes. Discussion of the topics presented at the lecture. Modern techniques related to the study of gene regulation.	

*5<sup>th</sup> week:* Post-translational modifications of proteins: phosphorylation/dephosphorylation, ADP-ribosylation, ubiquitination etc. Their role in the regulation of subcellular events. Discussion of the topics presented at the lecture. Modern techniques related to the study of post-translational modifications.

*6<sup>th</sup> week:* Types of signal transduction and their pathways. Signal transduction cascades. Their role in the functioning of cell as a whole. Discussion of the topics presented at the lecture. Modern techniques related to the study of signal transduction.

*7<sup>th</sup> week:* Typical examples of hormone or growth regulator mediated signal transduction pathways. Discussion of the topics presented at the lecture. Modern techniques related to the study of signal transduction.

*8<sup>th</sup> week:* The cytoskeleton as the driving force of cellular dynamics. Microtubules, microfilaments and intermediate filaments. Discussion of the topics presented at the lecture. Modern techniques related to the study of cytoskeleton.

*9<sup>th</sup> week:* Dynamics of biological membranes. Current models of membrane structure and dynamics. Discussion of the topics presented at the lecture. Modern techniques related to the study of biological membranes.

*10<sup>th</sup> week:* The endomembrane system of eukaryotic cells. Interaction between membrane compartments and their dynamics. Discussion of the topics presented at the lecture. Modern techniques related to the study of endomembranes.

*11<sup>th</sup> week:* The extracellular matrix of eukaryotic cells. The glycocalyx, the fungal and plant cell wall, their structure and functions. Discussion of the topics presented at the lecture. Modern techniques related to the study of extracellular matrix.

*12<sup>th</sup> week:* Discussion of cell cycle regulation issues learned during the BSc courses. Molecular mechanisms of the regulation of mitosis and meiosis. Deregulation of mitosis, tumorigenesis. Discussion of the topics presented at the lecture. Modern techniques related to the study of the regulation of cell division.

*13<sup>th</sup> week:* Programmed cell death and apoptosis: the concept, pathways, their role in the development of multicellular organisms. Discussion of the topics presented at the lecture. Modern techniques related to the study of PCD.

*14<sup>th</sup> week:* Consultation: a survey of the topics discussed during the semester.

**Requirements:**

- *for a signature*

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

- *for a grade*

The course ends in an **examination** in case of the lecture.

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. Csaba Máthé, associate professor, PhD

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

<b>Title of course: Molecular and synthetic biology</b> <b>Code: TTBMG0125_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - practice: 28 hours - laboratory: - - home assignment: 24 hours - preparation for the exam: 24 hours Total: 76 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> TTBG0105-EN	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
In the first part, we review the molecular methods used in the thesis of the students, we discuss them in detail, try to find the possible problems and their solutions. We review molecular identification of the species, mitochondrial DNA, barcoding and its application. The second part focuses on systems biology, metabolic networks, approaches and tools directly utilized in synthetic biology, synthetic genomes and gene editing. Virtual experiment design.	
<b>Literature</b>	
<i>Recommended:</i> RJ Reece: Analysis of Genes and Genomes , Wiley and Sons Ltd ISBN:0-470-84379-9	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Review of basic molecular methods.  <i>2<sup>nd</sup> week:</i> Presentation. Discussion of the molecular method used, possible problems and their solutions.  <i>3<sup>rd</sup> week:</i> Presentation. Discussion of the molecular method used, possible problems and their solutions.  <i>4<sup>th</sup> week:</i> Presentation. Discussion of the molecular method used, possible problems and their solutions.  <i>5<sup>th</sup> week:</i> Presentation. Discussion of the molecular method used, possible problems and their solutions.  <i>6<sup>th</sup> week:</i> Presentation. Discussion of the molecular method used, possible problems and their solutions.	

7<sup>th</sup> week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

8<sup>th</sup> week: Genome, genome projects, genes, mitochondrial DNA. Finding genes in the databases.

9<sup>th</sup> week: Molecular identification of species, barcoding. Designing the experiment, required tools and methods, analysis of the results.

10<sup>th</sup> week: Synthetic biology, synthetic genomes, construction of *Mycoplasma mycoides* minimal genome.

11<sup>th</sup> week: Metabolic networks and gene editing.

12<sup>th</sup> week: Virtual lab.

13<sup>th</sup> week: Consultation.

14<sup>th</sup> week: Essay writing.

**Requirements:**

Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester.

Students have to submit a presentation.

- for a grade

The course ends in an **examination**.

The minimum requirement is 50%.

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. Ida Miklós, associate professor, PhD

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

<b>Title of course: Genetics</b> <b>Code: TTBME0130_EN</b>	<b>ECTS Credit points: 2</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: variable Total: 28 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 special genetic topics not discussed in the basic genetics course. Molecular mechanism of genetic recombination: detection of crossing over, gene conversion and postmeiotic segregation. Molecular models of genetic recombination. Mobile genetic elements: insertion sequences, transposons, inversion elements, retro sequences. The mechanisms of conservative, replicative and retro-transposition. Genetic transformation. Generalized transduction. Specialized transduction. Bacterial conjugation. R-factors and other plasmids. Extracromosomal inheritance: the construction of chondriome and plastome, mitochondrial inheritance.	
<b>Literature</b>	
<i>Compulsory:</i> - <i>Recommended:</i> -	
<b>Schedule:</b> <i>1<sup>st</sup> week</i> Description the course themes and requirements. Review of the processes of mitosis and meiosis. <i>2<sup>nd</sup> week</i> Molecular mechanism of genetic recombination I: detection of crossing over, gene conversion and postmeiotic segregation. <i>3<sup>rd</sup> week</i> Molecular mechanism of genetic recombination II: molecular models. <i>4<sup>th</sup> week</i> Mobilis genetic elements I: insertion sequences, transposons. <i>5<sup>th</sup> week</i> Mobilis genetic elements II: retro sequences, retro elements, retrons, retroposones, retroviruses, pararotaviruses.	

6<sup>th</sup> week

Mobilis genetic elements III: the mechanisms of conservative, replicative and retro-transposition.

7<sup>th</sup> week

Genetic transformation.

8<sup>th</sup> week

Transduction in bacteria: generalized transduction.

9<sup>th</sup> week

Transduction in bacteria: specialized transduction.

10<sup>th</sup> week

Conjugation in bacteria. R-factors and other plasmids.

11<sup>th</sup> week

Extrachromosomal inheritance I: the structure of chondriome and inheritance associated with mitochondria.

12<sup>th</sup> week

Extrachromosomal inheritance II: pollensterility and phylogenetic aspects.

13<sup>th</sup> week

Extrachromosomal inheritance III: the plastome and eukaryotic plasmids.

14<sup>th</sup> week

Consultation.

**Requirements:**

- *for a signature*

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

- *for a grade*

The course ends in an **examination**.

The minimum requirement for the examination respectively is 60%.

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. Csoma Hajnalka assistant professor, PhD

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

<b>Title of course: Physiology, Regulatory Biology and Immunology</b> <b>Code: TTBME0200_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: 0 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: 0 hours - laboratory: - - home assignment: 20 hours - preparation for the exam: 20 hours Total: 82 hours	
<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 objective of the course is to equip students with a strong foundation of fundamental physiological regulatory processes, which will enable them to acquire more specialized knowledge later in their career. Students will review homeostatic regulatory processes, organismal response to immune challenge and environmental stress, while a strong emphasis will be placed on methodological and technical details throughout the course.</p> <p>Topics: introduction to physiological principles. Chemistry, biochemistry, and cell physiology. Hormones and cell signalling. Homeostasis. Maintaining the balance of heat, water, nutrients and energy. Principle and limitations of economic design. Whole body integration of regulatory systems. Regulation of self-maintenance and reproduction. The immune system. Innate and acquired immunity. Immunisation and its use in public health and assay development.</p>	
<b>Literature</b>	
<p><i>Compulsory:</i></p> <p>1. Course material</p> <p><i>Recommended:</i></p> <p>- Moyes, C.D., Schulte, P.M.: Principles of animal physiology, Pearson (3rd edition, 2015)</p>	
<b>Schedule:</b>	
<i>1<sup>st</sup> week:</i> Introduction to physiological principles. Physiological evolution of animals	
<i>2<sup>nd</sup> week:</i> Chemistry, biochemistry, and cell physiology	
<i>3<sup>rd</sup> week:</i> Cell signaling and endocrine regulation	
<i>4<sup>th</sup> week:</i> Neuron structure and function	
<i>5<sup>th</sup> week:</i> Cellular movement and muscles	
<i>6<sup>th</sup> week:</i> Sensory systems	

7<sup>th</sup> week: Functional organization of nervous systems

8<sup>th</sup> week: Circulatory systems

9<sup>th</sup> week: Immune systems. Immunisation and its use in public health and assay development.

10<sup>th</sup> week: Respiratory systems

11<sup>th</sup> week: Locomotion

12<sup>th</sup> week: Ion and water balance. digestion and energy metabolism

13<sup>th</sup> week: Thermal physiology

14<sup>th</sup> week: Reproductive physiology

**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.

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 home assignments and the examination, the exam grade is calculated as an average of them:

- the average grade of home assignments
- 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: -

**Person responsible for course:** Dr. Adam Z Lendvai, associate professor, PhD

**Lecturer:** Dr. Adam Z Lendvai, associate professor, PhD

Dr. Zoltan Nemeth, assistant professor, PhD

<b>Title of course: Plant biology</b> <b>Code: TTBME0205_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> examination	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 40 hours Total: 68 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 dynamic plant cell. Regulation of plant cell cycle. Structure and functioning of the plant genome. Molecular regulation of photosynthesis. Light regulated gene expression. Hormonal and genetic regulation of plant development: embryogenesis, root, shoot and flower. Stress reactions and programmed cell death in plants. Secondary metabolism.	
<b>Literature</b>	
<i>Compulsory:</i> - Jones R, Ougham H, Thomas H, Waaland S, eds. (2013) The molecular life of plants. Wiley-Blackwell <i>Recommended:</i> - Buchanan BB, Gruissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASPB Books. - Fosket DE, Morejohn, LC (1992) Structural and functional organization of tubulin. Annu. Rev. Plant Physiol. Plant Mol. Biol. 43: 201-240. - Greenberg JT (1997) Programmed cell death in plant-pathogen interactions. Annu. Rev. Plant Physiol Plant Mol. Biol. 48: 525-545. - Kuriyama H, Fukuda H (2002) Developmental programmed cell death in plants. Curr. Op. Plant Biol. 5: 568-573.	
<b>Schedule:</b>	
<i>1<sup>st</sup> week:</i> General informations. Introduction into the main topics of plant molecular biology.  <i>2<sup>nd</sup> week:</i> The dynamic plant cell. The coordination between ER and microtubules for the concerted functioning of plant cell. Dynamics of organelles, with special emphasis on vacuoles. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell dynamics.  <i>3<sup>rd</sup> week:</i> Organization of nuclear and organellar genome, particularities of transcription and translation in plants. Special plant proteins. Biotechnological aspects. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant molecular genetics.	

*4<sup>th</sup> week:* Gene regulation in plants, with special emphasis on light-regulated expression. Post-transcriptional and post-translational regulation in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant gene regulation as well as post-transcriptional and post-translational regulations.

*5<sup>th</sup> week:* Particularities of the organization of plant cytoskeleton. Cell cycle regulation in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cytoskeleton and cell cycle regulation.

*6<sup>th</sup> week:* Photoreceptors: phytochromes, blue and UV receptors. Signal transduction events in photomorphogenesis. Regulation of gene expression by phytochromes. Chronobiology in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of photomorphogenesis.

*7<sup>th</sup> week:* Electron transport proteins in photosynthesis. Short characterization of the Calvin cycle. Molecular/ gene regulation of C- and N metabolism in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of C- and N metabolism in plants.

*8<sup>th</sup> week:* Signal transduction events mediated by plant growth regulators, with special emphasis on auxins. Functions of PIN proteins (auxin efflux carriers). Discussion of the topics presented at the lecture. Modern techniques related to the study of plant hormone mediated signal transduction and auxin transport.

*9<sup>th</sup> week:* Molecular mechanisms of embryo and root development, the role of plant growth regulators. Discussion of the topics presented at the lecture. Modern techniques related to the study of embryo and root development.

*10<sup>th</sup> week:* Molecular mechanisms of shoot and flower development, the role of plant growth regulators. Flower identity genes: the role of MADS box (homeotic) genes, analogies with homeobox genes-regulated developmental processes in animals. Discussion of the topics presented at the lecture. Modern techniques related to the study of shoot and flower development.

*11<sup>th</sup> week:* Plant responses to abiotic and biotic stresses. The formation of reactive oxygen species. Antioxidant systems and metabolites in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant stress responses.

*12<sup>th</sup> week:* Molecular mechanisms of senescence and plant cell death in plants. Plant-pathogen interactions, the hypersensitive response. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell death. Students present selected topics of this subject on the basis of scientific papers.

*13<sup>th</sup> week:* Secondary metabolism in plants, their synthesis. Terpenoids, alkaloids, phenoloids, polyketides. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant secondary metabolism.

*14<sup>th</sup> week:* Functions, effects of special plant metabolites. Allelopathy. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant special metabolites.

**Requirements:**

- *for a signature*

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

- *for a grade*

The course ends in an **examination** in case of the lecture.

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. Csaba Máthé, associate professor, PhD

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

Dr. Ilona Mészáros, associate professor, PhD

Dr. Márta M-Hamvas, associate professor, PhD

Dr. Gyula Surányi, senior lecturer, C.Sc.

Prof. Gábor Vasas, PhD, DSc

<b>Title of course: Microbiology/Microbial physiology</b> <b>Code: TTBME0210_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam (written)	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: - - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 122 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>	
The aim of this course is two-fold: first, it is to obtain a general understanding of the microorganisms (bacteria, fungi, yeasts, viruses), that includes their classification, metabolism, the way they interact with their environment and other living organisms such as plants, animals and humans. We will characterize the cellular biology of the microorganisms (cell wall, cell membrane, intracellular structures), and analyse their functions. Energy metabolism and reproduction will be discussed. Secondly, the course also deals with the applied aspects of microbiology including industrial fermentations (biogas, ethanol, hydrogen formation), environmental applications (bioremediation, biodegradation), agricultural as well as food technologies (preservation, food and feed production).	
<b>Literature</b>	
<p><i>Compulsory:</i>  Dawes IW, Sutherland IW: Microbial physiology. Blackwell Publishing, New York, U.S.A.</p> <p><i>Recommended:</i>  PM Rhodes, PF Stanbury: Applied Microbial Physiology – A Practical Approach. Oxford University Press, Oxford, UK</p>	
<b>Schedule:</b> <i>1<sup>st</sup> week: Principles of Microbiology</i> Introduction – microorganisms and microbiology. A brief journey to the microbial world. Chemistry of cellular components. Cell structure and function in <i>Bacteria</i> and <i>Archaea</i> . Nutrition and culture of microorganisms. Microbial growth.  <i>2<sup>nd</sup> Week: Microbial metabolism I.</i> Microbial biochemistry. Carbon catabolism and anabolism. Regulation of carbon metabolism. Carbohydrates and lipids. Carbon source vs. energy source.  <i>3<sup>rd</sup> Week: Microbial metabolism II.</i> Microbial genetics. Structure and composition of DNA and RNA.  <i>4<sup>th</sup> Week: Microbial metabolism III.</i> Amino acid biosynthesis and its regulation. Nucleic acid metabolism.	

*5<sup>th</sup> Week: Microbial metabolism IV.*

Sexual and asexual processes. Parasexual cycle. Regulation of Gene Expression. Protein synthesis and degradation.

*6<sup>th</sup> Week: Molecular Biology of Microorganisms*

Essentials of Molecular Biology. Archaeal and Eukaryotic Molecular Biology. Overview of Viruses and Virology. Principles of Bacterial Genetics. Genetic Engineering. Microbial Genomics.

*7<sup>th</sup> Week: Industrial microbiology: Upstream processing*

Bioreactor instrumentation and control. Sensors. Control systems – manual and automatic control. On-line analysis. Sterilization. Cell morphology. Inoculum preparation. Batch, fed-batch and continuous fermentation systems.

*8<sup>th</sup> Week: Industrial microbiology: Downstream processing*

Recovery and purification. Filtration, centrifugation, cell disruption, liquid-liquid extraction, solvent recovery, chromatography, crystallization, whole-broth processing. Fermentation analytics. Physical, chemical and biological (aerobic and anaerobic) treatment of the effluent. Fermentation economics.

*9<sup>th</sup> Week: Microbial enzymes*

Bioprocesses engineering of enzymes. Enzyme isolation. Classification of enzymes of industrial importance. Enzyme kinetics. Enzyme reactions in homogenous and heterogenous phase. Bioconversions. Enzyme immobilization.

*10<sup>th</sup> Week: Microbial bulk products*

Biomass production (SCP). Amino acid processes. Organic acid processes. Vitamin C and vitamin B<sub>12</sub> production. Biofuels – general outlook, classification, economic importance. Antibiotics – history, biosynthesis, biotechnology, application.

*11<sup>th</sup> Week: Microbial Diversity*

Microbial Evolution and Systematics. Bacteria: The Proteobacteria. Bacteria: Gram-Positive and Other Bacteria. Archaea. Eukaryotic Cell Biology and Eukaryotic Microorganisms. Viral Diversity.

*12<sup>th</sup> Week: Metabolic Diversity and Microbial Ecology*

Metabolic Diversity: Photography, Autotrophy, Chemolithotrophy, and Nitrogen Fixation. Metabolic Diversity: Catabolism of Organic Compounds. Methods in Microbial Ecology. Microbial Ecosystems. Nutrient Cycles, Bioremediation, and Symbioses.

*13<sup>th</sup> Week: Important microorganisms in agriculture and industry*

*Brevibacterium* sps., *Lactobacillus*, *Lactococcus*, *Streptococcus*, *Tetragenococcus*, *Carnobacterium*, *Weisella*, *Azotobacter chroococcum*, *Streptomyces* sps., *Botrytis cinerea*, *Plasmopara viticola*, *Uncinula necator*.

*14<sup>th</sup> Week: Important microorganisms in agriculture and industry*

*Penicillium* sps, *Aspergillus* sps, *Trichoderma* sps., *Rhizopus* sps., *Saccharomyces* sps, *Zymomonas* sps, *Corynebacterium glutamicum*,

**Requirements:**

- for a signature

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

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. Levente Karaffa, associate professor, PhD, DSc.

**Lecturer:** Dr. Levente Karaffa, associate professor, PhD, DSc.

<b>Title of course: Zoology, ethology</b> <b>Code: TTBME0215_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: 0 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> exam grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 56 hours - practice: 0 hours - laboratory: 0 hours - home assignment: 30 hours - preparation for the presentation: 30 hours Total: 116 hours	
<b>Year, semester:</b> 1st year, 1st semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
<p>The objective of the course is twofold, first to enable students to integrate previously acquired knowledge from the fields of zoology, animal behaviour, evolution and ecology, second, to use that knowledge to critically evaluate the latest studies of organismal response to urbanization and human induced rapid environmental change. The students will primarily learn about novel adaptations (behavioural, physiological, and morphological), which have recently appeared in response to colonization of built, urban environments in diverse taxonomic groups of animals. More than half of the global human population now resides in cities, therefore it is important that students become familiar with the effects of rapidly expanding urban environments on native organisms.</p>	
<b>Literature</b>	
- Diego Gil and Henrik Brumm (eds.): Avian Urban Ecology: Behavioral and Physiological Adaptations. (Oxford University Press, 2014) - Ulrika Candolin and Bob B. M. Wong (eds.) Behavioral Responses to a Changing World: Mechanisms and Consequences (Oxford University Press, 2012)	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction: Cities as evolutionarily novel environments. Urban ecosystems.  <i>2<sup>nd</sup> week:</i> Behavioural and ecological predictors of the propensity to colonize urban environments.  <i>3<sup>rd</sup> week:</i> Urban heat islands. Effects of light pollution.  <i>4<sup>th</sup> week:</i> Cities as never depleting food sources.  <i>5<sup>th</sup> week:</i> Urban phenology: timing of reproduction in cities.  <i>6<sup>th</sup> week:</i> Communication in urban noise.	

*7<sup>th</sup> week:* Urban predators.

*8<sup>th</sup> week:* Cities as sources of novel parasites and pathogens.

*9<sup>th</sup> week:* Effects of toxins and heavy metal pollution in urban areas.

*10<sup>th</sup> week:* Roles of phenotypic plasticity and genetic adaptation in urbanization.

*11<sup>th</sup> week:* Speciation in urban areas.

*12<sup>th</sup> week:* Invasive species in urban areas.

*13<sup>th</sup> week:* Research methods of adaptations to urban environments.

*14<sup>th</sup> week:* Student presentations.

**Requirements:**

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

Students will be evaluated based on two deliverables: (1) a brief, 15 min oral presentation given on the last class (14<sup>th</sup> week) on the topic of an adaptation to the urban environment, (2) a mini-review type paper submitted on the topic of the oral presentation.

The minimum requirement for both the presentation and the paper is 60%. The final grade will be composed (averaged) from the grades given to the presentation and the paper. Grades are 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. Zoltán Németh, PhD, assistant professor

**Lecturer:** Dr. Zoltán Németh, PhD, assistant professor

<b>Title of course: Evolutionary Biology</b> <b>Code: TTBME0220_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: 0 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> written exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: 0 hours - laboratory: 0 hours - home assignment: 0 hours - preparation for the exam: 40 hours Total: 82 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 3 <sup>rd</sup> semester	
<b>Its prerequisite(s):</b>	
<b>Further courses built on it:</b>	
<b>Topics of course</b> The Modern Synthesis of evolutionary biology. Evolution basics. Levels of selection. Evolution of individuality. Evolutionary conflicts. Genome evolution. Evolution of genetic regulatory systems. Evolution of development. Phenotypic plasticity and evolution of reaction norms. Epigenetics and evolution. Evolution of sex. Phylogenetics. Evolution of biodiversity. Darwinian medicine: evolution of pathogens, antimicrobial resistance, cancer.	
<b>Literature</b> Futuyma, D. J. & Kirkpatrick, M. (2017). Evolution 4th Ed. Sinauer Maynard Smith, J & Szathmáry, E. (1995). The major transitions in evolution. Oxford University Press. Buss, L. W. (1988). The evolution of individuality. Princeton University Press. West-Eberhard, M. J. (2003). Developmental plasticity and evolution. Oxford University Press Ewald, P. W. (1994) Evolution of infectious disease. Oxford University Press Burt, A. & Trivers, R (2008). Genes in conflict. Harvard University Press	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> The Modern Synthesis of evolutionary biology.  <i>2<sup>nd</sup> week:</i> Evolution basics.  <i>3<sup>rd</sup> week:</i> Levels of selection.  <i>4<sup>th</sup> week:</i> Evolution of individuality.  <i>5<sup>th</sup> week:</i> Evolutionary conflicts.  <i>6<sup>th</sup> week:</i> Genome evolution.	

*7<sup>th</sup> week:* Evolution of genetic regulatory systems.

*8<sup>th</sup> week:* Evolution of development.

*9<sup>th</sup> week:* Phenotypic plasticity and evolution of reaction norms.

*10<sup>th</sup> week:* Epigenetics and evolution.

*11<sup>th</sup> week:* Evolution of sex.

*12<sup>th</sup> week:* Phylogenetics.

*13<sup>th</sup> week:* Evolution of biodiversity.

*14<sup>th</sup> week:* Darwinian medicine: evolution of pathogens, antimicrobial resistance, cancer.

**Requirements:**

Participation at the classes is not compulsory.

The minimum requirement for the exam 60%. Grades are 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. Jácint Tökölyi, assistant professor, PhD

**Lecturer:** Dr. Jácint Tökölyi, assistant professor, PhD

<b>Title of course: Ecology</b> <b>Code: TTBME0225_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: 0 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: 0 hours - laboratory: 0 hours - home assignment: 40 hours - preparation for the exam: 40 hours Total: 122 hours	
<b>Year, semester:</b> 1st 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 basic ecological processes and their effect on the environment and nature. Besides providing the state-of-art theoretical background, case studies will also be provided to each topic in order to reveal practical aspects. The course provide knowledge on the aspects of vegetation succession; global and local effects of land use changes, habitat loss and fragmentation; ecological processes in urban habitats; ecosystem services and estimation of the ecological footprint; application of remotely sensed data in environmental and conservational projects.	
<b>Literature</b> Pásztor L., Botta-Dukát Z., Magyar G., Czárán T., Meszéna G. (2016) Theory-Based Ecology A Darwinian approach. Oxford University Press, pp. 301. ISBN: 978-01-995-7785-9 Whittaker, R.J., Fernández-Palacios, J.M. 2007: <a href="#">Island Biogeography Ecology, evolution, and conservation</a> . Oxford Univ. Press, USA ISBN 978-01-985-6612-0	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to the course  <i>2<sup>nd</sup> week:</i> Role of small habitat islands in human transformed landscapes – nature conservation, cultural and ecosystem services  <i>3<sup>rd</sup> week:</i> Island biogeography  <i>4<sup>th</sup> week:</i> Ecological impacts of invasive plant and animal species in a changing world  <i>5<sup>th</sup> week:</i> Application of remote sensing in ecology  <i>6<sup>th</sup> week:</i> Ecosystem services and ecological footprint	

7<sup>th</sup> week: Mid-term test

8<sup>th</sup> week: Ecological succession

9<sup>th</sup> week: Conservation and management of grassland ecosystems

10<sup>th</sup> week: Urbanisation, urban ecology

11<sup>th</sup> week: Role of ecosystem engineering species in natural habitats

12<sup>th</sup> week: Sustainable land use

13<sup>th</sup> week: Ecology and agriculture

14<sup>th</sup> week: End-term test

**Requirements:**

*- for a signature*

Participation at classes is compulsory. A student must attend the 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 more than three absences, a medical certificate needs to be presented.

*-an offered grade:*

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 offered grade is the average of them.

The minimum requirement for the tests (and also for the examination) is 60%. 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)

*- for a grade*

The course ends in a written exam. For the grades please refer the table above.

**Person responsible for course:** Prof. Dr. Béla Tóthmérész, professor, DSc

**Lecturer:** Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

<b>Title of course: Nature conservation and environmental protection</b> <b>Code: TTBME0230_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: - - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: - - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 122 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> Presenting environmental knowledge based on ecological background. Reviewing the actual problems, tasks and challenges in environmental protection. To understand the main questions of the environmental protection and relationship between the environmental protection and the human culture. Introducing nature conservation using ecological knowledge. This course establishes the basis needed for the involvement in the nature conservation.	
<b>Literature</b> <i>Compulsory:</i> <ol style="list-style-type: none"> <li>1. Fiedler, P.L. (ed.) 2013: Conservation Biology: The Theory and Practice of Nature Conservation Preservation and Management. Springer</li> <li>2. Newman, E. I. 2008: Applied Ecology and Environmental Management. Blackwell Science Ltd., Oxford.</li> <li>3. Gafta, D., Akeroyd, J. R. (eds.) 2006: Nature Conservation: Concepts and Practice. Springer</li> </ol> <i>Recommended:</i> -	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to the course.  <i>2<sup>nd</sup> week:</i> Nature, nature conservation. History of the nature conservation.  <i>3<sup>rd</sup> week:</i> Biodiversity. Spatial and temporal pattern of the biodiversity.  <i>4<sup>th</sup> week:</i> Population dynamics. Factors affecting the survival of populations. Conservation of populations.  <i>5<sup>th</sup> week:</i> Species-level conservation. Rarity and frequency. Ex-situ and in-situ conservation.	

6<sup>th</sup> week: Community-level conservation. Keystone species, functional species groups. Community dynamics and stability. Disturbances, invasion.

7<sup>th</sup> week: Mid-term test.

8<sup>th</sup> week: Environment and environmental elements. Inter-, multi- and transdisciplinarity in environmental science. Environmental problems and activities.

9<sup>th</sup> week: Atmosphere and its components. Air pollution. Air-related local and global environmental problems.

10<sup>th</sup> week: Water as environmental element. Water quality. Water pollution. Water-related local and global environmental problems.

11<sup>th</sup> week: Sewage treatment. Physical, chemical, and biological processes. Sewage sludge treatment.

12<sup>th</sup> week: Waste management. Waste-related local and global environmental problems.

13<sup>th</sup> week: Environmental noise, noise pollution. Noise control, noise mitigation.

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.

During the semester there are two tests: the mid-term test in the 7<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**.

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:** Prof. Dr. Béla Tóthmérész, professor, DSc

**Lecturer:** Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

<b>Title of course: Scientific communication and proposal writing</b> <b>Code: TTBMG0235_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 4 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> practical grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 56 hours - laboratory: 0 hours - home assignment: 40 hours - preparation for the exam: 40 hours Total: 136 hours	
<b>Year, semester:</b> 1st year, 2nd semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b> The course aims at to provide essential information in scientific communication and helps the students to develop their own research profile by supporting their skills in scientific writing and communication. The course introduces the essential indicators of scientific performance (impact factor, citation metrics, journal ranking) and provide guidelines for journal selection for their results in biological sciences. The students will be provided with the necessary tools of scientific writing, scientific presentations (scientific poster and oral presentation), paper writing and basic tools in proposal and grant writing.	
<b>Literature</b> - David H. Foster (2017): A concise guide to communication in science and engineering. Oxford University Press, Oxford. - Ken Peach (2017): Managing Science – Developing your Research Leadership and Management Skills. Oxford University Press, Oxford. - Heard S.B. (2016): The Scientist’s Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career. Princeton University Press, Princeton.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Essentials of scientific policy and communication  <i>2<sup>nd</sup> week:</i> Brief introduction to measuring science and scientometrics  <i>3<sup>rd</sup> week:</i> Formal and informal scientific communication  <i>4<sup>th</sup> week:</i> Scientific conference proceedings and poster presentations  <i>5<sup>th</sup> week:</i> Type of scientific papers, books and book chapters  <i>6<sup>th</sup> week:</i> Essentials of paper writing I	

*7<sup>th</sup> week:* Essentials of paper writing II

*8<sup>th</sup> week:* Essentials of paper writing III

*9<sup>th</sup> week:* Manuscript submission and review

*10<sup>th</sup> week:* Editorial work and manuscript reviews

*11<sup>th</sup> week:* Management of the own scientific profile

*12<sup>th</sup> week:* Scientific group management and proposal writing I

*13<sup>th</sup> week:* Scientific group management and proposal writing II

*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. Péter Török, associate professor, PhD, habil, D.Sc.

**Lecturer:** Dr. Péter Török, associate professor, PhD, habil, D.Sc.

<b>Title of course: Developmental genetics</b> <b>Code: TTBME1000_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hour/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: variable Total: 14 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> Introduction to developmental genetics. The course includes: a general introduction, the description of the major model organisms, the genetic factors determining polarity and positional information, segmentation, organogenesis, evolutionary disorders and the genetic determination of immunoglobulins.	
<b>Literature</b>	
<i>Recommended:</i> Gilbert, S.F.: Developmental Biology. 11th Edition. Sinauer Associates Inc, Sunderland, USA, 2016	
<b>Schedule:</b> 1 <sup>st</sup> week: Introduction to developmental biology and developmental genetics 2 <sup>nd</sup> week: Basic principles 3 <sup>rd</sup> week: <i>Cenorhanditis elegans</i> as model organism 4 <sup>th</sup> week: Genetic determination and regulation of development in <i>Cenorhabditis elegans</i> 5 <sup>th</sup> week: Description and characterisation of <i>Drosophila melanogaster</i> as a model organism 6 <sup>th</sup> week: Establishing positional information in <i>Drosophila</i> as the starting process of development 7 <sup>th</sup> week: Anterior-posterior subdivision of the <i>Drosophila</i> embryo 8 <sup>th</sup> week: Establishing segmentation in the <i>Drosophila</i> embryo 9 <sup>th</sup> week: Establishing segment identity in the <i>Drosophila</i> embryo	

*10<sup>th</sup> week: Organogenesis in Drosophila*

*11<sup>th</sup> week: Disorders of evolutionally conserved genes in human*

*12<sup>th</sup> week: Early development in mammals and stem cells*

*13<sup>th</sup> week: Genetics of immunoglobulins*

*14<sup>th</sup> week: End-of-semester consultation*

**Requirements:**

Attendance at lectures is recommended, but not 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.

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

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

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

<b>Title of course: Gene manipulation and Genomics</b> <b>Code: TTBMG1015_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 2 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: hours - practice: 28 hours - laboratory: hours - home assignment: 40 hours - preparation for the exam: 40 hours Total: 108 hours	
<b>Year, semester:</b> 1st year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> Genetics TTBME0130_EN	
<b>Further courses built on it:-</b>	
<b>Topics of course</b>	
History of gene manipulation with the emphasis on basic molecular biology technics. Vectors, transformation technics, transgenic animals and plants. Pharming and gene therapy. Prokaryote and eukaryote genomics: comparative and structural genomics, genomics in science and in everyday life.	
<b>Literature</b>	
<i>Compulsory:</i> Principles of gene manipulation and genomics. S.B. Primrose and R.M Twyman, Blackwell Publishing, 2013. Principles of genome analysis and genomics. S.B. Primrose and R.M Twyman, Blackwell Publishing, 2013. <i>Recommended:</i> Gene cloning and Genomics, Ravishankar B.V, Laxmi Book Publication, 2017.	
<b>Schedule:</b>	
<i>1<sup>st</sup> week:</i> Basic techniques. Cutting and joining DNA molecules.	
<i>2<sup>nd</sup> week:</i> Basic biology of plasmid and phage vectors.	
<i>3<sup>rd</sup> week:</i> Cosmids, phasmids, and other advanced vectors. Gene-cloning strategies. Sequencing genes and short stretched of DNA.	
<i>4<sup>th</sup> week:</i> Changing genes: site-directed mutagenesis and protein engineering.	
<i>5<sup>th</sup> week:</i> Cloning in bacteria <i>Escherichia coli</i> . Cloning in yeast <i>Saccharomyces cerevisiae</i> .	
<i>6<sup>th</sup> week:</i> Gene transfer to animal cells. Genetic manipulation of animals.	
<i>7<sup>th</sup> week:</i> Gene transfer to plants. GMO plants.	

8<sup>th</sup> week: Advanced transgenic technology. Applications of recombinant DNA technology.

9<sup>th</sup> week: The organization and structure of genomes.

10<sup>th</sup> week: Mapping and sequencing genomes.

11<sup>th</sup> week: Comparative genomics of prokaryotes, organelles and eukaryotes. Other aspects of comparative genomics.

12<sup>th</sup> week: Mapping protein interactions.

13<sup>th</sup> week: Applications of genome analysis and genomics: understanding the basis of polygenic disorders and identifying quantitative trait loci.

14<sup>th</sup> week: Summary.

**Requirements:**

- *for a signature*

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

- *for a grade*

The course ends in a writing **examination**.

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. Zsuzsa Antunovics, associate professor, PhD

**Lecturer:** Dr. Zsuzsa Antunovics, associate professor, PhD

<b>Title of course: Cell cycle and epigenetics seminar</b> <b>Code: TTBMG1130_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: - - seminar: 2 hours/week - laboratory: -	
<b>Evaluation:</b> presentation and test	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - - seminar: 28 hours - laboratory: - - home assignment: 12 hours - preparation for the test: 24 hours Total: 64 hours	
<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>Cell cycle events in eukaryotes are highly important and understanding the regulation in particular can contribute to the development of therapeutic agents against cancer. In this seminar we discuss mitotic cell division and the regulation of cell cycle, including the regulation of Start point, G2/M and metaphase/anaphase transitions. Also we talk about some aspects of differentiation and cancer development. Since epigenetics is a quite new field, more and more interesting results emerge how these epigenetic processes contribute to cell cycle regulation, differentiation and cancer development. During the classes we discuss miRNAs, CpG island DNA methylation and histone code epigenetic phenomena and their role in health and cell cycle. Also some experimental techniques will be explained to understand how these processes can be analyzed. Presentations must be given by the students.</p>	
<b>Literature</b>	
<p><i>Compulsory:</i>  - List of keywords sent out. Seminar materials sent out. Seminar notes taken during classes.</p> <p><i>Recommended:</i>  - C. David Allis et al.: Epigenetics, Second Edition; ISBN 978-1-936113-59-0.  - Coutts, Amanda S., Weston, Louise Cell Cycle Oscillators ISBN 978-1-4939-2957-3  - Eishi Noguchi and Mariana C. Gadaleta Cell Cycle Control 978-1-4939-0887-5</p>	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction: epigenetics as a scientific field; a historical overview.  <i>2<sup>nd</sup> week:</i> Review of the structure of DNA and chromatin. Review of basic cell cycle events and regulation.  <i>3<sup>rd</sup> week:</i> Epigenetic events I: DNA methylation and de-methylation.  <i>4<sup>th</sup> week:</i> Epigenetic events II: Changes in the histone code.  <i>5<sup>th</sup> week:</i> Epigenetic events III: micro and small interfering RNAs in epigenetic regulation. The phenomenon of gene silencing.	

6<sup>th</sup> week: Epigenetics and cell cycle interaction I: the basics.

7<sup>th</sup> week: The Epigenetics and cell cycle interaction II: tumor genesis.

8<sup>th</sup> week: Epigenetics and development. Developmental disorders.

9<sup>th</sup> week: Epigenetic changes in adults: our DNA sequence is not definitely our fate.

10<sup>th</sup> week: Epigenetics in medicine: diagnostics and treatments.

11<sup>th</sup> week: Review of studies, discussing further questions. Choosing the presentation materials.

12<sup>th</sup> week: Presentations and discussion I

13<sup>th</sup> week: Presentations and discussion II

14<sup>th</sup> week: End of semester test

**Requirements:**

- *for a signature*

Attendance at the seminars is compulsory.

- *for a grade*

An end of semester test will be written and a 5-10 minutes presentation will be required. Presentation must be accepted. The grade will be given based on the test as follows:

Percentage	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. Gyula Batta, assistant professor, PhD

**Lecturer:** Dr. Gyula Batta, assistant professor, PhD

<b>Title of course: Bioregulation and Proteomics</b> <b>Code: TTBME1135_EN</b>	<b>ECTS Credit points: 2</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: 0 hours - laboratory: - - home assignment: hours - preparation for the exam: 60 hours 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> Bioregulation at the molecular and at the cellular levels. Regulation of the energy charge and the catabolic/anabolic reduction charge of the cell. Hormonal regulation: sensing the environment in multicellular eukaryotic organisms. The interplay between metabolic and signaling pathways through heterotrimer G-protein coupled receptors and through insulin receptor. The phosphatidylinositol signaling. Ras-MAP kinase pathway. The complexity of the proteome. The different types of proteomics and their characterization.	
<b>Literature</b> <i>Compulsory:</i> - lecture notes <i>Recommended:</i> - Gerhard Krauss: Biochemistry of Signal Transduction and Regulation (Wiley-VCH Verlag GmbH & Co. KGaA, 2014), ISBN:9783527333660. -Albert B., Bray D. Essential Cell Biology Fourth edition, Garland Science 2014 ISBN : 978-0-8153-4454-4. - Nelson D.L., Cox M.M.: Lehninger Principles of Biochemistry (W. H. Freeman Sixth edition, 2012) ISBN-13: 978-14234146 -Nawin Mishra: Introduction to proteomics, Principles and application. (Wiley, 2010), ISBN: 978-0-471-75402-2.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Regulation at the cell level. Contribution of membrane proteins to the homeostasis of the cell. Processes that are sensitive to the energy charge and the catabolic/anabolic reduction charge of the cell.  <i>2<sup>nd</sup> week:</i> Regulation at the molecular level. Evolution of globin genes. Oxygen sensing mechanism in human erythrocytes. Expression of different human hemoglobin genes in human development. Methemoglobin reduction pathways. Hemoglobin and nitric oxide.	

*3<sup>rd</sup> week:* Redox homeostasis of the cell.

*4<sup>th</sup> week:* The reception and transmission of extracellular information hormones and signal transduction pathway The overview of signal transduction pathways. Classification of receptors and signal molecules. The receptor-ligand interactions.

*5<sup>th</sup> week:* The G protein signal cascade. The structure of the seven transmembrane helix receptors and the heterotrimeric G proteins. The G protein cycle. Synthesis of cyclic AMP. Signal termination. Bacterial toxins target G proteins. Classification of G proteins and their physiological effects.

*6<sup>th</sup> week:* Physiological effect of Glucagon and ephinephrine. Adrenergic receptor subtypes and their coupled G proteins and effectors.

*7<sup>th</sup> week:* The role of G-Protein coupled receptors in sensory perception. Signals which change the resting membrane potential of the nerve cells. Sensory transduction in vision. Signaling by olphactory receptor neurons.

*8<sup>th</sup> week:* Signal cascades based on the membrane lipid phosphatidylinositol. The domain structures of PLC and PKC and their function. The role of Ca<sup>2+</sup> in regulation.

*9<sup>th</sup> week:* Insulin signaling cascade. Processing and secretion of insulin. Insulin receptor and its tyrosine kinase activity. The role of SH2 domain. The activation of protein kinase B and the Glut4 translocation. Diabetes Mellitus and hyperglycemia.

*10<sup>th</sup> week:* Signaling through small GTP-binding proteins. Ras-MAP kinase pathway. Crosstalk among different Signaling Pathways.

*11<sup>th</sup> week:* Describing the complexity of the proteome. Protein domain functions and interactions.

*12<sup>th</sup> week:* Proteomics approach to protein expression profiling. Methods for proteomics separation and isolation of proteins. Proteomics of post-translationally modified proteins: phosphorylation, glycosylation.

*13<sup>th</sup> week:* Acquisition of protein structure information: Edman sequencing and mass spectrometry. Approach to quantitative proteomics. Protein arrays.

*14<sup>th</sup> week:* Functional proteomics. Mapping and Characterizing protein-protein interections in vivo and in vitro methods.

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

**Person responsible for course:** Dr. Teréz Barna, PhD, assistant professor

**Lecturer:** Dr. Teréz Barna, PhD, assistant professor

<b>Title of course: Plant cell and developmental biology</b> <b>Code:</b> TTBME0700_EN, TTBML0700_EN	<b>ECTS Credit points: 3+2</b>
<b>Type of teaching, contact hours</b> - lecture: 3 hours/week - practice: - - laboratory: 2 hours/week	
<b>Evaluation:</b> examination	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: - - laboratory: 28 hours - home assignment: - - preparation for the exam: 40 hours Total: 110 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>
Cytoskeleton and chromatin in plants. The mechanisms of sister chromatin segregation. The interactions between plant endomembranes with special emphasis on ER, mitochondria, plastids and peroxisomes. Signaling events in plant development including: embryogenesis, root, shoot and flower. The practical classes involve mainly modern techniques of microscopy, basic methods of histochemistry and immunohistochemistry and techniques for the analysis of subcellular structures in living plant cells. Regarding developmental biology, the students will learn how to study plant morphogenesis via tissue culture techniques.
<b>Literature</b>
<i>Compulsory:</i> - Buchanan BB, Grissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASPB Books.
<i>Recommended:</i> - Jones R, Ougham H, Thomas H, Waaland S, eds. (2013) The molecular life of plants. Wiley-Blackwell - Fosket DE, Morejohn, LC (1992) Structural and functional organization of tubulin. Annu. Rev. Plant Physiol. Plant Mol. Biol. 43: 201-240.

<b>Schedule:</b>
<b>Week 1</b> <b>Lecture:</b> General informations. A survey of the general and specific functions of the plant cell as learned during the BSc courses. <b>Practical:</b> Short presentation of the basic methods that will be used during the semester.
<b>Week 2</b> <b>Lecture:</b> The endomembrane system of plant cells and its dynamics. ER, Golgi, peroxisomes, plant vacuoles. Structure and functioning of the tonoplast.

**Practical:** Detection of endomembranes in living plant cells.

### Week 3

**Lecture:** The plastid system. Structure and dynamics of plastids, their structural and functional relationships with other cell compartments. Division of plastids, its molecular mechanisms.

**Practical:** Visualization of plastid division in living cells.

### Week 4

**Lecture:** Dynamics of subcellular structures, the role of cytoskeleton and endomembranes in intracellular movement in plant cells. Microtubules, microfilaments. Discussion of the topics presented at the lecture.

**Practical:** Modern techniques related to the study of intracellular dynamics. Immunohistochemistry for the detection of microtubules in root meristematic cells.

### Week 5

**Lecture:** The role of cytoskeleton in the division, differentiation and shape determination of plant cell. Discussion of the topics presented at the lecture. Mitosis and cytokinesis in higher plants.

**Practical:** Visualization of microfilaments in fixed and living plant cells.

### Week 6

**Lecture:** The mechanisms of sister chromatid segregation in mitotic cells. The cytoskeleton-kinetochore relationship. General features and particularities of plant cells. Discussion of the topics presented at the lecture.

**Practical:** Methods for chromatin labeling in plant cells.

### Week 7

**Lecture:** The regulation of plant cell cycle. Molecular mechanisms and particularities for plant cells regarding the role of cytoskeleton and regulation by plant growth regulators. Discussion of the topics presented at the lecture.

**Practical:** Methods for the labeling of subcellular structures in mitotic plant cells.

### Week 8

**Lecture:** Embryogenesis in vascular plants. A survey of the process and molecular/genetic mechanisms of its regulation. Discussion of the topics presented at the lecture.

**Practical:** Induction of somatic embryogenesis and observation of embryos in plant tissue cultures.

### Week 9

**Lecture:** Root and shoot development in vascular plants. The regulation of meristematic identity. A survey of the process and molecular/genetic mechanisms of its regulation. Discussion of the topics presented at the lecture.

**Practical:** Shoot development: observation of the shoot tip meristem in the aquatic plant *Ceratophyllum demersum*.

### Week 10

**Lecture:** Flower development in vascular plants. The regulation of floral meristem identity. A survey of the process and molecular/genetic mechanisms of its regulation. Discussion of the topics presented at the lecture.

**Practical:** The induction of shoot development in tissue cultures.

### Week 11

**Lecture:** Phylogenetic outlook: the evolution of root and shoot structures I. Discussion of the topics presented at the lecture.

**Practical:** The induction of root development in tissue cultures.

### Week 12

**Lecture:** Phylogenetic outlook: the evolution of root and shoot structures II. Discussion of the topics presented at the lecture.

**Practical:** Plant regeneration from somatic embryos.

**Week 13**

**Lecture:** Phylogenetic outlook: the evolution of flower structures. Discussion of the topics presented at the lecture.

**Practical:** Modern methods for the study of flower development: discussion forum.

**Week 14**

Consultation: a survey of the work performed during the semester.

**Requirements:**

**Lectures:**

- *for a signature*

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

- *for a grade*

The course ends in an **examination** in case of the lecture.

**Practical:**

Participation at the practicals is compulsory. The mark for laboratory grade consists of the activity shown during the semester and the results of two (mid-term and end-term) tests.

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. Csaba Máthé, associate professor, PhD

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

<b>Title of course: Plant genetics and biotechnology</b> <b>Code:</b> TTBME0710_EN, TTBMG0710_EN	<b>ECTS Credit points: 2+2</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - seminar: 2 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> examination	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 28 hours - seminar: 28 hours - laboratory: - - home assignment: - - preparation for the exam: 40 hours Total: 96 hours	
<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>
The plant genomes – structure and operation. Prokaryotic and eukaryotic gene expression in plant cells. The regulation levels of plant gene expression. Genetic and epigenetic regulation of plant metabolism, development and growth. Plant protein metabolism and post-translational modification of proteins. Forming of transgenic plants: methods and technology. Main applications of GMO plants.
<b>Literature</b>
<i>Compulsory:</i> Jones R, Ougham H, Thomas H, Waaland S, eds. The molecular life of plants. Wiley-Blackwell 2013
<i>Recommended:</i> 1.) Plant Biotechnology - New Products and Applications J. Hammond, P. McGarvey and V. Yusibov Eds. Springer-Verlag Berlin Heidelberg 2000.  2.) Thin Cell Layer Culture System – Regeneration and Transformation Applications D.T. Nhut, B.V. Le, K.T. T. Van and T. Thorpe Eds. Kluwer Academic Publishers, Netherlands 2003.  3.) Introduction to Plant Tissue Culture M. K. Razdan Science Publishers, Inc., Plymouth, UK

<b>Schedule:</b> -
<b>Requirements:</b> <b>Lectures:</b> - for a signature

*- for a grade*

**Seminar: -**

*-an offered grade:*

**Person responsible for course:** Dr. Gyula Surányi, assistant professor, CSc

**Lecturer:** Dr. Gyula Surányi, assistant professor, CSc; Dr. Csaba Máthé, associate professor, PhD;  
Dr. Márta Hamvas, associate professor, PhD; Dr. Viktor Oláh, assistant professor, PhD

<b>Title of course: Molecular plant taxonomy</b> <b>Code: TTBME0905_EN, TTBML0905_EN</b>	<b>ECTS Credit points: 2+2</b>
<b>Type of teaching, contact hours</b> - lecture: 2 hours/week - practice: 2 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 42 hours - practice: 28 hours - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 150 hours	
<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> This course will introduce the student to molecular phylogenetic methods in plants and their application to taxonomic studies. It gives an overview about the most important topics in plant molecular phylogenetics with an emphasis on taxonomic and conservation genetics implications. It will also use these information to introduce the students to modern plant taxonomy based on, not exclusively, molecular results. The course will also describe the most important DNA-fingerprinting methods and sequencing approaches with an emphasis on genomic methods. Finally, we will touch the issue of phylogeography, the distribution of genetic variation in geographic space.	
<b>Literature</b> <i>Compulsory:</i> Salemi M & Vandamme AM (2003, szerk.) The phylogenetic handbook: a practical approach to DNA and protein phylogeny. 2nd Edition. Cambridge University Press, Cambridge. Lowe A, Harris S & Ashton P (2004) Ecological genetics: design, analysis, and application. John Wiley & Sons, Oxford. <i>Recommended:</i> Soltis D, Soltis P, Endress P, Chase MW, Manchester S, Judd W, Majure L, Mavrodiev E. 2018. Phylogeny and Evolution of the Angiosperms: Revised and Updated Edition: University of Chicago Press.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to plant molecular taxonomy. The role of neutral mutations in the study of evolutionary and population genetic processes.  <i>2<sup>nd</sup> week:</i> Studies of plant genetic diversity at the level of populations and above the species rank. Question-specific sampling strategies.  <i>3<sup>rd</sup> week:</i> Basic molecular techniques: DNA-fingerprinting I. RAPD, RFLP, AFLP.  <i>4<sup>th</sup> week:</i> Basic molecular techniques: DNA-fingerprinting II. ISSR, SSR	

5<sup>th</sup> week: Basic molecular techniques: DNA-sequencing: Sanger-sequencing. NGS.

6<sup>th</sup> week: Analytical methods of DNA-fingerprinting data. Tree building based on genetic distance.

7<sup>th</sup> week: The usage of minisatellites and microsatellites in population genetics of plants.

8<sup>th</sup> week: Analytical methods of DNA-sequencing data. Phylogenetic tree reconstruction. Cladograms vs. phylograms.

9<sup>th</sup> week: The role of hybridisation and incomplete lineage sorting in the study of evolutionary history of plants. Paralogy and orthology in gene sequences.

10<sup>th</sup> week: Candidate genes in plant phylogenetics and phylogeography.

11<sup>th</sup> week: The properties of nrITS for the study of plant phylogenetics.

12<sup>th</sup> week: Next-generation sequencing (NGS) techniques. The nature of NGS data.

13<sup>th</sup> week: Generation and analysis of NGS data.

14<sup>th</sup> week: Homology assessment in NGS data. Phylogenetic tree reconstruction based on NGS data.

### **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 behaviour or conduct does not 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 two **mid-semester tests**: one can be expected during mid-term and one at the end-term. **Students have to sit for the tests at the practice class.**

- *for a grade*

The course ends with an **examination**. Based on the average of the grades of the mid-semester tests and the examination, the exam grade is calculated as a weighted average of them:

1. the average grade of the two mid-semester tests
2. the result of the examination weighted three-times.

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 retrial in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

**Person responsible for course:** Dr. Gábor Sramkó, postdoctoral researcher, PhD

**Lecturer:** Dr. Gábor Sramkó, postdoctoral researcher, PhD

<b>Title of course: Conservation biology</b> <b>Code: TTBME0510_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hour/week - practice: 0 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 40 hours Total: 54 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 science of conservation biology and related disciplines. Theoretical background and history and conservation biology. Distribution of biodiversity on Earth, biodiversity hotspots. Factors threatening biodiversity. Ecological economics, ecosystem services and functions. Invasive species and related conservational problems. Tools for invasion control. Habitat loss and degradation. Isolation, fragmentation, landscape-scale loss of biodiversity. Planning conservation areas, buffer zones, and ecological corridors. Basics of population conservation, minimum viable population. Species conservation programs and action plans. Nature conservation management, conservation of grassland biodiversity. Restoration ecology and ecological restoration. Theoretical background of the planning and monitoring of landscape-scale restoration projects. Legislation of nature conservation, international conventions.	
<b>Literature</b>	
<i>Compulsory:</i> Primack, R. B. 2014: Essentials of Conservation Biology, Oxford University Press. <i>Recommended:</i> Groom, M.J., Meffe, G.K., Carrol, C.R. 2006. Principles of Conservation Biology. 3rd Edition. Sinauer Associates, Inc. Sunderland	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to the course.  <i>2<sup>nd</sup> week:</i> The science of conservation biology and related disciplines. Theoretical background and history and conservation biology.  <i>3<sup>rd</sup> week:</i> Distribution of biodiversity on Earth, biodiversity hotspots. Factors threatening biodiversity.  <i>4<sup>th</sup> week:</i> Ecological economics, ecosystem services and functions.  <i>5<sup>th</sup> week:</i> Invasive species and related conservational problems. Tools for invasion control.	

*6<sup>th</sup> week:* Habitat loss and degradation. Isolation, fragmentation, landscape-scale loss of biodiversity.

*7<sup>th</sup> week:* Mid-term exam.

*8<sup>th</sup> week:* Planning conservation areas, buffer zones, and ecological corridors.

*9<sup>th</sup> week:* Basics of population conservation, minimum viable population. Species conservation programs and action plans.

*10<sup>th</sup> week:* Nature conservation management, conservation of grassland biodiversity.

*11<sup>th</sup> week:* Restoration ecology and ecological restoration.

*12<sup>th</sup> week:* Theoretical background of the planning and monitoring of landscape-scale restoration projects.

*13<sup>th</sup> week:* Legislation of nature conservation, international conventions.

*14<sup>th</sup> week:* End-term 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:** Prof. Dr. Béla Tóthmérész, professor, DSc.; Prof. Dr. Péter Török, professor, DSc,

**Lecturer:** Prof. Dr. Béla Tóthmérész, professor, DSc.; Prof. Dr. Péter Török, professor, DSc,

<b>Title of course: Conservation biology seminar</b> <b>Code: TTBMG0510_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - seminar: 2 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - seminar: 28 hours - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 108 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> Anthropogenic factors threatening biodiversity, the biodiversity crisis. Invasive species and related conservational problems. Tools for invasion control. Habitat loss and degradation. Isolation, fragmentation, landscape-scale loss of biodiversity. Planning conservation areas, buffer zones, and ecological corridors. Basics of population conservation, minimum viable population. Species conservation programs and action plans. Nature conservation management, conservation of grassland biodiversity. Restoration ecology and ecological restoration. Planning and monitoring of landscape-scale restoration projects.	
<b>Literature</b> <i>Compulsory:</i> Primack, R. B. 2014: Essentials of Conservation Biology, Oxford University Press. <i>Recommended:</i> Groom, M.J., Meffe, G.K., Carrol, C.R. 2006. Principles of Conservation Biology. 3rd Edition. Sinauer Associates, Inc. Sunderland	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to the course.  <i>2<sup>nd</sup> week:</i> Consultation lesson. Discussing the sub-topics of the course and the literature search for the sub-topics for each student.  <i>3<sup>rd</sup> week:</i> Student presentations of the first sub-topic (Anthropogenic factors threatening biodiversity, the biodiversity crisis) and discussion.  <i>4<sup>th</sup> week:</i> Student presentations of the second sub-topic (Invasive species and related conservational problems. Tools for invasion control) and discussion.  <i>5<sup>th</sup> week:</i> Student presentations of the third sub-topic (Habitat loss and degradation) and discussion.	

*6<sup>th</sup> week:* Consultation lesson. Discussing the sub-topics of the course and the literature search for the sub-topics for each student.

*7<sup>th</sup> week:* Student presentations of the fourth sub-topic (Isolation, fragmentation, landscape-scale loss of biodiversity) and discussion.

*8<sup>th</sup> week:* Student presentations of the fifth sub-topic (Planning conservation areas, buffer zones, and ecological corridors) and discussion.

*9<sup>th</sup> week:* Student presentations of the sixth sub-topic (Basics of population conservation, minimum viable population) and discussion.

*10<sup>th</sup> week:* Consultation lesson. Discussing the sub-topics of the course and the literature search for the sub-topics for each student.

*11<sup>th</sup> week:* Student presentations of the seventh sub-topic (Species conservation programs and action plans) and discussion.

*12<sup>th</sup> week:* Student presentations of the eighth sub-topic (Nature conservation management, conservation of grassland biodiversity) and discussion.

*13<sup>th</sup> week:* Student presentations of the ninth sub-topic (Restoration ecology and ecological restoration. Planning and monitoring of landscape-scale restoration projects) and discussion.

*14<sup>th</sup> week:* Consultation lesson.

**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 all students have to present a short lecture (with Power Point presentation) about a chosen topic in the field of conservation biology.

The grade for the presentation 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:** Prof. Dr. Béla Tóthmérész, professor, DSc.; Prof. Dr. Péter Török, professor, DSc,

**Lecturer:** Prof. Dr. Béla Tóthmérész, professor, DSc.; Prof. Dr. Péter Török, professor, DSc,

<b>Title of course: Plant Ecology</b> <b>Code: TTBME0600_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hours/week - practice: 0 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 14 hours - laboratory: 0 hours - home assignment: 40 hours - preparation for the exam: 40 hours Total: 94 hours	
<b>Year, semester:</b> 1st year, 2nd semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b>	
The course introduce the relationship between the plants and their abiotic and biotic environment. It provide essential information on plant population biology, life cycle and its most remarkable stages like seed dispersal, dormancy, germination and plant establishment. It introduce the most important type of positive and negative interactions between plant populations. The course provide information on the adaptation mechanisms of plants to different types of the abiotic environment. It also summarise current knowledge of spatial vegetation dynamics and succession.	
<b>Literature</b>	
- Begon, M., Harper, J. L. et Towsend, C. R. 1986: Ecology, Blackwell Scientific Publications, pp. 877, 4th Edition - 2004. - Harper, J. L. 1977: Population Biology of Plants, Academic Press, London, pp. 829. - Thompson, K. et Fenner M. 2005: Seed Ecology, Cambridge University Press, Cambridge, pp. 250.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> The history of plant ecology  <i>2<sup>nd</sup> week:</i> The plant life cycle I – Species dispersal  <i>3<sup>rd</sup> week:</i> The plant life cycle II – Dormancy and germination  <i>4<sup>th</sup> week:</i> The plant life cycle III – Essentials of plant reproduction  <i>5<sup>th</sup> week:</i> Types of interactions between populations I – Positive interactions  <i>6<sup>th</sup> week:</i> Types of interactions between populations I – Negative interactions  <i>7<sup>th</sup> week:</i> Plant life strategies	

8<sup>th</sup> week: Plant traits and trait based ecology

9<sup>th</sup> week: Environmental factors affecting plant life I - Climate

10<sup>th</sup> week: Environmental factors affecting plant life I – Edaphic and relief factors

11<sup>th</sup> week: Essentials of plant community ecology

12<sup>th</sup> week: Applied Plant ecology I

13<sup>th</sup> week: Applied Plant ecology II

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, professor, DSc.

**Lecturer:** Prof. Dr. Péter Török, professor, DSc.

<b>Title of course: Plant ecology seminar</b> <b>Code: TTBMG0600_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 2 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> practical grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 28 hours - laboratory: 0 hours - home assignment: 40 hours - preparation for the exam: 40 hours Total: 108 hours	
<b>Year, semester:</b> 1st year, 2nd semester	
<b>Its prerequisite(s):</b> -	
<b>Further courses built on it:</b> -	
<b>Topics of course</b> The course provide the students the most important knowledge in research planning, experimental research and introduce the most important field methods of data collection in plant ecology. The course focus on methods frequently used in assessment and evaluation focusing on essential sampling methods of vegetation coverage and height, biomass, soil seed bank or sampling of water plants and algae. The course provide knowledge on data collection and basic analysis and representation tools in data analyses and recording. The course introduce the theory of trait-based ecosystem analyses, provide information of trait measurements and analyses, and provide essential guideline for trait-based ecosystem engineering and ecological strategies based analyses in environmental sciences	
<b>Literature</b> - 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. - Gordon A. Fox, Simonetta Negrete-Yankelevich, Vinicio J. Sosa (eds.) (2015): Ecological Statistics – Contemporary theory and application. Oxford University Press, Oxford.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to the course  <i>2<sup>nd</sup> week:</i> Field measurement methods in plant ecology I  <i>3<sup>rd</sup> week:</i> Field measurement methods in plant ecology II  <i>4<sup>th</sup> week:</i> Qualitative variables of the plant community I  <i>5<sup>th</sup> week:</i> Qualitative variables of the plant community II	

*6<sup>th</sup> week:* Biomass harvest in plant communities

*7<sup>th</sup> week:* Non-destructive assessments of community biomass

*8<sup>th</sup> week:* Seed bank sampling and analysis

*9<sup>th</sup> week:* Measuring freshwater communities I

*10<sup>th</sup> week:* Measuring freshwater communities II

*11<sup>th</sup> week:* Plant traits and their measurement in field and laboratory

*12<sup>th</sup> week:* Essentials of data capture and analysis

*13<sup>th</sup> week:* Field experimentation and research planning

*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, professor, DSc.

**Lecturer:** Prof. Dr. Péter Török, professor, DSc.

<b>Title of course: Animal ecology lecture</b> <b>Code: TTBME0605_EN</b>	<b>ECTS Credit points: 1</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: 40 hours - preparation for the exam: 40 hours Total: 108 hours	
<b>Year, semester:</b> 1st 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 is to introduce animal ecology. The course gives knowledge about the effects of temperature, light, radiation and salt content on animal population, the population dynamics of predation, parasitism, symbiosis and mutualism, decomposers and detritivores, intra- and interspecific competition.	
<b>Literature</b> <i>Compulsory:</i> 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 <i>Recommended:</i> Leibold MA, Wootton TJ. Animal Ecology. University of Chicago Press. 2001.	
<b>Schedule:</b> 1 <sup>st</sup> week: Introduction of course. 2 <sup>nd</sup> week: Effects of temperature on animal population. 3 <sup>rd</sup> week: Effects of light and radiation on animal population. 4 <sup>th</sup> week: Population dynamics of symbiosis and mutualism. 5 <sup>th</sup> week: Population dynamics of predation. 6 <sup>th</sup> week: Population dynamics of parasitism. 7 <sup>th</sup> week: Mid-term test.	

8<sup>th</sup> week: Population dynamics of decomposers.

9<sup>th</sup> week: Population dynamics of detritivores.

10<sup>th</sup> week: Population dynamics of decomposers intraspecific competition.

11<sup>th</sup> week: Population dynamics of decomposers interspecific competition.

12<sup>th</sup> week: Migration and dispersion in animal population.

13<sup>th</sup> week: Life history strategies of animal population.

14<sup>th</sup> week: End-term test.

**Requirements:**

- *for a signature*

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

During the semester there are two tests: the mid-term test in the 7<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*

3. The course ends in an **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:*

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 Kunderát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

**Lecturer:** Dr. Edina Kunderát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

<b>Title of course: Animal ecology seminar</b> <b>Code: TTBMG0605_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: - seminar: 2 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: - seminar: 28 hours - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 108 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 field and laboratory methods of animal ecology. The course gives knowledge about the methods of the soil and water sampling, the methods of analyses of soil and water, important physical and chemical parameters, field methods for the study of animal population: visual, acoustic, trapping and other sampling methods.	
<b>Literature</b> <i>Compulsory:</i> 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 <i>Recommended:</i> Leibold MA, Wootton TJ. Animal Ecology. University of Chicago Press. 2001.	
<b>Schedule:</b> 1 <sup>st</sup> week: Introduction of course. 2 <sup>nd</sup> week: Methods of soil and water sampling in field. 3 <sup>rd</sup> week: Analyses of soil physical parameters. 4 <sup>th</sup> week: Analyses of soil chemical parameters. 5 <sup>th</sup> week: Analyses of water physical parameters. 6 <sup>th</sup> week: Analyses of water chemical parameters. 7 <sup>th</sup> week: Analyses of morphological parameters of invertebrates.	

8<sup>th</sup> week: Visual field methods.

9<sup>th</sup> week: Acoustic field methods.

10<sup>th</sup> week: Trapping field methods.

11<sup>th</sup> week: Other sampling methods.

12<sup>th</sup> week: Preparation methods.

13<sup>th</sup> week: Identification methods.

14<sup>th</sup> week: End-term test.

**Requirements:**

*- for a signature*

Participation at **seminar 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 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 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.

During the semester there are two tests: the mid-term test in the 7<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 minimum requirement for the mid-term and end-term tests 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)

**Person responsible for course:** Dr. Edina Kunderát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

**Lecturer:** Dr. Edina Kunderát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

<b>Title of course: Biometry</b> <b>Code: TTBML0300_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 0 hours/week - laboratory: 4 hours/week	
<b>Evaluation:</b> written exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 0 hours - laboratory: 56 hours - home assignment: 0 hours - preparation for the exam: 40 hours Total: 106 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>	
Introduction to the R Statistical Environment. Data handling. Descriptive statistics. Statistical hypotheses. Statistical tests on group means. Non-parametric statistics. Statistical tests for variances and distributions. Analysis of variance. Testing the relationships between continuous variables. Linear regression and correlation. Analysis of covariance. Multivariate statistical models. Model selection. Checking model assumptions. Generalized Linear Models. Linear Mixed models. Principal Components Analysis.	
<b>Literature</b>	
Sokal RR. & Rohlf FJ. 1981. Biometry. W.H. Freeman, New York.	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction to the R Statistical Environment.  <i>2<sup>nd</sup> week:</i> Data handling.  <i>3<sup>rd</sup> week:</i> Descriptive statistics.  <i>4<sup>th</sup> week:</i> Statistical hypotheses. Statistical tests on group means.  <i>5<sup>th</sup> week:</i> Non-parametric statistics. Statistical tests for variances and distributions.  <i>6<sup>th</sup> week:</i> Analysis of variance.  <i>7<sup>th</sup> week:</i> Testing the relationships between continuous variables. Linear regression and correlation.  <i>8<sup>th</sup> week:</i> Analysis of covariance.	

*9<sup>th</sup> week:* Multivariate statistical models.

*10<sup>th</sup> week:* Model selection.

*11<sup>th</sup> week:* Checking model assumptions.

*12<sup>th</sup> week:* Generalized Linear Models.

*13<sup>th</sup> week:* Linear Mixed models.

*14<sup>th</sup> week:* Principal Components Analysis.

**Requirements:**

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

The minimum requirement for the exam 60%. Grades are 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. Jácint Tökölyi, assistant professor, PhD

**Lecturer:** Dr. Jácint Tökölyi, assistant professor, PhD

<b>Title of course: Research planning</b> <b>Code:</b> TTBML0305_EN	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 0 hours/week - laboratory: 2 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 0 hours - laboratory: 28 hours - home assignment: 20 hours - preparation for the exam: 20 hours Total: 68 hours	
<b>Year, semester:</b> 1 <sup>st</sup> year, 2 <sup>nd</sup> semester	
<b>Its prerequisite(s):</b> Biometry TTBML0300_EN	
<b>Further courses built on it:</b> Field practical TTBML0310_EN, Project evaluation and review TTBML0315_EN	
<b>Topics of course</b> <p>The goal of this course is that students can learn the essential steps required to plan a successful research project. This course is part of a complex that is comprised of three classes spanning over two semesters. The first part is the current course, in which the students will prepare a detailed, written research plan for a field research project that they will carry out in the following semester (Field trip). Following data collection in the field, in the final, third part of the curriculum, they will analyse the results, and write up a research paper that meets the formal requirements of a scientific publication. After that, students will practice peer-review by evaluating their peers' work. This set of courses make it an excellent opportunity to train students about every part of a scientific investigation from planning up to the publication of the results and critical evaluation of others' work.</p> <p>Thematic of the current course: Parts of the scientific investigations. The scientific method, positivism and the hypothetico-deductive approach. Generating hypotheses and making predictions. Experimental designs, sampling protocols with an emphasis on field methods. Standardization and randomization. Observer bias and the importance of blinding. Requirements of a research plan.</p>	
<b>Literature</b> <i>Compulsory:</i> 4. course material <i>Recommended:</i> - Gerry P. Quinn, Michael J. Keough. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.	
<b>Schedule:</b> <i>1<sup>st</sup> week: The scientific method. Generating hypotheses and drawing predictions.</i> <i>2<sup>nd</sup> week: Approaching a new scientific question. How to survey the literature.</i>	

3<sup>rd</sup> week: *Choosing study subjects, area and methodology*

4<sup>th</sup> week: *Principles of data collection: sampling designs, difference between experimental and observational studies.*

5<sup>th</sup> week: *Controlling for confounders. Spurious correlations.*

6<sup>th</sup> week: *Experimental protocols. Randomization, standardization, the importance of a control group. Blinding.*

7<sup>th</sup> week: *Experimental protocols. Randomized block design, Latin square, factorial design.*

8<sup>th</sup> week: *Analysing collected data - 1. Continuous variables.*

9<sup>th</sup> week: *Analysing collected data – 2. Comparing groups.*

10<sup>th</sup> week: *Analysing collected data – 3. Other methods.*

11<sup>th</sup> week: *Organizing research data. Data structures and reproducible research.*

12<sup>th</sup> week: *Writing up: structure of scientific communications (talks, posters and papers).*

13<sup>th</sup> week: *Publishing: from manuscript submission to peer review.*

**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. 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.

During the semester there are two assignments: a mid-term assignment in the 8<sup>th</sup> week and the end-term assignment in the 15<sup>th</sup> week. Students have to turn in the assignments.

- for a grade

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

4. the average grade of the two designing tasks
5. the result of the examination

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

Score	Grade
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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. Adam Z Lendvai, associate professor, PhD

**Lecturer:** Dr. Adam Z Lendvai, associate professor, PhD

<b>Title of course: Field practical</b> <b>Code: TTBML0310_EN</b>	<b>ECTS Credit points: 3</b>												
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 0 hours/week - laboratory: 3 hours/week													
<b>Evaluation:</b> exam													
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 0 hours - laboratory: 42 hours - home assignment: 26 hours - preparation for the exam: 0 hours Total: 68 hours													
<b>Year, semester:</b> 2 <sup>nd</sup> year, 1 <sup>st</sup> semester													
<b>Its prerequisite(s):</b> Research planning TTBML0305_EN													
<b>Further courses built on it:</b> Project evaluation and review TTBML0315_EN													
<b>Topics of course</b> This is a one week long field trip during which students will carry out the research plan that they prepared in the previous semester. During the field, students are faced with the feasibility of their plan and will learn practical details of the field methods. At the end of the field course, we discuss what they have learnt and the students are required to present the data that they collected and preliminary analyses.													
<b>Literature</b> <i>Compulsory:</i> - <i>Recommended:</i> -													
<b>Schedule:</b> <i>This is a one week long field course.</i>													
<b>Requirements:</b> - <i>for a signature</i> Participation at <b>practice classes</b> is compulsory. A student must attend the field course and since it is organized in the field, attendance cannot be partial. - <i>for a grade</i> The course ends in an <b>evaluation</b> of how well the student performed the required tasks during the field course. The grade for evaluation is given according to the following table: <table style="margin-left: 40px;"> <tr> <td>Score</td> <td>Grade</td> </tr> <tr> <td>0-59</td> <td>fail (1)</td> </tr> <tr> <td>60-69</td> <td>pass (2)</td> </tr> <tr> <td>70-79</td> <td>satisfactory (3)</td> </tr> <tr> <td>80-89</td> <td>good (4)</td> </tr> <tr> <td>90-100</td> <td>excellent (5)</td> </tr> </table> - <i>an offered grade:</i>		Score	Grade	0-59	fail (1)	60-69	pass (2)	70-79	satisfactory (3)	80-89	good (4)	90-100	excellent (5)
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. Adam Z Lendvai, associate professor, PhD

**Lecturer:** Dr. Adam Z Lendvai, associate professor, PhD  
Dr Miklós Bán, assistant professor, PhD

<b>Title of course: Project evaluation and review</b> <b>Code: TTBML0315_EN</b>	<b>ECTS Credit points: 2</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 0 hours/week - laboratory: 2 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 0 hours - laboratory: 28 hours - home assignment: 40 hours - preparation for the exam: 0 hours Total: 68 hours	
<b>Year, semester:</b> 2 <sup>nd</sup> year, 1 <sup>st</sup> semester	
<b>Its prerequisite(s):</b> Research planning TTBML0305_EN	
<b>Further courses built on it:</b>	
<b>Topics of course</b>	
In depth data analysis and presentation of the results collected during the field course. The evaluation of the presentations. Writing up a scientific report of the results meeting the formal requirement of a scientific publication. Performing peer review of the submitted manuscripts.	
<b>Literature</b>	
<i>Compulsory:</i> course material	
<i>Recommended:</i> Joshua Shimel: Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded. Oxford University Press Edward J. Shewan 2007. Writing A Research Paper. Christian Liberty Press.	
<b>Schedule:</b> <i>Students must independently work on the data collected during the field trip and then present their results as a form of a presentation, later as a written report and then provide critical feedback on their peers' work. Therefore the schedule of this class is nor organized by weeks, but there are an initial appointment at the beginning of the class, following by the presentation and the peer review.</i>	
<b>Requirements:</b> - for a grade Grade is given based on the following activities: (1) initial oral presentation (2) written research paper (3) peer review activity (4) submission of the revised paper. The grade for evaluation 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:	

**Person responsible for course:** Dr. Adam Z Lendvai, associate professor, PhD

**Lecturer:** Dr. Adam Z Lendvai, associate professor, PhD  
Dr Miklós Bán, assistant professor, PhD

<b>Title of course: Animal populations</b> <b>Code: TTBME0320_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hours/week - practice: 0 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: 0 hours - laboratory: 0 hours - home assignment: 28 hours - preparation for the exam: 28 hours Total: 70 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>	
Basics of population growth. Exponential growth in population of identical individuals and in state structured populations. Control of population growth: density dependence. Methods to estimate population size: absolute and relative estimates. Survey methods: point and line transects. Capture-mark-recapture methods. Spatial distribution.	
<b>Literature</b>	
<i>Compulsory:</i> <i>Recommended:</i> Pásztor et al. 2017, Theory Based Ecology. Oxford University Press. Łomnicki, A. 1988. Population Ecology of Individuals, Monographs in Population Biology 25. Princeton University Press, Princeton	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Population dynamics. Birth and death rates.  <i>2<sup>nd</sup> week:</i> Exponential population growth. Examples for exponential growth.  <i>3<sup>rd</sup> week:</i> Computer simulation of exponential growth. Effects of parameters.  <i>4<sup>th</sup> week:</i> Estimation of growth parameters.  <i>5<sup>th</sup> week:</i> Exponential growth in structured populations.  <i>6<sup>th</sup> week:</i> Computer simulation of exponential growth in structure populations. Effects of parameters.  <i>7<sup>th</sup> week:</i> Consultations on exponential growth.	

*8<sup>th</sup> week:* Limits of population growth. Environmental capacity, density dependence. Chaotic population dynamics.

*9<sup>th</sup> week:* Simulation of limited population growth. Effects of parameters.

*10<sup>th</sup> week:* Limited growth in structured populations.

*11<sup>th</sup> week:* Simulation of limited growth in structure populations.

*12<sup>th</sup> week:* Competitive exclusion.

*13<sup>th</sup> week:* Population dynamics and evolution.

*14<sup>th</sup> week:* Consultations on limited growth.

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

**Person responsible for course:** Dr. Zoltan Barta, professor, PhD, DSc

**Lecturer:** Dr. Zoltan Barta, professor, PhD, DSc

<b>Title of course: Animal populations practical</b> <b>Code: TTBML0320_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 1 hours/week - laboratory: 0 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 14 hours - laboratory: 0 hours - home assignment: 28 hours - preparation for the exam: 28 hours Total: 70 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>	
During the practical the students will carry out two experiments. In one of them they maintain three colonies of Collembola and count the number of individuals in colonies. After gathering the data they analyse population growth. In the second experiment, they simulate capture-mark-recapture methodology to estimate the „population size” of rice.	
<b>Literature</b>	
<i>Compulsory:</i> <i>Recommended:</i> Krebs, C.J. 1989. Ecological methodology. Harper and Row, New York Southwood, T.R.E. and P.A. Henderson 2000. Ecological methods. Blackwell	
<b>Schedule:</b>	
<i>1<sup>st</sup> week:</i> Introduction: sampling populations, sampling methods. Absolute and relative estimates of population size, population indices. Capture-recapture methods.	
<i>2<sup>nd</sup> week:</i> Estimation population parameters for the sparrow population of the University Botanical Garden.	
<i>3<sup>rd</sup> – 5<sup>th</sup> week:</i> Carry out the Botanical Garden sampling.	
<i>6<sup>th</sup> week:</i> Analyses of Botanical Garden data.	
<i>7<sup>th</sup> week:</i> Population growth in Collembola. Setup of Collembola colonies. Planning of sampling.	
<i>8<sup>th</sup> – 9<sup>th</sup> week:</i> Measuring population growth in Collembola colonies.	
<i>10<sup>th</sup> week:</i> Capture-recapture methods. Estimation of population “size” of rice.	

*11<sup>th</sup> week:* Analysing “rice” population size data.

*12<sup>th</sup> week:* Measuring population growth in Collembola.

*13<sup>th</sup> week:* Analysing Collembola data.

*14<sup>th</sup> week:* Consultations on population data analyses.

**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.

*- for a grade*

Students have to present two talks on the Botanical Garden data, “rice” data or Collembola data.

**Person responsible for course:** Dr. Zoltan Barta, professor, PhD, DSc

**Lecturer:** Dr. Zoltan Barta, professor, PhD, DSc

<b>Title of course: Animal behaviour lecture</b> <b>Code: TTBME0325_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hours/week - practice: 0 hours/week - laboratory: -	
<b>Evaluation:</b> exam grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: 0 hours - laboratory: - - home assignment: 0 hours - preparation for the exam: 30 hours Total: 44 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 goals of the course are (1) to provide an overview of the incredibly diverse behavioural patterns exhibited by both vertebrate and invertebrate organisms, and (2) to aid students in explaining the origin and function of these behaviours by using approaches guided by Tinbergen's four questions. Students will be exposed to various experimental design templates, data collection as well as statistical methods used in behavioural research. Moreover, students will get hands-on training in behavioural research by completing three small experiments. By the end of the course, students will be able to design their own behavioural research project, collect and evaluate their data to draw conclusions about their research questions or hypotheses.	
<b>Literature</b> <i>Compulsory:</i> Course material <i>Recommended:</i> <ul style="list-style-type: none"> <li>- Rubenstein, D., Alcock J. 2018. Animal Behaviour. Sinauer Associates.</li> <li>- Martin P. &amp; Bateson P. 1993. Measuring Behaviour. Cambridge University Press, Cambridge.</li> <li>- Dawkins MS. 2007. Observing Animal Behaviour. Oxford University Press, Oxford.</li> <li>- Danchin E., Giraldeau L.-A., Cézilly F. 2008. Behavioural Ecology. Oxford University Press, Oxford.</li> </ul>	
<b>Schedule:</b> <i>1<sup>st</sup> week:</i> Introduction: studying behaviour using Tinbergen's four questions (lecture).  <i>2<sup>nd</sup> week:</i> Observing and measuring behaviour: methods and techniques (practice).  <i>3<sup>rd</sup> week:</i> Grouping behaviour (lecture).  <i>4<sup>th</sup> week:</i> Grouping behaviour (practice).  <i>5<sup>th</sup> week:</i> Animal personality (lecture)	

6<sup>th</sup> week: Animal personality: measuring individual differences in aggressive behaviour (practice).

7<sup>th</sup> week: Brood parasitism (lecture).

8<sup>th</sup> week: Brood parasitism (practice).

9<sup>th</sup> week: Social networks (lecture)

10<sup>th</sup> week: Social networks (practice)

11<sup>th</sup> week: Decision-making and individual preferences (lecture).

12<sup>th</sup> week: Decision-making and individual preferences (practice).

13<sup>th</sup> week: Cooperation: the use of game theoretical models in behavioural research (lecture and practice)

14<sup>th</sup> week: Consultation.

### Requirements:

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 three lab reports** as scheduled minimum at a sufficient level. The average scores calculated from the three lab reports will produce the final practical grade. See grading table below.

The course ends in an **examination**. Exam grade is calculated based on the grading table below.

The minimum requirement for passing the examination and receiving an exam grade as well as a practical grade is 60%. The grade for the examination and the lab reports 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.

**Person responsible for course:** Dr. Zoltán Németh, PhD, assistant professor

**Lecturers:** Dr. Zoltán Németh, PhD, assistant professor,  
Prof. Dr. Tamás Székely, PhD, professor,  
Prof. Dr. Zoltán Barta, PhD, professor,  
Dr. Miklós Bán, assistant professor

<b>Title of course: Animal behaviour practice</b> <b>Code: TTBME0325_EN</b>	<b>ECTS Credit points: 1</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 1 hours/week - laboratory: -	
<b>Evaluation:</b> practice grade	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 14 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 0 hours Total: 44 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 goals of the course are (1) to provide an overview of the incredibly diverse behavioural patterns exhibited by both vertebrate and invertebrate organisms, and (2) to aid students in explaining the origin and function of these behaviours by using approaches guided by Tinbergen's four questions. Students will be exposed to various experimental design templates, data collection as well as statistical methods used in behavioural research. Moreover, students will get hands-on training in behavioural research by completing three small experiments. By the end of the course, students will be able to design their own behavioural research project, collect and evaluate their data to draw conclusions about their research questions or hypotheses.	
<b>Literature</b> <i>Compulsory:</i> Course material <i>Recommended:</i> - Rubenstein, D., Alcock J. 2018. Animal Behaviour. Sinauer Associates. - Martin P. & Bateson P. 1993. Measuring Behaviour. Cambridge University Press, Cambridge. - Dawkins MS. 2007. Observing Animal Behaviour. Oxford University Press, Oxford. - Danchin E., Giraldeau L.-A., Cézilly F. 2008. Behavioural Ecology. Oxford University Press, Oxford.	
<b>Schedule:</b> 1 <sup>st</sup> week: Introduction: studying behaviour using Tinbergen's four questions (lecture). 2 <sup>nd</sup> week: Observing and measuring behaviour: methods and techniques (practice). 3 <sup>rd</sup> week: Grouping behaviour (lecture). 4 <sup>th</sup> week: Grouping behaviour (practice). 5 <sup>th</sup> week: Animal personality (lecture)	

6<sup>th</sup> week: Animal personality: measuring individual differences in aggressive behaviour (practice).

7<sup>th</sup> week: Brood parasitism (lecture).

8<sup>th</sup> week: Brood parasitism (practice).

9<sup>th</sup> week: Social networks (lecture)

10<sup>th</sup> week: Social networks (practice)

11<sup>th</sup> week: Decision-making and individual preferences (lecture).

12<sup>th</sup> week: Decision-making and individual preferences (practice).

13<sup>th</sup> week: Cooperation: the use of game theoretical models in behavioural research (lecture and practice)

14<sup>th</sup> week: Consultation.

### **Requirements:**

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 three lab reports** as scheduled minimum at a sufficient level. The average scores calculated from the three lab reports will produce the final practical grade. See grading table below.

The course ends in an **examination**. Exam grade is calculated based on the grading table below.

The minimum requirement for passing the examination and receiving an exam grade as well as a practical grade is 60%. The grade for the examination and the lab reports 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.

**Person responsible for course:** Dr. Zoltán Németh, PhD, assistant professor

**Lecturers:** Dr. Zoltán Németh, PhD, assistant professor,  
Prof. Dr. Tamás Székely, PhD, professor,  
Prof. Dr. Zoltán Barta, PhD, professor,  
Dr. Miklós Bán, assistant professor

<b>Title of course: Life history evolution seminar</b> <b>Code: TTBML0340_EN</b>	<b>ECTS Credit points: 3</b>
<b>Type of teaching, contact hours</b> - lecture: 0 hours/week - practice: 0 hours/week - laboratory: 3 hours/week	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 0 hours - practice: 0 hours - laboratory: 42 - home assignment: 40 hours - preparation for the exam: 0 hours Total: 82 hours	
<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>
The goal of the course is that students learn the basics of life history theory and its connections with other fields. Since life history evolution is responsible for a great part of biodiversity (through the evolution of diverse life histories), it provides a good opportunity for students to strengthen their ability to analyse evolutionary patterns and relationships between different fields of biology and integrate their knowledge into a system-wide view. Topics: Evolutionary patterns. Life history traits. The role of adaptation and constraints in life history evolution. Simple demographic models. Age-structured life populations, life tables. Reproductive value. The measurements of fitness components and their limitations. Basic quantitative genetics and reaction norms. Plasticity and consistency. The heritability of life history traits. The heritability of phenotypic plasticity. The integration of the plastic response. Trade-offs. Physiological, microevolutionary and macroevolutionary trade-offs, intra- and intergenerational trade-offs. Size at maturation and lifespan. The size and number of offspring. Reproductive lifespan and ageing. The evolutionary theories of ageing. Human life history.
<b>Literature</b>
<i>Compulsory:</i> course material  <i>Recommended:</i> Stephen C. Stearns. The Evolution of Life Histories. (1992). Oxford University Press. Ricklefs R. Ageing: a natural history (1995). Scientific American Library.

<b>Schedule:</b> <i>1<sup>st</sup> week: The presentation of life-history theory and its connection with other fields of biology.</i>  <i>2<sup>nd</sup> week: Life history traits. Adaptation and constraints.</i>  <i>3<sup>rd</sup> week: Demography: age and stage structure. Life tables, The Euler–Lotka equation. Calculating r. The stable age distribution. Generation time. Rates of increase</i>
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4<sup>th</sup> week: *Reproductive value. Residual reproductive value and the costs of reproduction.*

5<sup>th</sup> week: *Quantitative genetics and reaction norms. Heritabilities of life history traits. Selection on quantitative traits.*

6<sup>th</sup> week: *Trade-offs. Concepts and types of trade-offs. Physiological trade-offs. Microevolutionary trade-offs: intra-individual and intergenerational*

7<sup>th</sup> week: *Lineage-specific effects*

8<sup>th</sup> week: *Age and size at maturity*

9<sup>th</sup> week: *Number and size of offspring*

10<sup>th</sup> week: *Reproductive lifespan and ageing. A phylogenetic perspective on lifespan.*

11<sup>th</sup> week: *Evolutionary theories of ageing and death.*

12<sup>th</sup> week: *Human life-histories.*

13<sup>th</sup> week: *Proximate regulators of life-histories.*

**Requirements:**

- *for a signature*

Participation at the seminar 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.

- *for a grade*

Students will be given home assignments regularly. In these assignments, students need to critically develop and apply the learned material to study problems related to life-history theory. Grades will be given based on 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. Adam Z Lendvai, associate professor, PhD

**Lecturer:** Dr. Adam Z Lendvai, associate professor, PhD

<b>Title of course: Conservation genetics</b> <b>Code: TTBME0420_EN, TTBMG0425_EN</b>	<b>ECTS Credit points: 1+2</b>
<b>Type of teaching, contact hours</b> - lecture: 1 hour/week - seminar: 2 hours/week - laboratory: -	
<b>Evaluation:</b> exam	
<b>Workload (estimated), divided into contact hours:</b> - lecture: 14 hours - practice: 28 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 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>	
The debate on the amount of variation in natural populations. The types of variation: phenotypic variation, chromosomal polymorphism, enzyme polymorphism, DNA techniques to study variation. Problems of small populations: the effect of inbreeding, inbreeding coefficient, inbreeding depression; the effect of genetic drift: loss of allele richness, bottle neck effect, founder effect. The forces forming the genetic structure of population systems: genetic differentiation, the indices of genetic differentiation (genetic distances and fixation index); migration, equilibrium between differentiation and migration, genetic consequences of isolation, models of migration. Habitat fragmentation. metapopulation structure.	
<b>Literature</b>	
<i>Compulsory:</i> Franham, R., Ballou, J.D. and Briscoe, D.A. 2004. <i>A primer of conservation genetics</i> . Cambridge University Press  <i>Recommended:</i>	
<b>Schedule:</b> 1 <sup>st</sup> week: Debate on the level of variation in natural populations. Types of variation I: phenotypic variation,  2 <sup>nd</sup> week: Types of variation II: chromosomal polymorphism, enzyme polymorphism.  3 <sup>rd</sup> week: Types of variation III: Variation at the DNA level (A). Classic methods: RFLP, RAPD, AFLP.	

*4<sup>th</sup> week:* Types of variation IV: Variation at the DNA level (B). New techniques: mini- and microsatellites, DNA sequencing. Nuclear DNA: SNP; mitochondrial DNA: phylogeography.

*5<sup>th</sup> week:* Evolutionary forces in small populations I. Inbreeding (A): Inbreeding and panmictic coefficients, genotypic changes in inbred populations, identical homozygotes.

*6<sup>th</sup> week:* Evolutionary forces in small populations II. Inbreeding (B): Inbreeding depression, the relationship between inbreeding and population size. The minimal size of viable populations.

*7<sup>th</sup> week:* Evolutionary forces in small populations III. Genetic drift (A): Random walk, allele fixation and loss of alleles, the erosion of variation. Relationship between population size and genetic drift.

*8<sup>th</sup> week:* Evolutionary forces in small populations IV. Genetic drift (B): Bottleneck effect, founder effect, the subpopulation structure within the populations.

*9<sup>th</sup> week:* Evolutionary processes in a population system I. Genetic differentiation (A): The background of genetic differentiation, differentiation and isolation.

*10<sup>th</sup> week:* Evolutionary processes in a population system II. Genetic differentiation (B): The measures of genetic differentiation. Geometric and genetic distances, fixation index, Wright's F-statistics.

*11<sup>th</sup> week:* Evolutionary processes in a population system III. Migration: The genetic consequences of migration. Models of migration.

*12<sup>th</sup> week:* Habitat fragmentation. Metapopulation structure, models.

*13<sup>th</sup> week:* Selection in small populations. Adaptive and neutral variation.

*14<sup>th</sup> week:* Problems in nature conservation. Ex-situ and in situ nature conservation.

**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 two 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 seminars will be recorded by the leader.

Students have to **prepare presentation on selected subject** on a sufficient level.

In the end of the semester there is a test. Students have to sit for the tests

*- for a grade*

The course ends with a verbal **examination**.

**Person responsible for course:** Dr. Katalin Pecsénye, associate professor, PhD; Dr. Judit Bereczki, assistant professor, PhD

**Lecturer:** Dr. Katalin Pecsénye, associate professor, PhD  
Dr. Judit Bereczki, assistant professor, PhD