Curriculum of the Doctoral School of Biology at the University of Szeged (2016–)

“In doctoral training, students must earn at least 240 credits over eight semesters. The program consists of two phases: the first four semesters constitute the 'training and research' phase, and the second four semesters make up the 'research and dissertation' phase. At the end of the fourth semester, students must pass a comprehensive exam, which serves both as the conclusion of the training and research phase and as a prerequisite for entering the research and dissertation phase. This exam assesses the student’s academic and research progress. The doctoral dissertation must be submitted within three years following the comprehensive exam.” (Act CCVI of 2015 on the amendment of certain laws regulating education, published in Issue 195 of the Hungarian Gazette, page 26097)

EXPECTED LEARNING OUTCOMES UPON COMPLETION OF THE DOCTORAL DEGREE:

1. Knowledge
The graduate possesses in-depth, up-to-date theoretical and practical knowledge in the field of biology, with particular expertise in their chosen research area. Capable of critically interpreting, integrating, and advancing the current international scientific literature and research findings within the discipline. Demonstrates a thorough understanding of scientific research methodology, including experimental design, data analysis, and scientific communication standards.

2. Skills
Able to independently identify complex scientific problems, formulate research questions, and select appropriate methodologies for their solution. Capable of contributing original scientific knowledge, developing new theories or methods, and disseminating results through internationally recognized channels (e.g., conferences, peer-reviewed journals). Applies advanced tools, technologies, and modeling techniques relevant to biological research with a high level of proficiency.

3. Attitudes
Committed to scientific integrity, ethical research conduct, and transparency; conducts research in accordance with international academic standards. Open to interdisciplinary dialogue, collaborative research, and receptive to constructive feedback and peer review. Promotes knowledge sharing, engages in mentoring, and actively contributes to the scientific community.

4. Autonomy and Responsibility
Able to plan and execute independent research and assume leadership roles in research teams. Demonstrates autonomy in making scientific decisions and takes full responsibility for the professional and societal implications of their research outcomes. Prepared to assume leading roles in academic, research, or innovation sectors, both nationally and internationally.

Program Duration: 4 years (8 semesters) — **240 credits**

Discipline: Biology
Form of training: Doctoral (PhD)
Program objective: Preparation for obtaining a scientific degree
Mode of study: Full-time
Financing: State-funded or tuition-based
*Admission requirements***:** Master's degree and successful entrance examination
Program completion: Issuance of the absolutorium upon earning 240 credits

Training Programs of the Doctoral School of Biology:

- Biochemistry and Molecular Biology
- Genetics
- Microbiology
- Biotechnology
- Plant Biology
- Neurobiology
- Human Biology
- Ecology and Evolution

Study Structure of the Doctoral School

Each semester, the lecturers of the Doctoral School or, if necessary, invited national or international collaborators offer doctoral courses. These courses are announced based on the students' research fields. During the structured training period, each student must complete at least eight courses. A list of courses developed by the faculty is included in the Appendix. The list may be expanded with new courses, and course descriptions are regularly updated by the lecturers.

Credit System

In the Doctoral School, the credit system is aligned with the Regulations on Doctoral Training and the Awarding of Doctoral Degrees of the University of Szeged, ensuring the implementation of the principle of consistent assessment.
All academic requirements in the program are expressed in credits (study points), and credits may only be awarded for activities that conclude with evaluation (on a 3- or 5-grade scale). Over the eight semesters, a total of 240 credits must be earned to receive the absolutorium. During any given reporting period (semester), students must complete a minimum of 20 and a maximum of 45 credits.

If a student participates in a partial program abroad or at another university, the Doctoral School Council may grant an exemption from this requirement. The credit value of such courses is determined by the Council.
There are eight academic fields (training programs) within the Doctoral School of Biology. Students must select their courses from the module that corresponds to their chosen program.

Basic courses

PhD students must earn a total of **10 credits** by completing the foundation courses:

- *Molecular Cell Biology I* – Lecture – 5 credits
- *Molecular Cell Biology II* – Lecture – 5 credits

General courses - Module I

Students must complete a minimum of **12 credits** from the general courses in Module I, selecting courses according to their enrolled program:

- *Molecular Biology I* – Lecture – 3 credits
- *Genetics I* – Lecture – 3 credits
- *Microbiology I* – Lecture – 3 credits
- *Biotechnology I* – Lecture – 3 credits
- *Plant Biology I* – Lecture – 3 credits
- *Neurobiology I* – Lecture – 3 credits
- *Human Biology I* – Lecture – 3 credits
- *Ecology and Evolution I* – Lecture – 3 credits

Module II

Students must complete a minimum of **6 credits** from the specialized courses in Module II. These may also be fulfilled through courses offered by other doctoral schools at the university or through partial studies at other institutions (domestic or international).

- *Molecular Biology II* – Lecture – 3 credits
- *Genetics II* – Lecture – 3 credits
- *Microbiology II* – Lecture – 3 credits
- *Biotechnology II* – Lecture – 3 credits
- *Plant Biology II* – Lecture – 3 credits
- *Neurobiology II* – Lecture – 3 credits
- *Human Biology II* – Lecture – 3 credits
- *Ecology and Evolution II* – Lecture – 3 credits

Elective Courses

Students must complete a minimum of **3 credits** from elective courses:

- *PhD Elective Course* – Lecture – 3 credits

Note: The elective theoretical courses labeled **BDIT19** can be counted toward either module.

Research Work

A total of at least **160 credits** must be earned through research activities. The following courses are included in this category:

- **PhD Laboratory**: 20 hours/week – 20 credits per course. Students must complete **160 credits**.
- **Progress Report**: At the end of each academic year, the PhD student submits a written summary of their research activities, signed by both the student and the supervisor. Credit value: 3 credits. A total of **12 credits** must be earned.
- **Poster Presentation**: Credits can be awarded for active poster participation at conferences, provided the abstract is published in the conference proceedings. One poster equals 3 credits. A minimum of **3 credits** must be earned.
- **Scientific Article**: The PhD student must have at least two scientific articles published or accepted for publication in peer-reviewed journals with impact factor. The student must be the first author of at least one of them. Credit value per article: 5 credits.
- **Oral Presentation**: The PhD student may give presentations at conferences, department's or research group's seminars. Each presentation equals 3 credits. A minimum of **3 credits** must be earned.
- **Literature Review**: 5 hours/week – 5 credits. A total of **20 credits** must be earned.

Course List:

PhD Laboratory 1–4 – Practice – 20 credits
PhD Laboratory D 1–4 – Practice – 20 credits
Progress Report 1–2 – Consultation-based practice – 3 credits
Progress Report D 1–2 – Consultation-based practice – 3 credits
Poster 1, 2, … – Consultation-based practice – 3 credits
Poster D 1, 2, … – Consultation-based practice – 3 credits
Lecture 1, 2, … – Consultation-based practice – 3 credits
Lecture D 1, 2, … – Consultation-based practice – 3 credits
Paper 1, 2, … – Consultation-based practice – 5 credits
Paper D 1, 2, … – Consultation-based practice – 5 credits
Scientific Literature D 1–4 – Practice – 5 credits

Teaching Activity

A maximum of **24 credits** can be earned through teaching.
Leading a seminar or practical session for 1 hour per week over 14 weeks is worth **2 credits**.

- *Teaching* – Seminar – 2 credits
- *Teaching D* – Seminar – 2 credits

Courses to complete during the whole training

1st period: Training and research period (1-4. semester) min. 120 credits

Type of the course	Credits to complete	Courses (pieces)	Credit/course
Basic courses (BDIT01, 02)	10	2	5
General courses (BDIT03, 04, 05, 06, 07, 08, 22,23)	12	4	3
Specialized courses (BDIT9, 10, 11, 12, 13, 14, 24,25)	6	2	3
Elective courses (BDIT19)	3	1	3
Total:	**31**	**9**	

Type of the course	Credits to complete	Courses (pieces)	Credit/course
Laboratory 1,2,3,4	80	4	20
Progress report 1,2	6	2	3
Total:	**86**	**6**	

Type of the course	Credits to complete	Courses (pieces)	Credit/course
Lecture	min. 3	min. 1	3
Poster			3
Teaching			3
Paper			5
Total:	**3**	**1**	

Guide for taking courses in semesters

Autumn semester:

Name of the course	Credit to complete	Total (cr/semester)
Laboratory	20	min. 30
Basic + other courses	min. 10	

Spring semester:

Name of the course	Credit to complete	Total (cr/semester)
Laboratory	20	min. 30
Progress report	3	
Basic + other courses	min. 7	

2nd period: Research and dissertation (5-8. semester) min. 120 credits

Type of the course	Credits to complete	Courses (pieces)	Credit/course
Laboratory D 1,2,3,4	80	4	20
Progress report D 1,2	6	2	3
Sci. literature D 1,2,3,4	20	4	5
Total:	**106**	**10**	

Type of the course	Credits to complete	Courses (pieces)	Credit/course
Lecture D	min. 14	min. 4	3
Poster D			3
Teaching D			3
Paper D			5
Total*:	**14**	**4**	

**These courses can be repeated.*

Guide for taking courses in semesters

Autumn semester:

Name of the course	Credit to complete	Total (cr/semester)
Laboratory D	20	min. 30
Scientific literature D	5	
Other courses	min. 5	

Spring semester:

Name of the course	Credit to complete	Total (cr/semester)
Laboratory D	20	min. 30
Scientific literature D	5	
Progress report D	3	
Other courses	min. 2	

Note: **BDIT19 courses can substitute the general (=Module I.) and special (=Module II.) course**s.

(**Modules**: Molecular biology I., II. BDIT03, 09, Genetics I., II. BDIT04, 10, Microbiology I., II. BDIT05, 11, Biotechnology I., II. BDIT06, 12, Plant biology I., II. BDIT07, 13, Neurobiology I., II. BDIT08, 14, Humanbiology I., II. BDIT22, 24, Ecology and evolution I., II. BDIT23, 25)

Complex exam

After the first period. A successful exam is the condition for entering stage 2. The condition for the complex exam is to have completed at least 90 credits.

The dissertation/thesis has to be defended with 3 years after the complex exam.

Individual Doctoral Training

Program Duration: maximum 2 semesters

Total Credits: 240 credits
Upon successful admission, the student is awarded **40 credits**. These credits are granted based on previous scientific achievements and are recognized as completion of the following courses:

- *Paper* (5 credits)
- *Poster* (3 credits)
- *Lecture* (3 credits)

Courses for Individual Doctoral Candidates (80 credits):

1st Semester:
- *Paper 1–2* (5 + 5 credits)
- *Specialized Laboratory for Individual Candidates* (25 credits)

2nd Semester:
- *Consultation Preparing for the Dissertation Defence* (45 credits)

Comprehensive Exam: 120 credits

Total: 240 credits

Amendment to Section 49 of the Act on National Higher Education (Nftv.):

"(7a) The provision in paragraph (7), which requires that at least one-third (80 credits) of the total credits in doctoral education be earned within the given institution's doctoral program, does not apply in doctoral training."

This means that in doctoral education, the number of credits recognized based on prior studies or previously acquired knowledge may amount to up to 100% of the required 240 credits.

Based on the above, the Doctoral School Council has the authority to supplement the credits of individual doctoral candidates — in addition to the 120 credits earned for passing the comprehensive exam — with up to an additional 120 credits, thus reaching the full total of 240 credits.

ANNEX 1

Curriculum of the Doctoral School of Biology

Legend:

- **MK** – milestone
- **TT/KPR** – course or integrated training program
- **TE / Course Element** – component of a course
- **Compulsory** – name in **bold**
- **Compulsory elective** – name in **regular** font
- *Elective* – name in *italics*
- ***Specialization-specific compulsory milestone*** – name in ***bold italics***
- **++** – can be taken repeatedly
- **0,1,...** – recommended semester(s) and credit(s)
- **k** – credit points

Doctoral School of Biology (8 semesters) (X3B0_N_2016)

MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
MK-KEP **Training and research period**; to be fulfilled: min. 120k											
	MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
	MK-KRZ **Course**; to be fulfilled: min. 31k											
		MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
		MK-ALA **Basic courses**; to be fulfilled: min. 10k											
			BDIT01 **Molecular cell biology I.**; to be fulfilled min. 5k										
				BDIT01 **Molecular cell biology I.**, lecture 2 hours, exam ++					5				
			BDIT02 **Molecular cell biology II.**; to be fulfilled min. 5k										
				BDIT02 **Molecular cell biology II.**, lecture 2 hours, exam ++					5				
		MK-ALT **General courses**; to be fulfilled: min. 12k											
			BDIT03 Molecular biology I.; to be fulfilled min. 3k										
				BDIT03 **Molecular biology I.**, lecture 2 hours, exam ++					3				
			BDIT04 Genetics I.; to be fulfilled min. 3k										
				BDIT04 **Genetics I.**, lecture 2 hours, exam ++					3				
			BDIT05 Microbiology I.; to be fulfilled min. 3k										
				BDIT05 **Microbioology I.**, lecture 2 hours, exam ++					3				
			BDIT06 Biotechnology I.; to be fulfilled. 3k										
				BDIT06 **Biotechnology I.**, lecture 2 hours, exam ++					3				
			BDIT07 Plant Biology I.; to be fulfilled min. 3k										
				BDIT07 **Plant Biology I.**, lecture 2 hours, exam ++					3				
			BDIT08 Neurobiology I.; to be fulfilled min. 3k										
				BDIT08 **Neurobiology I.**, lecture 2 hours, exam ++					3				
			BDIT22 Human Biology I.; to be fulfilled min. 3k										
				BDIT22 **Human Biology I.**, Előadás minden félévben, 2 óra, Kollokvium					3				
			BDIT23 Ecology and Evolution I.; to be fulfilled min. 3k										
				BDIT23 **Ecology and Evolution I.**, lecture 2 hours, exam ++					3				
		MK-SPE **Specialized courses**; to be fulfilled: min. 6k											
			BDIT09 Molecular biology II.; to be fulfilled min. 3k										
				BDIT09 **Molecular biology II.**, lecture 2 hours, exam ++					3				
			BDIT10 Genetics II.; to be fulfilled min. 3k										
				BDIT10 **Genetics II.**, lecture 2 hours, exam ++					3				
			BDIT11 Microbiology II.; to be fulfilled min. 3k										

MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
		BDIT11 **Microbiology II.**, lecture 2 hours, exam ++						3			
	BDIT12	Biotechnology II.; to be fulfilled min. 3k									
		BDIT12 **Biotechnology II.**, lecture 2 hours, exam ++						3			
	BDIT13	Plant Biology II.; to be fulfilled min. 3k									
		BDIT13 **Plant Biology II.**, lecture 2 hours, exam ++						3			
	BDIT14	Neurobiology II.; to be fulfilled min. 3k									
		BDIT14 **Neurobiology II.**, lecture 2 hours, exam ++						3			
	BDIT24	Human Biology II.; to be fulfilled min. 3k									
		BDIT24 **Human Biology II.**, lecture 2 hours, exam ++						3			
	BDIT25	Ecology and Evolution II.; to be fulfilled min. 3k									
		BDIT25 **Ecology and Evolution II.**, lecture 2 hours, exam ++						3			
	MK-SZV	**Elective courses**; to be fulfilled: min. 3k									
	BDIT19	PhD elective course; to be fulfilled min. 3k									
		BDIT19 **PhD elective course**, lecture (each semester), 2 hours, exam ++						3			
	XD0010	General education courses PhD; to be fulfilled									
		XD0011 General education courses PhD, lecture (each semester), 2 hours, exam ++						2			
MK-KOK	**Research/teaching**; to be fulfilled: min. 89k										

MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
MK-MB	**Progress report**; to be fulfilled: min. 6k										
BDIT16	Progress report; to be fulfilled min. 3k										
		BDIT16 **Progress report**, consultation-based practice (each semester), evaluation – 3 grade scale ++						3			
MK-KM	**Research/teaching**; to be fulfilled: min. 3k										
BDIT17	Poster; to be fulfilled min. 3k										
		BDIT17 **Poster**, consultation-based practice (each semester), evaluation – 3 grade scale ++						3			
BDIT18	Lecture; to be fulfilled min. 3k										
		BDIT18 **Lecture**, consultation-based practice (each semester), evaluation – 3 grade scale ++						3			
BDIT20	Paper; to be fulfilled min. 5k										
		BDIT20 **Paper**, consultation-based practice (each semester), evaluation – 3 grade scale ++						5			
BDIT21	Teaching; to be fulfilled min. 2k										
		BDIT21 **Teaching**, seminar (each semester) 1 hour, evaluation – 3 grade scale ++						2			
MK-SZ	**PhD Laboratory**; to be fulfilled: min. 80k										
BDIT15	PhD Laboratory; to be fulfilled min. 20k										
		BDIT15 **PhD Laboratory**, practice (each semester), 20 hours, Practical grade ++						20			
MK-SZIG	**Complex exam**; to be fulfilled:										
BDIT33	**Compólex exam**; to be fulfilled										
		BDIT33 **Complex exam**, exam (each semester)						0			
MK-DISZ	**Research and dissertation period**; to be fulfilled: min. 120k										

MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
MK-KOK	**Research/teaching**; to be fulfilled: min. 120k										

MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
MK-KM	**Research/teaching (D)**; to be fulfilled: min. 14k										
BDIT28	Poster (D); to be fulfilled min. 3k							<<**BDIT33**			
		BDIT28 **Poster (D)**, consultation-based practice (each semester), evaluation – 3 grade scale ++								3	

MK	TT/KPR	Topic in the subject	0	1	2	3	4	5	6	7	8
		BDIT29 Lecture (D); to be fulfilled min. 3k									<<**BDIT33**
		BDIT29 **Lecture (D)**, consultation-based practice (each semester), evaluation – 3 grade scale ++								3	
		BDIT30 Cikk (D); to be fulfilled min. 5k									<<**BDIT33**
		BDIT30 **Paper (D)**, consultation-based practice (each semester), evaluation – 3 grade scale ++								5	
		BDIT32 Teaching (D); to be fulfilled min. 2k									<<**BDIT33**
		BDIT32 **Teaching (D)**, seminar (each semester) 1 hour, evaluation – 3 grade scale ++								2	
		MK-MB **Progress report (D)**; to be fulfilled: min. 6k									
		BDIT27 Progress report (D); to be fulfilled min. 3k									<<**BDIT33**
		BDIT27 **Progress report (D)**, consultation-based practice (each semester), evaluation – 3 grade scale ++								3	
		MK-SI **Scientific literature (D)**; to be fulfilled: min. 20k									
		BDIT26 Scientific literature (D); to be fulfilled min. 5k									<<**BDIT33**
		BDIT26 **Scientific literature (D)**, practice (each semester), 5 hours, Practical grade ++								5	
		MK-SZ **PhD Laboratory (D)**; to be fulfilled: min. 80k									
		BDIT31 PhD Laboratory (D); to be fulfilled min. 20k									<<**BDIT33**
		BDIT31 **PhD Laboratory (D)**, practice (each semester), 20 hours, Practical grade ++								20	

ANNEX 2

Courses Associated with the Training Modules of the Doctoral School of Biology at the University of Szeged

Each course may be assigned to multiple modules based on its thematic relevance and may also be offered under the "PhD Elective" code. Accordingly, a single course may have multiple codes. Apart from the basic courses, the course list is dynamic and subject to change. Students can find up-to-date information about currently available courses in the Neptun system.

Basic courses

Molecular cell biology I.

Vágvölgyi Csaba (University of Szeged, Department of Biotechnology and Microbiology)

Chromatin-associated architectural linker DNA proteins
Zsuzsanna Hamari PhD, associate professor, USz Department of Biotechnology and Microbiology
Studies on yeast mitochondrial genomes outline the first evolutionary events toward the development of eukaryotic chromosomes
Zsuzsanna Hamari PhD, associate professor, USz Department of Biotechnology and Microbiology
Biological energy production
Kornél Kovács PhD, DSc, emeritus professor, USz Department of Biotechnology and Microbiology
Metabolomics: aims, tools and application areas
András Szekeres PhD, associate professor, USz Department of Biotechnology and Microbiology
Key points and molecular mechanisms of plant ontogenesis
Jolán Csiszár PhD, associate professor, USz Department of Plant Biology
Microbial communication and chemotaxis
Péter Galajda PhD, senior research associate, BRC Institute of Biophysics
Sleep and circadian rhythms
Áron Szabó PhD, senior research associate, BRC Institute of Genetics
Biosynthesis of secondary metabolites in fungi
Tamás Papp PhD, full professor, USz Department of Biotechnology and Microbiology
G-protein signaling in plants and animals
AttilaFehér PhD, DSc, full professor, USz Department of Plant Biology
Prions in yeasts
Ilona Pfeiffer PhD, associate professor, USz Department of Biotechnology and Microbiology

Molecular cell biology II..

Vágvölgyi Csaba (University of Szeged, Department of Biotechnology and Microbiology)

Tumorbiology
Tibor Pankotai PhD, senior research associate, USZ, Albert Szent-Györgyi Medical School, Institute of Pathology
Chromatin and its role in transcription regulation
László Bodai PhD, associate professor, USZ, Department of Biochemistry and Molecular Biology
Stem cells: a life story
Melinda Pirity PhD, senior research associate, BRC, Institute of Genetics
Postsynthetic modifications in cell cycle control
Zoltán Lipinszki PhD, senior research associate, BRC, Institute of Biochemistry
Inflammasomes; structure, activation and mechanism of action
Attila Gácser PhD, full professor, USZ, Department of Biotechnology and Microbiology
Introduction to pain mechanisms
Karcsúné Kis Gyöngyi, PhD, senior lecturer, USZ, Department of Physiology, Anatomy and
Neuroscience
DNA repair
Ildikó Unk PhD, senior research associate, BRC, Institute of Genetics
The use of model organisms in research
Rita Sinka PhD, associate professor, USZ, Department of Genetics
Gonadal hormones and the nervous system

Árpád Párducz PhD, DSc, professor emeritus, BRC, Institute of Biophysics
Cell membrane, a fascinating supramolecular aggregate
Imre Gombos PhD, senior research associate, BRC, Institute of Biophysics
The structure and evolution of the cell nucleus
Péter Vilmos PhD, senior research associate, BRC, Institute of Genetics
Systems Biology and Experimental Evolution in the Fight Against Pathogens
Viktória Lázár PhD, Group Leader, HUN-REN Biological Research Centre, Institute of Biochemistry

Modul I. - II. (basic and specialized) and elective courses

Modern topics in life sciences

Walter Fruzsina (HUN-REN, BRC)

The "Modern Topics in Life Sciences" course is a formal journal club for PhD students. Course participants give an oral presentation in English (length: max. 15 min) of a freely selected research paper during each semester, followed by a discussion. The main point is to practice scientific presentation, how to give an oral talk, and how to summarize research data.

Practical course on presenting scientific lectures

Honti Viktor (HUN-REN, BRC)

The Institute of Genetics of the HUN-REN Biological Research Centre organizes the course, in which Ph.D. students participate in weekly meetings. The course aims to provide students with opportunities to practice delivering scientific talks, preparing posters, and writing articles in English. In the theoretical part of the course, we discuss the most important features of a good scientific talk, as well as potential pitfalls in presenting scientific work. We focus on institute seminars and short conference talks. In the practical part of the course, each student selects a published scientific paper and presents it in a 20-minute talk to an audience of PhD students. Alternatively, they can present their own PhD project. The presentation is followed by an open discussion and constructive criticism of both the slideshows and the delivery of the talks. Depending on the time of year, we discuss posters and abstracts of scientific work that the students will present at upcoming conferences. The requirements to complete the course include attendance at the Journal Club and the presentation of either a selected scientific article or a PhD project.

Cyanobacteria in science and biotechnology

Ughy Bettina, Domonkos Ildikó (HUN-REN, BRC)

Cyanobacteria in photosynthesis research, cyanobacterium as a model for plant chloroplasts.
Cell biology of cyanobacteria.
Cyanobacterial photosynthesis.
Structure of photosynthetic membranes; structure and function of membrane lipids in cyanobacteria. Proteomic and lipidomic investigations.
Role of carotenoids in cyanobacteria and plants.
Molecular biology of cyanobacteria.
Cyanobacterial cell division.
Application of cyanobacteria in biotechnology and their potential role as energy source.

Role of lipids in photosynthetic organisms

Ughy Bettina, Domonkos Ildikó (HUN-REN, BRC)

General structure of photosynthetic membranes, lipids and fatty acids; distribution of lipids.
Biosynthesis of fatty acids and lipids of thylakoid membranes.
Thylakoid lipid classes: PG, SQDG, DGDG and MGDG.
Other lipids in photosynthetic organisms.
Role of lipids in stress adaptation.
Membrane phases. Macroorganization of membranes –assembly of thylakoids.
Carotenoids.
Introduction of some investigation methods.

Role of plant peptides in symbiotic nitrogen fixation

Kereszt Attila (HUN-REN, BRC)

The aim of the course is to provide PhD students specializing in microbiology, plant biology, or molecular biology with more advanced knowledge on the topic of symbiotic nitrogen fixation.
Topics:
Details of the establishment of nitrogen-fixing symbiosis
Root nodules and nitrogen-fixing bacteroids, as well as their developmental types
The role of peptides in the process of symbiosis formation
Plant-derived antimicrobial peptides in the regulation of bacteroid differentiation

Biology of human pathogen protist parasites

Hamari Zsuzsanna (University of Szeged, Department of Biotechnology and Microbiology)

Brief description:
The one semester-long Parasitology curriculum provides a comprehensive knowledge about the human pathogen protists. The course covers the major topics of the lyfe cycle of parasites, the molecular pathomechanisms, the clinical manifestation-, the epidemiology-, prevention- and diagnostics of the related human diseases.
Detailed description:
General characterization of human pathogen protists (overview of cellular structures of amoebozoids, kinetoplastids, metamonada and apicomplexa, their motility, reproduction, life- cycles, virulence factors, pathology and intracellular survival strategies).
Characterization of Entamoeba histolytica, description of life-cycle, molecular pathomechanism, virulence factors, clinical manifestation of amoebiasis, diagnostics, epidemiology and prevention.
Characterization of Giardia lamblia, description of life-cycle, molecular pathomechanism, virulence factors, clinical manifestation of giardiasis, diagnostics, epidemiology and prevention.
Characterization of Trichomonas vaginalis, description of life-cycle, molecular pathomechanism, virulence factors, clinical manifestation of trichomoniasis, diagnostics, epidemiology and prevention.
Overview of cellular characteristical features, molecular mechanism of host invasion and intracellular survival strategy of Apicomplexa species.
Characterization of Cryptosporidium sp., description of life-cycle, molecular pathomechanism, virulence factors, clinical manifestation of cryptosporidiosis, diagnostics, epidemiology and prevention.
Characterization of Plasmodium sp., description of life-cycle, molecular pathomechanism, virulence factors, clinical manifestation of malaria, diagnostics, epidemiology and prevention.

History of malaria, overwiev of human genetic mutations and the related molecular mechanisms that endow humans to survive malaria.
Characterization of Toxoplasma gondii, description of life-cycle, molecular pathomechanism, virulence factors, clinical manifestation of toxoplasmosis, diagnostics, epidemiology and prevention.
Overview of cellular characteristical features-, life cycles and survival strategies of extracellular and intracellular Kinetoplastid parasites.
Characterization of Trypanosoma rhodesiense and T. gambiense, description of life-cycle, molecular pathomechanism, survival strategy in host, clinical manifestation of sleeping sickness, diagnostics, epidemiology and prevention.
Characterization of Trypanosoma cruzi, description of life-cycle, molecular pathomechanism, survival strategy in host cell, clinical manifestation of chaga's-disease, diagnostics, epidemiology and prevention.
Characterization of Leishmania sp., description of life-cycle, molecular pathomechanism, survival strategy in host cell, clinical manifestation of leishmaniasis, diagnostics, epidemiology and prevention.
Learning Outcomes:
Knowledge and Understanding:
The Parasitology course will provide detailed knowledge about the cellular features, life-cycles, virulence factors, pathology of human protist parasits. Students will gain the understanding of pathomechanism at molecular level through learning the up-to –date results of the recent molecular researches. The topics are designed and presented at a level suitable for PhD students working in life sciences. The lectures cover various areas of cellular and medical microbiology, epidemiology, molecular biology and immunology. Upon completion of the course, students will have a comprehensive knowledge about the microbiology of human parasite protists and a sound understanding of the pathomechanisms and the related clinical manifestations of the diseases at molecular level.
Skills and Attributes:
The students gain solid knowledge regarding the cellular features-, life cycles of human parasite protists. They become familiar with the molecular pathomechanisms of parasites and how the clinical manifastations relate to the patomechanism. They will understand the survival strategies of pathogens in the host and will develop an understanding of epidemiological concepts and prevention strategies.

The Structure and Function of Chloroplasts - Theory and Laborat

Garab Győző (HUN-REN, BRC)

Why photosynthesis? Photosynthesis and the evolution of life; transformation of the atmosphere of Earth; biogeochemical cycles.
An overview of photosynthesis: light reactions and dark reactions; block scheme, time-scale of photosynthesis.
Global aspects of photosynthesis: nature of solar radiation, solar energy spectra, variations in insolation, global solar energy utilization, atmospheric effects.
Introduction to photobiophysics I: electromagnetic radiation, basic processes, Jablonski diagram.
Introduction to photobiophysics II: photosynthetic pigments, spectral properties, energy transfer mechanisms.
Chlorophyll a fluorescence measurement using Handy Pea.
Analysis of OJIP curve.
Structure of photosynthetic complexes. Part A
Structure of photosynthetic complexes. (Part B)
Tutorial: Measurement of photosynthetic parameters using Pulse Amplitude modulator (PAM); Analysis of Photosynthetic parameters.
Light-harvesting antenna systems.
Cryo-EM, the interim future of structural determination of large complexes .

Isolation of chloroplast/thylakoids from spinach leaves using differential centrifugation.
Isolation of chloroplast/thylakoids from spinach leaves using differential centrifugation.
Assembly and architecture of the thylakoid membranes, lipid classes and stoichiometries.
Spectral characterization of thylakoid membranes. UV-Vis absorbance and Circular Dichroism.
The ultrastructure of thylakoid membrane systems: cyanobacteria, algae, higher plants.
Organization and assembly of chloroplast membrane proteins during greening.
Regulatory processes: adaptation and photoprotection of the photosynthetic apparatus - non-photochemical quenching mechanisms, state transitions.
Biophysical techniques in understanding photosynthesis mechanisms in different stress conditions.

Introduction to Neuroscience

Szegedi Viktor (University of Szeged, Department of Physiology, Anatomy and *Neuroscience*)

This introductory course will provide an overview of the current status of neuroscience as a scientific discipline. We will discuss the concepts associated with this field and briefly explore its history, including notable scientists. The course will cover lectures on neurodevelopment, electrophysiology, nociception, and higher cognitive functions. Additionally, relevant topics such as the current frontiers of modern neuroscience, the ethical issues they present, and potential future directions will be addressed.
Viktor Szegedi: Introduction
Celia Soares: Neurodevelopment
Karri Lamsa: Basics of electrophysiology
Gyöngyi Kis: Nociception I
Jose Antonio Lopez Garcia: Higher Cognitive Functions
Gyöngyi Kis: Nociception II
Jose Antonio Lopez Garcia: Higher Cognitive Functions
Viktor Szegedi: Current Frontiers of neuroscience

Fungal-based expression systems: From gene design to protein production

Galgóczi László (University of Szeged, Department of Biotechnology and Microbiology)

The main aim of the course to review fungal-based expression systems, and their potential application in (recombinant) protein production.
The students acquire knowledge about the types of fungal-based (heterologous) expression systems, their advantages and disadvantages in comparison with other protein expression systems.
The students are able to categorize and characterize the fungal-based expression systems regarding to proteins for production, and they are able to design genes for the protein production and possible protein modifications.
The students get theoretical knowledge about the process of (recombinant) protein production in fungal-based expression systems.
At the end of the course the students will be able to handle critically the advantages and disadvantages of fungal-based expression systems, furthermore they will be able to provide solutions for the arising expression problems.
The students acquire knowledge about the industrial application of fungal-based expression systems.
Topics:
Challenges of research on fungi in relation to human welfare and a sustainable bio-economy
Gene-protein design for fungal expression systems 1. (gene design strategies)
Gene-protein design for fungal expression systems 2. (considerations at gene level for protein

production)
Yeasts as cell factories - expression systems 1.
Yeasts as cell factories - expression systems 2.
Filamentous fungi as cell factories - expression systems 1.
Filamentous fungi as cell factories - expression systems 2.
The process of heterologous protein production by fungi: from vector cloning to large-scale expression 1. (vector design, cloning, transformation)
The process of heterologous protein production by fungi: from vector cloning to large-scale expression 2. (selection of transformants, optimization for production)

Human pathogenic fungi and diagnosis

Galgóczi László (University of Szeged, Department of Biotechnology and Microbiology)

The main aim of the course to review the topic, knowledge and methods of clinical mycology and its terminologies.
The students acquire knowledge about the epidemiology of fungal infections, causative agents and they will be able to characterize them.
The students get theoretical knowledge about the main diagnostic techniques in the identification of fungal infections and their methodologies.
The students are able to categorize and characterize the main antifungal agents, they know their antifungal mechanism, efficacy and therapeutic application. Furthermore, they get knowledge about the antifungal susceptibility testing methods.
After the acquired knowledge about the potential antifungal mechanisms, the students get information about alternative antifungal strategies.
Topics: History of clinical mycology. Subjects and methodologies of clinical mycology. Human pathogenic fungi and diagnosis.
Overview of history of clinical-medical mycology: Terminologies, history, most influential researchers in clinical-medical mycology.
Epidemiology: Development of different mycoses, incidence and prevention, critically ill patients (diabetes, haematological cancer, organ transplantation, HIV/AIDS).
Mycoses caused by yeasts: Mycoses caused by Candida, Cryptococcus. Rhodotorula, Saccharomyces, Malassezia, Trichosporon, Blastoschizomyces and Sporobolomyces spp.
Mycoses caused by filamentous fungi: Mucormycoses and entomophtoramycoses, aspergilloses, hyalohyphomycoses, phaeohyphomycoses.
Mycoses caused by dimorph fungi: Histoplazmycoses, blastomycoses, coccidioidomycoses, paracoccidioidomycoses, sporotrichoses, penicillioses.
Cutaneous and subcutaneous mycoses: Eumycetoma, chromoblastomycosess. Mycoses caused by Trichophyton and Microsporum spp.
Other mycoses: Pneumocystoses, other neglected infections caused by fungi.
Clinical diagnosis and fungal infections: Identification of fungi based on macro- and micromorphology. Molecular and other diagnostic techniques.
Clinical therapy of mycoses: Antifungal agents, investigation of antifungal efficacy, therapeutic applications, antifungal resistance mechanisms, alternative antifungal therapies.

Current aspects of the pathology of the enteric nervous system

Sótiné Bagyánszki Mária (University of Szeged, Department of Physiology, Anatomy and *Neuroscience*)

After the introductory lectures that deal with the structure and function of the enteric nervous system, the students read and discuss scientific papers connected with the enteric nervous system and diabetes, inflammatory bowel diseases (Crohn's disease and ulcerative colitis). During the course, the students prepare two short presentations of their choice relating to the course.
Topics
Introduction
Nervous tissue, Central Nervous System
Evolution of the nervous system, ontogenesis of the nervous system
Peripheral Nervous System
Enteric nervous system (ENS)
About our ENS Lab, visit the ENS Lab
Personal consultation (online, not obligatory, at a pre-arranged time)
Student presentations
Summary
Requirements
- participation of the seminar work
- 2 ppt presentations (10-15 min) literature: articles from the PubMed, from the last 5 years

Advanced genetics

Török Tibor (University of Szeged, Department of Genetics)

Introduction, Eukaryotic chromosomes
Genome organization
Mechanism of eukaryotic gene regulation
Extranuclear Inheritance
Genetics of the circadian clock
Genetics of the Immune System
Genetic Control of Development
Cancer Genetics
Introduction to Population Genetics

Molecular plant physiology

Fehér Attila (University of Szeged, Department of Plant Biology)

The Plant Molecular Physiology course is designed to introduce students into the life of plants. First, the genetic basis of the growth and development of plants is described. The first lecture explores the molecular regulatory factors with high importance in functioning of the genome and controlling the expression of genes. The following lectures discuss the demand of plants for minerals, the uptake and transport of water and nutrients, and the mechanisms and significance of photosynthesis. The main endogenous factors (plant hormones) and the most important exogenous signal (light) and related signalling events affecting plant life and adaptation are also discussed. The plant-specific aspects of these biological processes, their regulatory and signalling mechanisms will be described. Then, the key points of plant ontogenesis including growth and development, reproduction and senescence are highlighted.

Understanding how plants function internally and how they adapt to their environment provide deeper insight into their unique and vulnerable life strategy that is essential to maintain the human civilization and the whole biosphere on this planet.
Topics:
Why plant biology is interesting and important (An introduction)?
Genome organization and expression.
Mineral nutrition
Short and long-distance transport.
Photosynthesis
Photoperception
Plant hormones
Vegetative plant growth and development.
Flowering and plant reproduction.
Senescence, ripening and cell death.

Field trip

Feigl Gábor (University of Szeged, Department of Plant Biology)

The course provides an insight into the origin and diversity of the fauna and flora of the Pannonian Biogeographic Region, as well as the main factors threatening biodiversity in the Carpathian Basin. By visiting some natural and semi-natural habitats, students also gain practical insight into habitat conservation and management.
Topics:
European Ecoregions
The origin and diversity of the fauna and flora of the Pannon Ecoregion.
National Parks of Hungary
Important habitats (based on The Habitats Directive of the EU (Council Directive 92/43/EEC))
Cultural and economic importance
Field visiting I.
Field visiting II.

Exciting trends in cellular and molecular biology

Benyhe Sándor (HUN-REN, BRC)

The course is actually the Journal Club of the Institute of Biochemistry of the BRC.The organizer of the course is Ildikó Karcagi (email address: karcagi.ildiko@brc.hu).
Number of registrants: 20
Language of Course: English
The Course's aim is to help young scientist interpret scientific works and get familiar with the structure of scientific publications.