BULLETIN

UNIVERSITY OF DEBRECEN

ACADEMIC YEAR 2016/2017

MSc in Molecular Biology

FACULTY OF MEDICINE

Coordinating Center for International Education

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CHAPTER 1
INTRODUCTION

The aim of the University of Debrecen is to become a university of medical sciences committed to the prevention and restoration of health of the people, not only in its region but in the entire country.

In the past two decades both medical science and health care have entered a new era: the medical science of the 21st century. Molecular medicine is opening up and new possibilities are available for the diagnosis, prevention, prediction and treatment of the diseases. One can witness such a progress in medical sciences that has never been seen before. Modern attitudes in health care should be enforced in practice, including therapeutical approaches that consider the explanation and possible prevention of diseases, and attempt to comprehend and take the human personality into consideration. These approaches demand the application of the most modern techniques in all fields of the medical education.

All curricula wish to meet the challenges of modern times and they embody some very basic values. They are comprehensive; they take into consideration the whole human personality (body and soul) in its natural and social surroundings; and they are based upon the best European humanistic traditions. Moreover, all curricula prepare students for co-operation and teamwork.

With respect to education, both students and teachers are inspired to acquire higher levels of professionalism, precision, and problem solving skills, upon which the foundations of specialist training and independent medical practice can be built. This approach enables the assimilation of new scientific developments, facilitating further education and the continuous expansion of knowledge. The interplay of these factors ensures the ability to understand and handle the changing demands of health care.

With respect to research, the faculty members continuously acquire, internalize and subsume new knowledge, especially concerning the genesis, possible prevention and treatment of diseases. Moreover, new information aimed at improving, preserving and restoring the health of the society is also absorbed. The University of Debrecen is already internationally recognized in the fields of both basic and clinical research, and the clinicians and scientists of the University are determined to preserve this achievement. Special attention is given to facilitate and support the close co-operation of researchers representing basic science and clinical research, and/or interdisciplinary studies.

With respect to therapeutic practice, the main objective is to provide high quality, effective, up to date and much devoted health care to all members of the society, showing an example for other medical institutions in Hungary. One of the primary tasks is to continuously improve the actual standards of the diagnostic and therapeutic procedures and techniques, and to establish regional or even nationwide protocols.

With respect to serving the community, all faculty members wish to play a central role in shaping the policies of the health service; both within the region and in Hungary. They also want to ensure that sufficient number of medical doctors, dentists and other health care experts with university education is provided for the society.

With respect to the development, all employees strive for reinforcing those features and skills of the lecturers, scientists, medical doctors, health care professionals, collaborators and students which are of vital importance in meeting the challenges of medical education, research and therapy of the 21st century. These include humanity, empathy, social sensitivity, team-spirit, creativity, professionalism, independence, critical and innovative thinking, co-operation and management.

The organizational structure, including the multi-faculty construction of the institution, is a constantly improving, colorful educational environment, in which co-operation is manifest between the individual faculties and colleges, the various postgraduate programs as well as the molecular-

and medical biology educations.

HIGHER EDUCATION IN DEBRECEN
A Brief History
1235: First reference to the town of Debrecen in ancient charters.
1538: Establishment of the “College of Reformed Church” in Debrecen.
1567: Higher education begins in the College.
1693: Declaration of Debrecen as a “free royal town”.
1849: Debrecen serves as the capital of Hungary for 4 months.
1912: Establishment of the State University of Debrecen comprising the Faculties of Arts, Law, Medicine and Theology.
1918: Inauguration of the Main Building of the Medical Faculty by King Charles IV of Hungary.
1921: The Medical Faculty becomes operational.
1932: Completion of buildings of the campus.
1944: Although during the Second World War, Debrecen became the capital of Hungary again (for 100 days), the University itself is abandoned for a while.
1949: The only year when the University has five faculties.
1950: The Faculty of Law idles; the Faculty of Science is established.
1951: The University is split up into three independent organizations: Academy of Theology, Medical School, Lajos Kossuth University of Arts and Sciences.
1991: The “Debrecen Universitas Association” is established.
1998: The “Federation of Debrecen Universities” is founded.
2000. The federation is transformed into the unified “University of Debrecen” with all the relevant faculties and with some 20,000 students.

Debrecen is the traditional economic and cultural center of Eastern Hungary. In the 16th century Debrecen became the center of the Reformed Church in Hungary and later it was referred to as the "Calvinist Rome". The 17th century was regarded as the golden age of the city because Debrecen became the mediator between the three parts of Hungary: the part under Turkish occupation, the Kingdom of Hungary and the Principality of Transylvania. For short periods of time, Debrecen served twice as the capital of Hungary. Nowadays, with its population of approximately a quarter of a million, it is the second largest city in Hungary.
Debrecen is a unique city: although it has no mountains and rivers, its natural environment is rather interesting. One of the main attractions and places of natural uniqueness in Hungary is Hortobágy National Park, known as “puszta" (“plain”), which begins just in the outskirts of Debrecen. This is the authentic Hungarian Plain without any notable elevations, with unique flora and fauna, natural phenomena (e.g. the Fata Morgana), and ancient animal husbandry traditions. The region is unmatched in Europe, no matter whether one considers its natural endowments or its historic and ethnographic traditions. A very lovely part of Debrecen is the “Nagyerdő” (“The Great Forest”), which is a popular holiday resort. Besides a number of cultural and tourist establishments, luxurious thermal baths and spas, Nagyerdő accommodates the University campus too.
The history of higher education in Debrecen goes back to the 16th century when the College of the Reformed Church was established. The University Medical School of Debrecen has its roots in this spiritual heritage. It was in the year of the millennium of the establishment of Hungary (1896) when the foundation of the present University was decided. The University of Debrecen was established in 1912, initially having four faculties (Faculties of Arts, Law, Medicine and Theology). The University was officially inaugurated by King Charles IV of Hungary on October 23rd, 1918.
The educational activity at the University started in 1924, although the construction of the whole University was completed only in 1932. In 1951 the Faculty of Medicine became a self-contained,

independent Medical University for training medical doctors.
The special training of dentists began in 1976. As a further development the University Medical School established the Health College of Nyíregyháza in 1991. In 1993, as part of a nationwide program, the University was given the rights to issue scientific qualifications and new Ph.D. programs were also launched. Several new programs (e.g. the training of molecular biologists, pharmacists, general practitioners) were commenced in the '90s. The Faculty of Public Health was established in 1999, while the Faculty of Dentistry was founded in 2000.
The Faculty of Medicine celebrated the 90th anniversary of its foundation in October 2008 with a highly successful international scientific conference.

Education at the University of Debrecen
Debrecen, the second largest city of Hungary, is situated in Eastern Hungary. Students enrolled in the various programs (e.g. Medicine, Dentistry, Pharmacy, Public Health, Molecular Biology, etc.) study on a beautiful campus situated in the area called "Great Forest".
The Hungarian Government gives major priorities to the higher education of health sciences in its higher education policy. One of these priorities is to increase the ratio of college level training forms within the Hungarian higher education system. The governmental policy wishes to implement conditions in which the whole health science education system is built vertically from the lowest (post-secondary or certificate) to the highest (PhD-training) levels. In fact, this governmental policy was the reason behind the establishment of the new Health Science Education Center within the Federation of Debrecen Universities (DESZ), based partially on the intellectual resources of the University of Debrecen. The new programs – with specialized training for paramedics – will help to correct the balance of the Hungarian labor-market that became rather unsettled in the past few decades.
The Act of Higher Education (1993) has restored the rights of the medical universities to award postgraduate degrees and residency, and permission was also given to license Physicians' procedures. This kind of training required a new structure, a new administrative apparatus, and a suitable training center. The new residency programs were commenced in 1999.
The introduction of the credit system, starting in September 2003, has been mandatory in every Hungarian university, helping the quantitative and qualitative evaluation of the students' achievements. Admission requirements for Hungarian students are defined at national level, and they are applicable for every student wishing to be enrolled into the Medicine or Dentistry programs.
International students must pass an entrance exam in biology and (depending on their preference) in physics or chemistry. In some special cases it may be possible for the candidates to apply for transfer to higher years on the basis of their previous studies and achievements. International students study in English language. Entrance for certain courses of the Health College is also possible on the basis of a special evaluation (scoring) and an entrance interview.
The syllabuses and classes of all courses correspond to European standards. The total number of contact hours in medical education is over 5,500, which can be divided into three main parts: basic theoretical training (1st and 2nd year), pre-clinical subjects (3rd year) and clinical subjects (4th and 5th year) followed by the internship (6th year). The proportion of the theoretical and practical classes is 30% to 70%; whereas the students/instructors ratio is about 8/1. The first two years of dentistry education are similar to the medicine program, but the former contains a basic dental training that is followed by a three-year-long pre-clinical and clinical training. Besides the medicine and dentistry programs, there are several other courses also available, including molecular biology. The various Health College courses include more and more new curricula.
The Medicine program delivered in English and intended for international students was commenced in 1987; whereas the Dentistry and Pharmacy programs for international students started in 2000

and 2004, respectively. The curriculum of the English language Medicine program meets all the requirements prescribed by the European medical curriculum, which was outlined in 1993 by the Association of Medical Schools in Europe. Compared to the Hungarian program, the most important differences are:
-Hungarian language is taught,
-More emphasis is laid upon the tropical infectious diseases (as parts of the "Internal Medicine" and "Hygiene and Epidemiology" courses).
Otherwise, the English language curriculum is identical with the Hungarian one. The 6th year of the curriculum is the internship that includes Internal Medicine, Pediatrics, Surgery, Obstetrics and Gynecology, Neurology, and Psychiatry. The completion of these subjects takes at least 47 weeks, although students are allowed to finish them within a 24-month-long period. The successfully completed internship is followed by the Hungarian National Board Examination. Just like the rest of the courses, the internship is also identical in the Hungarian and English programs.
A one-year-long premedical (Basic Medicine) course, which serves as a foundation year, is recommended for those applicants who do not possess sufficient knowledge in Biology, Physics and Chemistry after finishing high school.
After graduation, several interesting topics are offered for PhD training, which lasts for three years. If interested, outstanding graduates of the English General Medicine and Dentistry programs may join these PhD courses ("English PhD-program"). Special education for general practitioners has been recently started and a new system is in preparation now for the training of licensed physicians in Debrecen.

The accredited PhD programs include the following topics:
-Molecular and Cell Biology; Mechanisms of Signal Transduction
-Microbiology and Pharmacology
-Biophysics
-Physiology-Neurobiology
-Experimental and Clinical Investigations in Hematology and Hemostasis
-Epidemiological and Clinical Epidemiological Studies
-Cellular- and Molecular Biology: Study of the Activity of Cells and Tissues under Healthy and Pathological Conditions
-Immunology
-Experimental and Clinical Oncology
-Public Health
-Preventive Medicine
-Dental Research

The PhD-programs are led by more than 100 accredited, highly qualified coordinators and tutors.

Medical Activity at the Faculty of Medicine
The Faculty of Medicine is not only the second largest medical school in Hungary, but it is also one of the largest Hungarian hospitals, consisting of 49 departments; including 18 different clinical departments with more than 1,800 beds. It is not only the best-equipped institution in the area but it also represents the most important health care facility for the day-to-day medical care in its region.
The Kenézy Gyula County Hospital (with some 1,400 beds) is strongly affiliated with the University of Debrecen and plays an important role in teaching the practical aspects of medicine. There are also close contacts between the University and other health care institutions, mainly (but not exclusively) in its closer region. The University of Debrecen has a Teaching Hospital Network consisting of 24 hospitals in Israel, Japan and South Korea.

It is also of importance that the University of Debrecen has a particularly fruitful collaboration with the Nuclear Research Institute of the Hungarian Academy of Sciences in Debrecen, allowing the coordination of all activities that involve the use of their cyclotron in conjunction with various diagnostic and therapeutic procedures (e.g. Positron Emission Tomography 'PET').

Scientific Research at the Faculty of Medicine

Scientific research is performed both at the departments for basic sciences and at the laboratories of clinical departments. The faculty members publish about 600 scientific papers every year in international scientific journals. According to the scientometric data, the Faculty is among the 4 best of the more than 80 Hungarian research institutions and universities. Lots of scientists reach international recognition, exploiting the possibilities provided by local, national and international collaborations. Internationally acknowledged research areas are Biophysics, Biochemistry, Cell Biology, Immunology, Experimental and Clinical Oncology, Hematology, Neurobiology, Molecular Biology, Neurology, and Physiology. The scientific exchange program involves numerous foreign universities and a large proportion of the faculty members are actively involved in programs that absorb foreign connections (the most important international collaborators are from Belgium, France, Germany, Italy, Japan, the UK and the USA).

CHAPTER 2
ORGANISATION STRUCTURE

RECTOR OF THE UNIVERSITY OF DEBRECEN	
Rector	Zoltán Szilvássy M.D., Ph.D., D.Sc.
Address	4032 Debrecen, Egyetem tér 1.
Phone	+36-52-416-060
Phone/fax	+36-52-416-490
E-mail	rector@unideb.hu

COORDINATING CENTER FOR INTERNATIONAL EDUCATION	
Director	Attila Jenei M.Sc., Ph.D.
Address	4032, Debrecen, Nagyerdei krt. 94.
Phone	+36-52-258-058
Fax	+36-52-414-013
E-mail	info@edu.unideb.hu

FACULTY OF MEDICINE	
Dean	László Mátyus M.D., Ph.D., D.Sc.
Address	4032, Debrecen, Nagyerdei krt. 98.
Phone	+36-52-258-086
Fax	+36-52-255-150
E-mail	dekan@med.unideb.hu

Vice Dean of General Affairs	Zoltán Szekanecz, M.D., Ph.D., D.Sc.
Address	4032, Debrecen, Nagyerdei krt. 98.
Phone	+36-52-255-091
Fax	+36-52-255-091
E-mail	dekan@med.unideb.hu

Vice-Dean for Educational Affairs	Zoltán Papp M.D., Ph.D., D.Sc.
Address	4032, Debrecen, Nagyerdei krt. 98.
Phone	+36-52-255-978

Fax	+36-52-255-978
E-mail	dekan@med.unideb.hu
Vice-Dean of Scientific Affairs	László Virág M.D., Ph.D., D.Sc.
Address	4032, Debrecen, Nagyerdei krt. 98.
Phone	+36-52-417-345
Fax	+36-52-412-566
E-mail	dekan@med.unideb.hu
Dean’s advisor	Endre Nagy M.D.,Ph. D., D.Sc.
Address	4032, Debrecen, Nagyerdei krt. 98.
Phone	+36-52-417-717/54166
Fax	+36-52-419-807
E-mail	dekan@med.unideb.hu
DEAN'S OFFICE OF THE FACULTY OF MEDICINE	
Head of Directory Office	Katalin Juhász M.A.
Address	4032, Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-258-085, +36-52-255-150
E-mail	kjuhasz@edu.unideb.hu
REGISTRAR'S OFFICE	
Head of Registrar's Office	Csilla Kerékgyártó M.D.
Address	4032, Debrecen, Nagyerdei krt. 94.
Phone/Fax	+36-52-258-001
E-mail	kerekgy@med.unideb.hu
FACULTY OF DENTISTRY	
Dean	Csaba Hegedűs M.D., L.D.S.,Ph.D.,
Address	4032 Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-255-208
E-mail	hegedus.csaba.prof@dental.unideb.hu

Vice-Dean for Educational Affairs	István Tornai M.D.,Ph.D.
Address	4032 Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-255-208
E-mail	itornai@med.unideb.hu

Vice-Dean for General Affairs	Pál Redl M.D., L.D.S., Ph.D.
Address	4032 Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-255-208
E-mail	redl.pal@dental.unideb.hu

FACULTY OF PHARMACY

Dean	Miklós Vecsernyés Pharm.D., Ph.D., D.Sc.
Address	4032 Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-411-717/54033
E-mail	vecsernyes.miklos@pharm.unideb.hu

Vice-Dean For General and Developement Affairs	Gábor Halmos Pharm.D,. Ph.D
Address	4032 Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-411-600/55292
E-mail	halmos.gabor@pharm.unideb.hu

Vice-Dean for Educational Affairs	Ildikó Bácskay Pharm.D., Ph.D.
Address	4032 Debrecen, Nagyerdei krt. 98.
Phone/Fax	+36-52-411-600/54034
E-mail	bacskay.ildiko@pharm.unideb.hu

FACULTY OF PUBLIC HEALTH

Dean	Margit Balázs Msc.,Ph.D., D.Sc.
Address	4028 Debrecen, Kassai út 26/b.
Phone	+36-52-460-194
Fax	+36-52-460-195
E-mail	balazs.margit@sph.unideb.hu

Vice-Dean	Attila Bánfalvi MA., Ph.D.

Address	4032, Debrecen, Móricz Zsigmond. krt. 22.
Phone	+36-52-411-600
Fax	+36-52-255-487
E-mail	banfalvi.attila@sph.unideb.hu

FACULTY OF HEALTH

Dean	Imre Semsei, D.Sc.
Address	4400 Nyíregyháza, Sóstói u. 2-4.
Phone	+36-42-598-235
Fax	+36-42-408-656
E-mail	dekan@foh.unideb.hu

Vice-Dean for Scientific Affairs	János Kiss Ph.D.
Address	4400 Nyíregyháza, Sóstói út 2-4.
Phone	+36-42-598-235
Fax	+36-42-408-656
E-mail	kiss.janos@foh.unideb.hu

Vice-Dean for Educational Affairs	Attila Sárváry Ph.D.
Address	4400 Nyíregyháza, Sóstói út 2-4.
Phone	+36-42-598-235
Fax	+36-42-408-656
E-mail	sarvary.attila@foh.unideb.hu

Vice-Dean for General and Development Affairs	Gergely Fábián Ph.D.
Address	4400 Nyíregyháza, Sóstói út 2-4.
Phone	+36-42-598-235
Fax	+36-42-408-656
E-mail	fabian.gergely@csello.hu

FOREIGN MEDICAL STUDENT ASSOCIATION (FMSA)

Address	4032 Debrecen, Móricz Zsigmond krt. 22. III.sz. Markusovszky Kollégium
Phone	+36-52-411-717/55376

Fax	+36-52-255-028
Internet	www.fmsa.hu
E-mail	info@fmsa.hu

KENÉZY LIFE SCIENCES LIBRARY

Address	4032 Debrecen, Egyetem tér 1.
Phone/Fax	+36-52-518-610, +36-52-518-605
E-mail	kenezy@lib.unideb.hu
Internet	http://kenezy.lib.unideb.hu

CHAPTER 3
ADMINISTRATIVE UNITS

REGISTRAR'S OFFICE

Nagyerdei krt. 94., Debrecen, 4032, Tel: +36-52-258-020
E-mail: eduoffice@med.unideb.hu;info@med.unideb.hu

Head of Registrar's Office	Ms. Csilla Kerékgyártó M.D.
Vice-Head of Registrar's Office	Ms. Edit Fábián M.A.
Secretary	Ms. Tünde Fekete M.Sc.
English Program Officer	Ms. Zsófia Galaczi M.A.
	Ádám Richárd Jasák B.A.
	Ms. Éva Ludánszki
	Ms. Réka Rónai M.Sc.
Hungarian Program Officer	Ms. Marianna Baloghné Holhós M.A.
	Ms. Zsuzsa Barta B.A.
	Tamás Buka M.A.
	Ms. Judit Derzsi M.A.
	Ms. Anikó Karcza B.Sc.
	Ms. Alexandrea Kulcsár-Szemán M.Sc.
	Ms. Réka Mosolygó M.A.
	Ms. Anna Mária Pásztori B.Sc.
Center for Specialization and Further Education Officer	Ms. Regina Csató
	Ms. Szabina Királyné Sári B.A.
	Ms. Tímea Sólyomné Dihen B.A.
	Ms. Erzsébet Takács-Szabó B.A.
	Ms. Ibolya Takácsné Csatári

COORDINATING CENTER FOR INTERNATIONAL EDUCATION

Nagyerdei krt. 94., Debrecen, 4032
Telephone: +36-52-258-058 Fax: +36-52-414-013
E-mail: info@edu.unideb.hu, Web: www.edu.unideb.hu

Director	Prof. Attila Jenei Ph.D.
Program Coordinator	Prof. Ferenc Erdődi Ph.D, D.Sc.

BMC Coordinator	Ms.	Beáta Lontay Ph.D.
Manager Assistants	Ms.	Anna Kapitány M.Sc.
	Ms.	Andrea Tiba B.Sc.
Contract&Marketing Coordinator		Ábrahám Gergely Varga J.D.
Financial Coordinator	Ms.	Rita Kovács J.D.
Agent Coordinator		József Harmati J.D.
English Program Coordinators	Ms.	Dóra Benkő B.A. (Admissions, Visa issues, BMC)
	Ms.	Adrienn Gagna-Szakó M.Sc. (Admissions, BMC, US Loans, Wyckoff HMC Applications)
	Ms.	Anett Galvácsi M.A (Tuition fee, Financial Certificates, Refunds, USMLE Coordinator)
	Ms.	Katalin Györe M.A. (Admissions, Visa issues, BMC)
	Ms.	Krisztina Németh M.Sc. (Bulletin)
	Ms.	Enikő Sallai M.Sc. (Tuition fee, Health Insurance)
	Ms.	Bella Brigitta Szilágyi M.A. (Stipendium Hungaricum Coordinator)
IT Project Coordinator		Imre Szűcs B.Sc.

CHAPTER 4
FACULTY OF MEDICINE - DEPARTMENTS OF BASIC SCIENCES

DEPARTMENT OF ANATOMY, HISTOLOGY AND EMBRYOLOGY

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-255-567
Web: http://www.anat.dote.hu

Associate Professor, Head of the Department		Péter Szűcs M.D., Ph.D.
Full Professor, Head of Oral Anatomy Division	Ms.	Klára Matesz M.D., Ph.D., D.Sc.
Full Professor		Miklós Antal M.D., Ph.D., D.Sc.
Professor Emeritus		István Földes M.D., Ph.D., D.Sc.
		László Módis M.D., Ph.D., D.Sc.
		György Székely M.D., Ph.D., D.Sc., M.H.A.Sc.
Associate Professor		András Birinyi M.Sc., Ph.D.
		Szabolcs Felszeghy Ph.D., D.D.S.
		Zoltán Kisvárday M.Sc., Ph.D., D.Sc.
		Ervin Wolf M.Sc., Ph.D.
	Ms.	Róza Zákány M.D., Ph.D.
Assistant Professor	Ms.	Krisztina Holló M.Sc., Ph.D.
		Tamás Juhász M.Sc., Ph.D.
		Csaba Matta M.Sc., Ph.D.
		Zoltán Mészár M.Sc., Ph.D.
Postgraduate Lecturer	Ms.	Cintia Angel M.Sc.
	Ms.	Zsófia Antal M.D., Ph.D.
	Ms.	Anita Balázs M.Sc., Ph.D.
		Botond Gaál M.Sc., Ph.D.
	Ms.	Krisztina Hegedűs M.Sc.
		Zoltán Hegyi M.Sc., Ph.D.
	Ms.	Edina Karanyecz M.Sc.
	Ms.	Éva Katona M.Sc.
	Ms.	Szilvia Kecskés M.Sc., Ph.D.
	Ms.	Annamária Kenyeres M.Sc.
	Ms.	Lívia Kicska M.Sc.
	Ms.	Gréta Kis M.Sc.

	Ms.	Ildikó Papp M.Sc., Ph.D.
	Ms.	Éva Rácz M.Sc., Ph.D.
	Ms.	Zsanett Sólyom M.Sc.
	Ms.	Csilla Somogyi M.Sc.
	Ms.	Ildikó Wéber M.Sc., Ph.D.
Junior Scientific Officer	Ms.	Nóra Dobrosi M.Sc.
		László Ducza M.Sc.
		Zsolt Kocsis M.D.
		Roland Takács M.Sc.
Invited Lecturer		Gary Kish M.D.
Course Director		Tamás Juhász M.Sc., Ph.D. (Macroscopic Anatomy)
		Zoltán Kisvárday M.Sc., Ph.D., D.Sc. (Neurobiology)
		Ervin Wolf M.Sc., Ph.D. (Histology and Embryology)
PhD Student	Ms.	Klaudia Dócs M.Sc.
	Ms.	Javdani Fariba M.D.
	Ms.	Andrea Gajtkó M.Sc.
		Tibor Hajdú M.D.
	Ms.	Andrea Hunyadi M.Sc.
		Mohit Srivastava M.Sc.
	Ms.	Rita Varga M.Sc.
Academic Advisor for 1st year medical and dental students	Ms.	Gréta Kis M.Sc.
Academic Advisor for 2nd year medical and dental students	Ms.	Mónika Szakadát M.Sc.

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-416-432
E-mail: tokes@med.unideb.hu, Web: http://bmbi.med.unideb.hu

Full Professor, Head of Department		József Tőzsér M.Sc., Ph.D., D.Sc.
Head of Dental Biochemistry Division	Ms.	Zsuzsa Szondy M.D., Ph.D., D.Sc.
Full Professor		Endre Barta M.Sc., Ph.D.
		László Fésüs M.D., Ph.D., D.Sc., M.H.A.Sc.
	Ms.	Mónika Fuxreiter M.Sc., Ph.D., D.Sc.

		László Nagy M.D., Ph.D., M.H.A.Sc.
Associate Professor		Zoltán Balajthy M.Sc., Ph.D.
	Ms.	Réka Révészné Tóth M.Sc., Ph.D.
		István Szatmári M.Sc., Ph.D.
Assistant Professor		Bálint Bálint L. M.D., Ph.D.
	Ms.	Éva Csősz M.Sc., Ph.D.
		Róbert Király M.Sc., Ph.D.
		Zsolt Sarang M.Sc., Ph.D.
	Ms.	Beáta Scholtz M.Sc., Ph.D.
		Lóránt Székvölgyi M.Sc., Ph.D.
		Lajos Széles M.Sc., Ph.D.
	Ms.	Szilvia Tőkés M.Sc., Ph.D.
Senior Research Fellow		András Mádi M.Sc., Ph.D.
Research Fellow	Ms.	Beáta Bartáné Tóth M.Sc., Ph.D.
		Máté Demény M.D.,Ph.D.
		Márton Miskei M.Sc., Ph.D.
		Szilárd Póliska M.Sc., Ph.D.
	Ms.	Mónika Szentandrássyné Gönczi M.Sc., Ph.D.
		Tamás Varga M.Sc., Ph.D.
Junior Research Fellow	Ms.	Rita Hegymeginé Elek M.Sc.
	Ms.	Krisztina Joóné Matúz M.Sc., Ph.D.
	Ms.	Beáta Kiss M.Sc.
		Endre Károly Kristóf M.D.
	Ms.	Krisztina Lenténé Köröskényi M.Sc., Ph.D.
		Mohamed Faisal Mahdi M.D.
	Ms.	Ágnes Mosolygó-Lukács M.Sc.
		János Mótyán M.Sc., Ph.D.
		Gergely Nagy M.Sc.
		Attila Pap M.Sc.
	Ms.	Éva Péntek-Garabuczi M.Sc., Ph.D.
Biologist		Tamás Kerekes M.Sc.
	Ms.	Erzsébet Mátyás M.Sc.
	Ms.	Éva Nagy M.Sc.
	Ms.	Tímea Silye-Cseh M.Sc.

PhD Student	Viktor Ambrus M.Sc.
	Ms. Dóra Bojcsuk M.Sc.
	Pál Botó M.Sc.
	Ms. Zsófia Budai M.Sc.
	Ms. Mária Csumita M.Sc.
	Tamás Csuth M.Sc.
	Erik Czipa M.Sc.
	Ms. Katalin Dánielné Sándor M.Sc.
	Ms. Eszter Deák M.D., M.Sc.
	Norbert Duró M.Sc.
	Ms. Ergulen Elvan M.Sc.
	Ms. Edina Erdős M.Sc.
	Ms. Lívia Gazda M.Sc.
	Ms. Mária Golda M.Sc.
	László Halász M.Sc.
	Szabolcs Hetey M.Sc.
	Attila Horváth M.Sc.
	József Horváth M.Sc.
	Ms. Monroy Ixchelt Cuaranta M.Sc.
	Ms. Bernadett Jakob M.Sc.
	Károly Jambrovics M.Sc.
	Gergely Joós M.D.
	Gergő Kalló M.Sc.
	Norbert Kassay M.Sc.
	Thangarajan Kiruphagaran M.Sc.
	Ms. Ágnes Klusóczki M.Sc.
	Ms. Lilla Ozgyin M.Sc.
	Andreas Patsalos M.Sc.
	Ms. Rashmi Rashmi M.Sc.
	Tibor Sághy M.Sc.
	Ms. Mária Szatmári Tóth M.Sc.
	Ms. Zsófia Szojka M.Sc.
	Ms. Erika Takács M.Sc.
Academic Advisor	Ms. Szilvia Tőkés M.Sc., Ph.D. (E-mail: tokessz@dote.hu, Ext.:64439)

DEPARTMENT OF BIOPHYSICS AND CELL BIOLOGY

Egyetem tér 1., Debrecen, 4032

Full Professor, Head of Department		János Szöllősi M.Sc., Ph.D., D.Sc., M.H.A.Sc.
Full Professor		Attila Jenei M.Sc., Ph.D.
		György Vereb M.D., Ph.D., D.Sc.
Professor Emeritus		Sándor Damjanovich M.D., Ph.D., D.Sc., M.H.A.Sc.
Associate Professor		Zsolt Bacsó M.D., Ph.D.
Assistant Professor		Zsolt Fazekas M.Sc., Ph.D.
		Péter Hajdu M.Sc., Ph.D.
Assistant Lecturer	Ms.	Ágnes Tóth M.Sc., Ph.D.
Research Fellow	Ms.	Beáta Mészáros M.Sc., Ph.D.
	Ms.	Ágnes Nagyné Dr. Szabó M.Sc., Ph.D.
		Pál Pap M.Sc., Ph.D.
	Ms.	Tímea Váradi M.Sc., Ph.D.
	Ms.	Barbara Zsebik M.Sc., Ph.D.
Junior Research Fellow		László Ujlaky-Nagy M.D.
		Tamás Kovács M.D.
	Ms.	Julianna Volkó M.Sc.
Biologist		Gábor Szalóki M.Sc.
Bioimaging expert		Gábor Mocsár M.Sc..
PhD Student		András Balajthy M.D.
		Csaba Bankó M.Sc.
		István Csomós M.Sc.
	Ms.	Ágota Csóti M.Sc.
	Ms.	Erfaneh Firouzi Niaki D.Pharm.
	Ms.	Tímea Hajdu M.Sc.
		Péter Nánási M.D.
		Zoltán Dénes Pethő M.D.
		István Rebenku M.Sc.
	Ms.	Tímea Szendi-Szatmári M.Sc.
		Szabolcs Tarapcsák M.Sc.
		Gábor Tóth M.D.

	Ms.	Orsolya Vörös M.Sc.
	Ms.	Florina Zákány M.D.
Visiting Lecturer		László Bene M.Sc., Ph.D.
		Zoltán Krasznai M.Sc., Ph.D.
Academic Advisor		Zsolt Fazekas M.Sc., Ph.D.

Division of Biomathematics

Egyetem tér 1., Debrecen, 4032, Tel: +36 52 258 603
E-mail: biophysedu@med.unideb.hu, Web: http://biophys.med.unideb.hu

Full Professor, Head of Division		László Mátyus M.D., Ph.D., D.Sc.
Full Professor		Péter Nagy M.D., Ph.D., D.Sc.
Senior Research Fellow	Ms.	Andrea Dóczy-Bodnár M.Sc., Ph.D.
Teaching assistant	Ms.	Enikő Nizsalóczki M.Sc.

Division of Biophysics

Egyetem tér 1., Debrecen, 4032, Tel: +36 52 258 603
E-mail: biophysedu@med.unideb.hu, Web: http://biophys.med.unideb.hu

Full Professor, Head of Division		György Panyi M.D., Ph.D., D.Sc.
Assistant Professor		Zoltán Varga M.Sc., Ph.D.
Assistant Lecturer		Ferenc Papp M.Sc., Ph.D.
		G. Tibor Szántó M.Sc., Ph.D.
		Árpád Szöőr M.D., Ph.D.
Senior Research Fellow		György Vámosi M.Sc., Ph.D.

Division of Cell Biology

Egyetem tér 1., Debrecen, 4032, Tel: +36 52 258 603
E-mail: biophysedu@med.unideb.hu, Web: http://biophys.med.unideb.hu

Full Professor, Head of Division		Gábor Szabó M.D., Ph.D., D.Sc.
Assistant Professor	Ms.	Katalin Goda M.Sc., Ph.D.
Assistant Lecturer	Ms.	Éva Hegedüs M.Sc., Ph.D.
Biologist		László Imre M.Sc.

DEPARTMENT OF HUMAN GENETICS

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-416-531
E-mail: nagy.balint@med.unideb.hu, Web: http://www.genetics.dote.hu

Associate Professor, Head of Department		Bálint Nagy M.Sc., Ph.D. habil., D.Sc.
Full Professor		Sándor Biró M.Sc., Ph.D., D.Sc.
		László Takács M.D., Ph.D., D.Sc., M.H.A.Sc.
Professor Emeritus		György Barabás M.Sc., Ph.D., D.Sc.
Associate Professor		András Penyige M.Sc., Ph.D.
Assistant Professor	Ms.	Zsuzsanna Birkó M.Sc., Ph.D.
	Ms.	Judit Keserű M.Sc., Ph.D.
Assistant Lecturer		Gergely Buglyó M.D., Ph.D.
	Ms.	Melinda Paholcsek M.Sc., Ph.D.
	Ms.	Melinda Szilágyi-Bónizs M.Sc., Ph.D.
	Ms.	Krisztina Szirák M.Sc., Ph.D.
Molecular Biologist	Ms.	Beáta Soltész M.Sc.
Invited Lecturer		Zsigmond Fehér M.D., Ph.D.
		József Schlammadinger M.D., Ph.D.
		György Vargha M.D., Ph.D.
		Sándor Vitális M.D., Ph.D.
PhD Student		Gábor Fidler M.Sc.
Academic Advisor		András Penyige M.Sc., Ph.D. (BMC, Biology, Human Genetics)
Academic Advisor for 1st year medical and dental students		Sándor Biró Ph.D., D.Sc.

DEPARTMENT OF IMMUNOLOGY

Egyetem tér 1., Debrecen, 4032, Tel: +36-52-417-159
Web: www.immunology.unideb.hu

Full Professor, Head of Department		Tamás Bíró M.D., Ph.D., D.Sc.
Full Professor	Ms.	Éva Rajnavölgyi M.Sc., Ph.D., D.Sc.
Associate Professor		Attila Bácsi M.Sc., Ph.D.
		Árpád Lányi M.Sc., Ph.D.

Assistant Lecturer	Ms. Zsófia Agod M.Sc.
	Ms. Tünde Fekete M.Sc., Ph.D.
	Attila Szabó M.Sc., Ph.D.
	Ms. Aliz Varga M.Sc., Ph.D.
Research Fellow	Péter Gogolák M.Sc., Ph.D.
	Gábor Koncz M.Sc., Ph.D.
	Ms. Kitti Pázmándi M.Sc., Ph.D.
Research Assistant	Ms. Adrienn Gyöngyösi M.Sc.
PhD Student	Pál Krisztián Bene M.Sc.
	Ms. Eszter Boldizsár
	Ms. Noémi Miltner M.Sc.
	Máté István Sütő M.Sc.
	Ms. Márta Tóth M.Sc.
	Ms. Anett Türk-Mázló M.Sc.
Academic Advisor	Gábor Koncz M.Sc., Ph.D.

DEPARTMENT OF MEDICAL CHEMISTRY

Egyetem tér 1., Debrecen, 4010, Tel: +39-52-412-345
E-mail: medchem@unideb.hu, Web: medchem.unideb.hu

Full Professor, Head of Department	László Virág M.D., Ph.D., D.Sc.
Full Professor	Viktor Dombrádi M.Sc., Ph.D., D.Sc.
	Ferenc Erdődi M.Sc., Ph.D., D.Sc.
	Pál Gergely M.Sc., Ph.D., D.Sc., M.H.A.Sc.
Associate Professor	Péter Bay M.Sc., Ph.D.
	Ms. Csilla Csortos M.Sc., Ph.D.
	Ms. Ilona Farkas M.Sc., Ph.D.
Assistant Professor	Ms. Éva Bakó M.Sc., Ph.D.
	Ms. Edina Bakondi M.Sc., Ph.D.
	Tibor Docsa M.Sc., Ph.D.
	Csaba Hegedűs M.Sc., Ph.D.
	Ms. Andrea Kiss M.Sc., Ph.D.
	Endre Kókai M.Sc., Ph.D.
	Ms. Beáta Lontay M.Sc., Ph.D.
	Ms. Krisztina Tar M.Sc., Ph.D.
Assistant Lecturer	Bálint Bécsi M.Sc., Ph.D.

	Ms.	Karolina Cseri M.Sc.
	Ms.	Judit Iván M.Sc., Ph.D.
Research Fellow	Ms.	Anita Boratkó M.Sc., Ph.D.
	Ms.	Edit Kapitányné Mikó M.Sc., Ph.D.
	Ms.	Katalin Kovács M.Sc., Ph.D.
		Dénes Nagy M.Sc., Ph.D.
		András Vida M.Sc., Ph.D.
Junior Research Fellow	Ms.	Petra Lakatos M.Sc.
	Ms.	Adrienn Sipos M.Sc.
Invited Lecturer		Béla Tóth M.Sc., Ph.D.
PhD Student		Tamás Fodor M.Sc.
		Dániel Horváth M.Sc.
		Tamás Kéki M.Sc.
		Zoltán Kónya M.Sc.
	Ms.	Tünde Kovács M.Sc.
	Ms.	Judit Márton M.Sc.
	Ms.	Lilla Nikoletta Nagy M.Sc.
	Ms.	Margit Péter M.Sc.
	Ms.	Katalin Petrényi M.Sc.
		Zsolt Regdon M.Sc.
	Ms.	Ildikó Szabó M.Sc.
		István Tamás M.Sc.
	Ms.	Emese Tóth M.Sc.
	Ms.	Zsuzsanna Valkó M.Sc.
Academic Advisor	Ms.	Éva Bakó M.Sc., Ph.D.

DEPARTMENT OF MEDICAL MICROBIOLOGY

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-255-425
E-mail: mikro@dote.hu, Web: go.unideb.hu

Associate Professor, Head of Department		József Kónya M.D., Ph.D.
Professor Emeritus		Lajos Gergely M.D., Ph.D., D.Sc.
Associate Professor		László Majoros M.D., Ph.D.
	Ms.	Judit Szabó M.D., Ph.D.
		György Veress M.Sc., Ph.D.
Assistant Professor	Ms.	Eszter Csoma M.Sc., Ph.D.

		Gábor Kardos M.D., Ph.D.
	Ms.	Krisztina Szarka M.Sc., Ph.D.
Assistant Lecturer	Ms.	Zsuzsanna Dombrádi M.Sc., Ph.D.
	Ms.	Eszter Gyöngyösi M.Sc., Ph.D.
		Renátó Kovács M.Sc., Ph.D.
	Ms.	Brigitta László M.Sc., Ph.D.
Research Fellow	Ms.	Anita Szalmás M.Sc., Ph.D.
Biologist	Ms.	Cecilia Miszti M.Sc.
		Levente Szakács M.Sc.
Resident	Ms.	Evelin Bukta M.D.
Specialist	Ms.	Anita Kozák M.D.
Academic Advisor of Faculty of Medicine		György Veress M.Sc., Ph.D.
Academic Advisor of Faculty of Dentistry		György Veress M.Sc., Ph.D.
PhD Student	Ms.	Alíz Bozó M.Sc.
	Ms.	Dorottya Franyó M.Sc.
Academic Advisor of Faculty of Pharmacy		László Majoros M.D., Ph.D.

DEPARTMENT OF PHARMACOLOGY AND PHARMACOTHERAPY
Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-255-009
Web: http://pharmacology.med.unideb.hu

Full Professor, Head of Department		Zoltán Szilvássy M.D., Ph.D., D.Sc.
Professor Emeritus	Ms.	Judith Gergely D.Pharm., Ph.D., D.Sc.
Administration officer	Ms.	Oxána Kiszil J.D.
	Ms.	Andrea Szalai B.Sc., M.Sc.
Associate Professor	Ms.	Ilona Benkő M.D., Ph.D.
		Béla Juhász D.Pharm., Dr. habil., Ph.D.
		Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.
		József Szentmiklósi M.D., Ph.D.
Assistant Professor		Attila Megyeri M.D., Ph.D.
Assistant Lecturer	Ms.	Ágnes Cseppentő M.D.
		Balázs Varga D.Pharm., Ph.D.
Senior Research Fellow		József Németh M.Sc., Ph.D.
Research Fellow	Ms.	Zsuzsanna Gál M.Sc., Ph.D.
	Ms.	Rita Kiss M.D., Ph.D.

Nutricionist	Ms.	Katalin Szabó M.Sc.
Chemist		Lajos Veress M.Sc.
Molecular Biologist	Ms.	Diána Kovács M.Sc., Ph.D.
PhD Student	Ms.	Mariann Bombicz D.Pharm.
	Ms.	Beáta Lelesz M.Sc.
		Dániel Priksz D.Pharm.
Junior Lecturer	Ms.	Mariann Bombicz D.Pharm.
	Ms.	Andrea Kurucz M.D.
Academic Advisor		Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.

DEPARTMENT OF PHYSIOLOGY

Nagyerdei krt. 98., Debrecen, 4012, Tel: +36-52-255-575

Web: http://phys.dote.hu

Full Professor, Head of Department		László Csernoch M.Sc., Ph.D., D.Sc.
Full Professor, Head of Sport Physiology Division		János Magyar M.D.,Ph.D.,D.Sc.
Full Professor, Head of Dental Physiology and Pharmacology Division		Péter Nánási M.D., Ph.D., D.Sc.
Full Professor		László Csernoch M.Sc., Ph.D., D.Sc.
		János Magyar M.D.,Ph.D.,D.Sc.
		Péter Nánási M.D., Ph.D., D.Sc.
Professor Emeritus		László Kovács M.D., Ph.D., D.Sc., M.H.A.Sc.
Associate Professor		Tamás Bányász M.D., Ph.D.
Assistant Professor		János Almássy M.Sc., Ph.D.
	Ms.	Szilvia Benkő M.Sc., Ph.D.
		Balázs Horváth M.D.,Ph.D.
		Balázs Pál M.D.,Ph.D.
		Norbert Szentandrássy M.D., Ph.D.
		István Balázs Tóth M.Sc., Ph.D.
Assistant Lecturer	Ms.	Ágnes Jenes M.D., Ph.D.
		Attila Szöllősi M.D.
Postgraduate Lecturer		Attila Oláh M.D.
Senior Research Fellow		Péter Szentesi M.Sc., Ph.D.
Postdoctoral Fellow	Ms.	Johanna Mihály M.Sc., Ph.D.

	Ms.	Magdolna Szántó M.Sc., Ph.D.
Research Fellow	Ms.	Gabriella Czifra M.Sc., Ph.D.
	Ms.	Beatrix Dienes M.Sc., Ph.D.
	Ms.	Mónika Sztretye M.Sc., Ph.D.
Junior Research Fellow	Ms.	Lídia Ambrus M.Sc.
	Ms.	Adrienn Kovács M.Sc.
		Tamás Oláh M.Sc., Ph.D.
	Ms.	Anitta Kinga Sárvári M.Sc.
OTKA Postdoctoral Fellow		János Fodor M.Sc., Ph.D.
PhD Student	Ms.	Ágnes Angyal M.Sc.
		Norbert Balogh M.Sc.
	Ms.	Csilla Bordás M.Sc.
		Tamás Czirják M.Sc.
		Balázs Kelemen M.Sc.
	Ms.	Éva Kókai M.Sc.
		Gergő Kovács M.Sc.
		Arnold Markovics M.Sc.
		Imre Lőrinc Szabó M.D.
		Roland Veress M.Sc.
		János Vincze M.D.
Research Advisor		István Jóna M.Sc., Ph.D., D.Sc.

CHAPTER 5
FACULTY OF MEDICINE - CLINICAL DEPARTMENTS

DEPARTMENT OF INTERNAL MEDICINE

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-255-525

Full Professor, Head of Department	György Paragh M.D., Ph.D., D.Sc.
Education Officer, Contact Person	Péter Fülöp M.D., Ph.D.

Division of Nephrology

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-414-227

Full Professor, Head of Division of Nephrology	József Balla M.D., Ph.D., D.Sc.
Professor Emeritus	György Kakuk M.D., Ph.D.
Associate Professor	István Kárpáti M.D., Ph.D.
	János Mátyus M.D., Ph.D.
	László Újhelyi M.D., Ph.D.
Clinical Assistant	Ms. Mária Juhász M.D., Ph.D.
	Ms. Réka P. Szabó M.D.
	Ms. Klára Pucsok M.D.
	Ms. Zita Váradi M.D.
Senior Consultant	Ms. Csilla Trinn M.D.

DEPARTMENT OF MEDICAL IMAGING

Nagyerdei krt. 98, Debrecen, 4032, Tel: +36-52-255-510

Full Professor, Head of Department	Ervin Berényi M.D., Ph.D.

Division of Nuclear Medicine and Translational Imaging

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-255-510
E-mail: nmiroda@med.unideb.hu, Web: http://petunia.atomki.hu/Learning

Full Professor	László Galuska M.D., D.Sc.
Professor Emeritus	Lajos Trón M.Sc., Ph.D., D.Sc.
Associate Professor	Ms. Ildikó Garai M.D., Ph.D.
	József Varga M.Sc., Ph.D.
Assistant Professor	György Trencsényi M.Sc., Ph.D.

Senior Research Fellow	László Balkay M.Sc., Ph.D.
	Miklós Emri M.Sc., Ph.D.
Research Fellow	István Kertész M.Sc., Ph.D.
	Dezső Szikra M.Sc., Ph.D.
Resident	Ms. Zita Képes M.D.
Chemist	Ms. Anikó Fekete M.Sc., Ph.D.
	István Jószai M.Sc., Ph.D.
	Pál Mikecz M.Sc.
	Ms. Tünde Miklovicz M.Sc.
	Ms. Enikő Németh Várhalminé M.Sc.
	Ms. Judit Péliné Szabó M.Sc.
	Norbert Pótári M.Sc.
	Béla Rubleczky M.Sc.
Pharmacist	Ms. Viktória Arató D.Pharm.
	Ms. Zsuzsanna Ésik D.Pharm.
	Gergely Farkasinszky D.Pharm.
Physicist	Gábor Opposits M.Sc., Ph.D.
	László Pohubi M.Sc.
Specialist	Zoltán Barta M.D.
Invited Lecturer	Sándor Kristóf Barna M.D.
	Ms. Nikol Fedinecz M.D.
PhD Student	Csaba Aranyi M.Sc.
	Ms. Mónika Béresová M.Sc.
	Attila Forgács M.Sc.
Academic Advisor	László Balkay M.Sc., Ph.D.

Division of Radiology and Imaging Science

Nagyerdei krt. 98., Debrecen, 4032, Tel: +36-52-255-136

E-mail: gallasz.szilvia@med.unideb.hu, Web: radiologia.unideb.com

Full Professor, Head of Department	Ervin Berényi M.D., Ph.D.
Professor Emeritus	Mózes Péter M.D., Ph.D.
Professor	József Kollár M.D., Ph.D., C.Sc.
Assistant Professor	Péter Bágyi M.D.
	Gábor Endes M.D.
	Botond Karácsonyi M.D.

	Ms.	Éva Pásztor M.D.
College Associate Professor	Ms.	Réka Révészné Tóth M.Sc., Ph.D.
Assistant Lecturer		Szabolcs Hetényi M.D.
		István Lázár M.Sc., Ph.D.
Senior Lecturer	Ms.	Judit Tóth M.D.
Clinical Assistant		Levente István Lánczi M.D.
Resident	Ms.	Melinda Bán M.D.
	Ms.	Veronika Deczkiné Gaál M.D.
	Ms.	Zsuzsanna Ferenczi M.D.
	Ms.	Edina Kósik M.D.
		Ádám Leskó M.D.
	Ms.	Georgina Nagy M.D.
		Tamás Papp M.D., Ph.D.
		Máté Sik M.D.
	Ms.	Orsolya Szalmás M.D.
	Ms.	Anita Tresó M.D.
	Ms.	Nikoletta Vasas M.D.
Molecular Biologist	Ms.	Teréz Nyesténé Nagy B.Sc.
Analytical Chemist		Ervin Balázs
	Ms.	Eszter László
		Gergő Veres
PhD Student	Ms.	Mónika Béresová M.Sc.
		Péter Katona M.D.
		Kázmér Kovács M.D.
		Attila Laczovics M.Sc.
	Ms.	Szilvia Lakatos
	Ms.	Marianna Nagy M.Sc.
	Ms.	Edit Nagy M.D.
		András Székely M.D.
Academic Advisor	Ms.	Éva Pásztor M.D.

CHAPTER 6
OTHER DEPARTMENTS

DEPARTMENT OF AGROCHEMISTRY AND SOIL SCIENCE

Böszörményi út 138., Debrecen, 4032, Tel: +3652508444

Full Professor, Head of Department		János Kátai C.Sc.
Professor Emeritus		Jakab Loch M.D., Ph.D., D.Sc.
Associate Professor	Ms.	Andrea Balla Kovács M.Sc., Ph.D.
	Ms.	Mária Micskeiné Csubák C.Sc.
		Imre Vágó C.Sc.
Assistant Professor	Ms.	Rita Erdei Kremper Ph.D.
	Ms.	Sándorné Kincses Ph.D.
Assistant Lecturer		Zsolt Sándor Ph.D.
Research Fellow	Ms.	Magdolna Tállai Ph.D.
Laboratory Assistant	Ms.	Antalné Gergely
	Ms.	Mónika Horváthné Rácz
	Ms.	Éva Katona M.Sc.
PhD Student	Ms.	Anita Jakab M.Sc.
	Ms.	Zsuzsanna Kovács M.Sc.
	Ms.	Anita Szabó M.Sc.

DEPARTMENT OF ALGEBRA AND NUMBER THEORY

Egyetem tér 1., Debrecen, 4032, Tel: +3652512900

Full Professor	Ákos Pintér Ph.D., D.Sc.
Assistant Professor	Gábor Horváth Ph.D.

DEPARTMENT OF ANIMAL BREEDING

Böszörményi út 138., Debrecen, 4032, Tel: +3652508444

Head of Department		István Komlósi D.Sc.
Full Professor		István Komlósi D.Sc.
Associate Professor		Béla Béri C.Sc.
	Ms.	Gabriella Novotniné Dankó Ph.D.
Assistant Professor	Ms.	Nóra Pálfyné Vass Ph.D.
		János Posta Ph.D.

Assistant Lecturer		Péter Bársony Ph.D.
		Levente Czeglédi Ph.D.
		László Stündl Ph.D.

DEPARTMENT OF BIOCHEMICAL ENGINEERING

Egyetem tér 1., Debrecen, 4032, Tel: +36-52-512-900/23180
E-mail: biochemeng@science.unideb.hu, Web: http://biochemeng.unideb.hu/en/home

Associate Professor, Head of Department		Levente Karaffa Ph.D.
Associate Professor	Ms.	Erzsébet Fekete M.Sc., Ph.D.
Assistant Professor		Ákos Péter Molnár M.Sc.
		Zoltán Németh M.Sc.
Research Fellow		Mojtaba Assadollahi M.Sc., Ph.D.
Other Invited Lecturers	Ms.	Zoltán Fekete B.Sc.
PhD Student		Norbert Ágh M.Sc.
	Ms.	Anita Orosz M.Sc.

DEPARTMENT OF BOTANY

Egyetem tér 1., Debrecen, 4032, Tel: +36-52-512-900

Associate Professor, Head of Department		Gábor Vasas M.Sc., Ph.D.
Full Professor		György Borbély M.Sc., D.Sc.
Associate Professor		Gábor Matus M.Sc., Ph.D.
	Ms.	Ilona Mészáros M.Sc., Ph.D., C.Sc.
		Gábor Vasas M.Sc., Ph.D.
Assistant Professor	Ms.	Márta M-Hamvas M.Sc., Ph.D.
		Csaba Máthé M.Sc., Ph.D.
		Attila Molnár M.Sc., Ph.D.
		Viktor Oláh M.Sc., Ph.D., C.Sc.
		Gyula Surányi M.Sc., C.Sc.
Assistant Lecturer		Sándor Gonda M.Sc.,D.Pharm.
Senior Research Fellow		János Kerékgyártó M.Sc., Ph.D., C.Sc.

DEPARTMENT OF ECOLOGY

Egyetem tér 1., Debrecen, 4032, Tel: +36 (52) 512-900 / 22617
E-mail: tothmerb@gmail.com

Full Professor, Head of Department	Béla Tóthmérész Ph.D., D.Sc.
Assistant Professor	Roland Horváth M.Sc., Ph.D.
	Ms. Ibolya Márkóczi M.Sc., Ph.D.
	Ms. Edina Simon M.Sc., Ph.D.
	Péter Török M.D., Ph.D.
	Ms. Orsolya Valkó M.Sc., Ph.D.
Assistant Lecturer	István Gyulai M.Sc.
Senior Research Fellow	Zoltán Szurmai Ph.D.
Invited Lecturer	Gábor Lövei M.Sc., Ph.D., D.Sc.

DEPARTMENT OF EVOLUTIONARY ZOOLOGY AND HUMAN BIOLOGY

Egyetem tér 1., Debrecen, 4032, Tel: +36 (52) 518-600 / 62334
E-mail: barta.zoltan@science.unideb.hu

Head of Department	Zoltán Barta M.D.

DEPARTMENT OF GENETICS AND APPLIED MICROBIOLOGY

Egyetem tér 1., Debrecen, 4032, Tel: +36 (52) 518-600 / 62056
E-mail: miklos.ida@science.unideb.hu

Head of Department	Ms. Ida Gálné Dr. Miklós Ph.D.
Full Professor	Mátyás Sipiczky M.D., Ph.D., D.Sc.
Senior Assistant Professor	Ms. Zsuzsa Antunovics Ph.D.
Assistant Professor	Ms. Terézia Barna Ph.D.
	Ms. Hajnalka Csoma Ph.D.
PhD Student	László Elek
	Ms. Enikő Horváth
	Zoltán Kállai
	Ms. Edina Karanyicz
	Ms. Erika Papp M.D.
	László Papp
	Walter Pfliegler

DEPARTMENT OF HIDROBIOLOGY

Egyetem tér 1., Debrecen, 4032, Tel: +36 (52) 512-900 / 22622
E-mail: nagy.sandor.alex@science.unideb.hu, Web: http://hidrobiologia.unideb.hu

Head of Department, Associate Professor	Sándor Alex Nagy Ph.D.

INSTITUTE OF BIOLOGY AND ECOLOGY

Egyetem tér 1., Debrecen, 4032, Tel: +3652-512-900

Head of Institute	Béla Tóthmérész Ph.D., D.Sc.

INSTITUTE OF CHEMISTRY

Egyetem tér 1., Debrecen, 4032, Tel: +3652512900

Head of Institute	László Somsák Ph.D., D.Sc.

Department of inorganic and analytical chemistry

Egyetem tér 1., Debrecen, 4032, Tel: +36-52-512-900
E-mail: inorg@science.unideb.hu, Web: http://www.inorg.unideb.hu

Full Professor, Head of Department		István Fábián M.Sc., Ph.D., D.Sc.
Full Professor	Ms.	Katalin Erdődi-Kövér M.Sc., Ph.D., D.Sc., M.H.A.Sc.
		Gábor Lente M.Sc., Ph.D., D.Sc.
Professor Emeritus		Ernő Brücher Ph.D.,D.Sc.,M.Sc.
	Ms.	Etelka Farkas M.Sc., Ph.D., D.Sc.
		Lajos Papp M.Sc., Ph.D., D.Sc.
		József Posta M.Sc., Ph.D., D.Sc.
		Imre Sóvágó M.Sc., Ph.D., D.Sc.
		Imre Tóth Ph.D.,D.Sc.,M.Sc.
Associate Professor		Péter Buglyó M.Sc., Ph.D.
		Attila Gáspár M.Sc., Ph.D., D.Sc.
	Ms.	Gyöngyi Gyémánt M.Sc., Ph.D.
		István Lázár M.Sc., Ph.D.
		Zoltán Tóth M.D., Ph.D., D.Sc.
	Ms.	Katalin Várnagy M.Sc., Ph.D., D.Sc.

Assistant Professor		Gyula Tircsó M.Sc., Ph.D.
Senior Research Fellow	Ms.	Csilla Kállay M.Sc., Ph.D.
Research Fellow		Zsolt Baranyai M.Sc., Ph.D.
	Ms.	Edina Baranyai M.Sc., Ph.D.
		Gábor Bellér M.Sc., Ph.D.
	Ms.	Linda Bíró M.Sc., Ph.D.
	Ms.	Ágnes Grenács M.Sc., Ph.D.
		József Kalmár M.Sc., Ph.D.
Academic Advisor	Ms.	Katalin Várnagy M.Sc., Ph.D., D.Sc.

Department of Organic Chemistry
Egyetem tér 1., Debrecen, 4032, Tel: +36-52-512-900

Full Professor, Head of Department		László Somsák M.Sc., Ph.D., D.Sc.
Full Professor, Head of the Institute of Chemistry		László Somsák Ph.D., D.Sc.
Full Professor		Sándor Antus Ph.D., D.Sc.
		Gyula Batta Ph.D., D.Sc.
Associate Professor		László Juhász M.Sc., Ph.D.
		Tibor Kurtán M.Sc., Ph.D.
Assistant Professor	Ms.	Éva Bokor Ph.D.
	Ms.	Tünde Zita Tóthné Illyés Ph.D.
	Ms.	Tóth Marietta Vágvölgyiné Ph.D.
Assistant Lecturer	Ms.	Éva Juhászné Tóth M.Sc., Ph.D.

Department of Physical Chemistry /MTA-DE Homogeneous Catalysis and Reaction Mechanisms Research Group
Egyetem tér 1., Debrecen, 4010, Tel: +36-52-512-900/22381
Web: fizkem.unideb.hu/indexe

Full Professor		Vilmos Gáspár D.Sc.
		Ferenc Joó M.H.A.Sc.
Professor Emeritus		György Bazsa D.Sc.
		Mihály Beck D.Sc., M.H.A.Sc.
Associate Professor		Attila Bényei Ph.D.
	Ms.	Katalin Ősz Ph.D.

		György Póta C.Sc.
Assistant Lecturer	Ms.	Réka Gombos M.Sc.
Senior Research Fellow	Ms.	Henrietta Győrvári-Horváth Ph.D.
	Ms.	Ágnes Kathó C.Sc.
Research Fellow		Gábor Papp Ph.D.
		Mihály Purgel Ph.D.
		Antal Udvardy Ph.D.
Junior Research Fellow	Ms.	Csilla Enikő Czégéni Ph.D.
		István Pontos M.Sc.
Secretary	Ms.	Istvánné Román B.Sc.
PhD Student	Ms.	Evelin Bolyog-Nagy M.Sc.
		Péter Pál Fehér M.Sc.

INSTITUTE OF CROP SCIENCES
Böszörményi utca 138., Debrecen, 4032, Tel: +3652508461
E-mail: pepopal@agr.unideb.hu

Full Professor, Head of Institute	Péter Pepó D.Sc.

INSTITUTE OF FOOD SCIENCE, QUALITY ASSURANCE AND MICROBIOLOGY
Böszörményi út 138., Debrecen, 4032, Tel: +36 (52) 418-624
E-mail: kovacsb@agr.unideb.hu

Head of Institute		Béla Kovács Ph.D.
Associate Professor	Ms.	Jánosné Borbély Ph.D.
	Ms.	Erzsébet Karaffa Ph.D.
		Péter Sipos Ph.D.
Assistant Professor		Ferenc Peles Ph.D.
Assistant Lecturer	Ms.	Diána Ungai Ph.D.

INSTITUTE OF MATHEMATICS
Egyetem tér 1., Debrecen, 4032, Tel: +36 (52) 512-900 / 23417
E-mail: apinter@science.unideb.hu

Director	Ákos Pintér Ph.D., D.Sc.

INSTITUTE OF PLANT PROTECTION

Böszörmény str. 138. , Debrecen, 4032, Tel: +3652 508378
E-mail: kovics@agr.unideb.hu, Web:
http://portal.agr.unideb.hu/tanszekek/novenyvedelmi/intezet/index

Head of Institute		György János Kövics C.Sc.
Professor Emeritus		István Szarukán M.D.
Associate Professor		András Bozsik C.Sc.
		György János Kövics C.Sc.
		László Radócz C.Sc.
Assistant Professor		Antal Nagy Ph.D.
Senior Research Fellow		Gábor Tarcali Ph.D.
Administrator	Ms.	Tünde Szabóné-Asbolt
PhD Student	Ms.	Rita Földesi M.Sc.
		Gábor Görcsös M.Sc.
		Miklós Varga M.Sc.

CHAPTER 7
UNIVERSITY CALENDAR

UNIVERSITY CALENDAR FOR MOLECULAR BIOLOGY MSC PROGRAM ACADEMIC YEAR 2016/2017

OPENING CEREMONY:11th September, 2016
GRADUATION CEREMONY: June 2017

1st SEMESTER

Year	Course	Examination Period
1st year, 2nd year	12th September - 23rd December, 2016 (15 weeks)	27th December, 2016 - 10th February, 2017 (7 weeks)

2nd SEMESTER

Year	Course	Examination Period
1st year	13th February - 26th May, 2017 (15 weeks)	29th May - 14th July 2017 (7 weeks)
2nd year	13th February - 5th May, 2017 (12 weeks)	8th May - 23rdJuly 2017 (7 weeks)

CHAPTER 8
CREDIT SYSTEM

ACADEMIC PROGRAM FOR CREDIT SYSTEM

The introduction of the credit system became compulsory in every Hungarian university, including the University of Debrecen by September, 2003. The aim of the credit system is to ensure that the students' achievements can be properly and objectively evaluated both quantitatively and qualitatively.
A credit is a relative index of cumulative work invested in a compulsory, a required elective or a freely chosen subject listed in the curriculum. The credit value of a course is based upon the number of lectures, seminars and practical classes of the given subject that should be attended or participated in (so called "contact hours"), and upon the amount of work required for studying and preparing for the examination(s). Together with the credit(s) assigned to a particular subject (quantitative index), students are given grades (qualitative index) on passing an exam/course/class. The credit system that has been introduced in Hungary meets the standards of the European Credit Transfer System (ECTS). The introduction of the ECTS promotes student mobility, facilitates more effective organization of students' exchange programs aimed at further education in foreign institutions, and allows recognition of the students' work, studies and achievements completed in various foreign departments by the mother institution. Credit-based training is flexible. It provides a wider range of choice, enables the students to make progress at an individual pace, and it also offers students a chance to study the compulsory or required subjects at a different university, even abroad. Owing to the flexible credit accumulation system, the term "repetition of a year" does not make sense any longer. It should be noted, however, that students do not enjoy perfect freedom in the credit system either, as the system does not allow students to randomly include subjects in their curriculum or mix modules. Since knowledge is based on previous studies, it is imperative that the departments clearly and thoroughly lay down the requirements to be met before students start studying a subject.
The general principles of the credit system are the following:

1. Students can be given their degree if, having met other criteria as well, they have collected 120 credits during their studies. Considering the recommended curriculum, this can be achieved in two years (four semesters).

2. According to the credit regulations, students should obtain an average of 30 credits in each semester.

3. The criterion of obtaining 1 credit is to spend 30 hours (including both contact and non-contact hours) studying the given subject.

4. Credit(s) can only be obtained if students pass the exam of the given subject.

5. Students accumulate the required amount of credits by passing exams on compulsory, required elective and freely chosen subjects. Completion of every single compulsory credit course is one of the essential prerequisites of getting a degree. Courses belonging to the required elective courses are closely related to the basic subjects, but the information provided here is more detailed, and includes material not dealt with in the frame of the compulsory courses. Students do not need to

take all required elective courses, but they should select some of them wisely to accumulate the predetermined amount of credits from this pool. Finally, a certain amount of credits should be obtained by selecting from the freely chosen courses, which are usually not related to the basic (and thus mandatory) subjects, but they offer a different type of knowledge.

6. 58, 19, 7 and 6 credits of the total of 120 credits should be accumulated by completing the compulsory, differentiated professional, oriented elective and freely chosen courses, respectively.
The curriculum in English program corresponds with the curriculum in Hungarian program.

7. The students qualified in molecular biology are required to know the principles of biology, to have general knowledge in the fields of natural sciences and to be familiar with the methods of scientific thinking and problem-solving approach.
The competency is based on the content of basic modules and the process of preparation of diploma thesis. Since the target can be reached mainly by collection and evaluation of knowledge, the lectures and seminars are important forms of education.
Besides the acquirement of knowledge, the professionals in molecular biology have to be able to recognize the problems, to elaborate the way of solution, to evaluate and interpret the results. From this respect, the practicals and the laboratory work during the making of diploma thesis offer good possibilities.
Nowadays there is an ever increasing demand for the skills regarding innovative activity, abilities for self-improvement of practical utilization of own results, and organization of individual activity. It can require some type of non-professional (legal, economical, management) knowledge, which can be achieved also by optional courses.
The students graduated in molecular biology master program know the most important results of molecular biology and the possibilities for their application, the approach and methodological tools of molecular biology, the structure and function of the human body to an extent necessary for acquirement of professional knowledge, the bases of genomics, medical immunology and microbiology, and have general knowledge in pharmacology. The differentiated professional subjects assure the acquirement of professional competencies. These subjects are offered in obligatory or oriented elective form. The topics are processed in lectures and practicals, which guarantee the acquirement of competencies. Considering the institutional characteristics and possibilities, it is warranted that in the given fields the highly qualified staff takes part in the education.

8. The pilot curricula show the recommended pacing of compulsory courses. If these courses are carefully supplemented with credits obtained from the necessary number of required elective and freely chosen courses, students can successfully accumulate the credits required for their degree within 4 semesters.

9. The diploma work is worth 30 credits.
The Degree thesis (dissertation) is a paper written about the individual scientific investigations in the field of molecular biology, which proves the profound knowledge of the student. It has to demonstrate, that the student became familiar with the basis of library and literature use as well as is able to formulate and document own opinion in adequate form, and defend the thesis in a debate taken before a professional committee.

10. Regulations concerning the training of students in the credit system prescribe a minimum amount of credits for certain periods as outlined in the Rules and Regulations for English Program

Students.

11. Although Physical Education is not recognized by credits, it have to be completed to get the final degree (see the rules outlined in the Information section about the conditions).

12. Evaluation of the students' achievements needed for grants or applications is described in Rules and Regulations for English Program Students.

13. Further information is available in the Rules and Regulations for English Program Students.

We very much hope that the system of training will contribute to the successful completion of your studies.
We wish you good luck with your university studies.

CHAPTER 9
ACADEMIC PROGRAM FOR CREDIT SYSTEM

Compulsory courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Biochemistry of Metabolism	AO_MBE_ACS01	30	15		ESE*	4	None
1	Biophysics	AO_MBE_BIF01	30			ESE	3	None
1	Human Physiology I.	AO_MBE_HET01	30			ESE*	3	None
1	Medical Genome Biology	AO_MBE_GRB01	30			ESE*	3	None
1	Medical Genome Biology Practicals	AO_MBE_GRG01			45	AW5	2	None
1	Methods of Molecular Biology	AO_MBE_MBE01	30			ESE*	3	None
1	Molecular Genetics	AO_MBE_GEN01	30		30	ESE*	4	None
1	Molecular Immunology	AO_MBE_IMM01	30	16		ESE*	3	None
1	Radioisotope Techniques in Biomedicine	AO_MBE_ITE01	30			ESE	3	None
1	Radioisotope Techniques In Biomedicine Practicals	AO_MBE_ITG01			15	AW5	1	together with Radioisotope Techniques in Biomedicine

Compulsory courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Bioinformatics	AO_MBE_BIE02	30			ESE	3	None
2	Bioinformatics Practicals	AO_MBE_BIG02			15	AW5	1	together with Bioinformatics
2	Biostatistics	AO_MBE_BST02	15			ESE	1	None
2	Cell and Organ Biochemistry	AO_MBE_SBK02	30			ESE*	3	None
2	Cell Biology	AO_MBE_SBI02	30	15	15	ESE*	4	Biochemistry of Metabolism
2	Human Physiology II.	AO_MBE_HET02	30			ESE*	3	Human Physiology I.
2	Human Physiology Practicals	AO_MBE_HEG02			30	AW5	2	Human Physiology I; together with Human Physiology II
2	Methods in Molecular Biology Practicals	AO_MBE_MBG01			45	AW5	2	Methods of Molecular Biology
2	Physiology of Prokaryotes, Molecular Virology	AO_MBE_PRO02	30		15	ESE	4	None
2	Plant Molecular Biology	AO_MBE_NBI02	30	30		ESE	4	None
2	Problem-solving exercises in Molecular Biology	AO_MBE_PMF02			45	AW5	2	None

Required Elective Courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Thesis I.	AO_MB_DD02			75	AW5	5	None

Required Elective Courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Thesis II.	AO_MB_DD03			150	AW5	10	None

Required Elective Courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Thesis III.	AO_MB_DD04			225	AW5	15	None

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics Required Elective Courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Structure and Function of Macromolecules	AO_MBE_MMS02	15		30	ESE	3	Medical Genom Biology

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics Required Elective Courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Gene Expression Regulation – Functional Genomics	AO_MBE_GES03	15		30	ESE	3	Medical Genom Biology
1	Genomic Bioinformatics	AO_NBE_BGI02	15		30	ESE	3	Medical Genom Biology, together with Bioinformatics
1	Molecular Mechanism of Diseases Concerning Great Populations	AOG167605	25			AW5	2	None

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics Required Elective Courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Enzymology	AO_MBE_ENZ03	15		60	AW5	4	Biochemistry of Metabolism
2	Proteomics	AO_MBE_PRO04	30		30	ESE	4	Structure and Function of Macromolecules

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics Freely Choosen Courses

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Anatomy, Histology and Embryology	Advanced Methods in Neurobiology	AO_MBE_MNB02	3	2	45	ESE	None	Miklós Antal M.D., Ph.D., D.Sc.
Department of Animal Breeding	Animal Genetics II.	AO_MBE_AGE02	3	2	45	ESE	None	István Komlósi D.Sc.
Department of Immunology	Basis of Conventional and Biological Immunotherapies	AO_MBE_HBI03	2	2	30	ESE	Impaired Signal Transduction in the Immune System	Árpád Lányi M.Sc., PhD.
Department of Biochemistry and Molecular Biology	Biochemistry of Apoptosis	AO_MBE_ABI03	3	1	30	ESE	Cell and Organ Biochemistry	Zsuzsa Szondy M.D., Ph.D., D.Sc.
Department of Biochemistry and Molecular Biology	Biochemistry of Nutrition	AO_MBE_TBI03	3	1	30	ESE	Biochemistry of Metabolism	Zsuzsa Szondy M.D., Ph.D., D.Sc.
Department of Medical Chemistry	Biochemistry of Oxidative Stress	AO_MBE_OST03	3	1	30	ESE	Biochemistry of Metabolism	László Virág M.D., Ph.D., D.Sc.
Department of Medical Chemistry	Bio Inorganic Chemistry	AO_MBE_BSZ03	3	1	30	ESE	None	Ferenc Erdődi M.Sc., Ph.D., D.Sc.
Department of Biochemistry and Molecular Biology	Biotechnology, Recombinant Techniques	AO_MBE_BRE04	3	1	30	ESE	None	Balajthy Zoltán M.Sc., Ph.D.
Department of Pharmacology and Pharmacotherapy	Cancer Chemotherapy	AO_MBE_DKT04	2	2	15	AW5	together with Cell Biology	Ilona Benkő M.D., Ph.D.
Department of Physiology	Cardiorespiratory Physiology	AO_MBE_CRE03	2	1	30	ESE	Human Physiology I.	Tamás Bányász M.D.,Ph.D
Division of Cell Biology	Cell Biology Practice	AO_MBE_SBG02	1	2	15	AW5	together with Cell Biology	Katalin Goda M.Sc., Ph.D.
Division of Cell Biology	Cell Biology Elucidated Pathophysiologic Processes	AO_MBE_SBP03	1	1	15	ESE	Cell Biology	

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Genetics and Applied Microbiology	Cell Cycle and Its Regulation	AO_MBE_SCS03	2	1	30	ESE	Molecular Genetics	Ida Gálné Dr. Miklós Ph.D.
Department of Organic Chemistry	Chemical Basics of Drug Effects	AO_MBE_GYH03	3	1	30	ESE	None	László Somsák M.Sc., PhD., D.Sc.
Department of Anatomy, Histology and Embryology	Clinically Oriented Anatomy of the Brainstem	AO_MBE_AFA04	2	2	16	ESE	None	Klára Matesz M.D.,Ph.D.,D.Sc.
Department of Microbial Biotechnology and Cell Biology	Cytogenetics	AO_MBE_CGE03	3	1	30	ESE	Molecular Genetics	
Department of Microbial Biotechnology and Cell Biology	Cytogenetics Practicals	AO_MBE_CGG	1	1	30	AW5	together with Cytogenetics	
Department of Biophysics and Cell Biology	Experimental Data Processing	AO_MBE_MAF02	1	2	15	ESE	None	Attila Jenei M.Sc., Ph.D.
Department of Biophysics and Cell Biology	Fluorescence Experimental Methods	AO_MBE_FVM03	2	1	30	ESE	Molecular Genetics	György Vereb M.D., Ph.D., D.Sc.
Department of Anatomy, Histology and Embryology	Functional Anatomy of the Visual System	AO_MBE_LFA04	1	2	16	ESE	None	Zoltán Kisvárday M.Sc., Ph.D., D.Sc.
Department of Anatomy, Histology and Embryology	Functional Neuroanatomy	AO_MBE_FNA04	3	2	60	ESE	None	Miklós Antal M.D., Ph.D., D.Sc.
Department of Genetics and Applied Microbiology	Genes and Diseases	AO_MBE_GGH03	2	1	30	ESE	Molecular Genetics	Ida Gálné Dr. Miklós Ph.D.
Department of Human Genetics	Genetics of Prokaryotes	AO_MBEPG02	3	2	45	ESE	Molecular Genetics	Zsigmond Fehér M.D., PhD.
Department of Anatomy, Histology and Embryology	Histochemistry, Histotechniques	AO_MBE_HIS02	3	2	60	AW5	Cell Biology	Róza Zákány M.D., Ph.D.

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Physiology	Homeostasis	AO_MBE_HOM04	3	2	25	ESE	None	Nánási Péter M.D., Ph.D., D.Sc
Department of Human Genetics	Human Molecular Genetics	AO_MBE_HMG04	3	2	30	ESE	Molecular Genetics	Biró Sándor M.Sc., Ph.D., D.Sc.
Department of Anatomy, Histology and Embryology	Human Histology and Embryology I.	AO_MBE_HSF03	3	2	60	ESE	Cell Biology	Róza Zákány M.D., Ph.D.
Department of Anatomy, Histology and Embryology	Human Histology and Embryology II.	AO_MBE_HSF03	4	1	75	ESE	Cell Biology	Róza Zákány M.D., Ph.D.
Department of Medical Microbiology	Human Pathogenic Viruses	AO_MBE_HBE04	2	2	30	ESE	Physiology of Prokaryotes, Molecular Virology	Judit Szabó M.D., Ph.D.
Department of Medical Microbiology	Human Pathogenic Viruses Practical	AO_MBE_HBG04	1	2	15	AW5	together with Human Pathogenic Viruses	Judit Szabó M.D., Ph.D.
Department of Medical Microbiology	Human Pathogenic Bacteria Practicals	AO_MBE_HBG03	1	1	15	AW5	together with Human Pathogenic Bacteria	Judit Szabó M.D., Ph.D.
Department of Medical Microbiology	Human Pathogenic Bacteria	AO_MBE_HBE03	2	1	30	ESE	Physiology of Prokaryotes, Molecular Virology	Judit Szabó M.D., Ph.D.
Department of Medical Microbiology	Human Pathogenic Eukaryotic Microorganisms	AO_MBE_PEM02	3	2	45	ESE	Physiology of Prokaryotes, Molecular Virology	Lajos Gergely M.D., Ph.D., D.Sc.
Department of Pharmacology and Pharmacotherapy	Human Pharmacology	AO_MBE_HFA02	4	2	60	ESE	None	Ilona Benkő M.D., Ph.D.
Department of Medical Chemistry	Introduction to Research Work	AO_MBE_BKU03	1	2	30	ESE	None	Pál Gergely M.Sc., Ph.D., D.Sc., M.H.A.Sc.
Department of Immunology	Impaired Signal Transduction in the Immune System	AO_MBE_ITZ03	2	1	15	ESE	Molecular Immunology	Tamás Bíró M.D., Ph.D., D.Sc.
Department of Immunology	Immunological Methods in Molecular Biology	AO_MBE_IME02	2	2	15	ESE	Molecular Immunology	Péter Gogolák M.Sc., Ph.D.

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Immunology	Immunological Methods in Molecular Biology Practicals	AO_MBE_IMG02	1	2	15	AW5	None	Péter Gogolák M.Sc., Ph.D.
Department of Physiology	Intracellular Calcium and Other Signaling Mechanisms	AO_MBE_ICK02	3	2	30	ESE	Human Physiology I.	Beatrix Dienes M.Sc., PhD.
Department of Biochemical Engineering	Microbial Strain Improvement	AO_MBE_MBT03	3	1	30	ESE	Medical Genetics	Levente Karaffa PhD.
Department of Physiology	Modelling of Physiological Processes	AO_MBE_EFM04	3	2	30	ESE	Human Physiology II.	
Department of Physiology	Molecular Neurobiology	AO_MBE_MNB04	3	2	30	ESE	None	
Department of Ecology	Molecular Phylogenetics	AO_MBE_MFG03	4	1	45	ESE	Medical Genetics	
Department of Immunology	New System Biology Paradigms in Immunology	AO_MBE_UPI02	3	2	30	ESE	Molecular Immunology	Éva Rajnavölgyi M.Sc., Ph.D., D.Sc.
Department of Physiology	Neuroendocrine Regulation of Feeding and Energy Balance	AO_MBE_NES03	2	1	30	ESE	Human Physiology II.	Norbert Szentandrássy M.D., PhD.
Department of Anatomy, Histology and Embryology	Nociceptive sensory information processing at the level of the spinal cord in health and disease	AO_MBE_NEH04	3	2	30	ESE	Functional Neuroanatomy	Miklós Antal M.D., Ph.D., D.Sc.
Department of Pharmacology and Pharmacotherapy	Pharmacology of Central Nervous System	AO_MBE_KIF04	1	2	15	ESE	None	Ilona Benkő M.D., Ph.D.
Department of Pharmacology and Pharmacotherapy	Pharmacology of System of Organs	AO_MBE_KIF03	1	3	30	ESE	Human Physiology II.	lona Benkő M.D., Ph.D.
Department of Medical Microbiology	Pathomechanism and Prevention of Infectious Diseases	AO_MBE_FBP03	3	1	30	ESE	None	György Veress M.Sc., Ph.D.

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Microbial Biotechnology and Cell Biology	Physiology and Stress Responses of Microorganisms and Fungi I.	AO_MBE_MGF03	3	1	45	ESE	Physiology of Prokaryotes, Molecular Virology	István Pócsi Ph.D.
Department of Microbial Biotechnology and Cell Biology	Physiology and Stress Responses of Microorganisms and Fungi II.	AO_MBE_MGF04	3	1	30	ESE	Physiology of Prokaryotes, Molecular Virology	István Pócsi Ph.D.
Department of Biophysics and Cell Biology	Physical Principles of Techniques Used in Cell Biology	AO_MBE_SBM02	2	2	30	ESE	Cell Biology	György Panyi M.D., Ph.D., D.Sc.
Department of Botany	Plant Cell Biology	AO_MBE_NSB03	2	1	30	ESE	Molecular Genetics	Csaba Máthé M.Sc., PhD.
Institute of Crop Sciences	Plant Genetics II.	AO_MBE_NGE02	3	2	45	ESE	None	
Department of Medical Chemistry	Post-translational Modification of Proteins	AO_MBE_FPT04	3	2	30	ESE	Cell and Organ Biochemistry	Ilona Farkas M.Sc., Ph.D.
Department of Physiology	Regulatory Role of the Cell Membrane in Physiological and Pathological Conditions	AO_MBE_SMS04	3	2	20	ESE	Human Physiology I.	Péter Szentesi M.Sc., Ph.D.
Department of Biochemistry and Molecular Biology	Retroviral Biochemistry	AO_MBE_REB04	3	2	30	ESE	Cell and Organ Biochemistry	József Tőzsér M.Sc., Ph.D., D.Sc.
Department of Ecology	Scientific Communication	AO_MBE_TUK03	4	1	60	ESE	None	
Department of Anatomy, Histology and Embryology	Selected problems of the neural control: Modelling of single neurons and neural networks	AO_MBE_ISZ02	1	2	12	ESE	None	Ervin Wolf M.Sc., Ph.D.
Department of Medical Chemistry	Signalling Pathways in the Cells	AO_MBE_SJF03	3	1	30	ESE	Cell and Organ Biochemistry	Ferenc Erdődi M.Sc., Ph.D., D.Sc.
Department of Medical Microbiology	Sexually Transmitted Diseases, Congenital and Perinatal Infections	AO_MBE_NEM04	1	2	15	ESE	Physiology of Prokaryotes, Molecular Virology	József Kónya M.D., Ph.D.
Department of Medical Microbiology	Traveller's Diseases	AO_MBE_UFE04	1	2	15	ESE	Physiology of Prokaryotes, Molecular Virology	Lajos Gergely M.D., Ph.D., D.Sc.

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Immunology	Transgenic and KO Technologies in Molecular Biology	AO_MBE_TGK03	1	1	15	ESE	Molecular Immunology	Árpád Lányi M.Sc., Ph.D.
Department of Medical Microbiology	Zooneses	AO_MBE_ZOO04	1	2	15	ESE	Physiology of Prokaryotes, Molecular Virology	Lajos Gergely M.D., Ph.D., D.Sc.

CHAPTER 10
ACADEMIC PROGRAM FOR THE 1ST YEAR

Department of Biochemistry and Molecular Biology

Subject: **BIOCHEMISTRY OF METABOLISM**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

1st week:
Lecture: The biology of the mitochondria I. Mitochondrial transport. The processes and regulation of citric acid cycle and oxidative phosphorylation.

2nd week:
Lecture: The biology of the mitochondria II. Oxidative phosphorylation 2. Anaplerotic reactions. The mitochondrial genome - maintenance and mutations.

3rd week:
Lecture: Carbohydrate metabolism I. Basic metabolic pathways, tissue-specific regulation of carbohydrate metabolism.

4th week:
Lecture: Carbohydrate metabolism II. Inherited diseases of carbohydrate metabolism. Biochemistry of diabetes.

5th week:
Lecture: Lipid metabolism I. Transport and processing of lipids in the digestive track and in the circulation. Covalent lipid-protein interactions, lipoprotein complexes. Synthesis and degradation of triacyl glycerols.

6th week:
Lecture: Lipid metabolism II. Metabolic changes during the well-fed state and during starvation. Ketone bodies. The mevalonate pathway. Synthesis of steroid hormones, bile acids, eicosanoids. Lipid peroxidation. Vitamin D metabolism.

7th week:
Lecture: Lipids in health and disease. Cholesterol synthesis, transport, storage and efflux - processes, regulatory mechanisms, drug treatment. The LDL receptor. Obesity and metabolic syndrome.

8th week:
Lecture: Nutrition: Vitamins.
Self Control Test (Topics of week 1-7.)

9th week:
Lecture: Protein structure I. Fundamentals of protein structure, determining the macromolecular structure of proteins. Hierarchy of protein structures, primary, secondary, tertiary, quaternary structures. Characteristics of alpha helices and beta sheets. Schematic representation of secondary structures, topological diagrams.

10th week:
Lecture: Protein structure II. Intrinsically disordered proteins.

11th week:
Lecture: Amino acid metabolism I. Production and utilization of the intracellular amino acid pool. Exogenous and endogenous sources of amino acids. Common reactions of amino acid metabolism: the fate of nitrogen. Production and efflux of ammonia.

12th week:
Lecture: Amino acid metabolism II. Inter-organ nitrogen transport. Processes and regulation of the urea cycle. C1-transfer, transmethylation,

monooxygenation and dioxygenation reactions. Diseases of amino acid metabolism.

13th week:
Lecture: Nucleotide metabolism I. The nucleotide pool. Digestion and absorption of nucleotides. De novo synthesis of purine nucleotides, regulation, salvage reactions.

14th week:
Lecture: Nucleotide metabolism II. De novo synthesis of pyrimidine nucleotides, regulation. Diseases of nucleotide metabolism. Antiviral and antitumor effect of nucleoside analogs.

15th week:
Lecture: Summary, consultation.
Self Control Test (Topics of week 8-14.)

Requirements

Course content:
Please follow the announcements of the department about the control tests, exams and other current information on the bulletin board (LSB downstairs, 1st corridor), and on the website (http://bmbi.med.unideb.hu).

Department of Human Genetics

Subject: **MEDICAL GENOME BIOLOGY**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction into genomics. Nanotechnology in medicine.

2nd week:
Lecture: The technology of DNA sequencing. introduction into evolutionary genome biology.
Practical: General information about the subject.

3rd week:
Lecture: Whole genome sequencing. Significance, examples, databases.
Practical: Preparatory class on sequence alignments.

4th week:
Lecture: Variability of the human genome. New generation sequencing.
Practical: Sequence alignments.

5th week:
Lecture: Biostatistics in global genome analysis.
Practical: Preparatory class on databases.

6th week:
Lecture: Global proteome analysis.
Practical: Databases.

7th week:
Lecture: Analysis of protein sequences and structures. Protein databases.
Practical: Preparatory class on gene expression analysis.

8th week:
Lecture: Global analysis of gene expression.
Practical: Gene expression analysis.

9th week:
Lecture: Gene and proteome profiling in the diagnostics.

Practical: Preparatory class on polymorphisms.

10th week:
Lecture: Applied genome analysis in drug research.
Practical: DNA polymorphisms I.

11th week:
Lecture: Biomarkers in diagnostics. History of genome science, biotechnology, philosophical aspects.
Practical: DNA polymorphisms II.

12th week:
Lecture: Antibody-based proteomics in cancer diagnostics.
Practical: Preparatory class on genome-browsers.

13th week:
Lecture: Gene maps and polygenic diseases.
Practical: Genome browsers.

14th week:
Lecture: Integrative biology, genome-scale information.
Practical: Consultation.

15th week:
Lecture: Genomics of complex diseases.
Practical: Genomics of complex diseases.

Requirements

The program consists of lectures and seminars. Attendance of lectures is important, because the material which is required at the examination is presented here. Therefore, participation on at least 50 % of the lectures is compulsory. If the number of absences exceeds 50 % of the lectures the signature will be rejected. Attendance at the seminars is also important. If the student misses more than 2 seminars, he or she will have to take a test ("labtest") to qualify for the signature. If the student has more than 4 absences from the seminars, the signature will be rejected and the semester must be repeated. End of semester examination: 15-20 short essay questions are given to each student. Grading of the papers is the following:

0-49,99 %	fail (1)
50-59,99 %	pass (2)
60-69,99 %	satisfactory (3)
70-79,99 %	good (4)
80-100 %	excellent (5)

Academic Advisor: Professor László Takács, laszlo.takacs@biosys-intl.com
Course coordinator: Dr. András Penyige, penyige@med.unideb.hu

Subject: **MEDICAL GENOME BIOLOGY PRACTICALS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Practical: **45**

2nd week:
Practical: General information about the subject.

3rd week:
Practical: Preparatory class on sequence alignments.

4th week:
Practical: Sequence alignments.

5th week:
Practical: Preparatory class on databases.

6th week:
Practical: Databases.

8th week:
Practical: Gene expression analysis.

9th week:
Practical: Preparatory class on DNA polymorphisms.

10th week:
Practical: DNA polymorphisms and disease I.

11th week:
Practical: DNA polymorphisms and disease II.

12th week:
Practical: Preparatory class on genome browsers.

13th week:
Practical: Genome browsers.

14th week:
Practical: General consultation.

15th week:
Practical: Genomics of complex diseases.

Subject: **MOLECULAR GENETICS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**
Practical: **30**

1st week:
Lecture: 1. Introduction into molecular genetics. 2. Organization of genetic material in pro- and eukaryotic cells.
Practical: Methods of study, required and advised readings. Laboratory safety in the laboratory. Nucleus and chromatin. Cell division.

2nd week:
Lecture: 3. Cytogenetics I. Karyogram, ideogram, banding techniques. Human autosomal trisomies. 4. Cytogenetics II. Abnormalities of the X and Y chromosomes. Structural aberrations of human chromosomes.
Practical: Cytogenetics. Evaluation of karyograms

3rd week:
Lecture: 5. Cytogenetics III. Sex determination in humans. Molecular cytogenetics. 6. The function of genes. Gene expression.
Practical: Gene structure, function (gene, DNS replication, transcription, translation).

4th week:
Lecture: 7. Genetic code. Translation. 8. Bacterial genetics.
Practical: Gene regulation in prokaryotes. Bacterial genetics.

5th week:
Lecture: 9. Gene regulation in prokaryotes. 10. The structure of the genes and gene regulation in eukaryotes. The genes of immunglobulines.
Practical: Gene regulation in eukaryotes.
Self Control Test (1st self-control test in extra time.)

6th week:
Lecture: 11. Epigenetics. Imprinting. Uniparental disomy. 12. Repair of the DNA. Mutagenic agents. Ames test. Dinamic mutations.
Practical: Mutation, repair, Ames-test.

7th week:
Lecture: 13. Molecular genetics of the cell cycle. 14. Transmission genetics. Genes and alleles. Genotype and phenotype. Monohybrid

cross. Mendel's 1st law. Reciprocal cross and test cross. Different types of inheritance.
Practical: Oncogenes and tumorsupressors.

8th week:
Lecture: 15. Multiple alleles. Dominant and recessive genes: phenotypes and a molecular view.. 16. Genetic polimorhism I. Allelic polymorhism. X-linked genes. Note: lectures will be held on an other day because Monday will be holiday.
Practical: Problem solving and seminar on mendelian genetics.

9th week:
Lecture: 17. Dihybrid cross. Mendel's 2nd law and meiosis. Linked and not-linked genes. Recombination of non-allelic genes. Genetic mapping. 18. Gene interactions, epistasis, lethal genes. Variations of the gene expression. LOD score.
Practical: Pedigree analysis. Basic of the human genetics. Seminar on molecular genetics of inherited human diseases.

10th week:
Lecture: 19. Extranuclear inheritance. Mutations in mitochondrial genes. 20. Genetic polymorphisms II. Human genetic diversity. Genetics of blood types.
Practical: Study of sex chromatin. Demonstration of mammalian chromosomes. Preparation of metaphase spreads.
Self Control Test (2nd self-control test in extra time.)

11th week:
Lecture: 21. Genetic polymorphisms III. Genetics of MHC. DNS-polymorphisms as alleles: RFLP, SNP, micro- és minisatellites. Copy number variations. 22. The genetic basis of complex inheritance.
Practical: Transformation of Escherichia coli.

12th week:
Lecture: 23. Genetic polymorphisms IV. Pharmacogenetics, pharmacogenomics. 24. Applications of modern genetics in clinical diagnosis. Genetics of pregnancy and prenatal vitamins. Personalized medicine. Ecogenetics and ecogenomics.
Practical: Complementation test. The gene concept.

13th week:
Lecture: 25. Population genetics. Hardy-Weinberg equilibrium. Inbreeding. Genetical basis of evolution. 26. Transposable elements.
Practical: Detection of human DNA polymorphism by polymerase chain reaction.

14th week:
Lecture: 27. The genetic role of RNA. 28. Developmental genetics.
Practical: Seminar on population genetics.
Self Control Test (3rd self-control test in extra time.)

15th week:
Lecture: 29. Clinical applications of new biotechnology techniques. 30. Results of Human Genom Project.
Practical: PCR evaluation of the human polymorphism experiment. Induction of beta-galactosidase in E. coli cells.

Requirements

Conditions of signing the lecture book:

1, Attendance
Concerning attendance, the rules laid out in the EER of the University are clear. The presence of students at laboratory practices and seminars is obligatory and will be recorded. **Students are responsible for signing the list of attendance.** The professor refuses his/her

signature in the student's Lecture Book for the semester's course-work in the case of over four weeks of absence, even if the student has an acceptable excuse.
If the student is absent from more than two practices or seminars (taken together), the semester will be accepted only if they pass an examination based on the material covered by the laboratory classes and seminars of the semester (lab test).
Successful accomplishment of the laboratory practices will be controlled by signing the laboratory notes. If 3 or more practices will not be accepted, the lecture book will not be signed. These students must sit for a written exam from the laboratory material.
The lab notes for the experiments should contain the followings:
Part made at home during the preparation:
1. The title of the experiment
2. The basic principle of the experiment
3. Description of the used method(s)

Part that should be made not later than next week lab:
4. The results of the experiment
5. Conclusions drawn from the experiment

If these are not prepared the lab instructor dismisses the student from the class.
The presence of students on at least 50% of lectures is obligatory and will be recorded. The professor refuses his/her signature in the student's Lecture Book for the semester's course-work if the student was absent from more than 17 lectures, even if the student has an acceptable excuse.

2, Self-control tests
During the semester there will be **three self-control tests** offered in the 5th, 10th and 14th weeks. Participation in at least two of them is required for the signature. The questions include multiple choice and short essay questions, figures, pedigrees, definitions, problems, etc. The questions are selected from a question bank that will be published on the departmental home page (except the multiple choice questions). Based on the % average of the **three tests** a final grade will be offered according to the next table:

Percentage (%)	Grade
60.00 - 64.99	pass (2)
65.00 - 74.99	satisfactory (3)
75.00 - 84.99	good (4)
85.00 - 100	excellent (5)

Those students who want a better mark have to take the regular end of semester “A” exam. The result of this ESE is binding, it can be better, the same or worse than the offered mark. Students with lower achievement than 60 % should take the regular ESE.

Exemption requests:
Applications for exemption (based on previous studies in other universities) should be submitted during the first two weeks of the semester. Requests are not accepted after that deadline! Exemption is granted only, if the student can pass an "Assessment of knowledge" test. The passing limit is 50%.

Rules concerning repeaters:
Attendance of labs and seminars for those repeaters who have a signed lecture book from the previous year (i.e. they failed, or they are repeaters because they have never taken Molecular Genetics exam) is dispensable. Students should register for the subject electronically during the first weeks of the semester. They can take the three midterm tests in order to qualify for offered grade or test bonuses and they take the regular exam at the end of the semester. They cannot have home-work bonuses. Students, who did not earn a signature in the previous year, have to register and attend the labs and seminars and they are considered as the other students registering the course at the first time.

End of Semester Examination (ESE):
There will be a written examination at the end of the semester (ESE) that covers all the material of the semester taken in the lectures, seminars, laboratory practices and required parts of the textbook (for a detailed list see the University Bulletin). The examination questions include multiple choice and short essay questions, figures, definitions, etc. The marks are based on the student's performance, expressed in percentage (%) as shown in the table below:

Percentage (%)	Grade
0 - 49.99	fail (1)
50.00 - 64.99	pass (2)
65.00 - 74.99	satisfactory (3)
75.00 - 84.99	good (4)
85.00 - 100	excellent (5)

The percentage values include the student's performance at the ESE as well as the bonus percentage they have obtained by taking the three mid-semester tests.
The following table shows the bonus percentage based on the average result of the semester tests. Absence counts as 0%.

Average of the 3 tests (%)	Bonus (%)
50.00 - 53.99	1
54.00 - 57.99	2
58.00 - 61.99	3
62.00 - 65.99	4
66.00 - 69.99	5
70.00 - 73.99	6
74.00 - 77.99	7
78.00 - 81.99	8
82.00 - 85.99	9
86.00 - 100	10

Further bonuses can be given for the timely completion of the following midterm homeworks:

- Problem solving in genetics (1 bonus)
- Analysis of human karyograms (1 bonus)
- Data search in human genetic databanks through the Internet (1 bonus)
- Problem solving in population genetics (1 bonus)

Only those home works are accepted for evaluations which are turned in within one week after the students receive them. The submission of the home-works is voluntary. Home-works are not accepted after the submission deadline.

Bonuses are calculated only in the year of acquisition.
Lecture and seminar files, hand-outs will be uploaded to the departmental homepage: www.genetics.dote.hu; username and password will be published on the first lecture.

Department of Immunology

Subject: **MOLECULAR IMMUNOLOGY**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **16**

1st week:
Lecture: Elements of the immune system and their role in defense against pathogens. Components and cells of the innate response. Characteristics and function of the innate immune response.

2nd week:
Lecture: Characteristics of the acquired immune response. T-lymphocytes. An introduction to antibody stucture and function.

3rd week:
Lecture: B-lymphocytes. The structure of lymphoid tissues and organs. Lymphatic circulation, immune surveillance by re-circulation of immunocytes within the immune system.

4th week:
Lecture: Recognition and elimination of pathogens by the innate arm of the immune system. The complement system. Inflammation and the acute phase response.
Seminar: Cells and tissues of the immune system.

5th week:
Lecture: Structure and function of proteins encoded by the major histocompatibility (MHC) gene complex. Genetics of MHC. Processing and presentation of antigens, antigen presenting cells.
Self Control Test

6th week:
Lecture: Requirements and consequences of T-cell activation. Effector function of helper T-cell. Activation and function of cytotoxic T-lymphocytes.
Seminar: Structure and function of MHC molecules. Requirements and consequences of T-cell activation.

7th week:
Lecture: Antigen dependent differentiation of B-lymphocytes. B-cell activation. Production of various antibody isotypes and their functions. Activatory and inhibitory coreceptors of B cells, ITAM and ITIM-mediated signal transduction.

8th week:
Lecture: Generation of B-cell receptor diversity. Antigen independent differentiation of B-lymphocytes. T-cell development.

9th week:
Lecture: Central tolerance. Mechanisms of peripherial tolerance. The function of regulatory T-cells.
Seminar: Effector function of lymphocytes. Generation of antigen receptor diversity. B and T-cell development.

10th week:
Lecture: The primary and secondary immune response. The development of immunological memory. Active and passive immunization, monoclonal antibodies.

11th week:
Seminar: Central tolerance. Mechanisms of peripheral tolerance. The development of immunological memory.
Self Control Test

Requirements

Signing of the Lecture Book:
Participation in the Seminars is compulsory, no absences are allowed. If there is any absences, the Department shall refuse to sign the students' Lecture book.

Self control tests (SCTs), offered grades, end-term exam:
During the semester two self control test (SCT) will be organised (weeks 5 and 11).
The first SCT contains the material of the lectures of weeks 1-3 as well as the material of seminars on weeks 4. To ensure a solid basic knowledge of immunology, students must score higher than 70% to qualify for the 2nd SCT, hence for an offered grade.
The 2nd SCT contains the material of lectures 4-10.
If a student's score for the first SCT is higher than 70% and is higher than 50% for the 2nd SCT, she/he will be offered a grade. Should student accept this offered grade, she/he will be exempted from the end-term exam.

The offered grades are calculated by the following algorithm, based on the cumulative percentage points of the two SCTs (i.e. 200 points maximum).

120 - 139:	pass (2)
140 - 159:	satisfactory (3)
160 – 179:	good (4)
180 – 200:	excellent (5)

Those students who have not qualified for an offered grade must take the end-term exam during the exam period. The end-term exam consists of a written and an oral part.
"A" exam: To qualify for the oral part of an "A" exam, students must score higher than 70% on the written (entry) exam. Students who score less than 70% on the written part will fail (thus, the oral exam will not take place).
"B" exam: "B" exams are identical to "A" exams except when the student failed the oral, but not the written, part of the "A" exam. With a score of higher than 70% on the written part of the "A" exam, the student is exempt from the written exam on the "B" exam.
"C" exam: "C" exams are oral exams only, without a written entry test.
Those students who would like to improve the grade of a successful ("A" or "B" exam) or do not accept the offered grade, are also exempted from the entry test.
The list of exam topics is available on the departmental website (www.immunology.unideb.hu).
Lecture materials and other information concerning education can be found on our website at www.immunology.unideb.hu by clicking the link "For Students".

Department of Medical Chemistry

Subject: **METHODS OF MOLECULAR BIOLOGY**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Isolation of nucleic acids (DNA and RNA) from biological sources, agarose gel electrophoresis

2nd week:
Lecture: Enzymes of nucleic acid investigation, cloning of DNA

3rd week:
Lecture: Generation and screening of DNA libraries

4th week:
Lecture: DNA and RNA hybridization techniques, DNA chips1st self-control test from the topics of weeks 1-3

5th week:
Lecture: In situ hybridization, FISH and CGH

6th week:
Lecture: Synthesis of oligonucleotides, Polymerase Chain Reaction applications, in vitro mutagenesis

7th week:
Lecture: DNA sequencing, genome projects

8th week:
Lecture: Purification of proteins, peptide synthesis2nd self-control test from the topics of weeks 4-7

9th week:
Lecture: Preparation of antibodies, analysis of proteins by immunological methods

10th week:
Lecture: Peptide sequencing, proteomics

11th week:
Lecture: Detection and quantitative analysis of protein-protein interactions 3rd self-control test from the topics of weeks 8-10

12th week:
Lecture: Expression systems for the production of recombinant proteins, transgenic plants

13th week:
Lecture: Biotechnology, fungal expression systems

14th week:
Lecture: Genetic manipulations: gene silencing, gene replacement, KO animals, gene therapy

15th week:
Lecture: 4th self-control test from the topics of weeks 11-14

Requirements

The program consists of a series of lectures that aim to extend the molecular biology knowledge of the first year MSc. students and provide a solid methodological basis for experiments to be performed in the next semester during molecular biology practical. It covers molecular biology approaches to complex problems, reveals the available methods and offers essential theoretical

knowledge that can be used both in applied and research fields. The course is divided into four teaching blocks: 1st block: weeks 1-3 2nd block: weeks 4-7 3rd block: weeks 8-10 4st block: weeks 11-14 During the semester four written self-control test will be held to evaluate the midterm progress of the students. The results of these tests can be used as an offered grade for selected or for all of the blocks of questions at the end of semester exam (ESE), provided the student accepts these marks in a letter sent to the program coordinator before the start of the examination period. In the absence of such a letter all of the midterm marks will be erased at the beginning of the exam period. ESE is a written test composed of four blocks of questions, each covering a given teaching block as described above. The knowledge of each block at least at the basic level is required for the passing grade. Both self-control and ESE tests will be evaluated according to the following table:

Percentage (%)	Mark
0-50	fail (1)
51-60	pass (2)
61-70	satisfactory (3)
71-80	good (4)
81-100	excellent (5)

Department of Physiology

Subject: **HUMAN PHYSIOLOGY I.**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Foundations of cellular physiology. Homeostatic parameters of human body.

2nd week:
Lecture: Membrane potentials and action potentials.

3rd week:
Lecture: Compartmentalization of body fluids.

4th week:
Lecture: Compartments of blood plasma and function of blood proteins.

5th week:
Lecture: Electrical properties of the heart.

6th week:
Lecture: Contractile properties of the heart.

7th week:
Lecture: Principles of hemodinamics.

8th week:
Lecture: Circulation of special areas (pulmonary, cerebral, coronary, splanchnic, cutaneous and muscular).

9th week:
Lecture: Regulation of the circulatory system.

10th week:
Lecture: Microcirculation.

11th week:
Lecture: Respiratory system.

12th week:
Lecture: The gastrointestinal tract. Nutrition, digestion, absorption I.

13th week:
Lecture: The gastrointestinal tract. Nutrition, digestion, absorption II.

14th week:
Lecture: Thermoregulation.

15th week:
Lecture: Neuromuscular transmission, functions of smooth and skeletal muscles.

Requirements

1. **Signature of Lecture Book**
Attendance of lectures is compulsory. If one has more than 2 lecture absences, the end-semester examination (ESE) may not be substituted with the average test score (see later). For continuous updates on all education-related matters, please check the departmental web-site (http://phys.dote.hu).

2. **Evaluation during the semester (mid-semester tests)**
The knowledge of students will be tested 2 times per semester in the form of a written test (multiple choice questions). Participation on mid-semester written tests is compulsory.

3. **Examination**
The first semester is closed by an end-semester exam (ESE) covering the topics of all lectures. The A and B chances of the end-semester exams are written tests (multiple choice questions), while the C chance is an oral exam. The grade of the written test is calculated according to the following table:

score	mark
0 – 59.9 %	fail
60 – 69.9 %	pass
70 – 79.9 %	satisfactory
80 – 89.9 %	good
90 – 100 %	excellent

ESE grade based on the average score of mid-semester tests will be offered if one's average score of the three mid-semester tests is above 60% and none of the individual tests' results are less than 40%. and (s)he has fewer than 3 lecture absences (see the table above).

- If one is not satisfied with the offered grade, (s)he may participate in ESE during the examination period. In his case the previously offered grade is canceled.

Division of Biophysics

Subject: **BIOPHYSICS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: 1. Introduction. Electromagnetic waves, the properties of light (interference, photoelectric effect, photon theory). Matter waves.
2. X-ray, X-ray crystallography.

Seminar: Although there are no Biophysics seminars in Molecular Biology MSc training program, we encourage students to attend one General Medicine or Dentistry Biophysics seminar. (See timetable on the webpage of Department of Biophysics and Cell Biology.) Please notify the manager of education your seminar attendance.

2nd week:
Lecture: 3. Thermal radiation, light absorption and emission. Atomic and molecule spectra, absorption spectroscopy.
4. Fluorescence spectroscopy, application of fluorescence.

3rd week:
Lecture: 5. Lasers and their application in medicine.
6. Optics, optical microscopy, electron microscopy.

4th week:
Lecture: 7. Physical properties of sound, ultrasound, Doppler effect. Medical applications of ultrasound.
8. Nuclear physics. Nuclear binding energy, radioactivity, law of radioactive decay, radioactive series.

5th week:
Lecture: 9. Features of nuclear radiation and its interaction with absorbing material. Detection of radiation.
10. Radiation biophysics: target theory, direct and indirect action of radiation. Dosimetry. Biological effects of radiation.

6th week:
Lecture: 11. Experimental and diagnostic application of isotopes. Accelerators, Gamma camera.
12. Principles of tomographic methods. PET, SPECT and X-ray absorption CT.

7th week:
Lecture: 13. Basic principles of Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR).
14. Magnetic resonance imaging (MRI). Magnetic resonance spectroscopy (MRS).

8th week:
Lecture: 15. Free enthalpy, chemical potential. Thermodynamic probability, Brownian motion, osmosis.
16. Diffusion at the molecular level, statistical interpretation. Fick's I and II Law.

9th week:
Lecture: 17. The structure of biological membranes. Membrane transport.
18. Thermodynamic equilibrium potentials (Nernst, Donnan). Diffusion potential, Goldman-Hodgkin-Katz equation.

10th week:
Lecture: 19. Resting potential, action potential, and electrical excitability. Measurement of membrane potential.
20. Ion channels (gating, selectivity), the "patch clamp" technique.

11th week:
Lecture: 21. The physical background of ECG and EEG.
22. Fluid mechanics, blood circulation.

12th week:
Lecture: 23. The human ear. Mechanism of hearing. The Weber-Fechner law.
24. The human eye. Photoreceptors. The molecular mechanism of vision.

13th week:
Lecture: 25. Biomechanics.
26. Flow cytomtery and its application in medicine.

14th week:
Lecture: 27. Biophysics of respiration.
28. Modern microscopic techniques, near field, atomic force microscopy, confocal laser scanning microscopy.

15th week:
Lecture: 29. Research in the Institute.
30. Preparation for the exam: questions, answers.

Requirements

Aim of the course:
To provide the necessary theoretical and practical background for the understanding the physical principles applied in biology and medicine, and for the description of the physical processes in living organisms.
To introduce the biophysical techniques in order to (1) understand the pathomechanism of diseases (2) develop of novel therapeutic approaches (3) develop of novel diagnostic tools: e.g. ECG, MRI, PET (4) understand the operation of cells, tissues and organs at the molecular level (5) provide a solid background for Physiology, Clinical Physiology, Radiology.

Short description of the course:
Students will be introduced to the quantitative description of the physical basis of selected topics in biology and medicine. Structure of the course: (1) Introduction to natural sciences (e.g. basic principles of atomic and nuclear physics) (2) Medical physics (e.g. physical principles of diagnostic and therapeutic procedures) (3) Molecular biophysics (e.g. diffusion, membrane biophysics) (4) Organ biophysics (e.g. vision, hearing, circulation)

Compulsory reading: Medical Biophysics (Editors.: S. Damjanovich, J. Fidy, J. Szöllősi, Medicina, Budapest, 2009, ISBN: 978-963-226-127-0)
Educational material published on the web page of the Department.

Web page of the Department: http://biophys.med.unideb.hu/en

Exam: Oral exam during the exam period after the 1st semester.

1. Lectures
Attendance to lectures is not compulsory but emphatically recommended. All material covered in lectures is an integral part of the subject and therefore included in the self-control tests and the final exam. Some new concepts and ideas are discussed in the lectures only and are not present in the textbook.

2. Seminars
No seminars are included in the course, however, it is recommended to attend the seminars of the medicine students, which might aid preparation for the exam.

3. Practicals
There are no practicals included in the course.

4. Exemption
In order to get exemption from the biophysics course the student has to write an application to the Educational Office. The Department of Biophysics and Cell Biology does not accept such applications. The following documents have to be submitted: 1. application with an explanation why the student thinks that he/she is eligible for an exemption; 2. certificates about the courses the student has taken; 3. a reliable description of the curriculum of the courses taken. An application is either rejected or accepted and exemption granted, or in most cases, students applying for an exemption will be examined by the Biophysics Chairman before granting an exemption. Applicants will be notified by the Department whether they have to take such an examination.

5. Conditions for signing the lecture book: no special requirements.

6. Self-control tests
There will be 2 self-control tests (SCT) during the semester. None of the SCTs are obligatory. Each SCT will be graded (0-100 %, 0% for absence) and the results of the two SCTs will be averaged (Xave). The missed test will be counted as 0% in the average. Missed SCTs cannot be made up at a later time. Based on the written tests students may be offered the following grades:

55-64.99:	pass (2)
65-74.99:	satisfactory (3)
75-84.99:	good (4)
85-100:	excellent (5)

7. Final Examination (FE)
Final Examination (FE): Students have three chances (A, B, C) for passing the biophysics final exam in the winter exam period after the semester in which the course was taken.
The FE consists of two parts:
Part I. Minimum requirement questions. It consists of a written quiz of 20 minimum requirement questions. One must pass this part to continue with the oral exam (part II.). Minimum requirement questions and the answers thereto are provided on the website of the Department (biophys.med.unideb.hu). 16 out of 20 have to be answered correctly in order to pass this part. This part of the FE is evaluated as pass or fail, once passed it is valid for further exam chances (B- or C-chance) of the FE.
Part II. Students take an oral exam, where two questions chosen from the topic list (provided on the departmental website) at random should be answered. In order to complete the exam successfully students need to get pass (2) for both questions. Students are exempted from the FE exam if the grade offered based on the self-control tests is accepted by the student (see point 6.)

8. Rules for calculator usage during self-control tests and the final examination
In order to ensure a fair evaluation, to avoid disturbances in the testing room, and to protect the security of the test material the following types of calculators are NOT permitted:
- calculators with built-in computer algebra systems (capable of simplifying algebraic expressions)
- pocket organizers, handheld or laptop computers
- any device capable of storing text. Calculators with a typewriter keypad (so-called QWERTY devices), electronic writing pads and pen-input devices are not allowed either. Calculators with letters on the keys (e.g. for entering hexadecimal numbers or variable names) are permitted as long as the keys are not arranged in QWERTY format.
- Calculators or other devices capable of communicating with other devices
- Calculators built into wireless phones
- Calculators with paper tape or models that make noise

In general, students may use any four-function, scientific or graphing calculator except as specified above. However, we reserve the right to prohibit the usage of ANY type of calculator, computer and data storage and retrieval device during some tests if no calculations or only very simple calculations are necessary. Sharing calculators during tests is not allowed, and the test proctor will not provide a calculator.

9. Information for repeaters
- repeating the course means attending the lectures
- according to the relevant rules (point 6) self-control tests may be written and grade may be offered again
- the results of the self-control tests written in the failed semester are lost
- exemption from minimals obtained in the exam period of the failed semester is lost.

10. Information for exam course students
Points 1-6 and 9 are irrelevant. Point 7 and 8 applies fully. Results of the self-control test written in the previous semester are lost. Exemptions from minimals obtained in a previous exam period is lost.

Further information: Zsolt Fazekas, Ph.D., manager of education, Dept. of Biophysics and Cell Biology

E-mail: biophysedu@med.unideb.hu

Office hours: The location and time of office hours are shown in the News section of the Department's web page.

Division of Nuclear Medicine and Translational Imaging

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE PRACTICALS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Practical: **15**

10th week:
Practical: Half life and gamma spectrum

11th week:
Practical: Labeling and gamma measurement

12th week:
Practical: In vitro isotope diagnostics (RIA)

13th week:
Practical: Dosimetry

14th week:
Practical: Liquid scintillation measurement

Requirements

Aim of the course (partial/complete skills and competencies):
To provide participants with practical training in basic methodologies of analytical laboratory work with radioisotopes. The course will broaden the participants' knowledge of methodological approaches, thus establishing later applications in practice.

Topics:
measuring half-life and dead time; characteristic curve of a GM tube; gamma spectra; absorption and self-absorption of beta radiation; liquid scintillation counting: efficiency; protein labeling with I-125; dosimetry

Practical 15, 5x3 hours

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction: radioisotopes in biomedicine.
Basic of atomic physics, decay modes

2nd week:
Lecture: Analytical methods with radiotracers

3rd week:
Lecture: Interactions of radiation with matter

4th week:
Lecture: Scintillation detection of gamma and beta radiation

5th week:
Lecture: Setting for measuring radiation. Gas ionization detectorsimits

6th week:
Lecture: General safety regulation, rules of working with radioisotopes. Compulsary before practices!

7th week:
Lecture: Basic terms and devices of dosimetry. Dose limits.
Biological effects of radiation.

8th week:
Lecture: Labeling techniques, autoradiography

9th week:
Lecture: Experimental error calculations, error propagation

10th week:
Lecture: "In vitro" isotope diagnostics

11th week:
Lecture: Characteristics and quality control of radiopharmaceuticals

12th week:
Lecture: Analyzing receptor binding and kinetics

13th week:
Lecture: "In vivo" nuclear medicine

14th week:
Lecture: Students' presentations

Requirements

Aim of the course (partial/complete skills and competencies):
To get acquainted with the possibilities of applying radioisotopes in biological and medical research, and the safety rules of handling radionuclides.

Topics:
basics of atomic physics, decay modes, law of decay; interactions of radiation with matter; methods and devices for detecting radiation: gas ionization and scintillation detectors, liquid scintillators, autoradiography; evaluation of the results of measurements; basic terms and devices of dosimetry; dose calculations; radiation protection, the biological effects of radiation; basic rules of working with radioisotopes, general safety regulations; applications: protein labeling techniques, analyzing receptor binding and kinetics, molecular biology

Department of Biochemistry and Molecular Biology

Subject: **BIOINFORMATICS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction to bioinformatics

2nd week:
Lecture: Molecular biology databases I. Primary databases

3rd week:
Lecture: Molecular biology databases II. Secondary databases

4th week:
Lecture: Database searches, ENTREZ, SRS

5th week:
Lecture: Sequence similarities, alignment searches I.

6th week:
Lecture: Sequence similarities, alignment searches II.

7th week:
Lecture: UNIX, softwares for sequence analysis I.

8th week:
Lecture: UNIX, softwares for sequence analysis II.

9th week:
Lecture: EMBOSS, a sequence analysis software package

10th week:
Lecture: Genomics I.

11th week:
Lecture: Genomics II.

12th week:
Lecture: Transcriptomics I.

13th week:
Lecture: Transcriptomics II.

14th week:
Lecture: Phylogenetics

15th week:
Lecture: Structural bioinformatics

Requirements

Requirements for oral examination:
Participation in the obligatory lectures. Only one absence is accepted from the obligatory lectures - in case of more absences students will not be permitted to take the oral exam.

Grading: Grades will be offered based on oral examination during the exam period. The student's performance will be assessed on a five-grade scale. The list of exam topics and the examination rules will be announced by the Department at the beginning of the semester (lecture slides are available at the http://bmbi.med.unideb.hu web site, username and password are provided at the beginning of the semester). Students may take one improvement exam per exam period.

Subject: **BIOINFORMATICS PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **15**

2nd week:
Practical: Molecular biology databases I. Primary databases

3rd week:
Practical: Molecular biology databases II. Secondary databases

4th week:
Practical: Database searches, ENTREZ, SRS

5th week:
Practical: Sequence similarities, alignment searches I.

6th week:
Practical: Sequence similarities, alignment searches II.

7th week:
Practical: UNIX, softwares for sequence analysis I.

8th week:
Practical: UNIX, softwares for sequence analysis II.

9th week:
Practical: EMBOSS, a sequence analysis software package

10th week:
Practical: Genomics I.

11th week:
Practical: Genomics II.

12th week:
Practical: Transcriptomics I.

13th week:
Practical: Transcriptomics II.

14th week:
Practical: Phylogenetics

15th week:
Lecture: Structural bioinformatics

Requirements

Requirements for grade offer:
Students are required to attend the practicals. Only one absence is accepted from the practicals - in case of more absences students will not be offered a grade.

Grading: Grades will be offered based on the student's performance during the practicals, on a five-grade scale. The list of evaluation topics and the evaluation rules will be announced by the Department at the beginning of the semester.

Subject: **CELL AND ORGAN BIOCHEMISTRY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Cell proliferation I.

2nd week:
Lecture: Cell proliferation II./apoptosis
Practical: Polymerase chain reaction - basics of experimental design and optimization.

3rd week:
Lecture: Gene expression I.

4th week:
Lecture: Gene expression II.

5th week:
Lecture: Signaling I.

6th week:
Lecture: Signaling II.

7th week:
Lecture: Iron, haem
Self Control Test (Topics for week 1-6.)

8th week:
Lecture: Hgl, inflammation
9th week:
Lecture: Liver

10th week:
Lecture: Haemostasis I.

11th week:
Lecture: Haemostasis II.

12th week:
Lecture: Extracellular matrix

13th week:
Lecture: Stress
Self Control Test (Topics for week 7-12.)

14th week:
Lecture: Biochemistry of the sport

15th week:
Lecture: Summary, consultation.

Requirements

Content of Organ and Cell Biochemistry: Topics presented at the lectures and discussed during the seminars (available at the http://bmbi.med.unideb.hu web site, username and password are announced on the first lecture). At the weekly seminars the lectures of the previous week will be discussed with the seminar teacher.

Requirements for the written exam: Participation in the seminars, and in the obligatory lectures. Only one absence is accepted from the obligatory lectures, and three absences are accepted from the seminars. In case of more absences students will not be permitted to take the written exam.

Self-control tests: (not obligatory) During the semester students may choose to write two self-control tests addressing the curriculum of the lectures and seminars. The self-control tests consist of single-choice and multiple-choice test questions, and by writing the both tests a total of maximum 40 points can be collected. If the combined score of the two tests is above 60% of the total score, bonus points can be awarded and added to the end-of-semester exam test score. Students can also be awarded 3 or 6 bonus points based on their performance during the seminars. The bonus points can be added to the points collected from the self-control testes, if the combined score of the two tests is above 60% of the total score.

Grading: Grades will be offered based on the written examination during the exam period. The written exams consist of single-choice and multiple-choice test questions - a maximum of 100

points can be collected. If the exam test score is 60 points or above, bonus points earned during the semester can also be added to it. The student's performance will be assessed on a five-grade scale.

pass (grade 2): 60-69,5 points
satisfactory (grade 3): 70-79,5 points
good (grade 4): 80-89,5 points
excellent (grade 5): 90-100 points

Students may take one improvement exam per exam period. Students must register for the exams on the NEPTUN until the end of the 15th week.
Please follow the announcements of the department on the announcement table (LSB downstairs 1st corridor), and on the website (http://bmbi.med.unideb.hu)

Department of Botany

Subject: **PLANT MOLECULAR BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **30**

1st week:
Lecture: Introduction into signal perception and transduction in plants. Role of developmental and environmental factors in gene expression in plants dispersion.
Seminar: Discussion of lecture topics.

2nd week:
Lecture: Plant DNA, nuclear genome structure. Properties and role of chloroplast and mitochondria genome organization in plants. Control of plant gene expression, basic features of light-dependent gene expression. Concept of transgenic plants and their application in plant biotechnology.
Seminar: Discussion of case studies.

3rd week:
Lecture: Gene expression in plant nucleus, chloroplast and mitochondria. Process and regulation of plant transcription. Plant RNAs: structure and function. Splicing mechanism of RNA.
Seminar: Discussion of case studies. Discussion of lecture topics.

4th week:
Lecture: Protein synthesis, metabolism in plant cells. Concept and process of post-transcriptional regulation in plants. Specific plant proteins. Mechanism and features of plant protein degradation and transport.
Seminar: Discussion of case studies.

5th week:
Lecture: Relationship of programmed cell death and development (differentiation), senescence progression and stress-related events in plant cells.
Seminar: Discussion of lecture topics. Case studies.

6th week:
Lecture: The organization of plant cell cytoskeleton and its function in regulating plant cell shape, morphogenesis, cell division. Regulation of plant cell cycle. The structure and function of plant cell membranes.
Seminar: Discussion of lecture topics. Methods in studying cytoskeleton and cell cycle regulation in plant cells.

7th week:
Lecture: Molecular biology of plant growth regulators: auxins, cytokinins- functions, transport, signal transduction pathways, regulation of gene expression.
Seminar: Discussion of lecture topics. Methods of studying molecular biology of auxin and cytokinin action. Immunohistochemistry, live cell imaging, molecular biology methods.

8th week:
Lecture: Molecular biology of plant growth regulators: auxins, cytokinins- functions, transport, signal transduction pathways, regulation of gene expression.
Seminar: Discussion of lecture topics. Methods of studying molecular biology of auxin and cytokinin action.

9th week:
Lecture: Molecular biology of plant growth regulators: gibberellic acids (GAs), abscisic acid (ABA), ethylene, brassinosteroids, salycilic acid, jasmonic acid - functions, signal transduction pathways, regulation of gene expression.
Seminar: Discussion of lecture topics. Methods of studying molecular biology of GA, ABA, ethylene action.

10th week:
Lecture: Plant life cycle and molecular regulation of plant morphogenesis; photoreceptors and light-regulated gene expression.
Seminar: Discussion of lecture topics. Case studies.

11th week:
Lecture: Photosynthesis and its regulation. Proteins in photosynthetic electron transport chain; Responses of plants to different light conditions (intensity, wavelength, duration) and changes in other environmental factors; regulation of carbohydrate metabolism.
Seminar: Discussion of lecture topics. Methods of studying photochemical activity and carbon assimilation pathways.

12th week:
Lecture: Responses to abiotic stresses; basic mechanisms underlying adaptation processes necessary for withstanding unfavourable growth conditions; stress signal transduction and physiological reactions.
Seminar: Discussion of lecture topics. Case studies

13th week:
Lecture: Secunder metabolic pathways in plants. Terpenoids, alkaloids, phenoloids and polykhetides.
Seminar: Discussion of lecture topics.

14th week:
Lecture: Function, allelopathy and bioactivity of secondary metabolites in plants.
Seminar: Discussion of lecture topics. Case studies.

15th week:
Lecture: final exam

Requirements

The program consists of lectures, seminars and laboratory practices. Attendance at seminars is recorded. Students should attend at least 80% of seminars.

Textbook:
Plant Biology Manual, Department of Botany. Material is published on the botany.ttk.unideb.hu web page.

Subject: **PROBLEM-SOLVING EXERCISES IN MOLECULAR BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **45**

Department of Medical Chemistry

Subject: **METHODS IN MOLECULAR BIOLOGY PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **45**

1st week:
Practical: Preparation of genomic DNA, PCR, agarose gel electrophoresis. Preparation and assay of total RNA, RT-PCR, Q-PCR. Cultivation of bacterial and eukaryotic cells. Preparation and transformation of competent E. coli cells, DNA cloning.

2nd week:
Practical: Extraction of proteins. SDS-PAGE, Western blotting. Expression and affinity chromatographic purification of GFP. Preparation and restriction mapping of plasmid DNA. ELISA. Immunocytochemical analysis.

Requirements

During an intensive practical course the students learn how to execute molecular biology experiments, utilize the methods for solving practical questions as well as understand the limitations and power of the molecular biology approaches. The program consists of laboratory practices concentrated in the first two weeks of the semester. Attendance on laboratory practices is obligatory and will be recorded. The successful completion of all practical experiments, including the proper discussion of the results, is a strict requirement that will be checked based of the students' notebook by the lab instructors. Missed experiments may be made up in an extracurricular time with the instructor. In the absence of a notebook signed by all of the lab instructors the subject will not be accepted. The complete and duly signed notebook has to be submitted to the course coordinator before the start of the examination period. The work of the students will be evaluated based on the written notes of the student in the notebook. The point is that all of the experiments should be described so that it would be possible to reproduce it by a graduated molecular biologist.

Department of Medical Microbiology

Subject: **PHYSIOLOGY OF PROKARYOTES, MOLECULAR VIROLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Practical: **15**

1st week:
Lecture: History of virology. Structure and taxonomy of viruses.

2nd week:
Lecture: Virus replication.

3rd week:
Lecture: Replication strategies of viruses.

4th week:
Lecture: Pathogenesis of viral infections. Virus-host interactions. Tumour viruses.

5th week:
Lecture: Host defense against viral infections. Evasion of immune responses by viruses.

6th week:
Lecture: Immunization. Vaccine types. Antiviral treatment.

7th week:
Lecture: Subviral agents. Prions.

8th week:
Lecture: Bacterial cell structure. Propagation of bacteria.
Practical: 8th week 1st day: Propagation of bacteria. Macroscopic, microscopic morphology. Demonstration: Bacteria on solid media Staphylococcus aureus NA, BAα-haemolytic Streptococcus BA, ChABacillus subtilis NA, BAE scherichia coli NA, EMBK lebsiella p. NA, EMB Proteus mirabilis NA, EMBP seudomonas aeruginosa NA, EMB2. Stained smears. Working task: 1. Preparing smear from bacterial cultures. Gram staining of smears. (Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa)2. Preparing hanging drop to study motility of bacteria (Bacillus subtilis, Klebsiella sp., Escherichia coli, Pseudomonas aeruginosa)8th week 2nd day: Biochemical tests. Demonstration: a. MR (methyl-red reaction): E. coli, Klebsiella sp.b. VP (Voges-Proskauer reaction): E. coli, Klebsiella sp.c. Esculin hydrolisis (BEA medium): Enterococcus faecalisd. indol test: E. coli, Klebsiella sp.e. ureum hydrolisis test: E. coli, Klebsiella sp.f. phenylalanin-deaminase test: Proteus sp., E. colig. Oxidase reaction: Pseudomonas sp., E. colih. Catalse test: S. aureus, E. faecalisi. Coagulase test: S. aureus, S. epidermidis Working task: 1. MR (methyl-red reaction): E. coli, Klebsiella sp. 2. VP (Voges-Proskauer reaction): E. coli, Klebsiella sp. 3. indol test: E. coli, Klebsiella sp. 4. Oxidase reaction: Pseudomonas sp., E. coli 5. Catalse test: S. aureus, E. faecalis 6. Coagulase test: S. aureus, S. Epidermidis 7. Calturing of bacteria (E. coli) for antibiotic sensitivity test 8th week 3rd day: Antibiotic sensitivity tests. Serological reactions. Demonstration: ELISA, Western-blot. Working task: VDRLSlide agglutination (Escherichia coli)Validation and interpretation of ELISA, Western-blotEvaluation of antibiotic sensitivity test.

9th week:
Lecture: Photosynthesis of bacteria. Chemolithotrophic bacteria. Bacterial catabolism. Archea.
Practical: 9th week 1st day: Working task: Inoculation of embrionated egg with Newcastle disease virus (NDV)9th week 2nd day: Working task: Harvesting and freezing the chorioallantoic fluid (virus solution) from the infected embrionated eggs. 9th week 3rd day: Demonstration: Haemagglutination inhibition. Working task: Haemagglutination with the previously harvested and frozen virus solution. Calculation the haemagglutination titer. Immunofluorescence staining: human cytomegalovirus antigenaemia for pp65 antigen.

10th week:
Lecture: Bacterial DNA replication. Regulation of gene expression in prokaryotes.

11th week:
Lecture: Plasmids, transformation of bacteria.

12th week:
Lecture: Pathogenicity, virulence. Host defense against bacterial infections. Immunization.

13th week:
Lecture: Sterilization, disinfection

14th week:
Lecture: Antibacterial therapy

15th week:
Lecture: Consultation

Requirements

The program consists of lectures and laboratory practices. Attendance at laboratory practices and lectures is recorded. Students should attend 100% of laboratory practices. In exceptional cases, the student may make up one missed practice after consultation with the lab teacher. Students should prepare a laboratory notebook which is collected at the end of the practices. From the 2nd week at the beginning of the lecture a short (10-15 min) test is written during the whole semester. Test contains questions about the materials from the previous lecture and the actual practice. Based on the cumulative results of the tests, students are offered an End-Semester-Examination (ESE) grade. Those who are not satisfied with the offered grade or are bellow the passing level, should take an end- semester-examination (A –chance) hold in the examination period. The student's test will be assessed on a five-grade scale. The written examination (A and B chance) consists of assay questions. C-chance is a written examination and in case of failed result the student has to take an oral examination. The examination rules will be announced during the semester.

Topics:
Replication and propagation of bacteria; prokaryotic energy metabolism; regulation of gene expression in prokaryotes; pathogenicity, virulence; host defense against bacterial infections; immunization; sterilization, disinfection; antibacterial therapy; plasmids, transformation of bacteria

Replication of viruses; viral pathogenesis; host defense against viral infections, immunization; oncogenic viruses; antiviral agents; prions;

Department of Physiology

Subject: **HUMAN PHYSIOLOGY II.**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Principles in renal physiology. The nephron. Quantitative description.

2nd week:
Lecture: Glomerular filtration and tubular transports.

3rd week:
Lecture: Osmoregulation, water balance. Control of body fluid volume.

4th week:
Lecture: Regulation of acid-base balance.

5th week:
Lecture: General principles of endocrinology.

6th week:
Lecture: The thyroid gland.

7th week:
Lecture: The hormones of adrenal cortex.

8th week:
Lecture: The hormones of adrenal medulla.

9th week:
Lecture: General principles in the regulation of gonadal functions. Male and female gonadal functions.

10th week:
Lecture: Ca-homeostasis.

11th week:
Lecture: Regulation of blood glucose level.

12th week:
Lecture: Cellular neurophysiology.

13th week:
Lecture: The sensory system. Physiology of hearing, taste and smell sensation.

14th week:
Lecture: Physiology of the vision.

15th week:
Lecture: Control of movements. Vestibular system.

Requirements

1. Signature of Lecture Book
Attendance of lectures is compulsory. If one has more than 2 lecture absences, the end-semester examination (ESE) may not be substituted with the average test score (see later). For continuous updates on all education-related matters, please check the departmental web-site (http://phys.dote.hu).

2. Evaluation during the semester (mid-semester tests)
The knowledge of students will be tested 3 times per semester in the form of a written test (multiple choice questions). Participation on mid-semester written tests is compulsory.

3. Examination
The semester is closed by an an end-semester exam (ESE) covering the topics of all lectures of the semester. The A and B chances of the end-semester exams are written tests (multiple choice questions), while the C chance is an oral exam. The grade of the written test is calculated according to the following table:

score	mark
0 – 59.9 %	fail
60 – 69.9 %	pass
70 – 79.9 %	satisfactory
80 – 89.9 %	good
90 – 100 %	excellent

ESE grade based on the average score of mid-semester tests will be offered if one's average score of the three mid-semester tests is above 60% and none of the individual tests' results are less than 40%. and (s)he has fewer than 3 lecture absences (see the table above). - If one is not satisfied with the offered grade, (s)he may participate in ESE during the examination period. In his case the previously offered grade is canceled.

Subject: **HUMAN PHYSIOLOGY PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **30**

1st week:
Practical: Investigation of the cardiovascular functions.

2nd week:
Practical: Determination of parameters characterising the respiratory functions.

3rd week:
Practical: Examination of the blood.

4th week:
Practical: Computer aided aquisition and processing of biological signals.

5th week:
Practical: Effects of electrolytes on the uterinal smooth muscle function.

6th week:
Practical: Effects of neurotransmitters and hormones on the uterinal smooth muscle function.

7th week:
Practical: Computer simulation of the frank-straling-mechanism.

8th week:
Practical: Simulation of the renal transport mechanisms.

9th week:
Practical: Computer simulation of the glucose tolerance test.

10th week:
Practical: Remedial lab.

11th week:
Practical: Closing lab.

Requirements

1. Signature of Lecture Book
Attendance of laboratory practices is compulsory. The signature of the Lecture Book may be refused for the semester in case of more than two absences from the practices. All missed practices must be made up. Completion of all topic sheets in the Exercise Book, each verified by the signature of the teacher, is also a precondition of the signature of the Lecture Book.
For continuous updates on all education-related matters, please check the departmental web-site (http://phy.dote.hu).

2. Evaluation during the semester
Laboratory practical knowledge of the students will be tested at the end of the semester as part of the Closing Lab, evaluation with five level grades. As a precondition of attending the Closing Lab, the fully completed Exercise Book (with all the verified topics) must be presented during the Closing Lab. Students are expected to perform the given experiment on their own and must also be familiar with theoretical background. In case of a negative result, the Closing Lab can be repeated, but only once before the beginning of the exam period.

Division of Biomathematics

Subject: **BIOSTATISTICS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**

7th week:
Lecture: Biostatistics. Probability theory. Set theory. Random events. Conditional probability, marginalization. Independent events.

8th week:
Lecture: Biostatistics. Random variable. Cumulative distribution function, distribution function of random variable. Mean, standard deviation.

9th week:
Lecture: Biostatistics. Discrete probability distributions: binomial and Poisson-distribution.

10th week:
Lecture: Biostatistics. Continuous probability distribution. Normal distribution. Standard normal distribution. Sampling.

11th week:
Lecture: Biostatistics. Hypothesis testing. Null hypothesis. Statistical significance. z-test.

12th week:
Lecture: Biostatistics. Paired, unpaired t-test, F-test.

13th week:
Lecture: Consultation.
Biostatistics final test.

Requirements

1. The aim of the course
To give an introduction to biostatistical methods, which can be used in different branches of medicine to solve biostatistical problems and to evaluate experimental results. In addition to providing a solid theoretical foundation the course will also introduce the students to the art and science of performing the simplest calculations.

2. Short description of the subject
Brief introduction to the most basic concepts of calculus (slope, fitting, area under the curve); counting techniques; descriptive statistics; algebra of events; probability; random variables; statistical distributions and their properties; binomial, Poisson and normal distributions; sampling techniques and characterization of samples; statistical test (z, t, F tests)

3. Requirements for the Biostatistics course
Attendance to classes is mandatory. Students must not miss more than 1 class. No kind of certificate, including a medical certificate, is accepted for the absences. Making up for missed classes is not possible. All material covered in lectures is an integral part of the subject and therefore included in the final exam. In the classes, students are encouraged to ask questions related to the topic of the lectures discussed (see timetable of lectures and seminars).

4. Requirements for signing the lecture book:
Signing of the lecture book is denied if there are more than 1 absences from groupwise classes.

5. Course test and final exam:
Students must take a written exam. Students will write a grade-offering course test after the last seminar. The structure of this test will be identical to that of the final exam: it contains theoretical questions (true or false questions, multiple choice question, fill-in questions, open-ended questions) and calculations. A maximum 100 points can be obtained in the test. Based on the final score of the exam the following grades are offered

- FS<50 fail
- 50=<FS<65 pass
- 65=<FS<75 satisfactory
- 75=<FS<85 good
- 85>=FS excellent

Exams will be held once every two weeks during the exam period. A grade of 2 or better achieved on the grade-offering test is valid for the final exam.

6. Obligatory reading
Educational material published on the web page of the Department which can be downloaded in pdf format (web page: biophys.med.unideb.hu)

7. Compulsory reading
Wayne W. Daniel: Biostatistics, A foundation for Analysis in the Health Sciences, John Wiley&Sons

8. Exemptions:
Applications for exemption from the biostatistics course has to be turned in to the Credit Transfer Committee. Such requests are not accepted by the Biomathematics Division or the Department of Biophysics and Cell Biology.

9. Information for repeaters
For repeaters the attendance to seminars is not compulsory. According to the relevant rules self-control tests may be written and exemptions may be obtained again

10. Rules for C-chance exams
If the result of the written part of a C-chance exam is at least a pass (2) according to the rules pertaining to A- and B-chance exams, the grade of the C-chance exam will be what is to be offered based on the rules of the A- and B-chance exams.. If the result of a C-chance exam is a fail, the written part will be followed by an oral exam. In this case the grade of the C-chance exam will be determined by the result of the written test and the performance on the oral exam.

Division of Cell Biology

Subject: **CELL BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**
Practical: **15**

1st week:
Lecture: Lecture 1: Introduction.
Lecture 2: Cell membrane. Membrane transport

2nd week:
Lecture: Lecture 1: ABC transporters and related diseases
Lecture 2:Ion channels, membrane potential

3rd week:
Lecture: Lecture 1: Calcium homeostasis
Lecture 2:Osmo-, volume and pH regulation

4th week:
Lecture: Lecture 1: Cellular organelles. Trafficking between cellular organelles, overview.
Lecture 2:Intracellular membrane systems I: lysosome, peroxisome, endoplasmic reticulum.

5th week:
Lecture: Lecture 1: Intracellular membrane systems II: The Golgi complex, endo- and exocytosis, protein sorting.
Lecture 2:The nuclear envelope. Transport through the nuclear pores

6th week:
Lecture: Lecture 1: The nucleus
Lecture 2:Structure of chromtatin

7th week:
Lecture: Lecture 1: Cytoskeleton I: microtubules.
Lecture 2:Cytoskeleton II: intermedier filaments, actin cytoskeleton.

8th week:
Lecture: Lecture 1:Cell energetics/mitochondrion.
Lecture 2:Cell-cell contacts, cell-extracellular matrix contacts.

9th week:
Lecture: Lecture 1: Cell signaling I. General concepts. Nuclear receptors. G-protein coupled receptors.
Lecture 2:Cell signaling II. Receptor tyrosine kinases. The Ras/MAPK, PI3K/Akt and PLC/CaMK pathways.

10th week:
Lecture: Lecture 1: Cell signaling III. Pathways to the nucleus. Oncogenes in signaling.
Lecture 2: Cell signaling IV. Cell-cell communication in the nervous and immune systems.

11th week:
Lecture: Lecture 1: Mitosis, meiosis. Experimental systems for studying the cell cycle.
Lecture 2: Mechanics of mitotic cell division

12th week:
Lecture: Lecture 1: Regulation of the mitotic cell division.
Lecture 2: Cell fates I: Overview / differentiation.

13th week:
Lecture: Lecture 1: Cell fates II: Stem cells.
Lecture 2: Cell fates III: Cell senescence, apoptosis.

14th week:
Lecture: Lecture 1: Cell fates IV: Tumor cell biology.
Lecture 2: Cells in broader context: Interactions with drugs, viruses and bacteria.

15th week:
Lecture: Lecture 1: Cellular motility.
Lecture 2: Main features of the prokaryotic and eukaryotic cells: an overview.

Requirements

Lectures:
Attendance of lectures is highly indispensable for acquiring the knowledge required to pass! They are your best source of synthesized and structured information. Some new concepts are discussed exclusively at the lectures. To further facilitate attendance, an attendance bonus system was introduced also in the case of Cell Biology lectures: If a student is present in every lecture, he/she automatically receives 5 bonus points which is added to the result of the final exam score.

Attendance will be checked randomly. The student will lose all these (5) bonus points, if he/she is caught missing any one of the lectures at these random checkings OR proves completely ignorant about the subject of the particular lecture, based on questions to be answered orally or in written. Certificates of any kind, including a medical certificate, will NOT be considered.

Books to be studied:
4th ed. of Essential Cell Biology (Alberts et al.,Garland Publ Inc. 2014. ISBN: 978-0-8153-4454-4) is the course book recommended as a foundation. It is concise, easy to read and the thorough knowledge of the material contained in its chapters (1. and 11-20.) is absolutely necessary for passing at the Final Exam. The preceding chapters contain explanations for basic molecular concepts: these chapters serve as reference and will not be directly asked in tests, except for certain parts indicated by the lecturer and also published in our website. In addition, there is a lot of additional information presented at lectures, and also discussed in the seminars, which the students are also required to know. The slides presented in lectures will be provided at the department website; however, you must attend the lectures and take notes to be able to interpret them. To read a full-text version of this additional material we recommend two books: Molecular Cell Biology (Lodish et al.) and Molecular Biology of the Cell (Alberts et al.)

Seminars:
In the seminars, students may ask their questions related to the topic of the lectures discussed (see final timetable of lectures and seminars that will be announced on the week 1. of the semester). Attendance of seminars is not compulsory. Students actively participating the seminars can give a short presentation on the topic of one of the lectures discussed in the seminar. The topics will be distributed in the first seminar or later can be asked from the educational manager. The talks are graded on a scale of 0-5.

Self-control Tests (SCT-s):
There are two SCT-s. The dates and topics for SCT-s will be announced on week 1 of the semester. Exact times and locations for each group will be posted during the semester. Types of the SCT questions are akin to the Final Exam questions; i.e. true or false, simple selection, multiple selection, relation analysis, fill in questions or define a definition type questions may be awaited. Lab questions will be included in the 2nd self-control test as well as in the Final Exam test, to approximately 10% of the total points. Based on the score of the SCT-s, you receive bonus points that count towards your grade in the Final Exam.

Conversion of SCT points into bonus points for Final Exam:
Bonus points based on the score (as a %) of an SCT. The bonus points are calculated as 0,05 x score (as a %). Maximum 5 bonus points can be earned with each SCT, so totally 10. Writing the SCT-s is highly recommended. If you miss a SCT, you will miss valuable points from your Final Exam score!
Grade offering based on SCT results:
For those performing well on SCT-s, i.e. earning 50 % or more in the average of the two SCT-s, based on the sum of their bonus points (lab points + lecture bonus + short presentation) and average

SCT result we offer final grades as follows:

60-69.5 points:	pass (2)
70-79.5 points:	satisfactory (3)
80-89.5 points:	good (4)
above 90 points:	excellent (5)

The offered grades will be posted on the Neptun system where students must declare acceptance or refusal. Accepting the grade means exemption from the final exam, so the accepted grade will be entered into the lecture book as the final grade. Students without offered grade must attend the Final Exam (see below). If a student did not accept the offered grade, but his/ her average of the two SCT-s is 60 % or more, he/she does not have to write A-part of the written Final Exam (see later). They got 14 points.

Requirements for signing the lecture book:
No

Final Exam: The exam is a written test of two parts (A and B).

Part A:
Part A of the written test is a set of 10 questions addressing the basic concepts listed among the key-words published in our website. These questions will include 5 brief descriptions of basic concepts, and 5 questions of yes/no type. The descriptions should contain 2 valuable and relevant facts/statements on the subject asked, for maximal score (2 points each; partial points may be considered). The A test has to be completed in 10 minutes. You will need to collect at least 14 points to pass the A test. Those earning below 14 points in part A fail the entire exam without regard to their score on part B, what will not be corrected and scored in this case. The score of a passed A test will be added to the score of part B, thus yielding 14-20% of the total exam points

Part B:
Part B is a complex test, including two short essays (2x10=20%), fill-in, short answer, multiple choice, relation analysis, sketch-recognition as well as simple choice and yes/no questions (50%). It contains material from the textbook, lectures and seminars. The lab questions are a section of the part B exam (to approximately 10% of the total test points).
Cell Biology part A written max. 20 points
Cell Biology part B written max. 80 points
Bonus points will be added only if the score of A+B part alone is above 50%:
Cell Biology short presentation bonus max. 5 points
Bonus points for lecture attendance max. 5 points
Bonus points based on SCT scores max. 10 points
Total 120 points

Your grade on the Final Exam:

below 60% points:	fail (1)
60-69.5% points:	pass (2)
70-79.5% points:	satisfactory (3)
80-89.5% points	good (4)
above 90% points	excellent (5)

Repeated exams:
On repeated exams during the exam period of the 2nd semester, points earned from SCT-s, lecture attendance and from short presentations are valid throughout. However, all bonuses and merits expire by next spring exam period. Note that all parts have to be repeated on repeated exams, that is, cell biology written part B (including the lab questions), and cell biology written part A with less than 14 points.
The test/exam grade earned should reflect the true knowledge of the student. Therefore, if there are

doubts whether the result of the written tests (SCTs, A, B, exam) really reflect the true knowledge of the student, the teachers/professors may also ask oral questions so as to be able to give a grade they deem justified.
The C chance exam always starts with a written part (similarly to A and B chance exams) and if the student fails on the written part, it is follwed by an oral exam in front of a committee. The committee summarizes the results of both parts and decides the grade, not necessarily averaging them.

Exemptions:
In order to get full exemption from the cell biology course the student has to write an application to the Educational Office. The Department of Biophysics and Cell Biology does not accept such applications. Applications for exemptions from part of the courses are handled by the department. The deadline for such applications is Monday on the second week. The following documents have to be submitted to the study adviser: 1. application with an explanation why the student thinks that he/she is eligible for an exemption; 2. certificates about the courses the student has taken; 3. a reliable description of the curriculum of the courses taken. The decision about exemption is based on a result of an "open-book"' exam test on the third week. Applicants will be notified whether they have to take such an examination.
Further Information:
* Study advisor from Cell Biology: Zsolt Fazekas Ph.D. (cellbioedu@med.unideb.hu)
* Info regarding tests, seminars, lectures is posted on the lab door ("Biophysics lab", ground floor, Theoretical Building), the department bulletin board and http://biophys.med.unideb.hu.
User names and passwords will be given out at the first cell biology seminar during the first week of the semester.
* We offer to keep an e-mail contact with the students whenever possible. This is smooth, fast and effective. Please write to cellbioedu@med.unideb.hu.
* Personal consultation with the study advisor: office hours are posted on the web site and the bulletin board of the Department. For appointments outside office hours please write an email.

Recommended books accessible online free of charge can be reached at the following URLs:
- Lodish et al.: MOLECULAR CELL BIOLOGY (4th ed.):
http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mcb
- Alberts et al.: MOLECULAR BIOLOGY OF THE CELL (4th ed.):
http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4

Every online book can be searched electronically for keywords.

CHAPTER 11
REQUIRED ELECTIVE COURSES

Department of Agrochemistry and Soil Science

Subject: **FOOD BIOCHEMISTRY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**
Practical: **15**

1st week:
Lecture: Water. The linkage of water in foods. Critical water activity value. Transport of water in food.

2nd week:
Lecture: Classification of minerals. Their physiological role dispersion.

3rd week:
Lecture: Carbohydrates in foods, their classification. Maillard reactions.

4th week:
Lecture: Carbohydrate-based flavourings and additives.

5th week:
Lecture: Food proteins. Functional properties of proteins. Denaturation of proteins in foodstuffs changes in food properties due to it.

6th week:
Lecture: Protein based flavorings and additives. Additives increasing nutritional value.

7th week:
Lecture: Lipids in foods. Indicator values for fat and oil quality. Problem of rancidity.

8th week:
Lecture: The essential amino acids and fatty acids, the possibilities for their intake.

9th week:
Lecture: Vitamins. The change in the amount of vitamin during storage.

10th week:
Lecture: Natural - and artificial dyes.

11th week:
Lecture: Taste and flavoring.

12th week:
Lecture: Preservation. Preservatives.

13th week:
Lecture: Eggs and egg products, milk and milk products, meat and meat product their chemical composition and its changes during processing and storage.

14th week:
Lecture: Hazardous components of foods (pesticides residuals, toxic elements, mycotoxins)

15th week:
Lecture: Products of plant origin (corn products, fruit and vegetable preparations), their chemical composition, and their role in our nutrition.

Requirements

Final written exams will be assessed as follows*:

Percentage (%)*	Mark
0-50	fail (1)
51-65	pass (2)
66-75	satisfactory (3)
76-84	good (4)
85-100	excellent (5)

Subject: **SOIL BIOLOGY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**
Practical: **15**

Department of Algebra and Number Theory

Subject: **EVALUATION OF MEASUREMENTS: MATHEMATICAL METHODS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**
Seminar: **30**

1st week:
Lecture: Basics of combinatorics.
Seminar: Exercises on combinatorics.

2nd week:
Lecture: Introduction to probability theory.
Seminar: Basic probability calculation exercises.

3rd week:
Lecture: Discrete and geometric probability.
Seminar: Exercises on discrete and geometric probability.

4th week:
Lecture: Conditional probability, independence.
Seminar: Exercises on conditional probability and independence.

5th week:
Lecture: Expected value, standard deviation, random variables, probability distribution.
Seminar: Calculation of expected values and standard deviations.

6th week:
Lecture: Discrete probability distributions.
Seminar: Exercises on discrete probability distributions.

7th week:
Lecture: Continuous probability distributions.
Seminar: Exercises on continuous probability distributions.

8th week:
Lecture: Preparing for the first full seminar long test.
Seminar: First full seminar long test.

9th week:
Lecture: Basics of statistics, mean, corrected and uncorrected sample variance.
Seminar: Calculation of mean and corrected and uncorrected sample variance.

10th week:
Lecture: Estimation of expected value and

standard deviation. Standard error of mean.
Seminar: Estimating expected values and standard deviations.

11th week:
Lecture: Confidence intervals.
Seminar: Estimation of expected values using confidence intervals.

12th week:
Lecture: Basic statistical tests: u-test, t-test, F-test.
Seminar: Exercises on statistical test I.

13th week:
Lecture: Statistical tests for testing independence and homogeneity.
Seminar: Exercises on statistical tests II.

14th week:
Lecture: Linear regression and error calculation.
Seminar: Exercises on linear regression and error calculation.

15th week:
Lecture: Preparing for the second full seminar long test.
Seminar: Second full seminar long test.

Requirements

The program consists of lectures, seminars. Attendance at seminars is recorded. Students should attend at least 80% of seminars. On every seminar there is a short test. On the 8th and 15th week there are full seminar long tests. The grade is based on the results of the short tests and of the two full seminar long tests.

Textbook:
Material presented on the lecture.

Department of Anatomy, Histology and Embryology

Subject: **ADVANCED METHODS IN NEUROBIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Practical: **15**

1st week:
Lecture: Neuronal tracing methods - I.

2nd week:
Lecture: Neuronal tracing methods - II.

3rd week:
Lecture: Pre- and postembedding immunohistochemical methods.

4th week:
Lecture: Fluorescent immunohistochemical methods.

5th week:
Lecture: Electron microscopy – I. Specimen preparation for TEM investigation.

6th week:
Lecture: Electron microscopy – II. The transmission electron microscope (TEM) and its application for the investigation of biological samples.

7th week:
Lecture: Computer assisted 3-D reconstruction and image analysis.- I. The Neurolucida System and its application for 3-D reconstruction and imageanalysis.

8th week:
Lecture: Computer assisted 3-D reconstruction and image analysis. - II. Advanced methods in image processing analysis.

9th week:
Lecture: In situ hybridization and its application in neurosciences.

10th week:
Lecture: PCR and „blotting" methods and their application in neurosciences.

11th week:
Lecture: In vitro electrophysiology –I. Sample preparation for in vitro electrophysiology.

12th week:
Lecture: In vitro electrophysiology – II. Application of patch-clamp recordings in neurosciences.

13th week:
Lecture: In vivo electrophysiology and juxtacellular labeling of neurons – I. Preparation of animals for in vivo electrophysiology.

14th week:
Lecture: In vivo electrophysiology and juxtacellular labeling of neurons – II. Practical introduction to in vivo electrophysiology and juxtacellular labeling of neurons.

Requirements

Concerning attendance, the rules written in the Regulations Governing Admission, Education and Examinations of the University are valid. The presence in practices, seminars and lectures will be recorded. The head of the department may refuse to sign the Lecture Book if a student is absent more than twice from practices and seminars in one semester even if he/she has an acceptable reason. The program of the lectures, seminars and practices is written in the University Calendar. Two midterm examinations will be held, one on the 7 week and on the 15 week. The exams cover the topics of lectures, seminars and practices of the second semester. The midterm exams will be evaluated with points and the points of the two examinations will be added. Students with scores higher than 60% earn an exemption from the final examination with a mark that will be calculated on the basis of the overall performance on the two midterm examinations. The end-semester exam is a written exam that covers the topics of lectures, seminars and practices of the semester. The exam will be evaluated with points that will be converted into final mark in the following way:

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

Registration for examinations: through the NEPTUN system.

Subject: **FUNCTIONAL NEUROANATOMY**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **30**

1st week:
Lecture: Development of the nervous system. Neurohistogenesis Histology of the nervous system.
Practical: Histology of the peripheral nervous system 1. Peripheral nerve (HE) 2. Spinal ganglion (HE) 3. Sympathetic ganglion (Bielschowsky's impregnation)

2nd week:
Lecture: Axon transport. Degeneration and regeneration in the nervous system. The chemical synapse.
Practical: Macroscopic structure of the brain and spinal cord I.

3rd week:
Lecture: Part of the nervous system. Meniges, Cerebrovascular system. Cerebrospinal fluid. The spinal cord and brain stem.
Practical: Macroscopic structure of the brain and spinal cord II.

4th week:
Lecture: Nuclei of the cranial nerves. The diencephalon.
Practical: Macroscopic structure of the brain and spinal cord III.

5th week:
Lecture: The cerebrum. The cerebellum.
Practical: Histology of the central nervous system I. 1. Spinal cord (HE) 2. Spinal cord (Bielschowsky's impregnation)

6th week:
Lecture: SELF CONTROL I.
Practical: SELF CONTROL I.

7th week:
Lecture: The skin as a sensory organ. Sensory functions of the nervous system. Receptors. Primary afferents.
Practical: Histology of the central nervous system II: 1. Cerebellum (HE) 2. Cerebrum (Golgi impregnation)

8th week:
Lecture: The somatosensory system. Overview of somatomotor functions. Motor unit. Strech and withdrawal reflexes.
Practical: Histology of the central nervous system III. 1. Cerebral cortex (Nissle staining) 2. Cerebral cortex (Golgi impregnation)

9th week:
Lecture: Hierarchy of motor systems. The autonomic nervous system.
Practical: The skin1. Finger tip (HE)

10th week:
Lecture: The neuroendocrin regulation. The hypothalamo-hypophyseal system. The pineal body, thyroid gland, parathyroid gland, suprarenal gland.
Practical: Histology of endocrin organs I. 1. Hypophysis (HE)

11th week:
Lecture: The monoaminergic system. The limbic system.
Practical: Histology of endocrin organs II.1. Thyroid gland (HE) 2. Suprarenal gland (HE)

12th week:
Lecture: SELF CONTROL II.
Practical: SELF CONTROL II.

13th week:
Lecture: Olfaction and taste. The eye ball. The retina.
Practical: The eye 1. the eye (HE)

14th week:
Lecture: The visual pathway The middle and inner ear.

Practical: The middle ear1. The middle ear (HE) system.
Practical: SELF CONTROL III.

15th week:
Lecture: The vestibular system The auditory

Requirements

Aim of the course (partial/complete skills and competencies):
The aim of the course is to provide an introduction to basic neurosciences. With the aid of a systematic description of the macroscopic and microscopic structure of the peripheral and central nervous system, the course will provide knowledge which is needed for the understanding neural functions.

Department of Animal Breeding

Subject: **ANIMAL GENETICS II.**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Practical: **15**

1st week:
Lecture: Breeding objectives in animal breeding.
Practical: Usage of laboratory equipments, laboratory rules and safety.

2nd week:
Lecture: Molecular aspects of individual genetics.
Practical: Statistical probes in individual genetics.

3rd week:
Lecture: Population genetics in animal breeding.
Practical: Calculations in population genetics.

4th week:
Lecture: Heritability, repeatibility, correlations.
Practical: Practical reports.

5th week:
Lecture: Inbreeding.
Practical: Calculation of inbreeding coefficients.

6th week:
Lecture: Genom studies.
Practical: Microsatellite analysis.

7th week:
Lecture: Genemaps.
Practical: qRT PCR method.

8th week:
Lecture: Gene mapping (candidate gene approach, QTL mapping).
Practical: Biostatistical methods of QTL.

9th week:
Lecture: Founding of test herd (backcross, F2, Fn, grandfather-grandchild, father-daughter design).
Practical: Type, characteristics of studied samples; number of samples, SNP detection: PCR RFLP, SSCP, DGGE, TGGE).

10th week:
Lecture: Proteomics in animal breeding.
Practical: Type, characteristics of samples, number of samples.

11th week:
Lecture: Genetic markers, marker assisted

selection, genetic diversity studies, pedigree analysis, study of product origin.
Practical: Methods for preparation of samples in proteomic studies.

12th week:
Lecture: Direct gene test sin different animal species.
Practical: Proteom analysis based on gel: 1D PAGE, 2D PAGE, blue native PAGE.

13th week:
Lecture: Genetic imprinting. Genotype-environment interaction.
Practical: Detection of candidate proteins.

14th week:
Lecture: Transgenic animals, molecular biology studies due to protection of indigenous breeds.
Practical: Practical reports.

15th week:
Lecture: Resistance breeding.
Practical: Practical reports.

Requirements

The program consists of lectures and laboratory practices. Attendance at laboratory practices and is recorded. Students should attend at least 80% of seminars and 100% of laboratory practices. During the semester students prepare two practical essays, which contribute 30% to the final mark.

Department of Biochemical Engineering

Subject: **MICROBIAL STRAIN IMPROVEMENT**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction: Molecular biology techniques used in microbial starin improvement.

2nd week:
Lecture: Bacterial and fungal genome; sequence databases.

3rd week:
Lecture: Bacterial and fungal model organisms.

4th week:
Lecture: Protoplast fusion, crossing of fungi.

5th week:
Lecture: Random mutagenesis.

6th week:
Lecture: Introducing DNA into fungi (Fungal transformation). Transformation protocols.

7th week:
Lecture: Transformation vectors.

8th week:
Lecture: Creating of deletion mutants, deletion casette, double-joint PCR.

9th week:
Lecture: Mutant isolation.

10th week:
Lecture: Biotechnological application of fungi: protein overexpression in yeast.

11th week:
Lecture: Biotechnological application of fungi: protein overexpression in filamentous fungi.

12th week:
Lecture: Overexpression of secunder metabolites: celluleses, hemicellulases.

13th week:
Lecture: Overexpression of secunder metabolites: penicillin and cephalosporin.

14th week:
Lecture: Regulation of secunder metabolite production: Lae, the global regulator of secunder metabolism in filamentous fungi.

15th week:
Lecture: Regulation of secunder metabolite production: carbon catabolite repression in filamentous fungi.

Requirements

ESE.

Department of Biochemistry and Molecular Biology

Subject: **GENE EXPRESSION REGULATION – FUNCTIONAL GENOMICS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**
Practical: **30**

1st week:
Lecture: Higher order regulation of eukaryotic gene expression.

2nd week:
Lecture: Experimental analysis of gene expression regulation I. Reporter systems, transfection. Experimental design, normalization.
Self Control Test

3rd week:
Lecture: Experimental analysis of gene expression regulation II. Detection of transcription factor binding: EMSA, footprinting, DNase hypersensitivity assay, chromatin immunoprecipitation.
Self Control Test

4th week:
Lecture: Experimental analysis of gene expression regulation III. Promoter mapping.
Self Control Test

5th week:
Lecture: Manipulation of gene expression. Expression of recombinant proteins. Protein-interaction based gene expression analysis. Repressive anti-gene treatment.
Self Control Test

6th week:
Lecture: Global analysis of active chromatin. Next generation sequencing approaches. The ENCODE project.
Self Control Test

7th week:
Lecture: Introduction to the practicals.
Practical: Identification of transgenic animals by PCR. Isolation of genomic DNA from mouse tail tissue, spectrophotometric characterization of DNA. Setting up a PCR reaction. Agarose gel electrophoresis, data interpretation.

8th week:
Practical: RNA isolation from cell culture, spectrophotometric characterization of RNA.

Reverse transcription. Setting up a real-time quantitative PCR reaction. Data analysis and interpretation.

9th week:
Practical: Transient transfection of cultured cells with protein expression vectors and promoter-reporter constructs. Cell lysis, beta-galactosidase assay, luciferase assay. Data analysis and interpretation.

Requirements

Requirements for oral examination:
Participation in the obligatory lectures. Only one absence is accepted from the obligatory lectures - in case of more absences students will not be permitted to take the oral exam. Absences from the practicals are not accepted.

Weekly tests: During the semester students have to write 5 tests addressing the curriculum of the lectures and 1 oral examination from the practicals. The tests consist of essay questions, and by writing the 5 tests + from the practical evaluation a total of maximum 50 points can be collected - this will constitute 50% of the final score for grading. Students are required to take an oral examination during the exam period. A total of 50 points can be offered for the oral exam.

Grading: Grades will be offered based on the points collected during the semester, plus the points given for the oral examination - a maximum of 100 points can be collected.
The student's performance will be assessed on a five-grade scale:
pass (grade 2): 60-69%
satisfactory (grade 3): 70-79%
good (grade 4): 80-89%
excellent (grade 5): 90-100%.

The list of in-semester test topics and the examination rules will be announced by the Department at the beginning of the semester (lecture slides are available at the http://bmbi.med.unideb.hu web site, username and password are provided at the beginning of the semester). Students may take one improvement exam per exam period.

Subject: **GENOMIC BIOINFORMATICS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**
Practical: **30**

Subject: **MOLECULAR MECHANISM OF DISEASES CONCERNING GREAT POPULATIONS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **25**

1st week:
Lecture: Introduction to molecular medicine

2nd week:
Lecture: Genomic medicine

3rd week:
Lecture: Diabetes

4th week:
Lecture: Obesity

5th week:
Lecture: Vitamin D and immundefects

6th week:
Lecture: Cancer I.

7th week:
Lecture: Cancer II.

8th week:
Lecture: Cancer II.

9th week:
Lecture: Osteoporosis

10th week:
Lecture: Immunedeficiencies

Requirements

Attendance on the lectures is compulsory.

Subject: **PROTEOMICS**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**
Practical: **30**

1st week:
Lecture: Introduction to proteomics. Proteins: characterization, production, analysis, therapeutical uses.

2nd week:
Lecture: The role of proteomics in modern medicine

3rd week:
Lecture: The basics of mass spectrometry

4th week:
Lecture: Protein sequencing

5th week:
Lecture: Databases for proteomics

6th week:
Lecture: Purification of proteins

7th week:
Lecture: Analysis of proteins

8th week:
Lecture: Analysis of protein-protein interactions

9th week:
Lecture: Identification of biomarkers by mass spectrometry. Targeted validation of biomarkers by proteomics.

10th week:
Lecture: Analysis and characterization of protein structure. Identification of post-translational modifications.

11th week:
Lecture: Quantifying proteins. Quantitative proteomics.

12th week:
Lecture: Production and utilization of

therapeutical proteins.

13th week:
Practical: Transformation of competent cells with plasmid vector. Production of recombinant proteins - an overview. Vector selection, construction of a restriction map with NEBCutter. Selection of host system. Vector preparation, primer design (basics and hands-on exercise) with the QuickChange software.

14th week:
Practical: Bacterial culture and induction with IPTG. Mass spectrometry - demonstration. Introduction to the Voyager DEPRO MALDI-TOF (Applied Biosystems) and Agilent 1100 HPLC-linked 4000 QTRAP (Applied Biosystems) systems. Basics of mass spectrometry and data analysis.

15th week:
Practical: Protein purification from bacteria. Data analysis and interpretation.

Requirements

Requirements for oral examination:
Participation in the obligatory lectures. Only one absence is accepted from the obligatory lectures - in case of more absences students will not be permitted to take the oral exam. Absences from the practicals are not accepted.

Grading: Grades will be offered based on oral examination during the exam period. The student's performance will be assessed on a five-grade scale. The list of exam topics and the examination rules will be announced by the Department at the beginning of the semester (lecture slides are available at the http://bmbi.med.unideb.hu web site, username and password are provided at the beginning of the semester). Students may take one improvement exam per exam period.

Subject: **STRUCTURE AND FUNCTION OF MACROMOLECULES**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**
Practical: **30**

1st week:
Lecture: Fundamentals of protein structure, determining the macromolecular structure of proteins. Hierarchy of protein structures, primary, secondary, tertiary, quaternary structures. Characteristics of alpha helices and beta sheets. Schematic representation of secondary structures, topological diagrams. Supersecondary structural elements. Crystallization of proteins. Basics of X-ray crystallography. Basics of NMR. Multidimensional NMR techniques. Secondary structure prediction algorithms.

2nd week:
Lecture: Apha domain, alpha-beta and beta sheet structures. Four helical bundle. The structure of globin. Structure and function of hemoglobin. Twisted helices, fibrous proteins. Organisational rules of alpha helices. The beta barrel structure. Open alpha-beta structure. Positioning of the active center. Antiparallel beta sheet. Greek key motif. Jelly roll motif.

3rd week:
Lecture: Examples of enzyme catalysis. Classification of proteases. Characteristics of serine proteases. Mechanism of catalysis. Factors

determining specificity.

4th week:
Lecture: Basic RNA and DNA structures. Building blocks of polynucleotides. Primary, secondary and tertiary structures of polynucleotides. The DNA double helix. A-, B- and Z-conformation of the DNA double helix. Secondary structure of RNA. The structure of tRNA.

5th week:
Lecture: Protein-nucleotide interactions. Prokaryotic transcription factors. Eukaryotic transcription factors. DNA polymerase, reverse transcriptase. NAD-dependent dehydrogenases. Kinases.

6th week:
Lecture: Lipid structures, lipoproteines, membrane proteins. Classification of lipids. Forms of lipid aggregates. Modification of proteins by lipids. Structure of bacteriorhodopsine and the photosynthetic reaction center. Protein receptors. Hydrophobicity predicting algorithms.

7th week:
Lecture: Structure of polysaccharides, glycoproteins and proteoglycanes. Building blocks of polysaccharides. Structure and function of cellulose, starch, glycogen, chitin and heparin. Protein glycosylation. Blood groups and glycosphingolipids. Structure and function of proteoglycanes.

Requirements

Requirements for oral examination:
Participation in the obligatory lectures and practicals. Only one absence is accepted from the obligatory lectures or practicals - in case of more absences students will not be permitted to take the oral exam.

Grading:
Grades will be offered based on oral examination during the exam period. The student's performance will be assessed on a five-grade scale. The list of exam topics and the examination rules will be announced by the Department at the beginning of the semester (lecture slides are available at the http://bmbi.med.unideb.hu web site, username and password are provided at the beginning of the semester). Students may take one improvement exam per exam period.

Subject: **THESIS I.**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **75**

Subject: **THESIS II.**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Practical: **150**

Subject: **THESIS III.**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Practical: **225**

Department of Biophysics and Cell Biology

Subject: **EXPERIMENTAL DATA PROCESSING**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**

Subject: **FLUORESCENCE EXPERIMENTAL METHODS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**

4th week:
Lecture: 1-2. Basics of fluorescence. Methods of fluorescent labeling.

5th week:
Lecture: 3-4. Basics of geometrical and physical optics

6th week:
Lecture: 5-6. Microscopy: foundations, conventional light micrsocopy, methods of contrast enhancement

7th week:
Lecture: 7-12. Fluorescence microscopy, confocal microscopy. Principles of flow cytometry.

8th week:
Lecture: 13-18. Laser scanning cytometry. Parameters measured in flow cytometry: storage, processing and presentation

9th week:
Lecture: 19-24. High resolution and special microscopies. Biological applications of flow cytometry

10th week:
Lecture: 25-26. Advanced methods of fluorescence based cell analysis. Consultation

11th week:
Lecture: 27-28. Self control test

Requirements

Requirement for signature: Maximum 3 recorded absences total. Presence will be checked randomly.
Exam dates: week 13, written exam for receiving an offered grade.
Those failing this exam, or wishing to improve should check NEPTUN for dates during the exam period.

Exam type: Short written essay questions

Subject: **PHYSICAL PRINCIPLES OF TECHNIQUES USED IN CELL BIOLOGY**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

3rd week:
Lecture: Medical applications of NMR and MRI.

4th week:
Lecture: Luminescence spectroscopy. Theoretical background and principles of application of fluorescence spectroscopy to study the structure of proteins, nucleic acids and that of the cell membrane. Fluorescence conjugation of biomolecules, techniques based on fluorescence polarization and fluorescence resonance energy transfer.

5th week:
Lecture: Modern microscopic methods for structural and functional characterization of cells. Theoretical background of fluorescence microscopy and image processing. Generation of scanning and wide-field images. Detectors, analog/digital conversion and digital storage of images. Digital image analysis: principles and biological applications. Principles of confocal microscopy. High resolution non-linear optical microscopy.

6th week:
Lecture: Principles and applications of flow cytometry. Structure of a flow cytometer and its application fields: immunogenetics, receptor and antigen research and diagnostics, DNA and cell cycle analysis, measurement of membrane potential, membrane permeability and determination of cytosolic pH and ion concentrations, application of fluorescence resonance energy transfer to determine protein associations. (FCET).

7th week:
Lecture: Structure of the cell membrane, functional consequences of the mobility (lateral and rotational movement) of proteins in the membrane. Novel models for the structure of the cell membrane, lipid domains. Time-dependent fluorescence and phosphorescence spectroscopy, fluorescence recovery after photobleaching (FRAP), fluorescence correlation spectroscopy.

8th week:
Lecture: Modern electrophysiological techniques. Passive and active electrical properties of the cell membrane, structure and function of ion channels. Principles and application of the patch clamp technique: recording ionic currents and membrane potential.

9th week:
Lecture: LSC - Laser-Scanning Cytometry (imaging cytometry, slide-based imaging cytometry). Limitations of the flow cytometry and microscopy. Comparing flow cytometry, confocal microscopy and laser-scanning cytometry. How does laser-scanning cytometry work? Strength and limitations of the laser-scanning cytometry. Laser scanning-cytometry in cell biology and clinical research.

10th week:
Lecture: Closing test

11th week:
Lecture: Test

Requirements

Aim of the course: Based on the principles covered in biophysics and cell biology discussion of problems with special relevance to medical biology from a modern molecular biophysical and quantitative biological aspect.

Short description of the course topics:
1. Application of nuclear magnetic resonance spectroscopy (NMR) and imaging (MRI) in biology and medicine
2.Luminescence spectroscopy.
3. Flow citometry and its applications.
4. Structure of the cell membrane, mobility of lipids and proteins in the plasma membrane.
5. Advanced microscopy.
6. Modern electrophysiological techniques
7. Slide-based citometry.

Compulsory literature: course material and lecture slides published on the website of the Department

Recommended reading: Medical biophysics (Damjanovich, Fidy, Szöllősi Eds.), Medicina, 2009;

Web address for the course material:
http://biophys.med.unideb.hu/en/elect_bpmethods_lecture.htm

Type of examination: practical grade, 5 levels

Requirements:
Conditions for signing the lecture book: attending 5 lectures out of 7. Attention! Lecture books are handled exclusively by the study advisor during the dedicated office hours!

Type of examination: practical grade, 5 levels

Examination: Written test. The exam date is shown in the curriculum.

below 50%:	fail
50%-59%:	pass
60-69 % :	satisfactory
70-79 %:	good
>= 80%	excellent

Repeated/improved exam: during the examination period, one occasion, written test.

Department of Ecology

Subject: **DETERMINISTIC AND STATIC MODELS IN EVOLUTIONARY BIOLOGY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**
Seminar: **15**

1st week:
Lecture: Classical models of natural selection.

2nd week:
Lecture: The role of mutation and recombination; linkage and its characterization.

3rd week:
Lecture: Drift and the neutral models of evolution.

4th week:
Lecture: Fisher's fundamental theorem of natural selection

5th week:
Lecture: Kimura's maximum principle; relationship of the Fisher's fundamental theorem of natural selection and the Kimura's maximum principle.

6th week:
Lecture: Shahshahani metrics and Shahshahani geometry of micro-evolutionary processes.

7th week:
Lecture: Wright-Fisher model of random drift.

8th week:
Lecture: Ewans' sampling formula.

9th week:
Lecture: The role of mutation in the Wright-Fisher model; multi-allele models.

10th week:
Lecture: Coalescence processes and evolutionary trees.

11th week:
Lecture: Estimation of the evolutionary time based on Wright-Fisher process.

12th week:
Lecture: Numerical exploration of the Wright-Fisher process: model building by computer simulation.

13th week:
Lecture: Generalizations of the Wright-Fisher process.

14th week:
Lecture: open-book exam

Requirements

Aim of the course (partial/complete skills and competencies):
Aim of the course is to introduce the models of microevolution developed by Fisher, Haldane, Wright, and Kimura. The techniques need to understand these models are also introduced.

Topics:
Classical models of natural selection; the role of mutation and recombination; linkage and its characterization; drift and the neutral models of evolution; Fisher's fundamental theorem of natural selection; Kimura's maximum principle; relationship of the Fisher's fundamental theorem of natural selection and the Kimura's maximum principle; Shahshahani metrics and Shahshahani geometry of micro-evolutionary processes; the Wright-Fisher model of random drift; Ewans' sampling; the role of mutation; multi-allele models; Coalescence processes; evolutionary trees; estimation of the

evolutionary time.

Subject: **MOLECULAR PHYLOGENETICS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

Requirements

Aim of the course (partial/complete skills and competencies):
The aim of the course is to provide an overview of molecular-based approaches to studying questions in evolutionary biology and ecology. The course emphasises practical skills by discussing worked-out examples and providing a detailed demonstration of the methods that are most relevant to students of molecular biology.

Topics:
Basic concepts: biological information, DNA and protein sequences, genetic variability; hypothesis-testing in ecology; the evolutionary links between environment and tolerance; natural selection, adaptation and fitness; concepts in molecular evolution; the neutral theory of population genetics; foundations in systematics and phylogenetics: fenetics and cladistics; methods in molecular phylogenetics; DNA and protein sequence divergences and homologies; reconstruction of phylogenetic trees based on molecular and morphological data; data collection from web-based data repositories (Entrez/GenBank, Blast etc.); identification of characters and character states, data preparation: sequence alignment, coding nucleotide substitutions, weighting characters and character states; major algorithms in phylogenetic reconstructions: methods based on distance or similarity, maximum parsimony, maximum likelihood, neighbour-joining and other modern approaches; reconstructing phylogenetic trees using computers (practice): demonstration of the most frequently used software; practical problems in tree reconstruction: rooting, out groups, consensus trees, super trees, DNA or protein-based trees, the role of underlying evolutionary models, analysis of coding regions, reliability analysis of trees using randomisation tests: bootstrap, jackknife and others; statistical testing of evolutionary hypotheses; geometric methods: phylogenetic analyses and the R programming environment: application and extensions; coalescent theory: gene trees, molecule-trees and protein family trees; classic evolutionary comparisons using allometry: physiology/anatomy and adaptations; the modern evolutionary comparative method; character state mapping on phylogenetic trees, tests to detect Darwinian selection, adaptation and evolutionary rate transitions; independent phylogenetic contrasts and other methods; applications: conservation genetics, taxonomy, population genetics, protein biochemistry and behavioural ecology. Seminars will be devoted to detailed discussion of lectures and methods, and to analysis of case studies.

Department of Evolutionary Zoology and Human Biology

Subject: **BEHAVIOURAL ECOLOGY**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Adaptation, natural selection and fitness. Definitions of fitness under different environments and population dynamics.

2nd week:
Lecture: Studying adaptation. Methods: models, experiments and phylogenetical comperative studies. Limits of adaptation.

3rd week:
Lecture: Evolution of cooperation. Definitions. Phylogeny of cooperation: from bacteria to humans.

4th week:
Lecture: Theory of cooperation. Why does the theory of cooperation pose a problem? Multilevel selection, Price equation. Local competition.

5th week:
Lecture: Reciprocity. Direct, indirect and generalised reciprocity. Theory and supporting empirical studies. Limits of reciprocity.

6th week:
Lecture: Human cooperation. Economical games: ultimatum game, dictator game and others. Evolution of human cooperation.

7th week:
Lecture: Physiology and behaviour. Health status, immune-ecology.

8th week:
Lecture: Hormones and behaviour. Hormonal bases of sexual behaviour.

9th week:
Lecture: Life history strategies. Life cycle vs. life history. Basics: resource allocation, trade-offs and life history traits.

10th week:
Lecture: Life history strategies. Life cycle vs. life history. Basics: resource allocation, trade-offs and life history traits.

11th week:
Lecture: Growth. Longevity. Pace of life. Aging.

12th week:
Lecture: Optimal annual routines. Timing of reproduction. Moult in birds. Migratory strategies. Effect of climate change.

13th week:
Lecture: Individual behaviour and population dynamics. Territorial behaviour and regulation of populations. Ideal free distribution and nature conservation.

14th week:
Lecture: Ecology of individuals: individual differences and population dynamics.

Requirements

Aims: To overview behavioural ecology and its relations to neigboughring fields like physiology, life history theory, game theory.

Topics:
* Adaptation: natural selection, fitness, studying adaptation, limits of adaptation
* Cooperative behaviour: phylogenetic overview, multilevel selection, Price equation, local competition, reciprocity
* Physiological constraints and behaviour: health status and behaviour, hormonal effects
* Life history strategies: resource allocation, trade-offs, life history traits, current and future reproduction, clutch size, age of first reproduction, growth vs. reproduction, longevity, aging

Subject: **EVOLUTIONARY BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **45**

Requirements

Aim of the course (partial/complete skills and competencies):
The course consists of several basic chapters of Evolutionary Biology, based on recent textbooks and comprehensive review papers. The aim of the lecture is mostly theoretical: the students should become familiar with the evolutionary interpretation of diverse biological patterns and processes. Preparation of the students for individual study of literary sources

Topics:
The major steps and transitions of evolution; the origin and organisation of the eukaryotic genom; origin of new genes and modular organisations in eukaryotes; types and evolutionary significance of transposable elements, the "rare genomic changes"; evolution of the Hox genetic block and the origins of segmentation; chromosomal organisation and evolution: inversions; Robertsonian fusions, fragmentation and polyploidy; chromosomal mechanisms of speciation; hybridogene speciation and allopolyploidy; the taxonomical, the biological and phylogenetic species concept; evolutionarily significant units within species; the genetic structure of species and speciation; prae- and postzygotal isolation mechanisms in the process of speciation; allopatric speciation, types and case studies; founder effect and rapid speciation in peripheric isolation; glacial periods, refugia and quaternary speciation; hybrid zones between allopatric species; character displacement and re-enforcement; synpatric speciation and genetic mechanisms in phytophagous and parasitic species; evolution of life cycles and reproductive strategies; coevolution: genetic mechanisms and types: coevolution of competitors; floral-pollinator and host-parasite coevolution; supra-specific evolution: cladogenesis and macro-evolutionary trends; evolution of the ontogenesis, the "Evo-Devo" approach; evolution of the biosphere; biogenic climatic stability; plate tectonic cycles, mass extinctions and adaptive radiations, case studies; the hominid evolution

Subject: **MOLECULAR BIOGEOGRAPHY AND PHYLOGEOGRAPHY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

Requirements

Aim of the course (partial/complete skills and competencies):
Outline of major geographical patterns and processes of biodiversity from molecular to ecosystem level; molecular methods of the survey of speciation processes in space and time illustrated by numerous recent case studies; the course substantiates further studies and practical works in Evolutionary and Conservation Biology.

Topics:
Geographical patterns of molecular and chromosomal variation, case studies; geographical patterns of polyploidy; "gene centres" of cultivated plants; molecular structure and dynamics of the

geographical range, the "leading edge" and "rear edge"; evolutionary genetics of colonising (invasive) species; phylogenetic diversity within monophyletic groups (within and among species): "Evolutionarily Significant Units", case studies in the nature conservation; coevolution, processes and results in biodiversity; methods of molecular biogeography and phylogeography: combination of demographic and population genetic methodsfor reconstruction of the population genetic and dynamic parameters, the coalescence theory and models; construction of molecular biogeographical trees, case studies; methods of phylogeography and phylogenetic biogeography: reconstruction of Quaternary speciation in different groups of plants and animals, case studies in Europe and in the Pannonian region; the geographical history of the Biosphere: cycles and trends, mass extinctions and radiations; plate tectonics and phylogenetic explanation of vicariant patterns; Tertiary and Quaternary climatic changes and faunal migrations; glacial refugia and disjunctions; late-glacial and post-glacial faunal migrations and extinctions, the recent macro-structure of the Biosphere: zonobiomes and orobiomes; threatened species: Biogeography and Nature Conservation.

Subject: **MOLECULAR ECOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

Requirements

Aim of the course (partial/complete skills and competencies):
Molecular ecology is an interface between molecular biology, ecology and population genetics. The aim of the course is to introduce this new scientific field to the students.

Topics:
The possibilities to measure molecular variation in natural populations: enzyme polymorphism, RFLP, RAPD, AFLP, mini- and microsatellites, and DNA sequencing; molecular identification: at the individual level – determination of mating systems (monogamy to promiscuity) and reproductive success; at the species level – distinction between evolutionary significant and conservation units; genetic variation and random processes; adaptive variation, selection in small populations; the evolutionary significance of genetic differentiation. How to measure genetic differentiation: genetic distance, fixation index; Wright's F-statistics; gene flow and genetic differentiation; habitat fragmentation and metapopulation structure; ecological corridors; Phylogeography; genetic variation in space: geographic patterns, genetic consequences of ice ages.

Subject: **MOLECULAR EVOLUTION**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**

Requirements

Aim of the course (partial/complete skills and competencies):
The analysis of different aspects of the molecular processes in evolution; the study of markers and tools suitable to construct phylogenetic trees

Topics:
The evolution of the genome, the C-value paradox; the role of the mobile elements in molecular evolution; the evolutionary significance of gene duplication, the emergence of new genes with new functions; concerted evolution and exon shuffling; genetic load and the neutral theory of molecular evolution; molecular clocks; the neutralist-selectionist debate concerning molecular evolution; rates and patterns of nucleotide substitution; molecular phylogeny: data collection – molecular markers: immunological similarity, DNA-DNA hybridization, enzyme polymorphism, RFLP, RAPD, microsatellites and DNA sequencing; data analyses: genetic distance and similarity; construction of phylogenetic trees using distance matrix; maximum parsimony and maximum likelihood methods in tree construction.

Department of Human Genetics

Subject: **HUMAN MOLECULAR GENETICS**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: General information on the course.

2nd week:
Lecture: Blood groups and HLA

3rd week:
Lecture: Molecular cytogenetics

4th week:
Lecture: DNA polymorphisms

5th week:
Lecture: Genome projects, model organisms. Organization of the human genome.

6th week:
Lecture: Molecular mechanism of human diseases.

7th week:
Lecture: Genome instability: Mutation, repair, transposition.

8th week:
Lecture: Gene mapping. Identification of disease genes.

9th week:
Lecture: Pharmacogenetics and pharmacogenomics.

10th week:
Lecture: Molecular genetics of cancer

11th week:
Lecture: Midterm test

12th week:
Lecture: Genetic testing in individuals and populations

13th week:
Lecture: Gene transfer into eukaryotic cells. Transgenic animals. Gene therapy

14th week:
Lecture: Consultation
Practical: Transformation of E. coli

15th week:
Lecture: Final exam

Requirements

The program consists of lectures. Attendance of the lectures is important, because the material which is required at the examination is presented here. Therefore, participation on at least 50% of the lectures is compulsory. If the number of absences exceeds 50% of the lectures, the signature will be rejected. A midterm test is given during the semester. Bonus points can be earned with a good test result, which can be used at the end of semester examination.

End of semester examination: 15-20 short essay questions are given to each student. Grading of papers is the following: 0-49,99%: fail (1), 50- 59,99%: pass (2), 60-69,99%: satisfactory (3), 70-79,99%: good (4), 80-100%: excellent (5).

Departmental homepage: www.genetics.dote.hu, username: molecular_genetics, password: restriction

Academic Advisor: Professor Sándor Biró, sbiro@med.unideb.hu

Course coordinator: András Penyige, penyige@med.unideb.hu

Department of Immunology

Subject: **IMMUNOLOGICAL METHODS IN MOLECULAR BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**

1st week:
Lecture: Antigens and antibodies. The properties of antigens. Antibodies, its properties, functions, and usage in practice. Monoclonal and polyclonal antibodies. Hybridomes. Purification of antibodies.

3rd week:
Lecture: Serology. Secondary reactions after the antigen-antibody interactions. Immuncomplexes. Precipitation. Agglutination. Activation of the complement system. Immunodiffusion methods. Investigation of the macrophage functions.

5th week:
Lecture: Methods based on primary antigen-antibody reactions 1. Principles of preparative and analytical methods based on antigen-antibody reactions. Investigation of the immunocompetent cells. Separation and functional examinations of the immunocompetent cells. Flow cytometry.

7th week:
Lecture: Methods based on primary antigen-antibody reactions 2. Polyclonal B and T lymphocyte activation. Blast transformation. ELISA types. Immunoblot methods. Immunohistochemistry. Fluorescent microscopy. ELISPOT. Cytokine detection methods.

9th week:
Lecture: Immunological high throughput screening methods. Investigation of T cell antigen specificity. Tissue (MHC) typing. Allery and hypersensitivity reactions. Mast cell degranulation. Passive cutaneous anaphylaxis.

Requirements

The lectures and the practices are thematically connected. The attendance is obligatory. As the 15 lectures are packed in 5 blocks, only one official (certificated) absence is allowed in the course.
As the topics of the practices and the lectures are connected, understanding of the practice topics should be a prerequisite of a successful examination at the end of the semester. A written examination is performed at the first or second week after the final lecture. If this exam is failed (the score is below 50%) the grade can be obtained in the exam period by passing a quick written entry test and a subsequent oral test.
Attendants who passed their written exam but are discontent with their written exam grade, can participate on the oral exam in the exam period without the need for passing the quick written entry test. The grade obtained in this way can exceed the previous written test's grade but could also fall below it.

Subject: **IMMUNOLOGICAL METHODS IN MOLECULAR BIOLOGY PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **15**

2nd week:
Practical: Establishing antibody producing hybridome cells: Basics of hybridome fusion method; Cell cloning; Antigen specific polyclonal antibody purification on affinity column; Calculation of the concentration in the experiments.

4th week:
Practical: Methods based on secondary reactions of antigen-antibody interactions; Precipitation, agglutination; Immunodiffusion; Complement activation; Examination of the macrophage effector functions: phagocytosis of opsonized and untreated yeast; Detection of the macrophages' NO production.

6th week:
Practical: Cell separation methods: adhesion and density based separation; Magnetic cell separation (MACS); Investigation of the homogeneity of the separated cell populations with cell surface markers by flow cytometry.

8th week:
Practical: 3 step indirect ELISA: measurement of antigen specific antibodies.

Requirements

The lectures and the practices are thematically connected. The attendance is obligatory. One official (certificated) absence is allowed in the case of the practices, but the practice note of the missed practice should be prepared posteriorly as a making up.
Practice notes should be prepared after the practices. The practice note should be submitted to the practice leader before the next practice. The exact details and timing of the submission will be discussed with the practice leader on the first practice. The inadequately prepared practice note will be returned to the attendant by the practice leader for posterior correction. The practice grading is based on the valuation of the practice notes and the summarized degree of the quick test at the beginning of the practices.

Subject: **IMPAIRED SIGNAL TRANSDUCTION IN THE IMMUNE SYSTEM**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**

11th week:
Lecture: The immune response to extracellular pathogens. The immune response to intracellular pathogens. Immune response to viral infection.

12th week:
Lecture: Active and passive immunization. Congenital immunodeficiencies I (B-cell deficiencies). Congenital immunodeficiencies II (T-cell deficiencies).

13th week:
Lecture: A hypersensitivity reactions, Type I hypersensitivity (Allergy). Hypersensitivity reactions, Type II-IV hypersensitivity. Mechanisms of the development of autoimmune diseases.

14th week:
Lecture: Characteristics of the most common autoimmune diseases. Tumor immunology. Tumor antigens and immune response to tumors. Escape mechanisms of tumors, suppression of anti-tumor responses. Approaches to overcome tumor-induced tolerance mechanisms. A hope for cancer immunotherapy.

15th week:
Lecture: The immune response associated with tissue and organ transplantation. Immunological aspects of Immune reconstitution. Hematopoietic stem-cell transplantation. Contemporary (hot) topics in Immunology.
Self Control Test

Requirements

To follow the progress of students one self control test (SCT) will be organised (Week 15). The SCT contains questions about the material of lectures given between week 11-14.
Students who score an average of 51% or above on the SCT will be offered a grade that he/she may accept as a grade for their end-term exam.
Those students who have not qualified for an offered grade must take the end-term exam during the exam period. The end-term exam consists of a written and an oral part.
"A" exam: To qualify for the oral part of an "A" exam, students must score higher than 70% on the written (entry) exam. Students who score less than 70% on the written part will fail (thus, the oral exam will not take place).
"B" exam: "B" exams are identical to "A" exams except when the student failed the oral, but not the written, part of the "A" exam. With a score of higher than 70% on the written part of the "A" exam, the student is exempt from the written exam on the "B" exam.
"C" exam: "C" exams are oral exams only, without a written entry test.
Those students who would like to improve the grade of a successful ("A" or "B" exam) or do not accept the offered grade, are also exempted from the entry test.
The list of exam topics is available on the departmental website (www.immunology.unideb.hu).
Lecture materials and other information concerning education can be found on our website at www.immunology.unideb.hu by clicking the link "For Students".

Subject: **NEW SYSTEM BIOLOGY PARADIGMS IN IMMUNOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **30**

5th week:
Seminar: Role of plasmacytoid dendritic cells in antiviral immunity.

6th week:
Seminar: Role of plasmacytoid dendritic cells in autoimmunity.

7th week:
Seminar: Viral infections and the modern world I.

8th week:
Seminar: Viral infections and the modern world II.

9th week:
Seminar: Replication of HIV-I in dendritic cells.

10th week:
Seminar: The role of innate lymphoid cells in allergic reactions.

11th week:
Seminar: Cell death mechanisms in the immune system.

12th week:
Seminar: Role of immune cells in the tumor microenvironment.

13th week:
Seminar: Members of the SLAM receptor family.

14th week:
Seminar: Function and properties of regulatory T lymphocytes.

Requirements

Acquired skills:
This is a formal seminar-discussion course for advanced students focused on recent developments in the field and consisting of literature research and intensive in-depth study of important and timely topics. A particular attention will be given to the biology and the mechanisms of viral infections. We will also have detailed discussions on the topics of allergy, tumor immunology and the modern immunological aspect of cell death.

Exam form - end-term exam (oral):
During the semester students have to present a scientific paper recently published in a peer-reviewed international journal in the field of immunology including the topics of Antiviral Immunity, Allergy, Immunology of Cell death and Tumor immunology.
The selected collection of the scientific papers will be defined by the Course Coordinator and students have to choose only one paper from this collection to prepare for the oral presentation based on the chosen scientific publication.

Instructions for the exam:
1. The student shall look for the Course Coordinator at the Department of Immunology to request a scientific paper till the end of the Semester.

2. The suitable examiner/teacher will be defined by the Course Coordinator according to the topic of the chosen paper.
3. Student has to prepare the presentation based on the article.
4. Student has to present his/her slides to the examiner in 10-20 minutes until the end of the exam period.
Form of the presentation:
- Power point slides (no limitation in the number of the slides or in the style of the slides).
- Please indicate the following information on the first slide: name, specialization, neptun code, title of the article, authors of the article, the name of the journal, the pages and the year of the publication.
- Structure of the presentation: backgrounds, aims, methods, results and discussion or conclusion including the significances of the work.

Signature:
Participation at the seminars is obligatory, attendance of students will be monitored. The Department shall refuse to sign the students' Lecture book if they are absent from more than two seminars in a semester.

Improvement of grade:
Students have to acquire their grade till the end of the exam period.

Department of Medical Chemistry

Subject: **BIOCHEMISTRY LABORATORY PRACTICALS 1.**
Year, Semester:
Number of teaching hours:
Practical: **45**

1st week:
Practical: Laboratory safety instructions. Chemical calculations. Concentration of solutions.

2nd week:
Practical: Laboratory techniques: Laboratory equipments, volumetric apparatus. Filtration. Preparations of solutions. Chemical analysis of drinking-water.

3rd week:
Practical: Quantitative analysis. Acid-base titrations.

4th week:
Practical: Separations of amino acids and proteins by ascending paper chromatography.

5th week:
Practical: Ion exchange chromatography and gel filtration. Desalting of a protein solution.

6th week:
Practical: Kinetic study of the saponification reaction of ethylacetate. Kinetic analysis of the oxidation of iodide ion using the Landolt-method.

7th week:
Practical: Electrometry. Electrometric pH measurement. Determination of buffering capacity.

8th week:
Practical: Spectrophotometry.

9th week:
Practical: Redox titrations. Iodometric titrations.

10th week:
Practical: Enzyme kinetics. Assay of glycogen phosphorylase activity.

11th week:
Practical: Qualitative analysis of mono- and disaccharides. Polarimetric analysis of carbohydrates.

12th week:
Practical: Quantitative protein analysis. Assay of glucose.

13th week:
Practical: Photometric determination of iron.

14th week:
Practical: Analysis of inorganic salts and complexes. Complexometric titrations.

15th week:
Practical: Practical exam

Requirements

The program consists of laboratory practices. Attendance at laboratory practices is recorded. Students should attend at all the laboratory practices. Upon approval by the laboratory teacher, missed and not accepted practices can be made up by the students on the same week or the next week (if the missed lab is still running). Students will be graded by a laboratory practical exam

written on the 15th week and will be assessed as follows*:

Percentage (%)*	Mark
0-56	fail (1)
57-65	pass (2)
66-75	satisfactory (3)
76-84	good (4)
85-100	excellent (5)

Subject: **ENZYMOLOGY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**
Practical: **60**

3rd week:
Lecture: 1. Enzymes, as biological catalysts. Michaelis-Menten kinetics. 2. Inhibition of enzyme activity. Competitive, noncompetitive, uncompetitive, and mixed types of inhibitors. 3. Methods for the determination of enzyme activity. Environmental factors, stability and interfering substances affecting the enzyme assays. 4. Enzyme regulation. Allosteric and covalent controls of enzyme activity. The kinetics of allosteric enzymes. 5. Supramolecular enzyme organization. Multienzyme complexes and conjugates. Protein complexes, and compartmentalization.

4th week:
Lecture: Enzymes of lipid and hydrogen peroxide degradation.
Practical: Assay of enzymes of lipid and hydrogen peroxide degradation.
5th week:
Lecture: Transaminases.
Practical: Investigation of transaminases.

6th week:
Lecture: Proteases.
Practical: Assay of proteases.

7th week:
Lecture: Transglutaminases.
Practical: Investigation of transglutaminases.

8th week:
Lecture: β-galactosidase.
Practical: Kinetics of β-galactosidase.

10th week:
Lecture: Mitochondrial metabolism
Practical: Analysis of mitocondrial metabolism

11th week:
Lecture: Glycogen phosphorylase
Practical: Kinetics of glycogen phosphorylase

12th week:
Lecture: Phosphorylase kinase
Practical: Assay of phosphorylase kinase

Requirements

Elective course recommended for the students of the genomics and biochemistry module. Limit of the participants: max. 10 students/semester. Exam: ESE (written test including theoretical and

Practical questions). The successful completion of the practical classes is a pre-requirement. The exam cannot be started in the absence of the signatures of all practical instructors at the back page.

Department of Medical Microbiology

Subject: **HUMAN PATHOGENIC BACTERIA**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Gram-positive cocci: Staphylococci

2nd week:
Lecture: Streptococci

3rd week:
Lecture: Gram-positive spore-forming rods: Bacillus, Clostridium

4th week:
Lecture: Non-spore forming anaerobes: Gram-positive: Peptococcus, Peptostreptococcus, Actinomyces, Lactobacillus, Eubacterium, Propionibacterium; Gram-negative: Veillonella, Bacteroides, Fusobacterium, Prevotella, Porphyromonas

5th week:
Lecture: Gram-positive non spore forming rods: Corynebacterium, Listeria, Erysipelothrix, Gardnerella, Mycobacterium

6th week:
Lecture: Enterobacteriaceae I: Escherichia, Salmonella, Shigella, Klebsiella, Enterobacter, Serratia, Proteus, Morganella, Providencia, Citrobacter

7th week:
Lecture: Enterobacteriaceae II: Campylobacter, Helicobacter, Vibro, Yersinia

8th week:
Lecture: Gram-negative cocci: Neisseria, Branhamella

9th week:
Lecture: Gram-negative coccobacilli: Haemophilus, Bordetella, Francisella, Brucella,

Moraxella, Pasteurella

10th week:
Lecture: Gram-negative non fermenting rods: Pseudomonas, Burkholderia, Acinetobacter, Stenotrophomonas, Alcaligenes

11th week:
Lecture: Spirochaetes: Treponema, Borrellia, Leptospira

12th week:
Lecture: Obligate intracellular bacteria: Rickettsia, Coxiella, Bartonella, Chlamydia

13th week:
Lecture: Cell wall free bacteria: Mycoplasma

14th week:
Lecture: Others: Legionella

15th week:
Lecture: Summary: STD, atypical penumonia, zoonotic diseases, nosocomial and opportunistic infections, transplacentally transmitted infections, food poisoning, meningitis

Requirements

Aim of the course (partial/complete skills and competencies):
The aim of this course is to provide differentiated professional knowledge and skill about bacteriology. Students will study about newest results of bacteriology and they will be able to use their skills in practice.

Topics:
Gram-positive cocci: staphylococci, streptococci; Gram-positive spore-forming rods: Bacillus, Clostridium; Gram-positive, anaerobic, non spore-forming bacteria: Peptococci, Peptostreptococci, Actinomyces, Mobiluncus, Bifidobacterium, Lactobacillus, Eubacterium, Propionibacterium; Gram-negative, anaerobic, non spore-forming bacteria: Veillonella, Bacteroides, Fusobacterium, Prevotella, Porphyromonas, Leptotrichia; Gram-positive, non spore-forming bacteria: Corynebacterium, Listeria, Erysipelotthrix, Gardnerella, Mycobacteria, Nocardia; Enterobacteriaceae I: E. coli, Salmonella, Shigella, Klebsiella, Enterobacter, Serratia, Proteus, Morganella, Providencia, Citrobacter; Enterobacteriaceae II: Campylobacter, Helicobacter, Vibrionaceae, Aeromonas, Pateruella, Yersinia; Gram-negative cocci: Neisseria, Moraxella; Gram-negative coccobacilli: Haemophilus, Bordetella, Francisella, Brucella; non fermenting Gram-negative rods: Pseudomonas, Burkholderia, Acinetobacter, Stenotrophomonas, Alcaligenes; Spirochetes: Treponema, Borrellia, Leptospira; obligate intracellular bacteria: Rickettsia, Coxiella, Bartonella, Chlamydia; Mycoplasma

Requirements:
The program consists of lectures and laboratory practices. Attendance at laboratory practices and lectures is recorded. Students should attend 100% of laboratory practices. In exceptional cases, the student may make up **one** missed practice after consultation with the lab teacher.

Signature of the lecture book: The Department may refuse to sign the students' lecture book if they are absent from more than one practic in a semester.

Examination:
Practical exam: Written test at 15th week consists of five diagnostical assay questions (five grade scale).

Three mid-semester tests are written during the semester. Based on the cumulative results of the tests, students are offered an End- Semester-Examination (ESE) grade. Those who are not satisfied with the offered grade or are bellow the passing level, should sit for an end- semester-examination (A –chance) hold in the examination period. The student's test will be assessed on a five-grade scale. The written examination (A and B chance) consists of assay questions. C-chance is an oral examination. A list of questions and the examination rules will be announced during the semester.

Subject: **HUMAN PATHOGENIC BACTERIA PRACTICALS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Seminar: **15**

1st week:
Practical: catalase test, coagulase test, detection of clumping factor, slide agglutination, CAMP test, bile test, optochin sensitivity, recognition of different types of hemolysis and colony morphology on blood agar and chocolate agar

2nd week:
Practical: Gram staining, spore staining, anaerobic culture techniques, lecitinase test, evaluation of rapid automatic tests, recognition of colony morphology on selective anaerobic media, usage of anaerobic chamber

3rd week:
Practical: Elek-test, API Listeria test, Ziehl-Neelsen staining, recognition of colony morphology on Löwenstein-Jensen media

4th week:
Practical: recognition of colony morphology on eozin-methylen blue, XLD media, biochemical reactions (oxidase, indole, urease, methyl red, Voges-Proskauer reaction, citrate, TSI, fenilalanine deaminase test)

5th week:
Practical: recognition of colony morphology on CCDA and TCBS media, evaluation of ID32E automatic identification, biochemical reactions (catalase, oxidase), urea breath test

6th week:
Practical: recognition of colony morphology on specific culture media (modified Theyer-Martin), biochemical reactions (oxidase), satellite phenomenon, evaluation of API NH test

7th week:
Practical: recognition of colony morphology on nutrient and eosine-methylene blue agar, biochemical reactions (oxidase, OF), evaluation of Kirby-Bauer disk diffusion test, determination of minimal inhibitory concantration by E-test, Hodge-test, evaluation of ID32 GN automatic identification

8th week:
Practical: serological methods (agglutination, precipitation, ELISA, Western-blot, complement fixation

9th week:
Practical: indirect immunfluorescence, evaluation of immunchromatography, evaluation of mycoplasma and ureaplasma identification kits, collection of specimens

10th week:
Practical: visiting of the bacteriological diagnostical laboratory

Requirements

Aim of the course (partial/complete skills and competencies):
The aim of this course is to provide experiences in the laboratory practice.

Topics:
Topics are related to the theoretical course and cover the practical knowledge about the diagnostic procedures in the bacteriology.

Subject: **HUMAN PATHOGENIC VIRUSES**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Influenza viruses.

2nd week:
Lecture: Paramyxoviruses (Parainfluenza, Mumps, Morbilli, RS virus

3rd week:
Lecture: Rubellavirus. Coronaviruses.

4th week:
Lecture: Hepatitis viruses (Hepatitis A, B, C, D, E viruses)

5th week:
Lecture: Herpesviruses (Herpes simplex viruses, Varicella-zoster virus, Cytomegalovirus, Epstein-Barr virus)

6th week:
Lecture: Adenovirus.. Parvoviruses. (B19 parvovirus)

7th week:
Lecture: Picornaviruses (Polio-, Coxackie-, Echo-, Rhinovirus). Reoviridae (rotavirus)

8th week:
Lecture: Poxviridae (Variola, Molluscum contagiosum). Rhabdoviridae (Rabies virus)

9th week:
Lecture: Slowly developing viral infections (SSPE, PML) . Prions (kuru, Creutzfeldt-Jacob disease)

10th week:
Lecture: Arboviruses (encephalitis viruses, yellow fever, dengue-fever)

11th week:
Lecture: Roboviruses (Hantaan virus, arenaviruses, filoviruses)

12th week:
Lecture: Human tumour viruses (papillomaviruses, oolyomaviruses, HTLV)

13th week:
Lecture: Human immundeficiencia virus (HIV)

14th week:
Lecture: Emerging viruses: SARS, avian influenza, Hendra virus, Nipah virus, Menangle virus.

15th week:
Lecture: Consultation

Requirements

Aim of the course (partial/complete skills and competencies):
The aim of this course is to provide differentiated professional knowledge and skill about virology. Students will learn about the newest results of virology and they will be able to use their skills in research and diagnostics.

Topics:
Respiratory pathogens: adenoviruses, rhinoviruses, human influenza viruses, paramyxoviruses, corona viruses. Enteral viruses: hepatitis viruses, rotaviruses, coxsackie viruses, echoviruses, caliciviruses, astroviruses. Central nervous system pathogens: polyoviruses, rhabies. Viruses which cause rash, lesions: morbilli, mumps, rubella, herpes simplex viruses, human herpesvirus 6, parvovirus, variola. Oncogenic viruses: papillomaviruses, polyomaviruses, molluscum contagiosum, Epstein-Barr virus, human herpesvirus 8, human T-cell leukemia/lymphoma viruses. HIV and AIDS. Arbo- and roboviruses. Slow viral infections and prions. Emerging pathogens, recently discovered pathogens: SARS, avian influenza, Hendra virus, Nipah virus, Menangle virus.

Requirements:
Two mid-semester tests are written during the semester. Based on the cumulative results of the tests, students are offered an End- Semester-Examination (ESE) grade. Those who are not satisfied with the offered grade or are bellow the passing level, should sit for an end- semester-examination (A –chance) hold in the examination period.

Subject: **HUMAN PATHOGENIC VIRUSES PRACTICAL**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Seminar: **15**

1st week:
Practical: Serological tests for demonstration of viruses, viral infections: ELISA, VIDAS

2nd week:
Practical: Serological tests for demonstration of viruses, viral infections: ELISA, VIDAS

3rd week:
Practical: Serological tests for demonstration of viruses, viral infections: ELISA, VIDAS

4th week:
Practical: Serological tests for demonstration of viruses, viral infections: Western-blot

5th week:
Practical: Serological tests for demonstration of viruses, viral infections: Western-blot

6th week:
Practical: Serological tests for demonstration of viruses, viral infections: Western-blot

7th week:
Practical: Serological test for demonstration of viruses, viral infections: Immunofluorescence staining

8th week:
Practical: Serological test for demonstration of viruses, viral infections: Immunofluorescence staining

9th week:
Practical: Serological test for demonstration of viruses, viral infections: Immunofluorescence staining

10th week:
Practical: PCR

11th week:
Practical: PCR

12th week:
Practical: PCR

13th week:
Practical: Real-time PCR

14th week:
Practical: Real-time PCR

15th week:
Practical: Real-time PCR

Requirements

Signature of the lecture book: The Department may refuse to sign the students' lecture book if they are absent from more than two practices in a semester.

Examination: Practical exam. The practical exam consists of five diagnostic essay questions (five grade scale).

Department of Microbial Biotechnology and Cell Biology

Subject: **CYTOGENETICS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Practical: **30**

1st week:
Lecture: Overview of processes involved in the transfer of genetic information
Seminar: The topology of bacterial DNA. Supercoiling of prokaryotic DNA. Sign inversion and rotation model of supercoiling

2nd week:
Lecture: Topological and higher order chromosomal organization of the genetic material
Seminar: The topology of eukaryotic DNA. Nucleosome the eukaryotic topological unit. Arrangement of nucleosome ”beads on string”

3rd week:
Lecture: Intermediates of chromatin condensation. I. Appearance of interphase chromosomes in the middle of S phase
Seminar: Comparison of DNA and RNA model structures

4th week:
Lecture: Intermediates of chromosome condensation. II. From interphase to metaphase chromosomes.
Seminar: Organisation levels of chromatin (30 nm, 300 nm, 600 nm, 1400 nm)

5th week:
Lecture: The structure of metaphase chromosomes.
Seminar: Hypothetical models of chromosome condensation

6th week:
Lecture: Evolution, origin, development and homology of chromosomes.
Seminar: Chomosomal maps: genetic, physical map, DNA sequences

7th week:
Lecture: Identification of chromosomes, chromosome pairs, bands, karyogram, ideogram.
Seminar: Characterization of mammalian

chromosomes, size, number, shape

8th week:
Lecture: Fluorescence in situ hybridization (FISH) and its application.
Seminar: Microscopic studies of chromosomes

9th week:
Lecture: DNA diagnostics, gene therapy. Prenatal diagnostics (amniocentesis)
Seminar: Visualization of intermediates of chromosome condensation

10th week:
Lecture: Aberrant chromosome numbers (euploidy. aneuploidy)
Seminar: Isolation of chromatin structures from synchronized cells

11th week:
Lecture: Structural deformities (inversion, translocation, isochromosomes, ring chromosomes)
Seminar: Synchronization of cell cultures and its cytometric validation

12th week:
Lecture: Oncological and hematological aspects of citogenetics
Seminar: Intermediates of chromatin condensation in the S phase of cell cycle

13th week:
Lecture: The role of genes in solid tumor and leukemia formation
Seminar: Visualization of linear arrangement of chromosomes

14th week:
Lecture: Tumor risk factors
Seminar: Chromatin structure of Drosophila and its mechanism of condensation

15th week:
Lecture: Computer analysis of chromosomes.
Seminar: Developmental forms of interphase chromosomes.

Requirements

Midterm reports: 2 midterm exams (1 oral, 1 written)

Subject: **CYTOGENETICS PRACTICALS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Seminar: **30**

Department of Organic Chemistry

Subject: **CHEMICAL BASICS OF DRUG EFFECTS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Chemical-biological foundation: chemical and biological space, their mutual correspondence, and connection to drug action. Types of primary chemical bonds with an emphasis on ionic and covalent bonds, methods

for their description (valence bond method, molecular orbital method), electron displacement phenomena. Secondary chemical bonds: hydrogen bonds, halogen bonds, orientation, induction and dispersion (van der Waals) interactions, hydrophobic effect, charge transfer complexes, aryl-aryl- alkyl-aryl, cation-π-system interactions and interactions of the sulfur atom.

2nd week:
Lecture: Structural properties and functional groups of organic compounds. Description of the electron system of organic compounds; relationship between electron structure and properties (geometry, polarity, participation in secondary bonding). Participation of side chains of proteinogenic amino acids in secondary binding effects.

3rd week:
Lecture: Thermodynamic and kinetic parameters determining chemical transformations and molecular interactions. Characterization of small molecule–biological macromolecule interactions: roles of binding energy and its components (enthalpy, enthropy), flexibility, solvation, repulsive forces, the shape of molecules, stereoisomerism (configuration conformation). Isosterism, bioisosterism.

4th week:
Lecture: Receptors as drug targets. Characterization of the receptor–small molecule complex: affinity (dissociation constant), efficiency. Definition and modelling of agonists and antagonists. Transport proteins, structural proteins, lipids as drug targets.

5th week:
Lecture: Enzymes as drug targets. Characterization of enzyme catalysis on the molecular level (general aspects: changing of the reaction mechanism, consequences of spatial approximation and orientation, strain and geometric distortion, stabilization of the transition state; specific aspects: acid-base catalysis, covalent catalysis, electrostatic catalysis, desolvation). Structure and function of cofactors, conezymes. Types of enzyme inhibitors: reversible (competitive, transition state analogs), irreversible (affinity labels, mechanism-based inactivators).

6th week:
Lecture: Nucleic acids as drug targets. Interactions of nucleic acids and small molecules. Alkylation of DNA. Chain splitting of DNA. Antisense therapy.

7th week:
Lecture: Glycoconjugates. Biological roles of glycosylation. Carbohydrates as general and ubiquitous information carriers. The carbohydrate code. Protein-carbohydrate interactions, multivalency. Glycoenzymes. Carbohydrates and glycomimics as drugs.

8th week:
Lecture: Recent practice of drug development, phases and problems. “Druggability”, “drug-like” molecules. “Hits”, “leads” and optimized “leads”. Elements of the early development phases.

9th week:
Lecture: Criteria of “drug-likeness”, possible interactions. Lipinski rules, Veber rules, Ghose filter. Requirements for drug candidates, “lead-likeness”. Molecules with reactive electrophilic centers, “warhead agents”, “promiscuous agents”, “frequent hitters”.

10th week:
Lecture: ADME-Tox characteristics. Models of permeability (Caco-2, MDCK, PAMPA). Metabolism, role of metabolism in the early period of drug development. Some typical metabolic pathways. Structure modifications leading to different metabolism (number of methylene groups, change of saturation, new substituents, H –F change). Role of chirality in the metabolism.
11th week:
Lecture: Toxicity and its role in the drug development. hERG inhibition, effect of structure modifications. Prodrug conception. Types of prodrugs, their use in the solution of ADME problems.

12th week:
Lecture: Structure-activity relationships and their types. Some important QSAR, Hansch and Hansch-Fujita analysis. Examples of LFER-type relationships, weaknesses. De novo methods, Free-Wilson analysis. Topliss' decision tree. Craig quadrants, develpoment and testing based on cluster analysis.

13th week:
Lecture: Role of similarity in the „lead" optimization. Isosters, bioisosters. Improvement of biological availability by bioisoster groups. Utilization entropic effects. Conception of enthalpic and entropic optimization, advantages and drawbacks.

14th week:
Lecture: Pharmacophoric groups, priviliged structures. Similarity and its descriptors. Scaffolds, scaffold hopping. Methods of the „lead" optimization, fragment based lead generation and development. Classical vs. parallel synthetic methods, molecular libraries.

15th week:
Lecture: Drug development – case studies.

Requirements

The program consists of lectures and ends with an oral examination.

Department of Pharmacology and Pharmacotherapy

Subject: **HUMAN PHARMACOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **45**
Seminar: **15**

1st week:
Lecture: Lecture 1: Pharmacodynamics. How drug acts at molecular level. Lecture 2: Pharmacodynamics. Targets for drug action.
Seminar: Seminar 1: Drug discovery and development. Preclinical phase. Seminar 2: Drug development. Clinical phase.

2nd week:
Lecture: Lecture 3: Pharmacodynamics. Full and partial agonists and antagonists. Lecture 4: Pharmacodynamics. Dose-response relationships. Potency and efficacy.
Seminar: Seminar 3: Drugs obtained from biotechnology. General principles of biological therapy. Seminar 4: Special aspects of development of drugs for biological therapies.

3rd week:
Lecture: Lecture 5: Selectivity and safety. Testing for toxicity. Lecture 6: Margine of safety, therapeutical index. Quantal dose-respose curves.
Seminar: Lecture 5: Selectivity and safety. Testing for toxicity. Lecture 6: Margine of safety, therapeutical index. Quantal dose-respose curves. Seminar 6: Requirements for drugs and dietary supplements

4th week:
Lecture: Lecture 7: Pharmacokinetics. Absorption, transport mechanisms and influencing factors. Lecture 8: Pharmacokinetics Bioavailability, first pass effect.
Seminar: Seminar 7: Method and measurement in pharmacology. Seminar 8: Animal models of

disease.

5th week:
Lecture: Lecture 9: Pharmacokinetics. Distribution of drugs in the body compartments. Lecture 10: Pharmacokinetics Volume of distribution, loading dose.
Seminar: Seminar 9: Drug formulas. Seminar 10: How drug formulas influence pharmacokinetics and effects of drugs.

6th week:
Lecture: Lecture 11: Pharmacokinetics. Biotransformation Phase I reactions. Lecture 12: Pharmacokinetics. Biotransformation Phase II reactions.
Seminar: Seminar 11: Drug interactions. Synergism. Seminar 12: Drug interactions. Antagonism.

7th week:
Lecture: Lecture 13: Pharmacokinetics. Excretion and ion trap. Lecture 14: Pharmacokinetics. Saturating and non-saturating kinetics in elimination of drugs. Half life.
Seminar: Seminar 13: Drugs used in stem cell therapy and bone marrow transplantation. Seminar 14: Calculation of loading and maintenance doses. Pharmacokinetic quantitative relationships and calculations.

8th week:
Lecture: Lecture 15: Pharmacokinetics. Drug elimination expressed as clearance. Single-compartment model Seminar 15: Written test Lecture 16: Administration schedules. Lecture 17: Effect of repeated dosage.

9th week:
Lecture: Lecture 18: Combinative therapy. Protocols in cancer chemotherapy. Lecture 19: General principles in chemotherapy. Resistance. Lecture 20: Antibacterial drugs affecting cell wall synthesis. Lecture 21: Antibacterial drugs affecting protein synthesis.

10th week:
Lecture: Lecture 22: Miscellaneous antibacterial agents. Lecture 23: Antifungal agents. Lecture 24: Antiviral drugs. Lecture 25: Drugs act on coagulation cascade.

11th week:
Lecture: Lecture 26: Antiplatelet and fibrinolytic drugs. Enzymes as drugs. Lecture 27: Cytokines in oncology. Lecture 28: Cytokines in hematology. Lecture 29: Insulin and insulin analogs.

12th week:
Lecture: Lecture 30: Drugs used in diabetes mellitus type 2. Lecture 31: Drugs used in dyslipidemias. Lecture 32: Pharmacotherapy of obesity. Lecture 33: Targets for anti-inflammatory and antiallergic treatment.

13th week:
Lecture: Lecture 34: Non-steroidal anti-inflammatory drugs I. Lecture 35: Non-steroidal anti-inflammatory drugs II. Lecture 36: Glucocorticosteroids. Lecture 37: Monoclonal antibodies as biopharmaceutical drugs.

14th week:
Lecture: Lecture 38: Pharmacotherapy of rheumathoid arthritis, a model of a chronic autoimmune inflammation. Lecture 39: Monoclonal antibodies in oncology. Lecture 40: Gene therapy by antisense drugs. Lecture 41: Gene therapy by drugs developed for gene transfer.

15th week:
Lecture: Lecture 42: Drug groups affect cholinergic neurotransmission I. Lecture 43: Drug groups affect cholinergic neurotransmission II. Lecture 44: Drug groups act on adrenergic receptors I. Lecture 45: Drug groups act on adrenergic receptors II.

Requirements

The program consists of lectures and seminars. Attendance at lectures/seminars is highly

recommended for acquiring the knowledge required to pass! They are the best source of synthesized and structured information. Some topics and new concepts are not found in your textbook we discussed them only in lectures. Attendance at seminars is recorded and the written test is obligatory. Students should attend at least 80% of seminars.

Department of Physiology

Subject: **HOMEOSTASIS**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **25**

1st week:
Lecture: Homeostatic parameters of human body.

2nd week:
Lecture: Compartmentalization of body fluids.

3rd week:
Lecture: Principles in renal physiology. The nephron.

4th week:
Lecture: Quantitative description of renal function.

5th week:
Lecture: Glomerular filtration. Regulation of GFR.

6th week:
Lecture: The tubular transport.

7th week:
Lecture: Renal concentrating and diluting function.

8th week:
Lecture: Osmoregulation.

9th week:
Lecture: Control of body fluid volume.

10th week:
Lecture: Regulation of acid-base balance.

11th week:
Lecture: Potassium-homeostasis.

12th week:
Lecture: Ca-homeostasis.

13th week:
Lecture: Regulation of blood glucose level.

14th week:
Lecture: Endocrine regulation of metabolism.

15th week:
Lecture: Heat regulation.

Requirements

1. Signature of Lecture Book
Attendance at lectures is compulsory. The lecture will not be delivered if 3 or fewer students show up.
For continuous updates on all education-related matters, please check the departmental web-site (http://phys.dote.hu).
2. Evaluation during the semester
None.

3. Examination
The semester is closed by an oral end-semester (ESE) exam covering the topics of all lectures.

Subject: **MOLECULAR NEUROBIOLOGY**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Neurons, glia cells, ion channels.

2nd week:
Lecture: Basic functions of synapses.

3rd week:
Lecture: Chemical synapses I.

4th week:
Lecture: Chemical synapses II. Biochemistry of learning and memory.

5th week:
Lecture: Somatic sensations, thermal sensation.

6th week:
Lecture: Somatic sensation: Pain.

7th week:
Lecture: Biochemistry of the vision. Test I.

8th week:
Lecture: Physiology of the vision.

9th week:
Lecture: The chemical senses - taste and smell.

10th week:
Lecture: Physiology of hearing.

11th week:
Lecture: Motor functions of the spinal cord. Control of motor functions.

12th week:
Lecture: EEG. Control of autonomic functions of the body.

13th week:
Lecture: Behavioral functions. Sleeping, a wakefulness.

14th week:
Lecture: Learning, memory.

15th week:
Lecture: Test II.

Requirements

1. Signature of Lecture Book
Attendance of lectures is compulsory. If one has two or more lecture absences, the end-semester examination (ESE) may not be substituted with the average test score (see later). For continuous updates on all education-related matters, please check the departmental web-site (http://phys.dote.hu).

2. Evaluation during the semester
The knowledge of students will be tested 3 times per semester in the form of a written test (multiple choice questions). Participation on mid-semester written tests is compulsory.

3. Examination
The semester is closed by an oral end-semester exam (ESE) covering the topics of all lectures of the semester.

An ESE grade based on the average score of mid-semester tests will be offered if
- one's average score of the three mid-semester tests is above 60%, and
- (s)he has fewer than 3 lecture absences
The grade based on the average score of mid-semester tests is calculated according to the following table:

score	grade
0 – 59 %:	fail
60 – 69 %	pass
70 – 79 %	satisfactory
80 – 89 %	good
90 – 100 %	excellent

- If one is not satisfied with this result, (s)he may participate in oral ESE during the examination period.

Division of Cell Biology

Subject: **CELL BIOLOGY ELUCIDATED PATHOPHYSIOLOGIC PROCESSES**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**

2nd week:
Lecture: Receptor tyrosine kinases: regulation by interactions and compartmentation of signaling components (2 lectures)

3rd week:
Lecture: From cell biology to preclinical models: CDKs as drug targets
GFP and friends - the molecule that drew the Nobel Prize in Chemistry in 2008

4th week:
Lecture: Targeting tumors with reprogrammed "designer" T cells

5th week:
Lecture: Molecular targets for cancer therapy in the signal transduction pathway of receptor tyrosine kinases

6th week:
Lecture: Ion channels: cellular physiology and disease

7th week:
Lecture: Something only your mother can give you: the mitochondrium

8th week:
Lecture: A strict rule in multicellular development: cells must behave, otherwise their fate is apoptosis or …

9th week:
Lecture: Newly discovered mechanisms in the regulation of cell division.

10th week:
Lecture: What goes up, must come down: Degrading proteins and lipids - and the consequences of aberrant pathways

11th week:
Lecture: Written test exam
Self Control Test

Requirements

PLEASE SIGN UP FOR THE COURSE IN NEPTUN!!!

Those who don't sign up, cannot get a signature.
Most classes are 95 min, but there will be lectures with two topics, consequently longer, so that the course could finish in time.
Do check the website http://biophys.med.unideb.hu/en/node/1886 regularly to see if there are any changes, news, etc!
DETAILS http://biophys.med.unideb.hu/en/node/1888

Compulsory reading:
Lecture material posted on the website
Requirement for signature:
- maximum 3 recorded absences total (no make-up possible)
- signing up for the electronic course by the end of week 5

Exam dates: week 13 written exam for receiving the practical grade.
The exam can also be taken during the exam period, but this counts as a first exam after a practical grade of "fail". Check NEPTUN for dates.
Exam type: Electronic test (see below)

Grading:

>50%	pass
>60%	satisfactory
>70%	good
>80%	excellent

In order to take an exam of the course "Cell biology elucidated pathophysiologic processes" you need to be registered for the electronic version of the course. Here is the procedure to follow:
Start your internet browser and type this address: https://exam.unideb.hu
NOTE: It only works from IP addresses of the university, so you need to be logged on to EDUROAM, use a PC from the library, or use a VPN connection from outside.
Select the English (en) language (top left)
At the Login, type your Username, which is: your network-id (the same as in the Neptun)
Type your Password: (the same as in the Neptun)
Click on the [Login] button

Attention: The authentication may take some time, it runs on a server related to the Neptun system. If your data are not complete in Neptun, you will be asked to complete them - usually your current valid email is missing, and the current city of residence (which shoud be Debrecen). You cannot continue to the course until you have complemented your data in Neptun. You will be asked to verify your personality by logging into your email account and clicking on a link sent to you by the system.
Even if your are not forced by the system to complement your data, you can edit your user profile by clicking the "You are logged in as [name] (Logout)" link. There you should fill in the required fields: give the country, city name and e-mail address.

Once finished, you can continue in the e-learning system:

Find your course category: Biofizika/Biophysics
Pick your course: Elective Courses - Selected topics in cell biology (Click on the course name)
Type the Enrolment key that will be provided in the first lecture
Click on the [Enrol me] button

Subject: **CELL BIOLOGY PRACTICE**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Seminar: **15**

1st week:
Practical: The following practices will be carried out in small groups (A-D) according to the schedule published in the website of the Department (www.biophys.med.unideb.hu): Studying the physical and chemical processes leading to cell death

2nd week:
Practical: Separation and staining (Feulgen and May-Grünwald-Giemsa staining) of blood cells

3rd week:
Practical: Luminescent labeling and microscopic detection of cellular components

4th week:
Practical: Examination of chromatin structure and DNA damage

Requirements

Students may attend the practicals according to their sub-group assignment only. Completing all labs, and writing up the results and their interpretation in a lab log book on the spot is required. You must prepare for the lab before the lab starts. The compulsory preparation for the lab includes the writing of an introduction to your lab logbook BEFORE THE LAB that outlines the problem you will address in the lab and the methods and approaches that are used to answer the question. ONLY HANDWRITTEN, BOUND LAB LOG BOOKS ARE ACCEPTABLE! Students write a short test in the beginning of each practice from the theoretical background of practices. The student's preparation and their work at lab will be graded at the end of each lab on a scale between 1-5 by the lab teachers. Detailed requirements of the labs (readings for the labs, instructions for logbook preparation, details of the grading system, etc.) are posted on the web page of the Department.

Aim of the course:
This is a practical course where students can learn the most important cell biology laboratory skills. Students work in small sub-groups (4-6 students per sub-group).

Description of the course:
The following cell biology laboratory techniques are used upon practices: determination of the cell count using haemocytometer, testing of cell viability by trypan blue in a light mocroscope, testing of cell viability by propidium iodide and fluorescein-diacetate using fluorescence microscopy, direct immunofluorescence labeling, indirect immunofluorescence labeling, labeling of filamentous actin by fluorescent dye tagged phalloidin, separation of mononuclear cells by centrifugation applying Ficoll, separation of granulocytes from red blood cells by dextran sedimentation, comet assay.

Compulsory reading:
Cell Biology Laboratory Manual, Department of Biophysics and Cell Biology, 2009 and the additional experimental protocols published in the web page of the Department.

Institute of Crop Sciences

Subject: **PLANT GENETICS II.**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

1st week:
Lecture: Fundamentals of plant genetics
Practical: Introduction the lab of the department

2nd week:
Lecture: The history of plant genetics
Practical: Introduction the experimental field of the department

3rd week:
Lecture: The basis of plant biotechnology
Practical: Plant tissue culture techniques

4th week:
Lecture: The history of plant biotechnology
Practical: Plant media and growth requirements

5th week:
Lecture: Biotechnology of sexual reproduction
Practical: Callus induction

6th week:
Lecture: Biotechnology of asexual reproduction
Practical: Elimination of pathogens

7th week:
Lecture: Somatic plant cell genetics
Practical: Methods of micropropagation

8th week:
Lecture: Plant regeneration from cultured cells
Practical: In vitro techniques

9th week:
Lecture: Structural elements of plant genes
Practical: Isolation of DNA fragments

10th week:
Lecture: Cloning and genetic engineering
Practical: Gene cloning

11th week:
Lecture: Genetic transformation in crop
Practical: Gel electrophoresis

12th week:
Lecture: Agrobacterium-mediated transformation
Practical: PCR (Polymerase Chain Reaction)

13th week:
Lecture: DNA markers and molecular plant breeding
Practical: RFLP, AFLP

14th week:
Lecture: Gene transformation for resistance to biotic and abiotic stresses
Practical: Southern blot, Northern blot, Western blot

15th week:
Lecture: Genetically Modified Organism certification protocols
Practical: Genetically Modified Plants in Hungary

CHAPTER 12
TITLES OF THESES

Institute of Food Science, Quality Assurance and Microbiology

1. Title: Phylogenetic correlation between special sequences for studying fungi
2. Title: Population genetic studies of plant pathogenic fungi
Tutor: Erzsébet Karaffa Ph.D.

Department of Biochemical Engineering

1. Title: Galactose and lactose metabolism in filamentous fungi
Tutor: Erzsébet Fekete M.Sc., Ph.D.

Department of Anatomy, Histology and Embryology

1. Title: Inhibition mediated by GABAA and GABAB receptors in the superficial spinal dorsal horn in health and disease
2. Title: Molecular organization of the endogenous cannabinoid signaling apparatus in the superficial spinal dorsal horn in health and disease
Tutor: Miklós Antal M.D., Ph.D., D.Sc.

3. Title: Role of the extracellular matrix in the plasticity of the vestibular system.
4. Title: Termination of the vestibulospinal tract in the rat
Tutor: Klára Matesz M.D., Ph.D., D.Sc.

5. Title: Dendritic impulse propagation in mice showing symptoms of Alzheimer's disease – computer modelling
Tutor: Ervin Wolf M.Sc., Ph.D.

6. Title: Basic mechanisms of visual contour integration in the primary visual cortex using voltage sensitive dye imaging.
7. Title: Dendritic integration of inhibitory and excitatoty cortico-cortical inputsin the primary visual cortex
8. Title: Functional mapping of callosal inputs on the dendritic arbour of neurons in the visual cortex
9. Title: Mapping horizontal connections in the human brain.
10. Title: Synaptic mapping of identified excitatory and inhibitory neurons in the primary visual cortex. Immun-electron microscopic study.
Tutor: Zoltán Kisvárday M.Sc., Ph.D., D.Sc.

11. Title: Investigation of signaling mechanisms that regulate cartilage maturation
Tutor: Róza Zákány M.D., Ph.D.

12. Title: Investigation of neuronal network development in the spinal cord
Tutor: Zoltán Mészár M.Sc., Ph.D.

13. Title: Investigation of PACAP signalling in skeletal tissues
Tutor: Tamás Juhász M.Sc., Ph.D.

14. Title: Identification of genes and proteins which play important role in the induction and maintenance of chronic inflammatory pain.
Supervisior: Krisztina Hollo MSc, PhD
Tutor: Krisztina Holló M.Sc., Ph.D.

15. Title: Correlative physiological and morphological investigation of propriospinal connections in the spinal dorsal horn
Tutor: Zsófia Antal M.D., Ph.D.

Department of Biochemistry and Molecular Biology

1. Title: Apoptosis of differentiating adipocytes
2. Title: Development of effective recombinant tissue transglutaminase production systems. Development of assays to test transglutaminase activity. Studying superGTPase tissue transglutaminases.
Tutor: László Fésüs M.D., Ph.D., D.Sc., M.H.A.Sc.

3. Title: Genetic modification of mesenchymal stem cells and differentiation into macrophages.

4. Title: Investigation of the phagocytosis of apoptotic cells
5. Title: The anti-inflammatory role of adenosine A2A receptor.
6. Title: The anti-inflammatory role of membrane-bound TNFalpha
7. Title: The potential role of LXR receptor in the dexamethasone-induced phagocytosis of apoptotic cells.
8. Title: The role of adenosine A3 receptor in mediating anti-inflammatory action of apoptotic cells.
9. Title: The role of transglutaminase 2 in calcium homeostasis.
Tutor: Zsuzsa Szondy M.D., Ph.D., D.Sc.

10. Title: The role of retroviral proteases in the retroviral life cycle.
Tutor: József Tőzsér M.Sc., Ph.D., D.Sc.

11. Title: The role of tissue transglutaminase in rolling and adhesion of neutrophil granulocytes
Tutor: Zoltán Balajthy M.Sc., Ph.D.

12. Title: Saliva biomarkers of oral cancer.
Tutor: Beáta Scholtz M.Sc., Ph.D.

13. Title: Production of dendritic cells and macrophages from embryonic stem cells.
14. Title: Transcriptional reprogramming of murine embryonic stem cell progenitors.
Tutor: István Szatmári M.Sc., Ph.D.

15. Title: The epigenetic components of transcriptional regulation.
Tutor: Bálint Bálint L. M.D., Ph.D.

16. Title: Modification of the enzymatic activity of transglutaminase 2 by site-directed mutagenesis. Therapeutic utilization of modified transglutaminase 2.
Tutor: Róbert Király M.Sc., Ph.D.

17. Title: Quantitative proteomic analysis of the tear proteins of diabetic patients.
Tutor: Éva Csősz M.Sc., Ph.D.

18. Title: Identification of regulatory SNPs in promoter regions of different species by bioinformatic analyses.
Tutor: Endre Barta M.Sc., Ph.D.

19. Title: The role of aim2 protein and native immune response in inhibiting cell proliferation
Tutor: Máté Demény M.D.,Ph.D.

20. Title: Alterations in structural properties of the transcription machinery in relation to disease development
21. Title: Molecular factors in cell differentiation
22. Title: Studying the re-programming mechanisms of viral proteins.
23. Title: The role of signaling pathway perturbations in cancer development
Tutor: Mónika Fuxreiter M.Sc., Ph.D., D.Sc.

Department of Inorganic and Analytical Chemistry

1. Title: Application of citrate buffers in clinical analysis and diagnosis. (A literature survey)
Tutor: Imre Tóth Ph.D.,D.Sc.,M.Sc.

2. Title: Experimental methods for the study of redox properties of copper(II) complexes (A literature survey)
Tutor: Katalin Várnagy M.Sc., Ph.D., D.Sc.

3. Title: The role of oxidation of biomolecules by catalysation of metal ions in the development and onset of neurodegenerative disorders. (A literature survey)
Tutor: Csilla Kállay M.Sc., Ph.D.

Department of Botany

1. Title: Stress tolerance and resistance mechanisms of higher plants
Tutor: Ilona Mészáros M.Sc., Ph.D., C.Sc.

2. Title: The study of chromatin and microtubule organization in cells of higher plants
Tutor: Csaba Máthé M.Sc., Ph.D.

3. Title: Plant bioactive compounds
Tutor: Gábor Vasas M.Sc., Ph.D.

4. Title: Role of glycoproteins in infection and immunology (bibliographic)
Tutor: János Kerékgyártó M.Sc., Ph.D., C.Sc.

Division of Clinical Physiology

1. Title: Improvement of myocardial inotropy under physiological and pathological conditions
Tutor: Zoltán Papp M.D., Ph.D., D.Sc.

2. Title: The role of posttranslational modifications in the contractile regulation of the heart.
3. Title: The role of vanilloid receptors in cardiovascular regulatory mechanisms
Tutor: Attila Tóth M.Sc., Ph.D., D.Sc.

4. Title: Endogenous regulation of the renin-angiotensin-aldosterone system and its clinical significance
Tutor: Miklós Fagyas M.D., Ph.D.

Division of Nuclear Medicine and Translational Imaging

1. Title: Development of E-learning material for nuclear medicine
Tutor: József Varga M.Sc., Ph.D.

2. Title: Analysis of metabolic and morphologic pattern of breast cancer in case of the diameters larger then 3 cm
3. Title: The role of Tc99m-Tektrotyd SPECT/CT to evaluate metastatic neuroendocrine tumors
Tutor: Ildikó Garai M.D., Ph.D.

Department of Human Genetics

1. Title: Characterization of factor-C protein family using sequence databases.
2. Title: Expression of WT1 and its splice variants in different diseases studied by real time PCR.
3. Title: Study of a gene regulating differentiation in bacteria.
4. Title: Study of the WT1 gene in urogenital malformations.
Tutor: Sándor Biró M.Sc., Ph.D., D.Sc.

5. Title: Human disease models in animals and lower eukaryotes (review).
Tutor: Zsigmond Fehér M.D., Ph.D.

6. Title: Ca++-binding proteins in Streptomyces
7. Title: Isolation of mono-ADP-ribosylated proteins from pro- and eukaryotic cells.
Tutor: András Penyige M.Sc., Ph.D.

8. Title: Analysis of an A factor non-producer bald mutant Streptomyces griseus strain with respect of antibiotic production and cell differentiation.
Tutor: Zsuzsanna Birkó M.Sc., Ph.D.

9. Title: Chromosome-tracking studies in complex diseases.
Tutor: György Vargha M.D., Ph.D.

10. Title: Factor-C: a protein regulating differentiation in Streptomycetes.
Tutor: Judit Keserű M.Sc., Ph.D.

11. Title: Copy number variation of WT-1 gene in hematological conditions
Tutor: Gergely Buglyó M.D., Ph.D.

12. Title: Functional analysis of the Streptomyces facC gene in Aspergillus
Tutor: Melinda Paholcsek M.Sc., Ph.D.

13. Title: Global analysis of the human blood plasma epitome and interactome in health and disease.
14. Title: Use of comparative monoclonal antibody proteomics to detect three dimensional conservation relevant to protein function.
Tutor: László Takács M.D., Ph.D., D.Sc., M.H.A.Sc.

15. Title: Study of antibiotic production and differentiation in Streptomyces bacteria.
16. Title: Study the role of miRNAs in oncogenic disorders.
Tutor: Melinda Szilágyi-Bónizs M.Sc., Ph.D.

Department of Clinical Oncology

1. Title: Relationship between exercise and development of malignant tumors

2. Title: Role of microRNAs in development of breast cancer
3. Title: Role of optimalisation of body weight in treatment and prevention of malignant tumors
Tutor: Zsolt Horváth M.D., Ph.D.

4. Title: Re-purposing of clinical drugs for cancer prevention
Tutor: Iván Uray M.D., Ph.D.

Department of Immunology

1. Title: Phenotypic and functional properties of dendritic cells
Tutor: Éva Rajnavölgyi M.Sc., Ph.D., D.Sc.

2. Title: Functional properties of SLAM receptor family proteins in dendritic cells
3. Title: The role of the HOFI/SH3PXD2B adaptor protein in the regulation of the tumor microenvironment
Tutor: Árpád Lányi M.Sc., Ph.D.

4. Title: The role of innate immune cells in the development of allergic responses
5. Title: The role of innate lympoid cells (ILC) in human diseases
Tutor: Attila Bácsi M.Sc., Ph.D.

6. Title: Altered differentiation of monocyte derived dendritic cells and their functional differences
Tutor: Péter Gogolák M.Sc., Ph.D.

7. Title: Study of non-apoptotic cytotoxic processes during immune response, new way of killing apoptosis resistant tumor cells
Tutor: Gábor Koncz M.Sc., Ph.D.

Department of Medical Chemistry

1. Title: Investigation of Ser/Thr protein phosphatase in pathogenic fungi
Tutor: Viktor Dombrádi M.Sc., Ph.D., D.Sc.

2. Title: Interaction of protein phosphatase 1 catalytic subunit with regulatory proteins
Tutor: Ferenc Erdődi M.Sc., Ph.D., D.Sc.

3. Title: Mechanism of oxidative stress-induced cell death
4. Title: Mesenchymal stem cell differentiation
5. Title: Regulation of macrophage activation and pyroptotic death
Tutor: László Virág M.D., Ph.D., D.Sc.

6. Title: Scaffolding proteins in the endothelium
Tutor: Csilla Csortos M.Sc., Ph.D.

7. Title: Structural and functional investigation of a fungus specific protein phosphatase
Tutor: Ilona Farkas M.Sc., Ph.D.

8. Title: Study of metabolic processes with special regard to the involvement of mitochondrial activity.
Tutor: Péter Bay M.Sc., Ph.D.

9. Title: Identification of adenosine receptor 2A interacting proteins in macrophages
Tutor: Endre Kókai M.Sc., Ph.D.

10. Title: Study of the role of protein phosphatase in wound healing
Tutor: Beáta Lontay M.Sc., Ph.D.

11. Title: Regulation of protein phosphatase-1 by inhibitory proteins and the translation of the targing subunit
Tutor: Andrea Kiss M.Sc., Ph.D.

12. Title: High-Throughput Screening
Tutor: Csaba Hegedűs M.Sc., Ph.D.

Department of Medical Microbiology

1. Title: Antimicrobial cell-mediated immunity measured by mRNA tests
Tutor: József Kónya M.D., Ph.D.

2. Title: Evaluation of in vitro efficacy of different new antibiotics against multiresistant bacteria
Tutor: Judit Szabó M.D., Ph.D.

3. Title: Role of HPV in head and neck cancers
Tutor: Krisztina Szarka M.Sc., Ph.D.

4. Title: Evaluation of fungicidal effect of antifungal agents using time-kill curves

5. Title: New and older agents in antifungal chemotherapy
Tutor: László Majoros M.D., Ph.D.

6. Title: Prevalence of human polyomaviruses
Tutor: Eszter Csoma M.Sc., Ph.D.

7. Title: Effects of human papillomavirus oncoproteins on cellular signaling pathways in keratinocytes
Tutor: Anita Szalmás M.Sc., Ph.D.

8. Title: Molecular epidemiology of aminoglycoside resistance in nosocomial Gram negative bacteria
Tutor: Gábor Kardos M.D., Ph.D.

9. Title: Intratypical variation of human papillomaviruses
Tutor: György Veress M.Sc., Ph.D.

10. Title: The importance of fungal quorum-sensing in antifungal therapy against Candida biofilms.
Tutor: Renátó Kovács M.Sc., Ph.D.

Department of Internal Medicine

1. Title: Immunotherapy of B cell lymphomas.
2. Title: Safety profile of prolonged rituximab therapy in lymphomas.
3. Title: Targeted therapy in non-Hodgkin's lymphomas
Tutor: Lajos Gergely M.D., Ph.D., D.Sc.

4. Title: Clinical testing of sinus node function.
Tutor: Péter Kovács M.D., DLA, Ph.D., D.Sc.

5. Title: Lipid abnormalities in hypothyreoidism.
6. Title: The function of LDL in lipid metabolism
Tutor: György Paragh M.D., Ph.D., D.Sc.

7. Title: Diagnostic tests and imaging techniques in endocrinology.
Tutor: Endre Nagy M.D., Ph.D., D.Sc.

8. Title: Antiarrhythmic drug treatment.
9. Title: Cardiac arrhythmias in patients end-stage renal failure.
10. Title: Pacemaker treatment and myocardial infarction.
11. Title: Pathophysiology of neurocardiogenic syncope.
12. Title: Rhythm disturbances and the autonomic system of the heart.
13. Title: Ventricular repolarization and drugs.
Tutor: István Lőrincz M.D., Ph.D.

14. Title: Investigations of lipoproteins in normo- and hypercholesterinemic patients.
Tutor: Judit Boda M.D.

15. Title: Adipokines and Insulin Resistance
16. Title: Obesity: Diagnosis and Treatment
17. Title: Obesity: Etiology and Co-morbidities
Tutor: Péter Fülöp M.D., Ph.D.

18. Title: Characteristics of rare systemic vasculitides
19. Title: Sjögren's syndrome associated with other autoimmune disease
Tutor: Margit Zeher M.D., Ph.D., D.Sc.

20. Title: Immunoregulatory abnormality in undifferentiated connective tissue disease
21. Title: Interstitial lung diseases in MCTD.
22. Title: The presence of antiphospholipide antibodies in the disease course of the MCTD
23. Title: Vascular involvement in mixed connective tissue disease.
24. Title: Vascular risk factors in undifferentiated connective tissue disease
Tutor: Edit Bodolay M.D., Ph.D., D.Sc.

25. Title: Dermato/polymyositis overlap with antiphospolipide syndrome.
26. Title: Genetical study in myositis
27. Title: Improvement of quality of life in polymyositis and dermatomyositis patients by physiotherapy
Tutor: Katalin Dankó M.D.,Ph.D.,D.Sc.

28. Title: Plasmapheresis treatment in intensive therapy
Tutor: Pál Soltész M.D., Ph.D., D.Sc.

29. Title: Autoimmune disorders and GI tract
Tutor: Zsolt Barta M.D., Ph.D.

30. Title: Ischemic colitis.
31. Title: Life quality of Raynaud syndrome
Tutor: Zoltán Csiki M.D., Ph.D.

32. Title: The disease course after stent inplantation in peripheral arterial disease
Tutor: György Kerekes M.D., Ph.D.

33. Title: Novel therapeutical approaches in multiple myeloma
34. Title: The impact of multi-drug resistance genes in the prognosis of lymphoproliferative disorders
Tutor: László Váróczy M.D., Ph.D.

35. Title: Inherited and acquired thrombophilia
36. Title: New direct oral anticoagulants
37. Title: Stem cell therapy in peripheral arterial disorders
Tutor: Zoltán Boda M.D.,Ph.D.,D.Sc.

38. Title: Gastric cancer: clinics and treatment
39. Title: Gastrointestinal bleeding
40. Title: Gluten sensitive enteropathy
41. Title: Inflammatory bowel diseases.
42. Title: Lymphomas in the gastrointestinal tract.
Tutor: István Altorjay M.D.,Ph.D.

43. Title: Langerhans histiocytosis
44. Title: Osteosclerotic myeloma
45. Title: Therapeutic challenges in rare haemostatic disorders
Tutor: György Pfliegler M.D., Ph.D.

46. Title: Epidemiology, diagnostics and therapy of chronic hepatitis C
47. Title: Pathomechanism of alcoholic hepatitis
48. Title: Signs, diagnostics and treatment of portal hypertension.
49. Title: Therapeutic options in primary sclerotizing cholangitis
50. Title: Treatment of autoimmune hepatitis
Tutor: István Tornai M.D.,Ph.D.

51. Title: A case history of an interesting acute myeloid leukaemia patient in the 2nd Department of Medicine (connection with the literature data)
Tutor: Attila Kiss M.D., Ph.D.

52. Title: Chronic neutrophilic leukaemia
Tutor: Béla Telek M.D., Ph.D.

53. Title: Therapeutic options of CML
Tutor: László Rejtő M.D., Ph.D.

54. Title: Biological treatment of ulcerative colitis
Tutor: Károly Palatka M.D., Ph.D.

55. Title: The role of Willebrand factor in various internal diseases.
Tutor: Ágota Schlammadinger M.D., Ph.D.

56. Title: Bacterial infection in liver cirrhosis
57. Title: Current therapeutic options of acute pancreatitis
Tutor: Zsuzsa Vitális M.D., Ph.D.

58. Title: Diagnosis and treatment of chronic lymphocytic leukemia
59. Title: Novel therapeutic approches in the treatment of multiple myeloma
60. Title: Philadelphia negative chronic myeloproliferative neoplasms - novel genetic and therapeutic improvements
61. Title: Recent advances in the management of chronic ITP
Tutor: Péter Batár M.D., Ph.D.

62. Title: Heparin-induced thrombocytopenia
Tutor: Zsolt Oláh M.D., Ph.D.

63. Title: Are the bacterial infections predictable in liver cirrhosis?
64. Title: Role of serological markers in prediction of disease course and response to therapy in inflammatory bowel diseases.
Tutor: Mária Papp M.D., Ph.D.

Department of Pharmacology and Pharmacotherapy

1. Title: Cardiovascular risk factors
2. Title: Metabolic link between obesity and insulin resistance
Tutor: Zoltán Szilvássy M.D., Ph.D., D.Sc.

3. Title: Arrhythmic patient in dentistry
4. Title: Optional title in pharmacology

5. Title: Pharmacological and clinical significance of adenosine receptor antagonists
6. Title: Pharmacological and non-pharmacological treatment of endothelial dysfunction
7. Title: Pharmacology of antidepressive drugs: dental implications
Tutor: József Szentmiklósi M.D., Ph.D.

8. Title: Emerging roles of prostaglandin DP1 and DP2 receptors in acute and chronic aspects of allergic diseases
9. Title: Optional title in pharmacology
10. Title: Pharmacological treatment of acute decompensated heart failure (ADHF)
11. Title: Pharmacology of herbal remedies
12. Title: Pharmacology of neurogenic inflammation
13. Title: Pharmacotherapy of Amyotrophic Lateral Sclerosis (ALS)
14. Title: Pharmacotherapy of Duchenne Muscular Dystrophy (DMD)
15. Title: Possible pharmacological exploitations of TRPV1 receptors
16. Title: Use of Histone deacetylase inhibitors (HDI): Novel advances in cancer treatment
Tutor: Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.

17. Title: Effect of colony stimulating factors or other drugs on bone marrow-derived cell lines
18. Title: How insulin resistance influences drug effects
19. Title: Selected topic in field experimental hemato-oncology
Tutor: Ilona Benkő M.D., Ph.D.

20. Title: Optional title on cancer chemotherapy
Tutor: Attila Megyeri M.D., Ph.D.

21. Title: Optional title in pharmacology
Tutor: Ágnes Cseppentő M.D.

22. Title: Optional title on antibacterial chemotherapy
Tutor: Zsuzsanna Gál M.Sc., Ph.D.

23. Title: Optional title in pharmacology
Tutor: Béla Juhász D.Pharm., Dr. habil., Ph.D.

24. Title: Optional title in pharmacology
Tutor: Balázs Varga D.Pharm., Ph.D.

25. Title: Optional title in pharmacology
Tutor: Mariann Bombicz D.Pharm.

26. Title: Optional title in pharmacology
Tutor: Dániel Priksz D.Pharm.

Department of Physiology

1. Title: Expression and significance of the TASK channels in physiological and pathological conditions
Tutor: Péter Szűcs M.D., Ph.D.

2. Title: Alterations of intracellular calcium concentration in pathological conditions
Tutor: László Csernoch M.Sc., Ph.D., D.Sc.

3. Title: Regional differences in the electrophysiological properties of cardiomyocytes
Tutor: Péter Nánási M.D., Ph.D., D.Sc.

4. Title: Role of afterdepolarization mechanisms in the arrhythmogenesis
Tutor: Tamás Bányász M.D., Ph.D.

5. Title: Electrophysiological properties of mammalian cardiac tissues
Tutor: János Magyar M.D., Ph.D., D.Sc.

6. Title: Beat-to beat variability of cardiac repolarization
Tutor: Norbert Szentandrássy M.D., Ph.D.

7. Title: Studies on ion channels incorporated into artificial membranes
Tutor: István Jóna M.Sc., Ph.D., D.Sc.

8. Title: Role of late sodium current in the arrhythmogenesis
Tutor: Balázs Horváth M.D., Ph.D.

9. Title: Role of potassium channels in neuron function
Tutor: Balázs Pál M.D., Ph.D.

10. Title: Properties of vanilloid receptors
Tutor: István Balázs Tóth M.Sc., Ph.D.

11. Title: Role of Protein Kinase C isoforms in cell function.
Tutor: Gabriella Czifra M.Sc., Ph.D.

CHAPTER 13
LIST OF TEXTBOOKS

1st year

Methods of Molecular Biology:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual.
3rd edition. Cold Spring Harbor Laboratory Press, 2001.
Department of Medical Chemistry: Department of Medical Chemistry.
URL: http://www.medchem.dote.hu
R. A. Meyers (ed.): Molecular Biology and Biotechnology.
A comprehensive desk reference, 1995.

Molecular Immunology:

Peter Parham: The Immune System.
3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.

Biophysics:

Damjanovich, S., Fidy, J., Szöllősi, J.: Medical Biophysics.
1st edition. Medicina, 2009. ISBN: 978 963 226 249 9.

Molecular Genetics:

Hartl D. L.: Essential Genetics: A Genomics Perspective.
6th edition. Jones & Bartlett Publishers, 2014. ISBN: 978-1-4496-8688-8.
Practical Courses in Genetics.
University Medical School of Debrecen, 2002.
: www.genetics.dote.hu
URL: http://www.genetics.dote.hu/
Robert L. Nussbaum, Roderick R. McInnes, Huntington F. Willard, Ada Hamosh: Thompson and Thompson Genetics in Medicine.
7th edition. Saunders Elsevier, 2007. ISBN: 978-1-4160-3080-5.
Tom Strachan, Andrew P. Read: Human Molecular Genetics.
4th. Garland Science, 2011. ISBN: 0-8153-4184-9.
Thomas D. Gelehrter, Francis S. Collins, David Ginsburg: Principles of Medical Genetics.
2nd. Williams and Wilkins, 1998. ISBN: 0-683-03445-6.

Medical Genome Biology:

Campbell, A. M., Heyer, L. J.: Discovering genomics, proteomics and bioinformatics.
Pearson Education Inc., ISBN: 0-8053-4722-4.
: www.genetics.dote.hu.
URL: http://www.genetics.dote.hu/

Radioisotope Techniques In Biomedicine Practicals:

J. Magill, J. Galy: Radioactivity Radionuclides Radiation.
Springer, 2005.

Radioisotope Techniques in Biomedicine:

J. Magill, J. Galy: Radioactivity Radionuclides Radiation.
Springer, 2005.

Biochemistry of Metabolism:

Thomas M. Devlin: Textbook of Biochemistry with Clinical Correlations.
6th edition. Wiley-Liss, 2006.

Human Physiology I.:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002.
ISBN: 963-242-726-2.
Physiology Practice. A Laboratory Guide.
revised edition.2000.
Physiology Practice. Exercise Book.
revised edition.2000.

Physiology of Prokaryotes, Molecular Virology:

Dimmock, N., Easton, A., Leppard, K.: Introduction to Modern Virology.
6th edition. Wiley-Blackwell, 2007.
White D.: The Physiology and Biochemistry of Prokaryotes.

3rd edition. Oxford University Press, 2006.
Alan J. Cann: Principles of Molecular Virology.
5th edition. Elsevier Ltd., 2012.
Carter, J., Saunders, V: Virology: Principles and Applications.
Wiley, 2007.

Cell Biology:

Alberts et al.: Essential Cell Biology.
3rd edition. Garland Public Inc., 2004. ISBN: 0-8153-3481-8.
Lodish et al.: Molecular Cell Biology.
4th edition..
Alberts et al.: Molecular Biology of the Cell.
5th edition. Garland Public Inc., 2007.

Biostatistics:

Wayne W. Daniel: Biostatistics. A foundation for Analysis in the Health Sciences.
John Wiley & Sons, ISBN: 0-471-16386-4.

Plant Molecular Biology:

Taiz, L., Zeiger, E.: Plant Physiology.
Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, 2003.
: Selected thematic reviews from Progress in Botany.
: Annual Review of Plant Biology.
: Tansley reviews of New Phytologist.

Advanced Methods in Neurobiology:

Advanced Methods in Neurobiology, Lecture Notes.

Animal Genetics II.:

Falconer, D.S.: Introduction to Quantitative Genetics.
3rd edition. Longman Scientific and Technical,1989.
Mrode, R.A.: Linear Models for the Prediction of Animal Breeding Experiments.
CAB International,1996.
Lynch, M., Walsh, B.: Genetics and Analysis of Quantitative Traits.
Sinauer Associates,1998.

Cell Biology Practice:

Cell Biology Laboratory Manual.
Department of Biophysics and Cell Biology, 2003.
Lodish et al.: Molecular Cell Biology.
4th edition..
Alberts et al.: Molecular Biology of the Cell.
5th edition. Garland Public Inc., 2007.

Evaluation of measurements: Mathematical Methods:

R. R. Sokal, F. J. Rohlf: Introduction to Biostatistics.
2nd edition. Dover Publications, 2009.

Evolutionary Biology:

Ridley, M: Evolution. 2**nd** edition.
Oxford UP, 2004.
Avise, J.C.: Phylogeography. The History and Formation of Species.
Harward UP, 2000.
Futuyma, D. J: Evolution.
Sinauer Ass., 2005.

Human Pharmacology:

Humphrey Rang, Maureen Dale, James Ritter, Rod Flower, Graeme Henderson: Rang & Dale's Pharmacology.
7th edition. Elsevier, 2011. ISBN: 978-0-7020-3471-8.
Katzung, B. G.: Basic and Clinical Pharmacology.
13th edition. McGraw-Hill Education, 2014. ISBN: 0-0718-2505-3.
Katzung, B.G., Trevor, A.J.: Pharmacology: Examination and Board Review.
6th edition. Appleton and Lange, Stamford, CT, 2002.

Immunological Methods in Molecular Biology:

Abul K. Abbas: Cellular and Molecular Immunology.
8th Edition. Elsevier, 2014. ISBN: 9780323222754.
Kenneth Murphy: Janeway's Immunobiology.
8th Edition. Garland Science, 2011. ISBN: 9780815342434.

Immunological Methods in Molecular Biology Practicals:

Abul K. Abbas: Cellular and Molecular Immunology.
8th Edition. Elsevier, 2014. ISBN: 9780323222754.
Kenneth Murphy: Janeway's Immunobiology.
8th Edition. Garland Science, 2011. ISBN: 9780815342434.

Molecular Ecology:

Avise, J.C.: Phylogeography. The History and Formation of Species.
Harward UP, 2000.
T. Beebee and G. Rowe: An introduction to molecular ecology.
2nd edition. Oxford University Press, 2008.
T. Beebee and G. Rowe: An introduction to molecular ecology.
2nd edition. Oxford University Press, 2008.

New System Biology Paradigms in Immunology:

Janeway CA and Travers P.: Immunbiology.
Garland Science.
Peter Parham: The Immune System.
3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.

Phylogeny of the Animal Kingdom:

Ridley, M: Evolution. 2**nd** edition.
Oxford UP, 2004.
Nielsen, C.: Animal Evolution. Interrelationships of Living Phyla.
Oxford University Press, 1996.
Albert, Victor: Parsimony, Phylogeny, and Genomics.
Oxford University Press, 2006.
Minelli, A.: Perspectives in Animal Phylogeny and Evolution.
Oxford University Press, 2009.
Skelton, P., Smith, A., Monks, N.: Cladistics.
Cambridge University Press, 2002.

Plant Microtechniques I.:

Hawes C, Satiat-Jeunemaitre B, Eds: Plant cell biology- a practical appoach.
Oxford Univ. Press., 2000.
Robards AW: Botanical microscopy.
Oxford Science Publications,1985.
Buchanan BB, Gruissem W, Jones RL: Biochemistry and Molecular Biologyof Plants.
ASPB Books.
Fosket DE, Morejohn, LC: Structural and functional organization of tubulin. Annu. Rev. Plant Physiol. Plant Mol. Biol.
.
Greenberg JT: Programmed cell death in plant-pathogen interactions. Annu. Rev. Plant Physiol Plant Mol. Biol..
.
Kuriyama H, Fukuda H: Developmental programmed cell death in plants. Curr. Op. Plant Biol..

Protein Crystallography:

Rupp, Bernhard: Biomolecular Crystallography: Principles, Practice and Applications for Structural Biology.
Garland Science, 2010. ISBN: ISBN-10: 0815340818.
: http://www.iucr.org.
URL: http://www.iucr.org
Messerschmidt, Albrecht: X-ray Crystallography of Biomacromolecules, A Practical Guide.
Wiley, 2007.
Glusker, JP; Lewis M, Rossi M: Crystal Structure Analysis for Chemists and Biologists.
New York: VCH Publishers, 1994. ISBN: ISBN 0-471-18543-4..
: http://www.ruppweb.org/.
URL: http://www.ruppweb.org/

Selected problems of the neural control: Modelling of single neurons and neural networks:

Christof Koch and Idan Segev: Methods in Neuronal Modeling, From Synapses to Networks.
MIT Press, Cambridge, Massachusetts, and London, England, 1991. ISBN: ISBN 0-262-61071-X.

Human Physiology II.:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002.
ISBN: 963-242-726-2.
Physiology Practice. A Laboratory Guide.

revised edition.2000.
Physiology Practice. Exercise Book.
revised edition.2000.

Human Physiology Practicals:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002.
ISBN: 963-242-726-2.
Physiology Practice. Exercise Book.
revised edition.2000.
Physiology Practice. A Laboratory Guide.
revised edition.2000.

Methods in Molecular Biology Practicals:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual.
3rd edition. Cold Spring Harbor Laboratory Press, 2001.
Department of Medical Chemistry: Department of Medical Chemistry.
URL: http://www.medchem.dote.hu
R. A. Meyers (ed.): Molecular Biology and Biotechnology.
A comprehensive desk reference, 1995.

Cancer Chemotherapy:

Humphrey Rang, Maureen Dale, James Ritter, Rod Flower, Graeme Henderson: Rang & Dale's Pharmacology.
7th edition. Elsevier, 2011. ISBN: 978-0-7020-3471-8.
Katzung, B. G.: Basic and Clinical Pharmacology.
13th edition. McGraw-Hill Education, 2014.
ISBN: 0-0718-2505-3.
Trevor, A. J., Katzung B. G., Masters S. B.: Katzung & Trevor's Pharmacology: Examination & Board Review.
11th edition. McGraw-Hill Education, 2015.
ISBN: 0-0718-2635-1.

Clinically Oriented Anatomy of the Brainstem:

Haines, D.E.: Fundamental Neuroscience Haines.
3rd edition. Churchill Livingstone, 2006. ISBN: 0-443-06751-1.

Pharmacology of Central Nervous System:

Humphrey Rang, Maureen Dale, James Ritter, Rod Flower, Graeme Henderson: Rang & Dale's Pharmacology.
7th edition. Elsevier, 2011. ISBN: 978-0-7020-3471-8.
Trevor, A. J., Katzung B. G., Masters S. B.: Katzung & Trevor's Pharmacology: Examination & Board Review.
11th edition. McGraw-Hill Education, 2015.
ISBN: 0-0718-2635-1.
Katzung, B. G.: Basic and Clinical Pharmacology.
13th edition. McGraw-Hill Education, 2014.
ISBN: 0-0718-2505-3.

2nd year

Plant Microtechniques II.:

Hawes C, Satiat-Jeunemaitre B, Eds: Plant cell biology- a practical appoach.
Oxford Univ. Press., 2000.

Deterministic and Static Models in Evolutionary Biology:

Nei, M.: Molecular Population Genetics and Evolution.
. North-Holland, Amsterdam and New York. 1975.
Tavaré, S.: Ancestral Inference in Population Genetics.

Tavaré, S. and Zeitouni, O: The Comparative Method in Evolutionary Biology.
Springer, pp. 3-188. 2004.
Akin, E.: Geometry of Population Genetics.
Springer, 1979.
Akin, E: Hopf Bifurcation in the Two Locus Genetic Model. (Memoirs of the American Mathematical Society).
American Mathematical Society. 1983.
Shahshahani, S: A new mathematical framework for the study of linkage and selection. (Memoirs of the American Mathematical Society).
American Mathematical Society. 1979.

Food Biochemistry:

Ronald H. Schmidt – Gary E. Rodrick: Food

Safety Handbook.
John Wiley & Sons, Inc., 2003.
P. A. Luning – F. Devlieghere – R. Verhé: Safety in the agri-food chain.
Wageningen Academic, 2007.
Owen R. Fennema: Food chemistry.
Marcel Dekker, Inc., 2007.
Colin F. Moffat – Kevin J. Whittle: Environmental Contaminants in Food.
CRC Press, 1999.
Fernanda A. R. Oliveira – Jorge C. Oliveira: Processing Foods. Quality Optimization and Process Assessment..
CRC Press, 1999.
Jim Smith – Lily Hong-Shum: Food Additives Databook.
Blackwell Publishing, 2003.
Clare M. Hasler: Regulation of Functional Foods and Nutraceuticals.
Blackwell Publishing, 2005.
Sarad R. Parekh: The GMO Handbook.
Humana Press, 2004.

Human Pathogenic Bacteria Practicals:

Warren Levinson: Medical Microbiology and Immunology.
11th edition. The McGraw-Hill Comp, 2010.
P. R. Murray, K. S. Rosenthal, M. A. Pfaller: Medical Microbiology.
7th edition. Elsevier Inc., 2013.

Fluorescence Experimental Methods:

Damjanovich, S., Fidy, J., Szöllősi, J.: Medical Biophysics.
1st edition. Medicina, 2009. ISBN: 978 963 226 249 9.

Cytogenetics:

Szeberényi József: Molekuláris sejtbiológia (vizsgáló módszerei).
Dialóg Campus Kiadó, Budapest, Pécs, 1999.
Thain M, Hickman: The Penguin Dictionary of Biology.
10th. Penguin Books, Clays Ltd., UK, 2001.
Bánfalvi G.: Molekuláris sejtbiológia.
2nd edition. Kossuth Kiadó, Debrecen, 2005.
Szabó G.: Sejtbiológia.
Medicina, Budapest, 2004.

Molecular Biogeography and Phylogeography:

Avise, J.C.: Phylogeography. The History and Formation of Species.
Harward UP, 2000.
Lomolino, M.V., Brown, J.H. and Riddle, B.R.: Biogeography.
3rd edition Sinauer Ass., 2005.
Futuyma, D. J.: Evolutionary Biology.
3rd edition, Sinauer Ass., 2006.
Hein, J; Schierup, M. H., and Wiuf, C.: Gene Genealogies, Variation and Evolution – A Primer in Coalescent Theory.
Oxford University Press, 2005.
Hewitt, G.M: The genetic legacy of the Quaternary ice ages.
Nature 405: 907-913. 2000.
Ridley, M: Evolution. 2**nd** edition.
Oxford UP, 2004.

Molecular Evolution:

Gaur, D., Li, W-H.: Fundamentals of Molecular Evolution.
2nd. Sinauer Associates, 2000.
Ridley, M.: Evolution.
2nd edition, Oxford UP, 2004.

Molecular Phylogenetics:

Futuyma, D. J.: Evolutionary Biology.
3rd edition, Sinauer Ass., 2006.
Lemey P, Salemi M, Vandamme A-M. (eds): The Phylogenetic Handbook: A Practical Approach to Phylogenetic Analysis and Hypothesis Testing.
2nd edition. Cambridge University Press, 2009.
Avise JC: Molecular Markers: Natural History, and Evolution.
Sinauer Associates, 2004.
Felsenstein J.: Inferring Phylogenies.
Sinauer Associates, 2003.
Graur D & Li W-H: Fundamentals of Molecular Evolution.
2nd sub edition, Sinauer Associates, 2000.
Nei M & Kumar S: Molecular Evolution and Phylogenetics.
Oxford University Press, 2000.

Biodiversity:

Gaston, K.J. and Spicer, J.I.: Biodiversity. An introduction..
Oxford: Blackwell Science, 1998.
Lévêque, C. and Mounolou, J-C.: Biodiversity.
Wiley, 2004.
Rosenzweig, M. L.: Species Diversity in Space and Time.
Cambridge University Press, 1995.

Scientific Communication:

Hall GM : How to Write a Paper.
3rd edition. BMJ Publishing Group, 2003.
Davis M.: Scientific Papers and Presentations.
2nd edition. Academic Press, 2004.
McMillan VE.: Writing Papers in the Biological Sciences.
4th edition. Bedford/St. Martin's, 2006.

Human Histology and Embryology II.:

Ross, M.H., Romrell, L.J., Kaye, G.I.: Histology. A Text and Atlas.
5th edition. Lippincott Williams & Wilkins, 2006. ISBN: 0-781-75056-3.
Sadler, T. W.: Langman's Medical Embriology.
12th edition. Lippincott Williams &Wilkins, 2012. ISBN: 978-1-4511-4461-1.

Experimental Design and Evaluation:

T.R. Morris: Experimental Design and Analysis in Animal Sciences.
CABI Publishing.
R.C. Campbell: Statistics for Biologist.
Cambridge University Press.

Plant Cell Biology:

Alberts B et al.: Molecular Biology of The Cell.
5th edition. Garland Sci., 2008.
Buchanan BB, Gruissem W, Jones RL: Biochemistry and Molecular Biologyof Plants.
ASPB Books.
Fosket DE, Morejohn, LC: Structural and functional organization of tubulin. Annu. Rev. Plant Physiol. Plant Mol. Biol.

Greenberg JT: Programmed cell death in plant-pathogen interactions. Annu. Rev. Plant Physiol Plant Mol. Biol.

Kuriyama H, Fukuda H: Developmental programmed cell death in plants. Curr. Op. Plant Biol.

Evolutionary Genetics:

Fox, C.W. and Wolf, J.B.: Evolutionary Genetics: Concepts and Case Studies.
Oxford University Press, 2006.
Ridley, M.: Evolution.
2nd edition, Oxford UP, 2004.

Cell Cycle and Its Regulation:

Alberts et al.: Essential Cell Biology.
3rd edition. Garland Public Inc., 2004. ISBN: 0-8153-3481-8.
G.S. Stein, A.B. Pardie: Cell Cycle and Growth Control: Biomolecular Regulation and Cancer, 2**nd** edition.
2nd. Wiley-Liss, 2004.
Lodish et al.: Molecular Cell Biology.
4th edition..

Methodology in Molecular Genetics:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual.
3rd edition. Cold Spring Harbor Laboratory Press, 2001.
Tom Strachan, Andrew P. Read: Human Molecular Genetics.
4th. Garland Science, 2011. ISBN: 0-8153-4184-9.
Watson, JD, Gilman, M, Wikowski, J, Zoller, M: Recombinant DNA.
Second edition. Scientific American Books, 1993. ISBN: 0-7167-2282-8.
: www.genetics.dote.hu.
URL: http://www.genetics.dote.hu/

Biochemistry of Oxidative Stress:

Department of Medical Chemistry: online textbook.
URL: http://medchem.unideb.hu/hu

Bio Inorganic Chemistry:

Gergely, P.: Introduction to Bioinorganic Chemistry for Medical Students.
Medical and Health Science Center, University of Debrecen, 2008.

Signalling Pathways in the Cells:

Alberts et al.: Essential Cell Biology.
3rd edition. Garland Public Inc., 2004. ISBN: 0-8153-3481-8.
Cell Signalling Biology.
URL: http://www.biochemj.org/csb/

Evolution of Microbes:

Miller, R., Day, M. (eds.): Microbial evolution – gene establishment, survival, and exchange.
ASM Press, 2004.

Pharmacology of System of Organs:

Humphrey Rang, Maureen Dale, James Ritter, Rod Flower, Graeme Henderson: Rang & Dale's Pharmacology.
7th edition. Elsevier, 2011. ISBN: 978-0-7020-3471-8.
Katzung, B. G.: Basic and Clinical Pharmacology.
13th edition. McGraw-Hill Education, 2014. ISBN: 0-0718-2505-3.
Trevor, A. J., Katzung B. G., Masters S. B.: Katzung & Trevor's Pharmacology: Examination & Board Review.
11th edition. McGraw-Hill Education, 2015. ISBN: 0-0718-2635-1.

Cardiorespiratory Physiology:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002. ISBN: 963-242-726-2.

Neuroendocrine Regulation of Feeding and Energy Balance:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002. ISBN: 963-242-726-2.
R. M. Berne, M. N. Levy, B. M. Koeppen, B. A. Stanton: Physiology.
5th edition. V.C. Mosby Co., 2003.

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