

**BULLETIN**

**UNIVERSITY OF DEBRECEN**

**ACADEMIC YEAR 2018/2019**

**MSc in Molecular Biology**

**FACULTY OF MEDICINE**

Coordinating Center for International Education



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## CHAPTER 1 INTRODUCTION

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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).



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Assistant Professor	Sándor Gonda D.Pharm., M.Sc., Ph.D. Viktor Oláh M.Sc., Ph.D. Gyula Surányi M.Sc., C.Sc.

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Assistant Professor	Ms. Terézia Barna Ph.D. Ms. Hajnalka Csoma Ph.D.
PhD Student	László Elek J.D. Ms. Enikő Horváth Zoltán Kállai Ms. Edina Karanyicz Ms. Erika Papp M.D. László Papp Walter Pfliegler

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	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.
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	István Fábián M.Sc., Ph.D., D.Sc.
	Ms. Katalin Várnagy M.Sc., Ph.D., D.Sc.
Professor Emeritus	Ernő Brücher Ph.D., D.Sc., M.Sc.
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	Ms. Ágnes Grenács M.Sc., Ph.D.
	Norbert Lihi M.Sc., Ph.D.
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	Tibor Kurtán Ph.D., D.Sc.
Associate Professor	László Juhász M.Sc., Ph.D. habil.
	Attila Kiss M.Sc., Ph.D. habil.
	László Lázár Ph.D. habil.
	Ms. Tóth Marietta Vágvolgyiné M.Sc., Ph.D. habil.
Assistant Professor	Ms. Éva Bokor M.Sc., Ph.D.
	Ms. Tóth Éva Juhászné M.Sc., Ph.D.
	Ms. Krisztina Kónya M.Sc., Ph.D.
	Ms. Tünde Zita Tóthné Illyés M.Sc., Ph.D.
Academic Advisor	Ms. Tóth Éva Juhászné M.Sc., Ph.D.

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## CHAPTER 7 UNIVERSITY CALENDAR

### UNIVERSITY CALENDAR for M.Sc. in MOLECULAR BIOLOGY PROGRAM 2018/2019 ACADEMIC YEAR

**OPENING CEREMONY: September 9, 2018**

**GRADUATION CEREMONY: June/July 2019**

#### 1<sup>st</sup> SEMESTER

Year	Course	Examination Period
1 <sup>st</sup> year M.Sc. in Molecular Biology 2 <sup>nd</sup> year M.Sc. in Molecular Biology	September 10 – December 14, 2018 (14 weeks)	December 17, 2018 – February 1, 2019 (7 weeks)

#### 2<sup>nd</sup> SEMESTER

Year	Course	Spring Break	Examination Period
1 <sup>st</sup> year M.Sc. in Molecular Biology	February 11 – April 19, 2019 April 29 – May 24, 2019 (14 weeks)	April 22 – 26, 2019 (1 week)	May 27 – July 12, 2019 (7 weeks)
2 <sup>nd</sup> year M.Sc. in Molecular Biology (before graduation)	February 11 – April 19, 2019 April 29 – May 10, 2019 (12 weeks)	April 22 – 26, 2019 (1 week)	May 13 – June 21, 2019 (6 weeks)

## CHAPTER 8

### CREDIT SYSTEM

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#### 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	28	14		ESE*	4	None
1	Biophysics	AO_MBE_BIF01	28			ESE	3	None
1	Human Physiology I.	AO_MBE_HET01	28			ESE*	3	None
1	Medical Genome Biology	AO_MBE_GRB01	28			ESE*	3	None
1	Medical Genome Biology Practicals	AO_MBE_GRG01			42	AW5	2	None
1	Methods of Molecular Biology	AO_MBE_MBE01	28			ESE*	3	None
1	Molecular Genetics	AO_MBE_GEN01	28		28	ESE*	4	None
1	Molecular Immunology	AO_MBE_IMM01	28	10		ESE*	3	None
1	Radioisotope Techniques in Biomedicine	AO_MBE_ITE01	28			ESE	3	None
1	Radioisotope Techniques In Biomedicine Practical	AO_MBE_ITG01			14	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	28			ESE	3	None
2	Bioinformatics Practicals	AO_MBE_BIG02			14	AW5	1	together with Bioinformatics
2	Biostatistics	AO_MBE_BST02	15			ESE	1	None
2	Cell and Organ Biochemistry	AO_MBE_CBI02	28	14		ESE*	4	Biochemistry of Metabolism
2	Cell Biology	AO_MBE_SBI022	28			ESE*	3	None
2	Human Physiology II.	AO_MBE_HET02	28			ESE*	3	Human Physiology I.
2	Human Physiology Practicals	AO_MBE_HEG02			28	AW5	2	Human Physiology I.; together with Human Physiology II.
2	Methods in Molecular Biology Practicals	AO_MBE_MBG01			46	AW5	2	Methods of Molecular Biology
2	Physiology of Prokaryotes and Molecular Virology	AO_MBE_PRO02	28		14	ESE	4	None
2	Plant Molecular Biology	AO_MBE_NBI02	28		28	ESE	4	None
2	Problem-solving exercises in Molecular Biology	AO_MBE_PMF02			45	AW5	2	None

**M.Sc. in Molecular Biology – Specialization Module in Biochemistry-Genomics****Required elective courses for the 1. year**

<b>Sem</b>	<b>Subjects</b>	<b>Neptun code</b>	<b>L</b>	<b>S</b>	<b>P</b>	<b>Exam</b>	<b>Crd</b>	<b>Prerequisites of taking the subject</b>
2	Cell Biology Practicals	AO_MBE_SBG42			15	AW5	3	together with Cell Biology
2	Proteomics	AO_MBE_PRO04	28		28	ESE	4	None
2	Structure and Function of Macromolecules	AO_MBE_MMS02	14		30	ESE	3	Medical Genom Biology
2	Thesis I.	AO_MB_DD02			70	AW5	5	None

**M.Sc. 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	Genomic Bioinformatics	AO_MBE_BGI02	14		28	ESE	3	Medical Genom Biology
1	Molecular Mechanism of Diseases Concerning Great Populations	AOG167605	22			ESE	0	None
1	Signalling Pathways in the Cells	AO_MBE_SJF03	28			ESE	3	Cell and Organ Biochemistry
1	Thesis II.	AO_MB_DD03			150	AW5	10	Thesis I.
2	Enzymology	AO_MBE_ENZ03	10		42	AW5	4	Biochemistry of Metabolism
2	Post-translational Modification of Proteins	AO_MBE_FPT04	28			ESE	3	Cell and Organ Biochemistry
2	Thesis III.	AO_MB_DD04			210	AW5	15	Thesis II.

**M.Sc. in Molecular Biology – Specialization Module in Biochemistry-Genomics****Module-specific Freely chosen courses for the 2. year**

<b>Department</b>	<b>Subject</b>	<b>Neptun code</b>	<b>Crd</b>	<b>Sem</b>	<b>Hours</b>	<b>Exam</b>	<b>Prerequisites of taking the subject</b>	<b>Coordinator</b>
Department of Biochemistry and Molecular Biology	Biochemistry of Apoptosis	AO_MBE_A BI03	3	1	28	ESE	Cell and Organ Biochemistry	Zsuzsa Szondy M.D., Ph.D., D.Sc.
Department of Biophysics and Cell Biology	Selected Topics in Cell Biology	AO_MB_SC T04	2	2	24	ESE	Cell Biology	György Vereb M.D., Ph.D., D.Sc.
Department of Medical Chemistry	Bioinorganic Chemistry	AO_MBE_B SZ03	3	1	28	ESE	None	Ferenc Erdódi M.Sc., Ph.D., D.Sc.

**Freely Chosen Courses for the 2. year**

<b>Department</b>	<b>Subject</b>	<b>Neptun code</b>	<b>Crd</b>	<b>Sem</b>	<b>Hours</b>	<b>Exam</b>	<b>Prerequisites of taking the subject</b>	<b>Coordinator</b>
Department of Immunology	Impaired Signal Transduction in the Immune System	AO_MBE_I TZ03	2	1	15	ESE	Molecular Immunology	Tamás Bíró M.D., Ph.D., D.Sc.
Department of Immunology	Immunological Methods in Molecular Biology	AO_MBE_I MM02	3	2	30	ESE	Molecular Immunology	Péter Gogolák M.Sc., Ph.D.
Department of Immunology	New System Biology Paradigms in Immunology	AO_MBE_U PI02	3	2	20	ESE	Molecular Immunology	Kitti Pázmándi M.Sc., Ph.D.
Department of Immunology	Basis of Conventional and Biological Immunotherapies	AO_MBE_H BI03	3	2	30	ESE	Impaired Signal Transduction in the Immune System	Árpád Lányi M.Sc., Ph.D.

## 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: **28**

Seminar: **14**

#### 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.

**Self Control Test (Topics of weeks 8-14)**

### Requirements

**Course content:**

Topics of metabolism presented at the lectures and discussed during the seminars (lecture slides are available at the <https://elearning.med.unideb.hu> web site, login with your university network ID and password). At the seminars the lectures of the previous week and new scientific information connected to the lectures will be discussed with the seminar teacher.

**Requirements:**

Lecture attendance is not compulsory, but recommended. Three absences are accepted from the seminars - in case of more absences students will not be permitted to take the written exam. Absences are accepted for medical reasons, certain family reasons or scientific programs - please provide certificates to the course administrator before the end of the semester.

**Self-control tests:** (not obligatory) During the semester students may choose to write 2 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 both tests a total of maximum 100 points can be collected. If the combined score of the tests is above 60% of the total score, grades will be offered based on the score at the end of the semester. If the offered grade is not accepted by the student, a written exam must be taken during the exam period.

**Grading:** Grades will be offered based on the combined score of the self-control tests, or the score of the written examination during the exam period, based on a five-grade scale.

Test grading:

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

The written exams also consist of single-choice and multiple-choice test questions. Students may take one improvement exam per exam period (for the offered grade or for the written exam). Please follow the **announcements** of the department about the control tests, exams and other current information on the bulletin board (LSB downstairs, 1 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: **28**

**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. Genomics of complex diseases.  
**Practical:** Genomics of complex diseases. Consultation.

### 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

## CHAPTER 10

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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

The slides of the lectures and up-to-date information can be found at <https://elearning.med.unideb.hu>, username and password is your network-id (same as Neptun-id) and password. You will be able to check the content after the Neptun has registered you to the subject.

Departmental homepage: <https://humangenetics.unideb.hu>

Subject: **MEDICAL GENOME BIOLOGY PRACTICALS**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Practical: **42**

**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:** Genomics of complex diseases.  
General consultation.

**Requirements**

The slides of the lectures and up-to-date information can be found at <https://elearning.med.unideb.hu>, username and password is your network-id (same as Neptun-id) and password. You will be able to check the content after the Neptun has registered you to the subject.

Departmental homepage: <https://humangenetics.unideb.hu>

Subject: **MOLECULAR GENETICS**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

Practical: **28**

**1st week:**

**Lecture:** 1. Introduction into molecular genetics. Organization of genetic material in pro- and eukaryotic cells. 2. Cytogenetics I. Karyogram, ideogram, banding techniques. Human autosomal trisomies.

**Practical:** Methods of study, required and advised readings. Laboratory safety in the laboratory. Nucleus and chromatin. Cell division.

**2nd week:**

**Lecture:** 3. Cytogenetics II. Abnormalities of the X and Y chromosomes. Structural aberrations of human chromosomes. 4. Cytogenetics III. Sex determination in humans. Molecular cytogenetics.

**Practical:** Cytogenetics. Evaluation of karyograms

**3rd week:**

**Lecture:** 5. The function of genes. Gene expression. 6. Genetic code. Translation.

**Practical:** Gene structure, function (gene, DNS replication, transcription, translation).

**4th week:**

**Lecture:** 7. Bacterial genetics. 8. Gene regulation in prokaryotes.

**Practical:** Gene regulation in prokaryotes. Bacterial genetics.

**5th week:**

**Lecture:** 9. The structure of the genes and gene regulation in eukaryotes. The genes of immunoglobulines. 10. Epigenetics. Imprinting. Uniparental disomy.

**Practical:** Gene regulation in eukaryotes.

**Self Control Test (1st self-control test in extra time.)**

**6th week:**

**Lecture:** 11. Repair of the DNA. Mutagenic agents. Ames test. Dinamic mutations. 12. Molecular genetics of the cell cycle.

**Practical:** Mutation, repair, Ames-test.

**7th week:**

**Lecture:** 13. Oncogenetics. 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 tumorsuppressors.

**8th week:**

**Lecture:** 15. Genetic polymorphism I. Allelic polymorphism. X-linked genes. 16. Dihybrid cross. Mendel's 2nd law and meiosis. Linked and not-linked genes. Recombination of non-allelic genes. Genetic mapping.

**Practical:** Problem solving and seminar on mendelian genetics.

**9th week:**

**Lecture:** 17. Gene interactions, epistasis, lethal genes. Variations of the gene expression. LOD score. 18. Extranuclear inheritance. Mutations in mitochondrial genes.

**Practical:** Pedigree analysis. Basic of the human genetics. Seminar on molecular genetics of inherited human diseases.

**10th week:**

**Lecture:** 19. Genetic polymorphisms II. Human genetic diversity. Genetics of blood types. 20. Genetic polymorphisms III. Genetics of MHC. DNS-polymorphisms as alleles: RFLP, SNP, micro- és minisatellites. Copy number variations.

**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. The genetic basis of complex inheritance. 22. Genetic polymorphisms IV. Pharmacogenetics, pharmacogenomics. Ecogenetics and ecogenomics.

**Practical:** Transformation of Escherichia coli. Complementation test. The gene concept.

**12th week:**

**Lecture:** 23. Population genetics. Hardy-Weinberg equilibrium. Inbreeding. Genetical basis of evolution. 24. Transposable elements.

**Practical:** Detection of human DNA polymorphism by polymerase chain reaction.

**13th week:**

**Lecture:** 25. The genetic role of RNA. 26. Developmental genetics.

**Practical:** PCR evaluation of the human polymorphism experiment. Induction of beta-galactosidase in E. coli cells.

**14th week:**

**Lecture:** 27. Clinical applications of new biotechnology techniques. 28. Results of Human Genom Project.

**Practical:** Seminar on population genetics.

**Self Control Test (3rd self-control test in extra time.)**

## 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 30% 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 homework 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

## CHAPTER 10

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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 and up-to-date information can be found at <https://elearning.med.unideb.hu>, username and password is your network-id (same as Neptun-id) and password. You will be able to check the content after the Neptun has registered you to the subject.

Departmental homepage: <https://humangenetics.unideb.hu>

## Department of Immunology

Subject: **MOLECULAR IMMUNOLOGY**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

Seminar: **10**

### 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. The structure of lymphoid tissues and organs.

### 2nd week:

**Lecture:** Structure and function of proteins encoded by the major histocompatibility (MHC) gene complex. Processing and presentation of antigens. T-lymphocytes. Requirements and consequences of T-cell activation.

### 3rd week:

**Lecture:** B-lymphocytes. Characteristics of the acquired immune response. An introduction to antibody structure and function. Lymphatic circulation, immune surveillance by re-circulation of immunocytes within the immune system. Inflammation and the acute phase response.

### 4th week:

**Lecture:** Recognition of pathogens by the innate arm of the immune system. Elimination of pathogens by the innate arm of the immune system. The complement system. Generation of B-cell receptor diversity.

**Seminar:** B-lymphocytes. An introduction to antibody structure and function. Inflammation and the acute phase response.

### 5th week:

**Lecture:** Antigen-independent differentiation of B-lymphocytes. Antigen-dependent differentiation of B-lymphocytes. B-cell activation. Production of various antibody isotypes and their functions.

**Seminar:** The innate arm of the immune system.

**Self Control Test**

### 6th week:

**Lecture:** T-cell development. central tolerance. Effector function of helper T-cell. Activation and function of cytotoxic T-lymphocytes.

**Seminar:** Generation of B-cell receptor diversity. Antigen-independent differentiation of B-lymphocytes. B-cell development.

### 7th week:

**Lecture:** Mechanisms of peripheral tolerance. The function of regulatory T-cells.

**Seminar:** T-cell development. Activation and function of cytotoxic T-lymphocytes. Effector function of helper T-cell.

### 8th week:

**Lecture:** The primary and secondary immune response. The development of immunological memory.

**Seminar:** Central tolerance. Mechanisms of peripheral tolerance. The function of regulatory T-cells.

### 9th week:

**Self Control Test**

## Requirements

### Signing of the Lecture Book:

Participation in the Seminars is compulsory, 1 absence is allowed. If there are more 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 9).

The first SCT contains the material of the lectures of weeks 1-3 as well as the material of seminar on week 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 4-8, respectively including the materials of the corresponding seminars.

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.elearning.med.unideb.hu](http://www.elearning.med.unideb.hu)).

Lecture materials and other information concerning education can be found on our website at [www.elearning.med.unideb.hu](http://www.elearning.med.unideb.hu).

## Department of Medical Chemistry

Subject: **METHODS OF MOLECULAR BIOLOGY**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

### 1st week:

**Lecture:** 1. Isolation of nucleic acids  
2. Enzymes of nucleic acid manipulation

### 2nd week:

**Lecture:** 3. Cloning of DNA  
4. DNA libraries

### 3rd week:

**Lecture:** 5. Nucleic acid hybridization  
6. DNA chips

### 4th week:

**Lecture:** 7. Fluorescence *in situ* hybridization (FISH)  
8. Comparative genomic hybridization (CGH)



**5th week:**

**Lecture:** 9.PCR and LCR  
10.PCR applications  
1st control test

**6th week:**

**Lecture:** 11.*In vitro* mutagenesis  
12.Genome editing

**7th week:**

**Lecture:** 13.Genome projects  
14.New generation DNA sequencing

**8th week:**

**Lecture:** 15.Protein purification  
16.Protein analysis  
2nd control test

**9th week:**

**Lecture:** 17.Preparation of antibodies  
18.Immunological methods in molecular biology

**10th week:**

**Lecture:** 19.Detection of protein-protein interactions  
20.Quantitative analysis of protein interactions

**11th week:**

**Lecture:** 21.Proteomics  
22.Mass spectroscopy for protein analysis  
3rd control test

**12th week:**

**Lecture:** 23.Expression of recombinant proteins  
24.Biotechnology

**13th week:**

**Lecture:** 25.Gene silencing and KO animals  
26.Gene therapy

**14th week:**

**Lecture:** Discussion  
4th control test

**Requirements**

The program consists of a series of lectures that aim to extend the molecular biology knowledge of the first year M.Sc. students and provide a solid methodological basis for experiments to be performed in the next semester during molecular biology practical. The course is divided into four teaching blocks. At the end of each block a written self-control test will be held to evaluate the midterm progress of the students. The self-control tests will be evaluated according to the following table:

<b>Percentage (%)</b>	<b>Mark</b>
0-49	fail (1)
50-59	pass (2)
60-69	satisfactory (3)
70-79	good (4)
80-100	excellent (5)

The average result of these tests will be used as an offered mark at the end of the semester, provided all of the tests were successfully completed at least with a passing grade. The students are expected to accept these offered grades in the Neptun system before the start of the examination period. In the absence of an accepted offered grade the students have to sit for an ESE during the exam period in accord with the rules and regulations of the Faculty of Medicine, University of Debrecen.

ESE is a written test composed of four assay questions, each covering a lecture of the given teaching block as described below:

1st block: Lectures 1-8

2nd block: Lectures 9-14  
3rd block: Lectures 15-20  
4th block: Lectures 21-26

The knowledge of each block at least at the basic level is required for the passing grade.

Textbook:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual, 3rd edition, Cold Spring Harbor Laboratory Press, 2001

Materials published in the web site.

e-mail: molecbiol@med.unideb.hu

## Department of Physiology

Subject: **HUMAN PHYSIOLOGY I.**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

**1st week:**

**Lecture:**

Introductory remarks

Humoral regulation of cell function

**2nd week:**

**Lecture:**

Electrical properties of the cell membrane

The mechanism of action potential

**3rd week:**

**Lecture:**

Physiology of the body fluids. Liquor. Blood plasma.

Functions of plasma proteins

**4th week:**

**Lecture:**

Red blood cells, white blood cells. Blood types.

Hemostasis

**5th week:**

**Lecture:** Electrophysiology of cardiac cells

**Self Control Test**

**6th week:**

**Lecture:**

Mechanics and contractility of cardiac cells  
The cardiac cycle, regulation of cardiac output

**7th week:**

**Lecture:**

Principles of hemodynamics, arterial circulation and microcirculation

Regulation of MAP I.

**8th week:**

**Lecture:**

Regulation of MAP II.

Regulation of circulation of specific organs

**9th week:**

**Lecture:** Functions of endothelium

**Self Control Test**

**10th week:**

**Lecture:**

Mechanics of respiration

Control of breathing

**11th week:**

**Lecture:**

Physiology of the gastrointestinal tract I

Physiology of the gastrointestinal tract II

**12th week:**

**Lecture:**

Food intake and its regulation  
Energy balance

**13th week:**

**Lecture:**

Regulation of striated muscle contraction  
Smooth muscle physiology

**14th week:**

**Lecture:** tutorial  
**Self Control Test**

**Requirements**

1. Signature of the semester

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.med.unideb.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:

<b>score</b>	<b>mark</b>
0 – 59 %	fail
60 – 69 %	pass
70 – 79 %	satisfactory
80 – 89 %	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 50%. 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 cancelled.

**Division of Biophysics**

Subject: **BIOPHYSICS**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

**1st week:**

**Lecture:** 1. Introduction. Electromagnetic waves, the properties of light (interference, photoelectric effect, photon theory). Matter waves. Thermal radiation.

2. Generation and absorption of X-ray, X-ray crystallography.

**Seminar:** Although there are no Biophysics seminars in Molecular Biology M.Sc 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. Molecule spectra, Jablonski diagram, fluorescence, fluorescence applications.

4. Sedimentation and electrophoresis. Mass spectrometry.

**3rd week:**

**Lecture:** 5. Optics, optical microscopy, electron microscopy.

6. Lasers and their application in biology and medicine.

**4th week:**

**Lecture:** 7. Physical properties of sound, ultrasound. Doppler effect. Medical and biological 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.

12. Basic principles of nuclear magnetic resonance, NMR spectroscopy in biology and

medicine.

**7th week:**

**Lecture:** 13. Principles of tomographic methods. X-ray absorption CT. PET.

14. Magnetic resonance imaging (MRI). Gamma camera, SPECT, PET.

**8th week:**

**Lecture:** 15. Chemical potential. Brownian motion. Diffusion at the molecular level, statistical interpretation. Fick's laws. Osmosis.

16. The structure of biological membranes. Membrane transport.

**9th week:**

**Lecture:** 17. Thermodynamic equilibrium potentials (Nernst, Donnan). Diffusion potential, Goldman-Hodgkin-Katz equation.

18. Resting potential, action potential, and electrical excitability. Measurement of membrane potential.

**10th week:**

**Lecture:** 19. Ion channels (gating, selectivity), the "patch clamp" technique.

20. The physical background of ECG and EEG.

**11th week:**

**Lecture:** 21. The human ear. Mechanism of hearing. The Weber-Fechner law.

22. The human eye. Photoreceptors. The molecular mechanism of vision.

**12th week:**

**Lecture:** 23. Biomechanics.

24. Fluid mechanics, blood circulation.

**13th week:**

**Lecture:** 25. Biophysics of respiration.

26. Flow cytometry. Confocal laser scanning microscopy.

**14th week:**

**Lecture:** 27. Modern microscopic techniques (atomic force microscopy, super resolution microscopy)

28. Research in the Institute.

## Requirements

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. Szöllösi, 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. Exemptions

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 minimal requirements 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 minimal requirements 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

## Division of Nuclear Medicine and Translational Imaging

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE PRACTICAL**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Practical: **14**

**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.

There will be 5 blocks of the practicals.

Topics:

Half life and gamma spectrum

In vitro isotope diagnostics (RIA)

Liquid scintillation measurement

Dosimetry

Labeling and gamma measurement

Practical 15, 5x3 hours

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

**1st week:**

**Lecture:** Introduction: radioisotopes in biomedicine. Decay modes, interactions of radiation with matter

**2nd week:**

**Lecture:** Introduction: radioisotopes in biomedicine. Decay modes, interactions of radiation with matter

**3rd week:**

**Lecture:** Experimental error calculations, error propagation

**4th week:**

**Lecture:** Settings for scintillation measurements  
1st test: Radioactivity, interactions, calculations

**5th week:**

**Lecture:** Basic terms and devices of dosimetry. Dose limits. Biological effects of radiation

**6th week:**

**Lecture:** General safety regulations, rules of working with radioisotopes. Compulsory before practices

**7th week:**

**Lecture:** "In vitro" isotope diagnostics

**8th week:**

**Lecture:** 8 "In vivo" nuclear medicine.  
2nd test: Radiation protection, "in vitro" diagnostics

**9th week:**

**Lecture:** Analytical methods with radiotracers

**10th week:**

**Lecture:** Characteristics and quality control of radiopharmaceuticals

**11th week:**

**Lecture:** Labeling techniques, autoradiography

**12th week:**

**Lecture:** Analyzing receptor binding and kinetics  
3rd test: Labeling, applications

**13th week:**

**Lecture:** Students' presentations

**14th week:**

**Lecture:** Students' presentations  
Review and summary

### 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: **28**

### 1st week:

**Lecture:** Introduction to bioinformatics

### 2nd week:

**Lecture:** Definition of 'omics'. Sequencing technologies. Functional genomics approaches, connection with bioinformatics. The human genome project.

### 3rd week:

**Lecture:** The basics of database technology. Databases in molecular biology. Primary databases.

### 4th week:

**Lecture:** Protein and protein domain databases. Special emphasis on the UNIPROT and INTERPRO databases.

### 5th week:

**Lecture:** Other databases. The TAXONOMY, evolutionary and GO databases.

### 6th week:

**Lecture:** Text searches in databases. Using the text search engines of Google and the main bioinformatics portals. Usage of PubMed, Entrez and SRS.

### 7th week:

**Lecture:** Algorithms for similarity searches. Pairwise alignments. The DOTPLOT method, local and global analyses.

### 8th week:

**Lecture:** Similarity searches in databases. The FASTA and BLAST algorithms and their usage. The BLAST and MEGABLAST program. Multiple alignments.

### 9th week:

**Lecture:** Bioinformatics program packages for molecular biology. Introduction to the EMBOSS program package.

### 10th week:

**Lecture:** Introduction to the main programs in the EMBOSS program package.

### 11th week:

**Lecture:** Bioinformatic aspects of molecular phylogenetics. Multiple alignment and the evolutionary tree. Distance and character based methods.

### 12th week:

**Lecture:** Structural bioinformatics

### 13th week:

**Lecture:** Transcriptomics and bioinformatics.

### 14th week:

**Lecture:** Bioinformatics for next generation sequencing. Short read alignment, analysis of ChIP-seq and RNA-seq data, de novo genome assembly. The GWAS technology.

## 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 <https://elearning.med.unideb.hu> web site, login with your university network ID and password). Students may take one improvement exam per exam period.

Subject: **BIOINFORMATICS PRACTICALS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **14**

### **2nd week:**

**Practical:** Using the sequence and domain databases. Downloading and analysis of sequence records from the EMBL, GenBank and SwissProt databases. Searching the INTERPRO database. Possible usages of SRS text search.

### **3rd week:**

**Practical:** Annotation of novel metagenomic sequences at the [annotathon.org](http://annotathon.org) website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

### **4th week:**

**Practical:** Annotation of novel metagenomic sequences at the [annotathon.org](http://annotathon.org) website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

### **5th week:**

**Practical:** Annotation of novel metagenomic sequences at the [annotathon.org](http://annotathon.org) website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

### **6th week:**

**Practical:** Annotation of novel metagenomic sequences at the [annotathon.org](http://annotathon.org) website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

### **14th 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: **28**

Seminar: **14**

**1st week:**

**Lecture:** RNA world I

**2nd week:**

**Lecture:** RNA world II.

**Practical:** Polymerase chain reaction - basics of experimental design and optimization.

**3rd week:**

**Lecture:** Transgene and knockout technologies I.

**Practical:** PCR primer design 1. Detection of alternative splice variants. Identify and download the target sequence from the Ensembl database. Primer design with the Primer3+ program. Quality control: IDT Oligoanalyzer program.

**4th week:**

**Lecture:** Transgene and knockout technologies II.

**Practical:** PCR primer design 2. Design of composite primers for directional cloning.

**5th week:**

**Lecture:** Stem cells I.

**Practical:** PCR primer design 3. Primer design for site directed mutagenesis. Identification of potential miRNA binding sites with the Targetscan program. 3' UTR sequence download from the UCSC Genome Browser database.

**6th week:**

**Lecture:** Stem cells II.

**Practical:** PCR primer design 4. Design of

sequencing primers.

**7th week:**

**Lecture:** Tumor microenvironment

**Practical:** Independent work and report writing

**Self Control Test (Topics for week 1-6.)**

**8th week:**

**Lecture:** Intrinsically disordered proteins

**Practical:** Independent work and report writing

**9th week:**

**Lecture:** Neurobiochemistry

**Practical:** Independent work and report writing

**10th week:**

**Lecture:** Tumor metabolism

**11th week:**

**Lecture:** Autophagy

**Self Control Test (Topics of weeks 7-10)**

**12th week:**

**Lecture:** Endoplasmic reticulum stress

**13th week:**

**Lecture:** Epigenetics I

**14th week:**

**Lecture:** Epigenetics II

**Self Control Test (Topics of weeks 11-14.)**

### Requirements

**Content of Organ and Cell Biochemistry:** Topics presented at the lectures and discussed during the seminars (available at the <https://elearning.med.unideb.hu> web site, login with your university network ID and password). 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 practical. Only one unexcused absence is accepted from the practicals, and three absences are accepted from the

seminars. Students will also have to submit the written report of their independent practical work in time. In case of more absences or missed report submission students will not be permitted to take the written exam.

**Self-control tests:** (not obligatory) During the semester students may choose to write 3 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 3 tests a total of maximum 70 points can be collected. If the combined score of the 3 tests is above 60% of the total score, grades will be offered at the end of semester.

**Grading:**

2 (pass)	42-48 points,
3 (satisfactory)	49-55 points,
4 (good)	56-62 points,
5 (excellent)	63-70 points.

**Grading:** Grades will be offered based on the combined score of the self control tests, or based on the score of the written examination during the exam period. The written exams also consist of single-choice and multiple-choice test questions - 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 points;
satisfactory (grade 3):	70-79 points;
good (grade 4):	80-89 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: **28**

Practical: **28**

**1st week:**

**Lecture:** General information. Introduction into the main topics of plant molecular biology.

**Seminar:** Discussion of seminar topics.

**2nd week:**

**Lecture:** The dynamic plant cell. The coordination between ER and microtubules for the concerted functioning of plant cell. Dynamics

of organelles, with special emphasis on vacuoles.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell dynamics. Students present selected topics of this subject on the basis of scientific papers.

**3rd week:**

**Lecture:** Organization of nuclear and organellar

genome, particularities of transcription and translation in plants. Special plant proteins. Biotechnological aspects.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant molecular genetics. Students present selected topics of this subject on the basis of scientific papers.

**4th week:**

**Lecture:** Gene regulation in plants, with special emphasis on light-regulated expression. Post-transcriptional and post-translational regulation in plants.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant gene regulation as well as post-transcriptional and post-translational regulations. Students present selected topics of this subject on the basis of scientific papers.

**5th week:**

**Lecture:** Particularities of the organization of plant cytoskeleton. Cell cycle regulation in plants.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cytoskeleton and cell cycle regulation. Students present selected topics of this subject on the basis of scientific papers.

**6th week:**

**Lecture:** Photoreceptors: phytochromes, blue and UV receptors. Signal transduction events in photomorphogenesis. Regulation of gene expression by phytochromes. Chronobiology in plants.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of photomorphogenesis. Students present selected topics of this subject on the basis of scientific papers.

**7th week:**

**Lecture:** Electron transport proteins in photosynthesis. Short characterization of the Calvin cycle. Molecular/ gene regulation of C- and N metabolism in plants.

**Seminar:** Discussion of the topics presented at

the lecture. Modern techniques related to the study of C- and N metabolism in plants. Students present selected topics of this subject on the basis of scientific papers.

**8th week:**

**Lecture:** Signal transduction events mediated by plant growth regulators, with special emphasis on auxins. Functions of PIN proteins (auxin efflux carriers).

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant hormone mediated signal transduction and auxin transport. Students present selected topics of this subject on the basis of scientific papers.

**9th week:**

**Lecture:** Molecular mechanisms of embryo and root development, the role of plant growth regulators.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of shoot and flower development. Students present selected topics of this subject on the basis of scientific papers.

**10th week:**

**Lecture:** Molecular mechanisms of shoot and flower development, the role of plant growth regulators. Flower identity genes: the role of MADS box (homeotic) genes, analogies with homeobox genes-regulated developmental processes in animals.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of shoot and flower development. Students present selected topics of this subject on the basis of scientific papers.

**11th week:**

**Lecture:** Plant responses to abiotic and biotic stresses. The formation of reactive oxygen species. Antioxidant systems and metabolites in plants.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant stress responses. Students present selected topics of this subject on the basis of

scientific papers.

**12th week:**

**Lecture:** Molecular mechanisms of senescence and plant cell death in plants. Plant-pathogen interactions, the hypersensitive response.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell death. Students present selected topics of this subject on the basis of scientific papers.

**13th week:**

**Lecture:** Secondary metabolism in plants, their synthesis.. Terpenoids, alkaloids, phenoloids, polyketides.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant secondary metabolism. Students present selected topics of this subject on the basis of scientific papers.

**14th week:**

**Lecture:** Functions, effects of special plant metabolites. Allelopathy.

**Seminar:** Discussion of the topics presented at the lecture. Modern techniques related to the study of plant special metabolites. Students present selected topics of this subject on the basis of scientific papers.

### 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](http://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**

### Requirements

Aim of the course (partial/complete skills and competencies):

The aim of the course is to give differentiated professional knowledge about a selected area of molecular biology. All departments involved in molecular biology education are entitled to announce exercises. The extensive collaboration offers possibility for students to encounter the present day problems and questions of molecular biology and search for the answers. Students can join to the current research projects and learn the independent laboratory work. This prepares them for their future work as a PhD or research group leader, which requires problem solving thinking and enables them to find the correct answers.

By acquiring the course material students will get a more in-depth knowledge of the related literature, will become able to solve problems using the method and summarize the results in a comprehensible form.

Topics:

The project is the elaboration of an exercise that can be solved using molecular biological methods.

The student gathers the possible methods leading to the solution (reading the literature) and suggests a solution with the method he believes the best. The student designs and performs the experiments and analyzes the data with the help of the supervisor. Students must summarize their work in a written report of 8-10 pages.

Recommended literature:

Related to the projects, offered by the tutors

## Department of Medical Chemistry

Subject: **METHODS IN MOLECULAR BIOLOGY PRACTICALS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **46**

### 1st week:

**Practical:** 1. Genotyping: DNA preparation, PCR, Agarose gel electrophoresis  
2. Investigation of gene expression: Cell culturing, RNA preparation, measurement of RNA concentration, RT reaction, PCR, Agarose gel electrophoresis  
3. DNA cloning: Cultivation of *E. coli*, Preparation of competent cells, Ligation, Transformation, Detection of GFP  
Demonstration: Quantitative PCR

of proteins, SDS-PAGE, Western blotting

5. Purification of recombinant GFP by affinity chromatography

6. Plasmid mini-preparation: Preparation of DNA, Restriction analysis, Agarose gel electrophoresis

7. Detection of antigens from blood: ELISA

8. Immunocytochemistry: Isolation, labeling and microscopic analysis of cells

### 2nd week:

**Practical:** 4. Investigation in proteins: Extraction

## Requirements

The successful completion of the exercises and the presence of the students at the demonstration will be acknowledged by the signature of the instructor. In the absence of these signatures the course will not be accepted. In case of justified absence the instructor offers one chance to make up the missed practical class.

The work of the student will be evaluated based on the notebook prepared by the student independently during the practical classes. The practical grade may be improved once, by upgrading/rewriting the notebook.

Textbook:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual, 3rd edition, Cold Spring Harbor Laboratory Press, 2001

Teaching materials: website.

e-mail: molecbiol@med.unideb.hu

## Department of Medical Microbiology

Subject: **PHYSIOLOGY OF PROKARYOTES AND MOLECULAR VIROLOGY**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

Practical: **14**

**1st week:**

**Lecture:** Structure and taxonomy of viruses. Virus replication.

**2nd week:**

**Lecture:** Replication strategies of viruses.

**3rd week:**

**Lecture:** Pathogenesis of viral infections

**4th week:**

**Lecture:** 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.

**7th week:**

**Lecture:** Antiviral treatment. Prions.

**8th week:**

**Lecture:** Bacterial cell structure. Propagation of bacteria.

**Practical:**

Propagation of bacteria. Macroscopic, microscopic morphology.

*Demonstration:*

Bacteria on solid media

*Staphylococcus aureus*

$\alpha$ -haemolytic Streptococcus

*Bacillus subtilis*

*Escherichia coli*

*Klebsiella p.*

*Proteus mirabilis*

*Pseudomonas aeruginosa*

2. Stained smears.

*Working task:*

1. Preparing smear from bacterial cultures. Gram staining of smears. (*Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*)

2. Examination of macroscopic morphology

3. Microscopic examination of bacteria

4. Culturing of *Escherichia coli*

**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 hydrolysis (BEA medium): *Enterococcus faecalis*

indol test: *E. coli*, *Klebsiella sp.*

e. ureum hydrolysis test: *E. coli*, *Klebsiella sp.*

f. phenylalanin-deaminase test: *Proteus sp.*, *E. coli*

g. Oxidase reaction: *Pseudomonas sp.*, *E. coli*

h. Catalase test: *S. aureus*, *E. faecalis*

i. 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. Catalase test: *S. aureus*, *E. faecalis*

6. Coagulase test: *S. aureus*, *S. Epidermidis*

7. Culturing of bacteria (*E. coli*) for antibiotic sensitivity test

**3rd day:**

Antibiotic sensitivity tests. Serological reactions.



*Demonstration:*

ELISA, Western-blot.

*Working task:*

VDRL

Slide agglutination (*Escherichia coli*)

Validation and interpretation of ELISA,

Western-blot

Evaluation of antibiotic sensitivity test.

**9th week:**

**Lecture:** Prokaryotic genome. Bacterial DNA replication. Plasmids, transformation of bacteria

**Practical:**

4th day: Propagation of viruses(animals, embrionated egg, cell cultures)

*Working task:*

Inoculation of embrionated egg with “virus”

5th day: Propagation of viruses

Harvesting and freezing the chorioallantoic fluid (“virus solution”) from the infected embrionated eggs.

6th day: Direct and indirect detection of viruses, viral infections

*Demonstration:*

Haemagglutination inhibition.

*Working task:*

Haemagglutination. Calculation the haemagglutination titer.

**10th week:**

**Lecture:** Prokaryotic transcription and translation. Regulation of gene expression in prokaryotes.

**Practical:** 2nd week practice:

4th day: Propagation of viruses (animals, embrionated egg, cell cultures)

*Working task:*

Inoculation of embrionated egg with “virus”

5th day: Propagation of viruses

*Working task:*

Harvesting and freezing the chorioallantoic fluid (“virus solution”) from the infected embrionated eggs.

6th day: Direct and indirect detection of viruses, viral infections

*Demonstration:*

Haemagglutination inhibition.

*Working task:*

Haemagglutination. Calculation the haemagglutination titer.

**11th week:**

**Lecture:** Photosynthesis of bacteria. *Chemolithotrophic bacteria. Bacterial catabolism. Archea.*

**12th week:**

**Lecture:** Pathogenicity, virulence. Mechanisms of secretion.

**13th week:**

**Lecture:** Control of microbial growth I. Sterilization, disinfection

**14th week:**

**Lecture:** Control of microbial growth II. Antibacterial therapy

**Requirements**

The program consists of lectures and laboratory practices. Attendance at laboratory practices and lectures is recorded. Students should attend 100% of laboratory practices. 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, B and C chance) consists of assay questions. In case of failed results based on the written part of the C chance, the examination

continues with oral examination. The examination rules will be announced during the semester.

Compulsory literature:

White D.: The Physiology and Biochemistry of Prokaryotes, 4th edition, Oxford University Press, 2011

Dimmock, N., Easton, A., Leppard, K: Introduction to Modern Virology, 7th edition, Wiley-Blackwell, 2016

Recommended literature:

Christopher Burrell Colin Howard Frederick Murphy: Fenner and White's Medical Virology (Fifth Edition), Academic Press, 2017

## Department of Physiology

Subject: **HUMAN PHYSIOLOGY II.**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

**1st week:**

**Lecture:**

Principles of renal morphology and renal function

Quantitative description of renal function

**2nd week:**

**Lecture:**

Mechanism and regulation of glomerular filtration

Tubular transport processes

**3rd week:**

**Lecture:**

Osmoregulation, water balance, diuretics

Defense of body fluid volume, sodium balance

**4th week:**

**Lecture:**

Acid-base balance and acid-base disturbances

Potassium balance, mycturition

**5th week:**

**Lecture:** General principles of endocrinology.

**Self Control Test**

**6th week:**

**Lecture:**

Pituitary gland, growth hormone

The hormones of thyroid gland

**7th week:**

**Lecture:**

The hormonal regulation of basal metabolic rate

Male, Female gonadal functions

**8th week:**

**Lecture:**

Pregnancy, lactation

The hormones of adrenal cortex

**9th week:**

**Lecture:**

The hormones of adrenal medulla, stress

The hormones of pancreatic islets

**10th week:**

**Lecture:** Endocrine regulation of intermediary metabolism

**Self Control Test**

**11th week:**

**Lecture:**

Calcium balance, physiology of bone

Sensory function of nervous system

**12th week:**

**Lecture:**

Mechanisms of vision, hearing and vestibular sensation. The taste and olfactory systems  
Somatomotor functions and spinal cord reflexes, proprioceptive and nociceptive reflexes.

**13th week:**

**Lecture:**

Role of brainstem, basal ganglia and cerebral

cortex in motor-coordination.

Cerebral Cortex, Intellectual Functions of the Brain,

**14th week:**

**Lecture:** Learning, memory, speech.

**Self Control Test**

**Requirements**

1. Signature of the semester

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.med.unideb.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 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:

<b>score</b>	<b>mark</b>
0 – 59 %	fail
60 – 69 %	pass
70 – 79 %	satisfactory
80 – 89 %	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 50%. 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 cancelled.

Subject: **HUMAN PHYSIOLOGY PRACTICALS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **28**

**1st week:**

**Practical:** Orientation lecture

**2nd week:**

**Practical:** INVESTIGATION OF THE CARDIOVASCULAR FUNCTIONS

**3rd week:**

**Practical:** DETERMINATION OF PARAMETERS CHARACTERISING THE RESPIRATORY FUNCTIONS

**4th week:**

**Practical:** EXAMINATION OF THE BLOOD

**5th week:**

**Practical:** COMPUTER AIDED ACQUISITION AND PROCESSING OF BIOLOGICAL SIGNALS

**6th week:**

**Practical:** Remedial lab

**7th week:**

**Practical:** EFFECTS OF ELECTROLYTES ON THE UTERINAL SMOOTH MUSCLE FUNCTION

**8th week:**

**Practical:** EFFECTS OF NEUROTRANSMITTERS AND HORMONES ON THE UTERINAL SMOOTH MUSCLE FUNCTION

**9th week:**

**Practical:** COMPUTER SIMULATION OF THE FRANK-STRAHLING-MECHANISM

**10th week:**

**Practical:** SIMULATION OF THE RENAL TRANSPORT MECHANISMS

**11th week:**

**Practical:** COMPUTER SIMULATION OF THE GLUCOSE TOLERANCE TEST

**12th week:**

**Practical:** Remedial lab

**13th week:**

**Practical:** Closing lab

**14th week:**

**Practical:** Closing lab

### Requirements

1. Signature of the semester

Attendance of laboratory practices is compulsory. The signature of the semester 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://phys.med.unideb.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**

**4th week:**

**Lecture:** Probability theory. Set theory. Random events. Conditional probability, marginalization. Independent events.

**5th week:**

**Lecture:** Random variable. Cumulative distribution function, distribution function of random variable. Mean, standard deviation.

**6th week:**

**Lecture:** Discrete probability distributions: binomial and Poisson-distribution.

**7th week:**

**Lecture:** Continuous probability distribution.

Normal distribution. Standard normal distribution. Sampling.

**8th week:**

**Lecture:** Hypothesis testing. Null hypothesis. Statistical significance. Z-test.

**9th week:**

**Lecture:** Paired, unpaired t-test, F-test.

**10th week:**

**Lecture:** 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= $\leq$ FS<65	pass
- 65= $\leq$ FS<75	satisfactory
- 75= $\leq$ FS<85	good
- 85 $\geq$ 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](http://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: **28**

**1st week:**

**Lecture:** Lecture 1: Introduction. Origin of life. Prokaryotes and eukaryotes  
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: Cell organelles. Overview of intracellular transport processes  
Lecture 2: Intracellular membrane systems I: lysosome, peroxisome, endoplasmic reticulum

**4th week:**

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

**5th week:**

**Lecture:** Lecture 1: Cytoskeleton I: microtubules  
Lecture 2: Cytoskeleton II: intermediate filaments, actin cytoskeleton

**6th week:**

**Lecture:** Lecture 1: Calcium homeostasis  
Lecture 2: Osmo-, volume and pH regulation

**7th week:**

**Lecture:** Lecture 1: Cell-cell and cell-matrix contacts  
Lecture 2: Cellular energetics, mitochondrion

**8th week:**

**Lecture:** Lecture 1: Nucleus, Chromatin  
Lecture 2: Mitosis, meiosis

**9th week:**

**Lecture:** Lecture 1: Mechanics of the cell cycle  
Lecture 2: Regulation of the cell cycle

**10th 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

**11th week:**

**Lecture:** Lecture 1: Cell signaling III. Pathways to the nucleus  
Lecture 2: Cell-cell communication in the nervous and the immune system

**12th week:**

**Lecture:** Lecture 1: The changing cell  
Lecture 2: Oncogenes. tumor cells

**13th week:**

**Lecture:** Lecture 1: Cell senescence, apoptosis  
Lecture 2: Stem cells

**14th week:**

**Lecture:** Lecture 1: Interaction of cells with viruses and bacteria.  
Lecture 2: Cell motility

**Requirements**

**Aims of the course:** The course gives an overview of the functional anatomy of higher eukaryotic animal cells with examples of the paradigmatic molecular mechanisms. Students successfully completing the course will have acquired an active professional vocabulary minimally required for studying biochemistry, molecular biology, genetics, histology and physiology. In addition, the course aims to provide a thorough knowledge base which serves to understand the functions and dysfunctions of the human body in their broader context.

**Course synopsis:** Structure and constituents of eukaryotic cells, the most important cellular functions: membrane transport, vesicular transport, cell signaling, cell division (mitosis, meiosis), differentiation, cell death

### **Material to be studied:**

**Compulsory sources:** 4th ed. of **Essential Cell Biology (Alberts et al., Garland Publ Inc. 2014. ISBN: 978-0-8153-4454-4)**. Chapters 1 and 11 through 20 are studied in depth during the course. Chapters 2 through 10 contain explanations for basic molecular concepts. There is additional core material that is available only in the lectures.

**Recommended:** The in depth full-text version of the course material can be found in:

Alberts et al.: *Essential Cell Biology*, 4<sup>th</sup> edition, Garland Publ. Inc., 2014, ISBN 978-0-8153-4455-1; Lodish et al.: *MOLECULAR CELL BIOLOGY*, 7th edition, W. H. Freeman, 2013, ISBN-13: 978-1-4292-3413-9; Alberts et al.: *MOLECULAR BIOLOGY OF THE CELL*; 6<sup>th</sup> edition, Garland Publ. Inc., 2015, ISBN 978-0-8153-4453-7;

The 4<sup>th</sup> editions of these are also available online:

<http://www.ncbi.nlm.nih.gov/books/NBK21475/>

<http://www.ncbi.nlm.nih.gov/books/NBK21054/>

**Knowledge that will be examined in this course** is comprised in the slides presented in the lectures. It is recommended to download these slides before the lectures and take notes on them during the lecture. Slides of central importance will be marked accordingly.

**Course home page:** [http:// biophys.med.unideb.hu/](http://biophys.med.unideb.hu/)

**Signature:** Signing for the course can be denied if the student has missed more than 2 seminars, has not performed all the lab practices or any of the lab logs has not been accepted.

**Type of exam:** Final exam

**Exemptions:** In order to get exemption from the complete Cell Biology course, the student has to apply to the Education Office. Applications for exemption from part of the courses are handled by the Department. The deadline for such applications is Monday on the second week of education. No application will be considered after this date. The following documents have to be submitted to the Educational Advisor: 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. Applicants may be interviewed before the decision is made.

### **Requirements:**

**1. Lectures:** Attendance of lectures is indispensable for acquiring the knowledge required to pass, understanding which parts of the material have the highest importance, and finding the proper sources for preparing for the exam.

**2. Seminars:** Seminars serve to discuss the lecture material. Use them well, study the material before the seminar and arrive with your questions. Attendance is not compulsory, but participation throughout the semester draws 3 bonus points towards the final grade. Students can attend the seminars with Gen Med. group whose schedule best fits, but must attend with the same group throughout. Students may sign up for one short interactive presentation during the semester. The teacher will choose the topic/questions on the spot and the presenter is required to pick the appropriate lecture slides and use them explain the topic. This requires the in depth knowledge of



all the topics presented at the lectures and studying the relevant textbook chapters. The presentations are graded on a scale of 0-5. This grade counts toward the bonus points earned during the semester.

**3. Labs:** Labs can be done under a separate subject code.

**4. Self-control Tests (SCT-s):**

There are at least two SCT-s. The dates and topics (covering roughly the whole material) for SCT-s are announced in the beginning of the semester. Test and essay questions are scored on a 0-100% scale, averaged for the SCTs ( $=SCT_{ave}$ ) and this average is used to offer exemptions and bonus points towards the final grade (see 5.2 and 5.4.1.). Similarly to the final exam, basic questions (on minimally required knowledge, part A) and in depth questions (part B) constitute the SCT. As opposed to the final exam, both A and B parts are evaluated in SCTs and contribute to the SCT score regardless of their value.

Writing the SCTs is not compulsory; SCTs cannot be made up for, even in the case of a justified absence. Missed SCTs contribute a score of 0 towards  $SCT_{ave}$ .

**5. Final Exam (written):**

**5.1. Parts of the Final Exam.** The exam is a written test of two parts (A and B).

**Part A** of the written test is a so-called minimum level test. It consists of a set of 10 true-or-false questions about basic cell biology knowledge (1 point each) and 5 questions asking for a brief description of basic terms (molecules, concepts). These terms are listed among the key-words published on the subject's website. The answers are scored on a 0-2 scale in increments of 0.5 points. The student has to score 16 or above out of the total 20 points in part A to pass. Below 16 points the grade of the exam is a fail (1) and part B is not marked (except C and last chance exams, see 5.5.). For writing Part A, 20 minutes are allocated. A successful passing of Part A (or exemption from writing Part A, see 5.4.2) is valid for B and C exams throughout the exam period, but not beyond.

**Part B** is a 90 minute complex written exam, including short essays (~20-25% of the total score), fill-in, short answer, multiple choice, relation analysis, sketch-recognition as well as simple choice and yes-or-no questions.

**5.2. Calculating the exam score.** As per 5.1., exam score is only calculated if Part A is passed.

1. % result of Part B expressed as points 100 points maximum

**If score on Part B is greater or equal to 50%, the following bonus points are added to the score of Part B:**

2. Bonuses for attendance of all seminars 3 points maximum

3. Presentation grade 5 points maximum

4. Average % result of SCTs ( $SCT_{ave}$ )

3 points for reaching 30%

and +1 point for each additional 10% reached 10 points maximum

Total: 118 points maximum

**N.B.** Bonuses are only valid in the semester they were obtained, except for the Lab bonus ( $QG_{ave}$ , see 6.).

### 5.3. Assigning grades to exam scores

Part A below 16 points: fail (1)

Exam score (see 5.2.):

below 60 points:	fail (1)
60-69 points:	pass (2)
70-79 points:	satisfactory (3)
80-89 points:	good (4)
reaching, and above 90 points:	excellent (5)

### 5.4. Exemptions

5.4.1. For those who achieve  $SCT_{ave} \geq 50\%$  at the self-control tests, a final grade offering score is calculated as follows:

1.  $SCT_{ave}$  % expressed as points 100 points maximum
2. Bonuses for attendance of all seminars 3 points maximum
3. Presentation grade 5 points maximum

Total: 108 points maximum

Grades are offered as listed under "5.3. Assigning grades to exam scores". (Part 'A' is considered to be passed in this case.)

5.4.2. Those who achieve  $SCT_{ave} \geq 66\%$  at the self-control tests and do not accept the offered grade calculated as under 5.4.1. and therefore take the final exam, are exempted from Part A of the written final exam during the given semester.

### 5.5. "C" chance and last chance exams

At "C" and last chance exams if the score on Part A is 16 or above, and the exam score is 60 or above, grades are assigned as usual (see 5.3.). However, if Part A is failed, Part B will nevertheless be marked. A failed written exam is followed by an oral exam and the final grade is determined from comprehensive evaluation of the written and oral parts.

## 6. Rules for repeating the course

**6.1. In a regular Cell Biology course** attending seminars and doing short presentations is evaluated as normally (see 2.). We encourage repeaters to write the SCTs since this is the only way to receive bonuses and exemptions based on  $SCT_{ave}$  scores.

**6.2. Repeaters can apply for a Cell Biology exam course** only if they have received a signature in the previous semester. The above items 1.-4. and 6.1. are irrelevant to the exam course and consequently no bonuses can be earned during the exam course. Otherwise the final exam proceeds as detailed under 5.

## CHAPTER 11

### REQUIRED ELECTIVE COURSES

#### Department of Biochemistry and Molecular Biology

Subject: **GENOMIC BIOINFORMATICS**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Lecture: **14**

Practical: **28**

#### **1st week:**

**Lecture:** Molecular databases, primary sequence databases (EMBL, GenBank. Analysis of scientific publications.

**Practical:** Introduction to UNIX. Downloading from databases, analysis with command line methods. Simple statistical analysis with UNIX commands.

#### **2nd week:**

**Lecture:** Similarity search methods. The BLAST program. Journal club. E

**Practical:** Usage of local command line BLAST programs. Database download, generating local BLAST databases. Different types of local BLAST searches, analysis of results.

#### **3rd week:**

**Lecture:** Theory and application of microarray technology. Journal club.

**Practical:** Downloading microarray data from the GEO and ArrayExpress databases. Analysis of raw microarray data with the Chipster program.

#### **4th week:**

**Lecture:** Alignment methods for short reads generated by next generation sequencing. De novo genome assembly, Velvet and SOAP methods. Journal Club.

**Practical:** Downloading next generation sequencing data from the SRA and ENA databases. Alignment to reference genome with BWA and Bowtie, using the supercomputer. De novo genome assembly with Velvet and SOAP methods using the supercomputer.

#### **5th week:**

**Lecture:** The ChIP-seq method. Journal Club.

**Practical:** Analysis of a ChIP-seq experiment on a local computer: from downloading the raw data to de novo motif finding

#### **6th week:**

**Lecture:** RNA-seq, TSS-seq and TSS-exon-seq methods. Journal club.

**Practical:** Downloading and analysis of RNA-seq and TSS-seq raw data on local computer.

#### **7th week:**

**Lecture:** The GWAS method. Understanding the causes of genetic disorders using SNP data.

**Practical:** Downloading and analysis of GWAS data

### Requirements

During this interactive course students will learn about genomics technologies through key publications. We will discuss the most important primary databases, the usage of BLAST and other similarity searching programs, the genome sequencing approaches and technologies, the microarray methods and the next generation sequencing applications. For the practicals students will have access to a local UNIX server, will download and analyze publicly available data with command line programming.

Lecture attendance and active participation in the practicals is required.

Subject: **MOLECULAR MECHANISM OF DISEASES CONCERNING GREAT POPULATIONS**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Lecture: **22**

**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 immunodefects

**6th week:**

**Lecture:** Cancer I.

**7th week:**

**Lecture:** Cancer II.

**8th week:**

**Lecture:** Cancer II.

**9th week:**

**Lecture:** Osteoporosis

**10th week:**

**Lecture:** Immunodeficiencies

### Requirements

**Course content:** topics presented at the lectures (available at the website of the Department of Biochemistry and Molecular Biology,) Follow the link: Educational materials- Elective courses

**Attendance:** Students are expected and required to attend all lectures of this course. No more than one unexcused absence is permitted. Students will fail the course on their second unexcused absence. Legitimate excuses should be presented in writing to the course administrator by the specified date.

**Grading policy:** The final grade will be based on the final oral exam at the end of the semester. Students have to select one topic from the full list of course topics for their oral exam, and can sign up for the topic at the link below. The final sign-up sheet will be posted on the department web-site at the beginning of the exam period. **It will be your responsibility to contact the lecturer for the assignment, and for the date of the oral examination.** The course lecturers will assign scientific

publications to the students based on the sign-up sheet. For the oral exam students are expected to prepare a short Powerpoint presentation (4-5 slides) based on the publication, and discuss the publication with the lecturer.

Please follow the **announcements** of the course administrator about exam dates or changes in the schedule on the bulletin board (LSB downstairs, 1 corridor), and on the department

Subject: **PROTEOMICS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

Practical: **28**

**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. Protein purification from bacteria. Data analysis and interpretation.

## Requirements

### Aims:

The course enlarges the knowledge of the students making them able to work on the specific field of proteomics. They will be able to understand proteomics data, to design proteomics experiments and by acquiring practical knowledge, the students will be able to work in proteomics labs, to carry out proteomics experiments, to do innovative proteomics research and to continue their studies at PhD level.

### Subject description:

During the course the students will get knowledge about the basics of proteomics, the gel- and mass spectrometry-based methods which make possible the identification and quantification of proteins and to detect the post-translational modifications. The practicals are in accordance with the lecture materials and the students can learn in practice the most important and critical steps of sample preparation and the major criteria of data analysis.

### Schedule of the lectures:

Introduction to proteomics – Why do we need proteomics? What kind of data proteomics can and cannot provide?

Basics of liquid chromatography

Basics of mass spectrometry

Protein identification using mass spectrometry. Peptide sequencing, data interpretation

Targeted proteomics (SRM/MRM, PRM), data dependent and data independent analysis (DDA, DIA)

Quantitative proteomics (iTRAQ, SILAC, label-free quantification, SRM, PRM)

Detection of post-translational modifications using mass spectrometry. Sample preparation strategies, specific enrichment

Two dimensional electrophoresis

Proteobioinformatics

Protein purification strategies

The study of protein-protein interactions

Biomarker identification and validation using mass spectrometry

Preparation and use of protein therapeutic agents. The role of mass spectrometry in quality control

Consultation

### Practice:

On three consecutive days at the end of the semester.

#### Day 1: 10 hours

4 hours: SDS-PAGE separation of protein mixtures. Gel staining with Coomassie dye.

1 hour: Scanning of Coomassie stained gels.

5 hours: Excising and destaining of gel bands, in-gel trypsin digestion.

#### Day 2: 10 hours

3 hours: Extracting the digested peptides from the gels.

6 hours: In-solution trypsin digestion of protein mixtures.

1 hour: Desalting of in-solution digested samples with C18 resin-containing tips

#### Day 3: 10 hours

3 hours: Mass spectrometry (demonstration).

Introduction to mass spectrometers located in the Proteomics Core Facility. Demonstration of sample injection techniques.

3 hours: Mass spectrometry data analysis. Analysis of MS/MS data with the MASCOT search engine. Analysis of MS/MS data with the ProteinPilot software (demonstration). Basics of mass spectrometry data interpretation.

4 hours: Basics of SRM assay design. SRM data analysis with the Skyline software.

Subject: **STRUCTURE AND FUNCTION OF MACROMOLECULES**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **14**

Practical: **30**

**1st week:**

**Lecture:**

1-2. Theoretical approaches in biochemistry. Principles of protein folding. Evolution of proteins.

**Practical:**

1. Introduction to the Pymol programme  
Installation of Pymol, reading a PDBfile, selection, representation, determination the chain orientation, representation of the surface residues.

**2nd week:**

**Lecture:**

3-4. Basis of protein structure and design. Properties of amino acids. Analysis and design of secondary structures.

**Practical:**

2. Visualisation of molecules  
Different representations, backbone display, determination of conformational parameters of the peptide chain. Analysis of helical structures, orientation of helix dipoles, interaction between helices.

**3rd week:**

**Lecture:**

4-5. Interactions between secondary structures. Generation of different domain types. Structure databases.

**Practical:**

3. Supersecondary structures  
Analysis of the Ramachandran map. Studying the ROP protein: orientation and interaction

between secondary structures, the roles of heteroatoms. Analysis of tropomyosin repeats, analysis of coiled coils. Interaction pattern, origin of stability.

**4th week:**

**Lecture:**

6-7. Experimental techniques of structure determination and analysis. Structure-function relationships.

**Practical:**

4. Tertiary structures of proteins. All alpha structures  
Searching for helical domains. The structure of myoglobin. Analysis of porphyrin structure. The structure of hemoglobin. Allosteric communication between the subunits. Potential pathways of oxygen binding. Comparative analysis of hemoglobin structures. Superposition of hemoglobin structures from different organisms.

**5th week:**

**Lecture:**

8-9. Prediction of tertiary protein structures. Homology modeling. Loop-design.

**Practical:**

5. Alpha/beta domain structures I  
The structure of the alpha-amylase. Analysis of helix and strand topology. Localization of the active site. Representation of the ligand, analysis of ligand binding. Searching for enzymes with similar structures. Evolutionary analysis of similar alpha/beta domain structures.

Superposition of other domains.

**6th week:**

**Lecture:**

10-11. Structure of nucleic acids. DNA-protein interactions. DNA recognition motifs and structural elements.

**Practical:**

6. Alpha/beta domain structures II  
The structure of flavodoxin. Secondary structure prediction for flavodoxin sequence and comparison with the observed structural elements. Analysis of beta strands in terms of localization, orientation and hydrogen bonding pattern. Studying the geometry of the connecting loop. Searching for similar structures, superposition.

**7th week:**

**Lecture:**

12-13. Enzymatic catalysis.

**Practical:**

7. All beta structures  
Hydrogen bonding pattern and characteristic residues in parallel and anti-parallel beta strands. Analysis of retinol binding protein. Analysis and categorization of beta turns. The greek key motif, studying the gamma-crystallin structure. Analysis of the beta strands in the ErbB receptor.

**8th week:**

**Lecture:**

14-15. Experiment design. Docking, amino acid replacements. Interpretation of experiments.

**Practical:**

8. Transmembrane proteins  
Analysis of the photosynthetic reaction center. Display of the different chains, selection of those, which are located in themembrane. Determination of the secondary structures, topology and membrane interactions. Determination of polar and apolar surfaces, and their positions wit respect to the membrane. Representation of chlorophyll molecules and their location with respect to secondary structures.

**9th week:**

**Practical:**

9. Analysis of transmembrane structures.

Prediction of G-protein coupled receptors.

Prediction of transmembrane protein segments based on secondary structure predictions and

analysis of hydrophobicity profiles. Analysis of pore forming proteins (Omp). Analysis of the inner and outer surface of the pore. Mutations affecting selectivity or stability. The strutcure of bacteriorhodopsin.

**10th week:**

**Practical:**

10. Pancrease lipase

Structural basis of the molecular mechanisms, which were introduced in biochemistry and molecular biology courses. Analysis of domain structure in free and ligand-bound forms.

Interactions of the ligand binding loop with the domain interfaces and its movement during enzymatic activity. Interactions of the colipase.

**11th week:**

**Practical:**

11. Specificity of enzymes

Comparative analysis of trypsin and chymotrypsin. Superposition of structures.

Analysis of active sites and substrate-binding pockets. Functional consequences of the different architectures. Specific and cross-docking of ligands. Active sites of aspartyl proteinases, potential catalytic mechanism.

**12th week:**

**Practical:**

12. DNA structures

A, B, Z DNA structures. Analysis of differences in the hydrogen bonding pattern and stacking interactions. Structural consequences of DNA lesions, analysis of a thymine dimer. The structure of the Holliday-junction and its biological role.

**13th week:**

**Practical:**

13. RNS structures.

Typical secondary structures in RNA.

Localization of Mg ions and their interactions with the different structural elements of RNA.

Analysis of t-RNA szerkezetének structure. The



structure of the ribozyme and basis of catalysis.

**14th week:**

**Practical:**

14. DNA - protein interactions.

Analysis of typical DNA recognition motifs:

helix-turn-helix, leucine zipper, Zn-finger, Ig-fold.

Distortion of DNA upon binding to TBP or CAP.  
DNA recognition by disordered proteins, the LEF-1 transcription factor.  
15. Consultation, discussion of homeworks.

**Requirements**

Goals: Design and interpretation of the biochemical and molecular biology experiments. Insights into the structure and function of proteins and nucleic acids, using physical principles.

Short description: Understanding and design of biomolecular structures. Experimental and computational methods for structure determination of biomolecules. Theoretical approaches to biochemical problems. Rational experimental design. Discussion of scientific papers, participation in scientific debates.

Literature:

Stryer: Biochemistry; A. Warshel: Computer modeling of chemical reactions in enzymes and solutions; A. Leach: Molecular modelling

Requirements of signature: Attendance of 80% of the lectures, 100% of practicals. Practical homeworks must be submitted and accepted.

Evaluation during the semester: Practical homeworks.

Evaluation at the end of the semester: oral exam

Subject: **THESIS I.**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **70**

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: **210**

## Department of Medical Chemistry

Subject: **ENZYMولوجY**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Lecture: **10**

Practical: **42**

**3rd week:**

**Lecture:** Enzymes, as biological catalysts. Michaelis-Menten kinetics.

**4th week:**

**Lecture:** Inhibition of enzyme activity. Competitive, noncompetitive, uncompetitive, and mixed types of inhibitors.

**Practical:** Enzymes of lipid and hydrogen peroxide degradation

**5th week:**

**Lecture:** Methods for the determination of enzyme activity. Environmental factors, stability and interfering substances affecting the enzyme assays.

**Practical:** Proteases

**6th week:**

**Lecture:** Enzyme regulation. Allosteric and covalent controls of enzyme activity. The kinetics of allosteric enzymes.

**Practical:** Transaminases

**7th week:**

**Lecture:** Supramolecular enzyme organization.

Multienzyme complexes and conjugates. Protein complexes, and compartmentalization.

**Practical:** Transglutaminases

**8th week:**

**Lecture:**  $\beta$ -galactosidase.

**9th week:**

**Practical:** Experiments with  $\beta$ -D-glucosidase

**10th week:**

**Lecture:** Mitochondrial metabolism

**Practical:** Glycogen phosphorylase

**11th week:**

**Lecture:** Glycogen phosphorylase

**12th week:**

**Lecture:** Phosphorylase kinase

**Practical:** Phosphorylase kinase

**14th week:**

**Practical:** Practical exam

### 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.

Subject: **POST-TRANSLATIONAL MODIFICATION OF PROTEINS**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Lecture: **28**

**1st week:**

**Lecture:**

Introduction to posttranslational modifications.

**2nd week:**

**Lecture:** Protein phosphorylation.

Serine/threonine-specific protein kinases.

**3rd week:**

**Lecture:** Dephosphorylation of proteins.

Serine/threonine protein phosphatases.

**4th week:**

**Lecture:** Protein phosphorylation on tyrosine side chains: tyrosine kinases and phosphatases.

**5th week:**

**Lecture:** Proteolysis: types and catalytic mechanisms of proteolytic enzymes.

**6th week:**

**Lecture:** Role of proteinases in the regulation of cellular functions. Ubiquitination of proteins.

**7th week:**

**Lecture:** Modification of proteins on cysteine residues.

**8th week:**

**Lecture:** Lipid modifications of proteins. Protein hydroxylation.

**9th week:**

**Lecture:** Glycosylation of proteins.

**10th week:**

**Lecture:** Acetylation and methylation of proteins. Epigenetics and histone modifications.

**11th week:**

**Lecture:** Protein mono-ADP-ribosylation.

**12th week:**

**Lecture:** ROS/RNS-induced posttranslational modifications: focus on poly-ADP-ribosylation.

**13th week:**

**Lecture:** Protein carboxylation and amidation. Transglutaminases.

**14th week:**

**Lecture:** Review of posttranslational modifications.

### Requirements

The aim of this course is to provide students with specific professional knowledge and understanding the aspects of postsynthetic protein modifications. The program consists of lectures. Attendance at the lectures is highly recommended. The End of Semester Examination is a written test containing two questions. The questions include the topics of all of the lectures. The knowledge of both questions at least at the basic level is required for the passing grade.

Materials are published on the web page.

## CHAPTER 11

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Subject: **SIGNALLING PATHWAYS IN THE CELLS**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Lecture: **28**

**1st week:**

**Lecture:** Introduction.

**2nd week:**

**Lecture:** Overview of cell signalling mechanisms.

**3rd week:**

**Lecture:** Cell signalling pathways.

**4th week:**

**Lecture:** Ion channels.

**5th week:**

**Lecture:** Sensors and effectors.

**6th week:**

**Lecture:** Off mechanisms

**7th week:**

**Lecture:** Spatial and temporal aspects of signalling

**8th week:**

**Lecture:** Cellular processes

**9th week:**

**Lecture:** Development

**10th week:**

**Lecture:** Cell cycle and proliferation

**11th week:**

**Lecture:** Cell stress, inflammatory responses and cell death

**12th week:**

**Lecture:** Neuronal signalling

**13th week:**

**Lecture:** Signalling defects and diseases

**14th week:**

**Lecture:** Students' presentations: novel mechanisms in signaling

### Requirements

The program consists of lectures. Attendance of the lectures is required and recorded. Evaluation of the student's performance at the end of semester examination includes the quality of student's presentation and the score of a written examination in which questions cover all topics. Improvement of the examination mark is possible by oral examination.

## Division of Cell Biology

Subject: **CELL BIOLOGY PRACTICALS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **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](http://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 microscope, 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.

**Attendance**

Maximum one practice can be missed, and it must be made up for in the last week. Only medical or official excuses are accepted, after showing the appropriate documents. After completing the lab, the lab tutor should sign on the cover of the log book, certifying your presence at the lab and sign separately for the acceptance of your work. You are eligible for this second signature only if you know what and why you did during the lab and what the result was. You should obtain these two signatures and the grade at the end of the lab and no later.

**Conditions for signing the lecture book:**

Presence at, and acceptance of all the labs.

**Final grade:**

At the end of the semester, the grades for your logs and your attitude during labs will be summed up

## CHAPTER 11

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as a Practical Grade (PG) on a scale of 1-5.

### 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.

## CHAPTER 12

### TITLES OF THESES

#### **Department of Anatomy, Histology and Embryology**

1. Title: Expression of extracellular matrix molecules in the olfactory system of the rat
2. Title: The role of the extracellular matrix in the regeneration of the nervous system.  
Tutor: Klára Matesz M.D., Ph.D., D.Sc.
3. Title: Possible applications of morphofunctional matrices for classification of neurons (computer modelling)  
Tutor: Ervin Wolf M.Sc., Ph.D.
4. Title: Investigation of contour integration processing in the primary visual cortex using voltage sensitive dye imaging
5. Title: Three-dimensional reconstruction of thalamocortical axons in the primary somatosensory cortex of rats  
Tutor: Zoltán Kisvárdy M.Sc., Ph.D., D.Sc.
6. Title: Investigation of signalling mechanisms that regulate cartilage development and maturation  
Tutor: Róza Zákány M.D., Ph.D.
7. Title: Interrogation of spinal dorsal horn circuits with electrophysiological and optogenetic tools
8. Title: Light- and electron microscopy level analysis of the axons and axon collaterals of spinal lamina I projection neurons
9. Title: Local synaptic connections of projection neurons in spinal lamina I
10. Title: Morphometric analysis of excitatory and inhibitory interneurons in the spinal dorsal horn  
Tutor: Péter Szücs M.D., Ph.D.
11. Title: Extracellular matrix in the developing brainstem  
Tutor: Ildikó Wéber M.Sc., Ph.D.
12. Title: Extracellular matrix molecules in the motor nuclei of the eye in the mouse
13. Title: Regeneration of the optic nerve in the

frog

14. Title: Regeneration of the vestibular system in the rat

Tutor: Botond Gaál M.Sc., Ph.D.

15. Title: Investigation of neuronal network development in the spinal cord

Tutor: Zoltán Mészár M.Sc., Ph.D.

16. Title: The role of the molecular clock in healthy and osteoarthritic chondrocytes

Tutor: Csaba Matta M.Sc., Ph.D.

17. Title: Role of PACAP signalling in cartilage differentiation and regeneration

Tutor: Tamás Juhász M.Sc., Ph.D.

18. Title: Distribution of the extracellular matrix in the red nucleus and parabrachial area

Tutor: Éva Rácz M.Sc., Ph.D.

19. Title: The endocannabinoid-mediated modulation of spinal nociception

20. Title: The role of astrocytes in spinal pain processing

Tutor: Zoltán Hegyi M.Sc., Ph.D.

21. Title: Quantitative morphological studies of primary afferent-motoneuron connections in the frog's brainstem

Tutor: András Birinyi M.Sc., Ph.D.

22. Title: Role of pro-inflammatory cytokines in neuron-glia interaction during inflammatory pain states

Tutor: Krisztina Holló M.Sc., Ph.D.

23. Title: Mapping of synapses on dendrites of GABAergic neuron subtypes in the cerebral cortex

Tutor: Petra Talapka Ph.D.

#### **Department of Biochemistry and Molecular Biology**

1. Title: Involvement of phagocytosis of apoptotic cells in the muscle regeneration

following injury

2. Title: Involvement of the impaired clearance of apoptotic cells in the control of insulin sensitivity

3. Title: Molecular mechanisms participating in the engulfment of apoptotic cells

4. Title: Signaling pathways mediating the effect of adenosine in the macrophage chemotaxis  
Tutor: Zsuzsa Szondy M.D., Ph.D., D.Sc.

5. Title: Dissecting and aligning the regulatory and effector mechanisms shaping murine M2 macrophages

6. Title: Dissecting the transcriptional network allowing macrophages to control angiogenesis

7. Title: The role of the transcription factor BACH1 in macrophage function and tissue homeostasis

Tutor: László Nagy M.D., Ph.D., M.H.A.Sc.

8. Title: The role of retroviral proteases in the retroviral life cycle.

Tutor: József Tózsér M.Sc., Ph.D., D.Sc.

9. Title: The role of tissue transglutaminase in rolling and adhesion of neutrophil granulocytes

Tutor: Zoltán Balajthy M.Sc., Ph.D.

10. Title: Saliva biomarkers of oral cancer.

Tutor: Beáta Scholtz M.Sc., Ph.D.

11. Title: Production of dendritic cells and macrophages from embryonic stem cells.

12. Title: Transcriptional reprogramming of murine embryonic stem cell progenitors.

Tutor: István Szatmári M.Sc., Ph.D.

13. Title: Studies in the regulation of tissue specific and cancer specific gene expression by using genomic and bioinformatic tools

Tutor: László Bálint Bálint M.D., Ph.D.

14. Title: Effects of various coeliac autoantibodies on transglutaminase 2 activities and interactome.

15. Title: Modification of the enzymatic activity of transglutaminase 2 by site-directed mutagenesis. Therapeutic utilization of modified transglutaminase 2.

16. Title: Studying structure and function relationship of transglutaminases and its application in translational medicine

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: Evaluation of the browning potential and inducibility from human fat tissue biopsies

Tutor: Mária Szatmári-Tóth M.Sc., Ph.D.

19. Title: Identification of regulatory SNPs in promoter regions of different species by bioinformatic analyses.

Tutor: Endre Barta M.Sc., Ph.D.

20. Title: The role of aim2 protein and native immune response in inhibiting cell proliferation

Tutor: Máté Demény M.D., Ph.D.

21. Title: Alterations in structural properties of the transcription machinery in relation to disease development

22. Title: Drug discovery for protein interactions

23. Title: Functional aggregation in innate immunity

24. Title: Molecular factors in cell differentiation

25. Title: New comparative methods of protein evolution and sequence analysis

26. Title: Regulation of protein half-life via protein interactions

27. Title: Studying the re-programming mechanisms of viral proteins.

28. Title: The role of signaling pathway perturbations in cancer development

Tutor: Mónika Fuxreiter M.Sc., Ph.D., D.Sc.

29. Title: Characterization of adipocytes with thermogenic potential

30. Title: In vitro study about the effect of environmental conditions (e.g.: temperature, oxygen availability) on the differentiation potential and beiging process of primary adipocytes

31. Title: Investigation of the beiging plasticity of adipocytes, identification of key extrinsic and intrinsic factors



Tutor: Beáta Bartáné Tóth M.Sc., Ph.D.

32. Title: Investigation of novel molecular elements of the browning machinery in different human adipose tissues

33. Title: Investigation of the biological significance of “batokine” secretion in human cell models

Tutor: Endre Károly Kristóf M.D.

34. Title: Characterization of genetic risk factors of chronic pancreatitis

Tutor: András Szabó M.Sc., Ph.D.

### **Department of Biophysics and Cell Biology**

1. Title: Investigation of cell surface distribution of erbB-2 oncoprotein in breast tumor cell lines.

2. Title: Role of tumor stem cells in trastuzumab resistant breast tumors

Tutor: János Szöllősi M.Sc., Ph.D., D.Sc., M.H.A.Sc.

3. Title: Studying the inactivation of voltage gated potassium ion channels in heterologous expression systems.

Tutor: György Panyi M.D., Ph.D., D.Sc.

4. Title: Epigenetic regulation of nucleosome-DNA cohesion

5. Title: Interactions between ABC transporters and their membrane environment

Tutor: Gábor Szabó M.D., Ph.D., D.Sc.

6. Title: Mathematical analysis and computer modelling of the topology of cell surface proteins.

7. Title: Role of MHC in the organization of cell surface proteins

Tutor: László Mátyus M.D., Ph.D., D.Sc.

8. Title: Examination of the channel function properties of the P170 multidrug pump by patch-clamp.

Tutor: Zoltán Krasznai M.Sc., Ph.D.

9. Title: Cytometry of cytotoxic lymphocytes

10. Title: Physiological roles of the multidrug resistance transporter P-glycoprotein.

Tutor: Zsolt Bacsó M.D., Ph.D.

11. Title: Elucidation of the catalytic mechanism of ABC transporters

Tutor: Katalin Goda M.Sc., Ph.D.

12. Title: Biophysical analysis and functional significance of cell surface protein patterns in T cell-mediated immune responses

Tutor: Andrea Dóczy-Bodnár M.Sc., Ph.D.

13. Title: Studying nuclear receptor function by modern microscopy techniques

Tutor: György Vámosi M.Sc., Ph.D.

14. Title: Quantitative investigation of the associations of ErbB proteins using biophysical and molecular biological methods

15. Title: The correlation between the metastatic potential and chemoresistance of breast tumors with the expression level and association state of ErbB proteins

Tutor: Péter Nagy M.D., Ph.D.

16. Title: Molecular characterization of multicomponent primary human cell cultures produced for regenerating stem cell deficient corneas.

17. Title: Molecular interactions in histopathological diagnosis: development of a FRET application for a confocal fluorescence digital slide scanner.

18. Title: Molecular mechanisms of anticancer immune therapy.

19. Title: Optimizing efficacy and in vivo persistence of reprogrammed (chimeric antigen receptor-transduced) human T cells.

20. Title: Role of molecular interactions between receptor tyrosine kinases and integrins in the therapy resistance of tumors.

Tutor: György Vereb M.D., Ph.D., D.Sc.

21. Title: Comparative study on Kv1.3 channels conjugated with fluorescent proteins

Tutor: Péter Hajdu M.Sc., Ph.D.

### **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., D.Sc.

4. Title: Role of glycoproteins in infection and immunology (bibliographic)

Tutor: János Kerékgyártó M.Sc., Ph.D., C.Sc.

### **Division of Nuclear Medicine and Translational Imaging**

1. Title: Development of interactive E-learning material for nuclear medicine

Tutor: József Varga M.Sc., Ph.D.

2. Title: Assessment of Diabetic Foot with Different Nuclear Medicine procedures

Tutor: Ildikó Garai M.D., Ph.D.

### **Division of Radiology and Imaging Science**

1. Title: Analysis of Pediatric Radiology Examinations

Tutor: Nóra Vrancsik M.D.

### **Department of Medical Imaging**

1. Title: Posttherapeutic I-131 whole body SPECT/CT in patients with thyroid cancer

2. Title: The role of Tc99m-Tektrotyd SPECT/CT to evaluate metastatic

neuroendocrine tumors

Tutor: Ildikó Garai M.D., Ph.D.

3. Title: Localisation of anatomical regions of CT scans with machine learning methods

Tutor: Zoltán Barta M.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<sup>++</sup>-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 Streptomyces.

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 Immunology**

1. Title: Phenotypic and functional properties of dendritic cells

Tutor: Éva Rajnavölgyi M.Sc., Ph.D., D.Sc.

2. Title: The role of the HOFI/SH3PXD2B adaptor protein in the regulation of the tumor microenvironment

Tutor: Árpád Lányi M.Sc., Ph.D.

3. Title: The role of innate immune cells in the development of allergic responses

4. Title: The role of innate lymphoid cells (ILC) in human diseases

Tutor: Attila Bácsi M.Sc., Ph.D.

5. Title: Altered differentiation of monocyte derived dendritic cells and their functional differences

Tutor: Péter Gogolák M.Sc., Ph.D.

6. Title: Investigation of phytocannabinoid effects on human monocyte-derived dendritic cells

7. Title: Investigation of transient receptor potential channels on human monocyte-derived dendritic cells

Tutor: Attila Szöllösi M.D., Ph.D.

8. Title: Identification of new viral sensors and new regulatory mechanisms in the antiviral responses of human dendritic cells

9. Title: Role of dendritic cells in the development of autoimmune diseases

Tutor: Kitti Pázmándi M.Sc., Ph.D.

10. 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: Regulation of macrophage activation

Tutor: László Virág M.D., Ph.D., D.Sc.

4. Title: Signal transduction pathways in pulmonary endothelial cells

Tutor: Csilla Csontos M.Sc., Ph.D., D.Sc.

5. Title: Structural and functional investigation of a fungus specific protein phosphatase

Tutor: Ilona Farkas M.Sc., Ph.D.

6. Title: Study of metabolic processes with special regard to the involvement of mitochondrial activity.

Tutor: Péter Bay M.Sc., Ph.D., D.Sc.

7. Title: Application of High-Content Screening in Life Sciences

Tutor: Endre Kókai M.Sc., Ph.D.

8. Title: Signalling pathways in endome

9. Title: Study of the role of protein phosphatase in wound healing

Tutor: Beáta Lontay M.Sc., Ph.D.

10. Title: Inhibition of sodium-glucose cotransporter of kidney by glucose-based compounds also interfering with glycogenolysis

Tutor: Tibor Docsa M.Sc., Ph.D.

11. Title: Regulation of protein phosphatase-1 by inhibitory proteins and the translocation of the targeting subunit

Tutor: Andrea Kiss M.Sc., Ph.D.

12. Title: High-Throughput Screening

Tutor: Csaba Hegedűs M.Sc., Ph.D.

13. Title: Autophagy in physiological and pathological processes

Tutor: Katalin Kovács M.Sc., Ph.D.

14. Title: Study of protein-protein interaction in the neurodegenerative Huntington's disease.

Tutor: Krisztina Tar M.Sc., Ph.D.

### **Department of Medical Microbiology**

1. Title: Antimicrobial cell-mediated immunity measured by mRNA tests

Tutor: József Kónya D.Sc.

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: Prevalance 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. habil.

4. Title: Lipid abnormalities in hypothyroidism.

5. Title: The function of LDL in lipid metabolism

Tutor: György Paragh M.D., Ph.D., D.Sc.

6. Title: Diagnostic tests and imaging techniques in endocrinology.

Tutor: Endre Nagy M.D., Ph.D., D.Sc.

7. Title: Adipokines and Insulin Resistance

8. Title: Insulin resistance and non-alcoholic fatty liver disease

9. Title: Obesity: Diagnosis and Treatment

10. Title: Obesity: Etiology and Co-morbidities

Tutor: Péter Fülöp M.D., Ph.D. habil.

11. Title: Diabetic neuropathy and oxidative stress

Tutor: Ferenc Sztanek M.D., Ph.D.

12. Title: Characteristics of rare systemic vasculitides

13. Title: Sjögren's syndrome associated with other autoimmune disease  
Tutor: Margit Zeher M.D., Ph.D., D.Sc.
14. Title: Basics of pharmacotherapy in the elderly  
Tutor: Gyula Bakó M.D., Ph.D., D.Sc.
15. Title: Immunoregulatory abnormality in undifferentiated connective tissue disease
16. Title: Interstitial lung diseases in MCTD.
17. Title: The presence of antiphospholipid antibodies in the disease course of the MCTD
18. Title: Vascular involvement in mixed connective tissue disease.
19. Title: Vascular risk factors in undifferentiated connective tissue disease  
Tutor: Edit Bodolay M.D., Ph.D., D.Sc.
20. Title: Dermato/polymyositis overlap with antiphospholipid syndrome.
21. Title: Genetical study in myositis
22. Title: Improvement of quality of life in polymyositis and dermatomyositis patients by physiotherapy  
Tutor: Katalin Dankó M.D., Ph.D., D.Sc.
23. Title: Familial antiphospholipid syndrome  
Tutor: Pál Soltész M.D., Ph.D., D.Sc.
24. Title: Autoimmune disorders and GI tract  
Tutor: Zsolt Barta M.D., Ph.D.
25. Title: Ischemic colitis.
26. Title: Life quality of Raynaud syndrome  
Tutor: Zoltán Csiki M.D., Ph.D.
27. Title: The disease course after stent implantation in peripheral arterial disease  
Tutor: György Kerekes M.D., Ph.D.
28. Title: Novel therapeutical approaches in multiple myeloma
29. Title: The impact of multi-drug resistance genes in the prognosis of lymphoproliferative disorders  
Tutor: László Váróczy M.D., Ph.D. habil.
30. Title: Inherited and acquired thrombophilia
31. Title: New direct oral anticoagulants
32. Title: Stem cell therapy in peripheral arterial disorders  
Tutor: Zoltán Boda M.D., Ph.D., D.Sc.
33. Title: Gastric cancer: clinics and treatment
34. Title: Gastrointestinal bleeding
35. Title: Gluten sensitive enteropathy
36. Title: Inflammatory bowel diseases.
37. Title: Lymphomas in the gastrointestinal tract.  
Tutor: István Altorjay M.D., Ph.D., D.Sc.
38. Title: Langerhans histiocytosis
39. Title: Osteosclerotic myeloma
40. Title: Therapeutic challenges in rare haemostatic disorders  
Tutor: György Pfliegler M.D., Ph.D. habil.
41. Title: Epidemiology, diagnostics and therapy of chronic hepatitis C
42. Title: Pathomechanism of alcoholic hepatitis
43. Title: Signs, diagnostics and treatment of portal hypertension.
44. Title: Therapeutic options in primary sclerosing cholangitis
45. Title: Treatment of autoimmune hepatitis  
Tutor: István Tornai M.D., Ph.D. habil.
46. 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.Sc., Ph.D. habil.
47. Title: Chronic neutrophilic leukaemia  
Tutor: Béla Telek M.D., Ph.D.
48. Title: Biological treatment of ulcerative colitis
49. Title: Extraintestinal association in IBD  
Tutor: Károly Palatka M.D., Ph.D. habil.
50. Title: The role of Willebrand factor in various internal diseases.  
Tutor: Ágota Schlammadinger M.D., Ph.D.
51. Title: Bacterial infection in liver cirrhosis
52. Title: Clinical significance of chronic pancreatitis

53. Title: Current therapeutic options of acute pancreatitis

Tutor: Zsuzsa Vitális M.D., Ph.D.

54. Title: Diagnosis and treatment of chronic lymphocytic leukemia

55. Title: Novel therapeutic approaches in the treatment of multiple myeloma

56. Title: Philadelphia negative chronic myeloproliferative neoplasms - novel genetic and therapeutic improvements

57. Title: Recent advances in the management of chronic ITP

Tutor: Péter Batár M.D., Ph.D.

58. Title: Are the bacterial infections predictable in liver cirrhosis?

59. Title: Role of serological markers in prediction of disease course and response to therapy in inflammatory bowel diseases.

Tutor: Mária Papp M.D., M.Sc., Ph.D. habil.

60. Title: Gastroesophageal reflux disease

Tutor: László Dávida M.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: Anxiety in the dental chair: pharmacological treatment

4. Title: Arrhythmic patient in dentistry

5. Title: Optional title in pharmacology

6. Title: Parkinson patient in the dental chair

7. Title: Pharmacological and clinical significance of adenosine receptor antagonists

8. Title: Pharmacological and non-pharmacological treatment of endothelial dysfunction

9. Title: Pharmacology of antidepressive drugs: dental implications

10. Title: Pharmacotherapy of trigeminal neuralgia

Tutor: József Szentmiklósi M.D., Ph.D.

11. Title: Emerging roles of prostaglandin DP1

and DP2 receptors in acute and chronic aspects of allergic diseases

12. Title: Optional title in pharmacology

13. Title: Pharmacological treatment of acute decompensated heart failure (ADHF)

14. Title: Pharmacology of herbal remedies

15. Title: Pharmacology of neurogenic inflammation

16. Title: Pharmacotherapy of Amyotrophic Lateral Sclerosis (ALS)

17. Title: Pharmacotherapy of Duchenne Muscular Dystrophy (DMD)

18. Title: Possible pharmacological exploitations of TRPV1 receptors

19. Title: Use of Histone deacetylase inhibitors (HDI): Novel advances in cancer treatment

Tutor: Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.

20. Title: Effect of colony stimulating factors or other drugs on bone marrow-derived cell lines

21. Title: How insulin resistance influences drug effects

22. Title: Selected topic in field experimental hemato-oncology

Tutor: Ilona Benkő M.D., Ph.D.

23. Title: Connections between rheumatoid arthritis and periodontal disease with a focus on pharmacotherapy

24. Title: Optional title on cancer chemotherapy

Tutor: Attila Megyeri M.D., Ph.D.

25. Title: Class I antiarrhythmic agents: dental implications

26. Title: Optional title in pharmacology

27. Title: Pharmacotherapy of bronchial asthma: dental implications

28. Title: Reflux disease and the dental patient

Tutor: Ágnes Cseppentő M.D.

29. Title: Optional title on antibacterial chemotherapy

Tutor: Zsuzsanna Gál M.Sc., Ph.D.

30. Title: Optional title in pharmacology

Tutor: Béla Juhász D.Pharm., Dr. habil., Ph.D.

31. Title: Optional title in pharmacology  
Tutor: Balázs Varga D.Pharm., Ph.D.

32. Title: Optional title in pharmacology  
Tutor: Mariann Bombicz D.Pharm.

33. 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 Szücs 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 Szentandrassy 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

**BMC****Introduction to Biophysics I.:**

Serway/Vuille: College Physics.  
10th edition. Cengage Learning, 2014. ISBN:  
978-1285737027.  
Gáspár R.: Physics for BMC students.  
University of Debrecen.

**Introduction to Medical Chemistry I.:**

McMurry, J., Fay, R.C.: Chemistry.  
7th edition. Pearson Education, 2015. ISBN:  
978-0321943170.

**Introduction to Medical Chemistry II.:**

McMurry, J., Fay, R.C.: Chemistry.  
7th edition. Pearson Education, 2015. ISBN:  
978-0321943170.  
F., Erdődi, Cs., Csontos: Organic Chemistry for  
Premedical Students.  
University of Debrecen, 2011.

**Hungarian Language for BMC students:**

Gerő Ildikó-Kovács Judit: Színesen magyarul.  
2017.

**Introduction to Biology I.:**

Sadava, Hillis, Heller, Berenbaum: Life: The  
Science of Biology.  
10th edition. Sinauer Macmillan, 2013. ISBN:  
978-1-4641-4124-9.

**Introduction to Biophysics II.:**

Serway/Vuille: College Physics.  
10th edition. Cengage Learning, 2014. ISBN:  
978-1285737027.  
Gáspár R.: Physics for BMC students.  
University of Debrecen.

**Introduction to Biology II.:**

Sadava, Hillis, Heller, Berenbaum: Life: The  
Science of Biology.  
10th edition. Sinauer Macmillan, 2013. ISBN:  
978-1-4641-4124-9.

**English for BMC students:**

Clive Oxenden-Christina Latham-Koenig. Paul  
Seligson: English File 3E Pre-Intermediate  
Student's Book With Itutor.  
3.. Oxford University Press, 2013. ISBN:  
9780194598651.  
Clive Oxenden-Christina Latham-Koenig. Paul  
Seligson: English File 3E Pre-Intermediate  
Student's Book With Itutor.  
3.. Oxford University Press, 2013. ISBN:  
9780194598651.

**SBMC****Introduction to Biophysics:**

Serway/Vuille: College Physics.  
10th edition. Cengage Learning, 2014. ISBN:  
978-1285737027.

**Introduction to Medical Chemistry:**

McMurry, J., Fay, R.C.: Chemistry.  
7th edition. Pearson Education, 2015. ISBN:  
978-0321943170.  
F., Erdődi, Cs., Csontos: Organic Chemistry for  
Premedical Students.  
University of Debrecen, 2011.

**Introduction to Biology:**

Sadava, Hillis, Heller, Berenbaum: Life: The  
Science of Biology.  
10th edition. Sinauer Macmillan, 2013. ISBN:  
978-1-4641-4124-9.

**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.  
Robert L. Nussbaum, Roderick R. McInnes,  
Huntington F. Willard, Ada Hamosh: Thompson  
and Thompson Genetics in Medicine.  
8th edition. Saunders Elsevier, 2016. ISBN: 978-  
1-4377-0696-3.  
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.

**Radioisotope Techniques In  
Biomedicine Practical:**

J. Magill, J. Galy: Radioactivity Radionuclides  
Radiation.  
Springer, 2005.

**Radioisotope Techniques in  
Biomedicine:**

J. Magill, J. Galy: Radioactivity Radionuclides  
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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.  
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Physiology Practice. Exercise Book.  
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**Physiology of Prokaryotes and  
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.

### **Human Physiology II.:**

A. Fonyó: Principles of Medical Physiology.  
Medicina Publishing House, Hungary, 2002.  
ISBN: 963-242-726-2.  
Physiology Practice. A Laboratory Guide.  
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Physiology Practice. Exercise Book.  
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### **Human Physiology Practicals:**

A. Fonyó: Principles of Medical Physiology.  
Medicina Publishing House, Hungary, 2002.  
ISBN: 963-242-726-2.  
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Physiology Practice. A Laboratory Guide.  
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### **Methods in Molecular Biology Practicals:**

J. Sambrook, E. F. Fritsch, T. Maniatis:  
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### **Cell Biology Practicals:**

Cell Biology Laboratory Manual.  
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Alberts et al.: Molecular Biology of the Cell.  
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### **2nd year**

#### **Bioinorganic Chemistry:**

Gergely, P.: Introduction to Bioinorganic  
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Medical and Health Science Center, University

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### **Impaired Signal Transduction in the Immune System:**

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### **Enzymology:**

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### **Post-translational Modification of Proteins:**

Christopher T. Walsh: Posttranslational  
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ISBN 0-9747077-3-2.  
J. Aradi, P. Bagossi, Z. Balajthy, M. Balázs, C.  
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**Basis of Conventional and Biological Immunotherapies:**

Abbas, A. K., Lichtman, A. H., Pillai, S.: Basic Immunology.

4th Edition. Saunders, 2012. ISBN: 1-4557-0707-4.

Peter Parham: The Immune System.

3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.

Fred S. Rosen: Case Studies in immunology. 3rd edition. 2001.

**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.

**New System Biology Paradigms in Immunology:**

Peter Parham: The Immune System.

3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.