Module Handbook

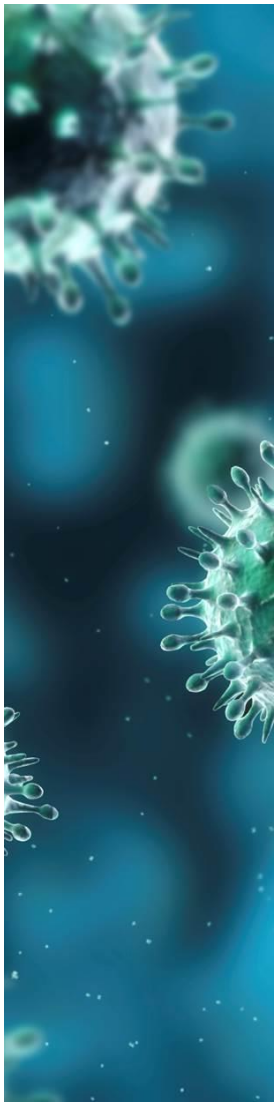
International Master of Science

Biomedical Sciences (IMBS)

Faculty of Medicine

Albert Ludwigs University of Freiburg

UNI FREIBURG



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In cooperation with
University of Buenos Aires, Argentina
Faculty of Medicine and Faculty of Pharmacy and Biochemistry

and
Hochschule Furtwangen University (HFU)
Thales-Akademie Freiburg

July 2018

UNIVERSITÄTS KLINIKUM FREIBURG

1. Program

1.1 Purpose and characteristics of the IMBS

The International Master of Science Biomedical Sciences (IMBS) is a joint program between the Faculty of Medicine of the Albert Ludwigs University of Freiburg (ALU) and the Faculty of Medicine and the Faculty of Pharmacy and Biochemistry of the University of Buenos Aires (UBA), Argentina. The program was implemented in a specific agreement co-signed by the Rectors of both Universities in 2008. The cooperation was strengthened by the UBA visit of the Minister President of Baden-Württemberg Winfried Kretschmann in 2011 when another agreement was signed. The IMBS course program with its final Master in Biomedical Sciences at UBA was accredited by the National Commission for University Evaluation and Accreditation (CONEAU), Argentina, with the best possible rating A in 2014 and was successfully reaccredited in 2018

The aim of the IMBS program is to provide scientific knowledge and state-of-the-art experimental experience to current and emerging biomedical research areas with a focus on translational research and development. It is also meant to foster teaching and research cooperation between the two Universities and to contribute to cultural exchange on the master student, PhD and professor level. The particularity of the program is therefore its **international, interdisciplinary and intercultural nature**.

The program is designed as an intensive time of studies and research with a specific and practical training that qualifies for success in academia or the private sector. IMBS modules treat the following topics: Biophysics: Bioenergetics and Biological Oxidation, Virology, Cellular and Molecular Immunology, Microbiology, Physiology, Pharmacology I, Toxicology I, Pathology, Biochemistry and Molecular Biology, Neurobiology, Molecular Oncology I, Clinical Medicine (at UBA) and Molecular and Cellular Biology, Pharmacology and Toxicology II, Molecular Cardiology, Molecular Oncology II, Genetics of Diseases and Cancer, Materials and Microsystems, Biostatistics and Bioethics (at ALU). In addition, at ALU participants can choose up to five personal lab research projects (lab rotations) of a total duration of 5 months. Each research project is individually supervised and has to last at least 1 month. It involves experimental work, data analysis and a written lab report in the format of a scientific research publication for each lab research project. The program is tailored to the interests of international graduate students with professional experience. Applicants should hold at least a Bachelor's degree or equivalent degree in Biology, Biochemistry, Medicine, Chemistry, or related fields[1] and have at least one year of working experience.

Since 2008 **over 75 students have completed the innovative IMBS program with good to excellent grades**. 75% of them continued their training with a PhD thesis in Germany, Argentina or elsewhere, 25% got a job in university or industry.

[1] Master, Diploma or other foreign degrees

Expected learning outcomes of the IMBS program

Knowledge

After successful completion of the program, the participants:

- Understand how relevant methods can be applied to address particular research questions in the area of Biomedicine
- Have sufficient knowledge in human pathology, physiology, pharmacology and toxicology and specific research areas like cardiology, oncology and immunology to direct translational, clinical human research
- Have a profound understanding in Bioethics to assess contemporary and future ethical issues in a responsible way
- Know the right statistical tools to apply to future experimental studies in Biomedicine and translational human research
- Know how to design and implement interdisciplinary research projects
- Can correspond and work with scientists from different cultures and scientific backgrounds

Cognitive skills

After successful completion of the program, the participants will be able to:

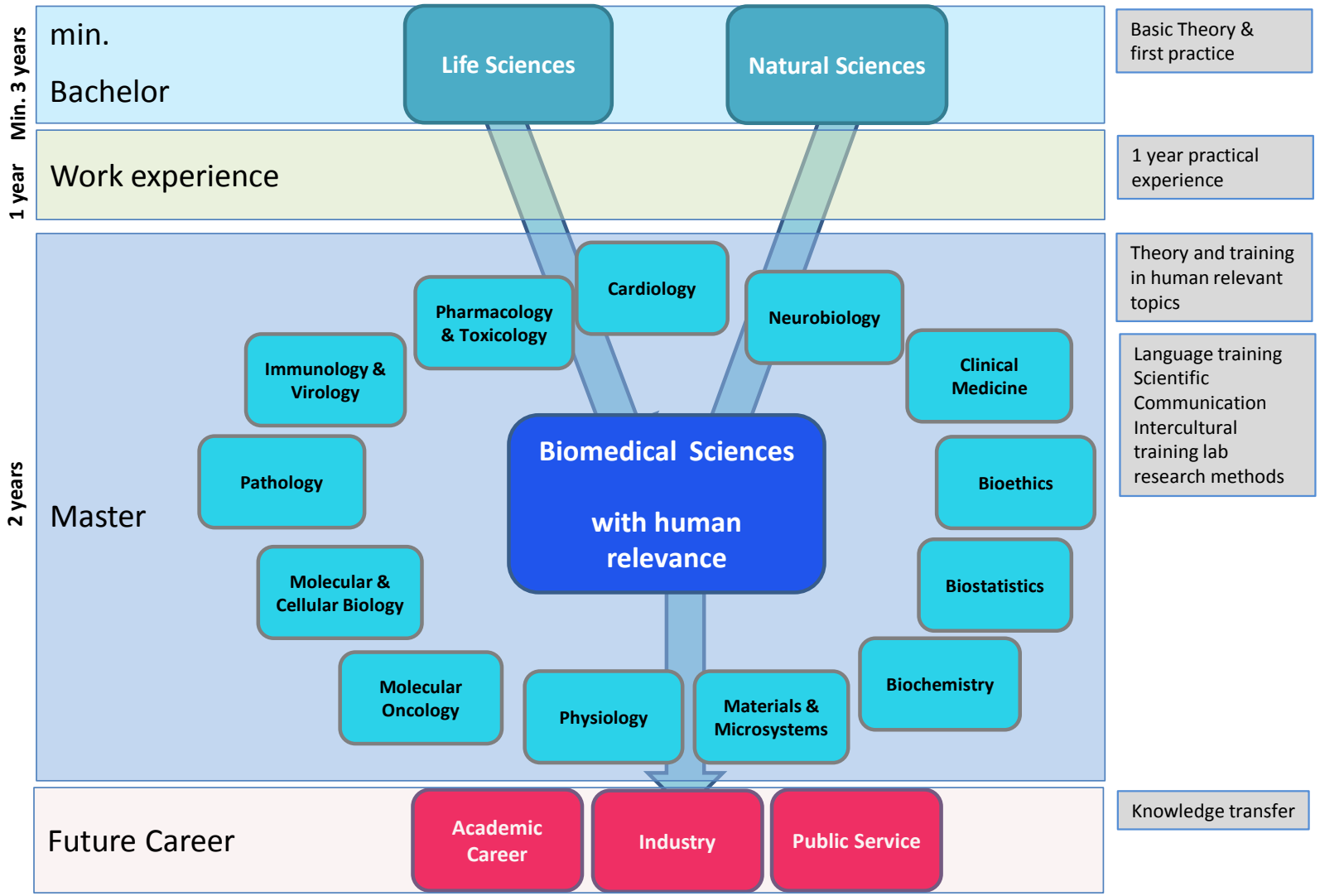
- Analyse, synthesize and evaluate information from a variety of sources in a critical manner
- Apply knowledge in a variety of contexts to analyse and reach evidence-based conclusions on complex human research problems and opportunities in the field of Biomedicine and translational research
- Put into practice the principles and values of ethical practice with regard to the design and implementation of operational research studies, consent and confidentiality in the collection, analysis, presentation, publication and dissemination of data
- Demonstrate creativity, innovation, inspiration and originality in the application of knowledge

Practical skills

After successful completion of the program, the participants will be able to:

- Formulate research questions, develop an appropriate research strategy and implement a systematic approach to biomedical project planning and quality management
- Undertake research studies in an ethical and responsible manner and accurately record the data collected
- Efficiently and effectively collect, analyse, manage and disseminate data collected in the field
- Inform policy-makers about short-, medium- and long-term policy options for biomedical and translational research design and preparedness in an increasingly interconnected, global environment

1.2. Conceptual framework of the IMBS program



The aim of the IMBS program is to provide bachelor students from all different disciplines of life- and natural sciences (with at least a bachelor degree and one year of working experience) an in-depth training in human relevant Biomedical Sciences. We expect these people to build an interdisciplinary network that crossfertilizes itself by bringing in different expertise with the same common goal, to apply knowledge to better understand human health and disease and to obtain better treatment options in the future. The charm of the program is not only its biomedical, translational orientation, but also its internationality. Participants from all continents (international) promote intercultural exchange and contribute to the increasing demand of solving scientific, economic, ethical and political issues on a global level. For the ALU the IMBS program will be the first international master program with a double master degree (MSc from ALU, Master in Biomedical Sciences from UBA) involving a collaborating partner in a Latin American country (Argentina). In this respect the program is a novelty at ALU. Together with the University College Freiburg, which is also an international, interdisciplinary program (BSc), the IMBS master program will increase the international profile of the university and contribute to a better visibility (and hopefully ranking) worldwide.

2. Structure and Organization

2.1 Interdisciplinary collaboration of institutions

The IMBS master program is a truly interdisciplinary and intercultural undertaking at Freiburg University incorporating different disciplines and faculties. The program is under the responsibility of the Faculty of Medicine and organized by the Institute of Molecular Medicine and Cell Research (IMMZ) in cooperation with the Faculty of Pharmacy and Chemistry and the Faculty of Medicine at the University of Buenos Aires, Argentina.

2.1.1 Faculty of Medicine at ALU

The Faculty of Medicine at ALU consists of the medical school and dental school and forms the university's biomedical research unit together with the University Medical Center Freiburg. The research at the Medical Center focuses on Immunology and Infectiology, Molecular Cell Research and Regenerative Medicine, Epigenetic and Functional Genetics, Neurosciences and Oncology and Functional Imaging. Professors from three of the five research areas teach in the IMBS program. In addition, the Faculty of Medicine encompasses eight research institutes, among them Molecular Medicine and Experimental and Clinical Pharmacology and Toxicology, which participate in the IMBS curriculum.

The Faculty of Medicine was founded in 1457 as one of Germany's oldest and is regarded among its most distinguished Institutes. It consistently ranks very highly in a variety of national and international rankings. According to the 2005 Humboldt Ranking, measuring the number of research stays by foreign fellows and award

winners sponsored by the Humboldt Foundation, the Faculty of Medicine at ALU placed second in the life sciences. Moreover, a recent survey done by the German Federal Ministry for Education and Research showed that the Faculty of Medicine at ALU topped the list of the most attractive medical schools for students, receiving the most applications for an MD program in Germany. Only about 5% of the applicants were admitted, also making Freiburg one of the most selective schools.
The Faculty of Medicine at ALU offers four study degree programs, Medicine, Dental Medicine, Molecular Medicine and Nursing (BSc). Currently, approximately 3,000 students are enrolled at the Faculty of Medicine, while the medical program is by far the largest with about 2,500 students. Each year, around 340 students are admitted to the medical program and circa 40 each to the dental and molecular medicine programs. Admission to all three programs is highly competitive. A MD/PhD program is also available in cooperation with the Spemann Graduate School of Biology and Medicine (SGBM). Additionally, as of 2008 the International Master Program in Biomedical Sciences (IMBS) is being offered as a joint program between ALU and UBA (but so far without a double master degree). Further recent developments have led to the creation of the Master Online in Periodontics, the Master Online in Palliative Care, and the Master Online in Technical Medicine, aimed at professionals and consisting of online and on-campus segments. The Faculty of Medicine employs 1334 physicians and researchers full-time and 116 professors.

Institute of Molecular Medicine and Cell Research (IMMZ)
The IMMZ was founded in 1999 as a cutting edge institute of the Faculty of Medicine at ALU. It is committed to research and teaching in Molecular Medicine with a special focus on cancer and stem cell research, research on proteases and programmed cell death and proteomics. The institute hosts the study program Bachelor and Master of Science Molecular Medicine which was implemented in 1999 and has since produced hundreds of biomedical scientists who followed up successful careers in academia, industry, the public and publishing sector worldwide. The Institute is directed by Prof. Christoph Peters who is also the head of the Freiburg Cancer Center (CCCF). His deputy Prof. Dr. Dr. h.c. Christoph Borner is the director of the IMBS program since 2014 and also leads the SGBM graduate school.

2.1.2 Faculty of Engineering at ALU

The **Faculty of Engineering** was founded in 1995. It is the eleventh and youngest faculty of the University of Freiburg. It consists of three departments: the Department of Computer Science, the Department of Sustainable Systems Engineering and the Department of Microsystems Engineering (IMTEK). Professors of the latter department teach in the IMBS program the module Materials and Microsystems. Here the master students get to know novel materials, which they can apply to human tissues or cells. In addition they get trained in microfluidity systems that allow them to analyse thousands of cell growth or behaviour conditions on a microscale.

2.1.3 Faculty of Theology at ALU

The **Faculty of Theology** was one of the four founding faculties of ALU in 1457. It is a Roman-Catholic faculty with about 700 students as candidates for priesthood or as graduate theologians for service in the church or to achieve graduate teaching qualifications. Degree programs offered at the Faculty of Theology include among others Caritas science and Christian social science, Christian archaeology and art history, and Catholic theology. The faculty also operates a Graduate School of Theology and Religious Studies under the roof of the University of Freiburg's International Graduate Academy. The faculty is subdivided into the Institute of Biblical and Historical Theology, Institute of Practical Theology and the Institute of Systematic Theology. In the latter one professor specialized in moral theology teaches in the Bioethics module of the IMBS program.

2.1.4 University of Buenos Aires

The **University of Buenos Aires** (Spanish: *Universidad de Buenos Aires*, **UBA**) is the largest university in Argentina and the second largest university by enrolment in Latin America. Founded on August 12, 1821 in the city of Buenos Aires, it consists of 13 faculties, 6 hospitals, and 10 museums and is linked to 4 high schools. Professors of the Faculties of Pharmacy and Biochemistry and the Faculty of Medicine teach in the IMBS program. They engage in renowned research projects in the area of mitochondrial biology, oxidative processes, oncology, immunology, virology, microbiology and parasitology. The implementation of the IMBS program in 2008 and the administration of the study program ever since has been managed by the Dean’s office of the Faculty of Pharmacy and Biochemistry. The reason for starting the IMBS program with UBA was the following: 1) The former Freiburg director of the program, Prof. Dr. Dr. h.c. em. Roland Mertelsmann initiated an exchange program of medical students with his former study colleague Prof. Dr. Ben Koziner from the Faculty of Medicine at UBA. Medical students on different study levels (undergraduates, graduates, doctoral students and postdocs) visited the partner university for short research stays or clinical trainings (“Famulatur”, practical year (PJ). This gradually turned into an idea to create an international master program in Biomedical Sciences, which involved a curriculum that was split between ALU and UBA and resulted in a master certificate at UBA. 2) According to the QS World University Rankings (2016/17) the University of Buenos Aires ranks number 85 in the world, which is even better than the University of Freiburg (number 163). The goal was therefore to team up with one of the best Latin American Universities to create the IMBS program. 3) Cesar Milstein from UBA and George Köhler from the MPI in Freiburg won the Nobel Prize for the development of monoclonal antibodies in 1984. They are the role model for innovative research collaborations between UBA and ALU that needs to be maintained by a sustainable interdisciplinary, intercultural training of excellent young scientists on the master, doctoral and postdoctoral level.

2.1.5 Hochschule Furtwangen University (HFU)

The **Hochschule Furtwangen University** (HFU), located in Furtwangen, Black Forest, is one of Germany's leading universities in the area of Applied Science. It is recognised for its excellence in the areas of high quality and innovation in teaching, practical focus through collaboration with industry, internationality, applied research, continuing education and lifelong learning, cooperation and motivation and social responsibility and safeguarding of the future. This makes it a perfect partner for our IMBS master program. HFU offers research and study tracks in engineering, computer science, information systems and management, engineering management, media, international business and health. A member of the Faculty of Medical Life Sciences teaches the crucial interdisciplinary module Biostatistics within the IMBS program.

2.1.6 Thales-Academy

The Thales Academy for Economy and Philosophy is an external, non-profit organization which allows managers, stakeholders, government officials and other leading personalities to find answers for pressing ethical questions and challenges. These challenges determine the success of a company and decide about the future of our society since it will become increasingly difficult to lead a business with an ethical responsibility at the same time as keeping it profitable. One of the directors of the academy therefore participates in the IMBS module Bioethics.

2.1.7 Freiburg Academy of Continuing Education

The Freiburg Academy of Continuing Education (FRAUW) coordinates continuing education programmes for those already working in a full-time job. These programmes include certificate courses designed to provide further theoretical grounding for practical work experience and a selection of master programmes, which can also be taken as distance learning programmes.

2.2 Organisation

The administration of the IMBS program is organized by program directors and coordinators at both universities. They exchange information regarding implementation and changes in the study program, organize student recruitment, travel to and accommodation at both places, ensure supervision of the students, overview the finances (in particular the tuition fees) and make sure that exams and master thesis defenses are correctly held and certificates are timely issued. Both of them also survey the quality of the teaching, the organization of the modules, determine the supervisors of the master thesis and the referees and jury of the defenses and foster scientific exchange between the research labs at ALU and UBA. Each year UBA professors travel to Freiburg to attend the exam after the lab rotations (yielding the DAS certificate) and ALU professors travel to Buenos Aires for the master thesis defenses. Both teams are equally involved in the assessment of the

exam/defense. In the future when master thesis defenses also take place in Freiburg, UBA professors will visit as well. During both visits the hosting university always organizes a symposium on Translational Medicine where ALU, UBA professors, IMBS alumni and external guest speaker present their newest research data in order to stimulate scientific interactions and to present to the IMBS students potential master or PhD projects. For the symposium at UBA we always invite a Nobel Prize winner from Germany, Switzerland or Austria who gives a lecture, meets the IMBS students and gets the honorary doctor title of UBA. This event is followed by a reception at the German Embassy in Buenos Aires. These activities make our master program visible to the world and transport the importance of a multidisciplinary, international training to other scientists and politicians. As an appreciation for setting up and maintaining the IMBS program, former Rektor Jäger and two ALU professors (Mertelsmann and Borner) received the doctor honoris causa from UBA and the former Dean of the Faculty of Pharmacy and Biochemistry, Prof. Boveris was awarded the Bundesverdienstkreuz.

2.3. Responsible persons

2.3.1 Scientific and program directors

ALU: Prof. Dr. Dr. h.c. Christoph Borner
UBA: Prof. Dr. Cristina Arranz

2.3.2 Program coordinators

ALU: Bärbel Schätzle, Dipl. Soz. Päd.
UBA: Lic. Julia Kirszman
Tamara Ferreiro

2.3.3 Teaching Staff

The teaching staff includes professors and lecturers of University of Freiburg (ALU), from a variety of faculties, professors and lecturer of the University of Buenos Aires (UBA) from two faculties and external lecturers of the Furtwangen University /Black Forest (HFU), of the University of Buenos Aires and the Thales-Academy in Freiburg (see list of lecturers in the Annex A).

2.3.4 Contact

International Master of Science Biomedical Sciences (IMBS)
University of Freiburg
Institute of Molecular Medicine and Cell Research
Stefan Meier Str. 17, 79104 Freiburg, Germany
Phone: +49-761/203-97489
imbs@mol-med.uni-freiburg.de
www.biomedmaster.org

2.4. Methods of instruction and studying techniques

Language: English

Presence:

- Lectures and seminars
- Exercises
- Group presentations
- Practical lab-work

Self Studies:

- Scientific reading
- Preparation of presentations in groups
- Preparation of exams
- Preparation of practical lab-work
- Consolidation of acquired knowledge

2.5. Form and length of the program

This Master Program is tailored as a full time program for 24 months and divided in three parts: The first eight months (basic unit) will take place at the University of Buenos Aires (UBA), Argentina, the second part with eight months studies (advanced unit) will take place at the University of Freiburg (ALU), Germany, and the third part (research project), which includes the Master thesis, can be performed either in Freiburg or in Buenos Aires.

2.5.1. Workload

The total workload is 3007 hours in 24 months full time study. It should be noted that 25 working hours equals 1 Credit Point (CP or ECTS).

2.6. Degree and credits

The program concludes with a Double Master Degree, i.e. a Master of Science (M.Sc.) at ALU and a Master of Biomedical Sciences at UBA with a total of 120 credit points in the European Credit Transfer System (ECTS).

2.6.1. European Credit Transfer System (ECTS)

ECTS is a learner-centred system for credit accumulation and transfer, based on the principle of transparency of the learning, teaching and assessment processes. Its objective is to facilitate the planning, delivery and evaluation of study programmes and student mobility by recognizing learning achievements and qualifications and periods of learning (http://ec.europa.eu/education/library/publications/2015/ects-users-guide_en.pdf)

According to the European Credit Transfer and Accumulation System (ECTS) one Credit Point corresponds to an average workload of 25-30 hours.

In Continuing University Education of the University of Freiburg, one Credit Point corresponds to an average workload of 25 hours (student effort). MSc students will receive 90 CP (ECTS) in taught modules and 30 CP (ECTS) in the Master Thesis Research Project module which accumulates to a **total 120 CP (ETCS)**. The programme consists of mostly 50 working hours per week.

2.6.2. Credit points and requirements

For being awarded credit points the following is required:

- Preparation according to the specifications and material provided by the professors
- Active participation in class
- Reading and self-study
- Active participation in group presentations
- Written and oral examinations

2.6.3. Examinations and grading

After each module the students will pass written or oral exams and sometimes provide lab reports.
After the lab rotations at ALU an oral exam of 20 min will take place yielding a Diploma of Advanced Studies (DAS).
At the end of the study program the master thesis defence will take place at UBA or ALU yielding a double master degree.

Grading Scale: 1,0 / 2,0 / 3,0 / 4,0 / 5,0 (failed)
(see conversion of grades in the study regulations)

2.7. Prerequisites and selection criteria of the International Master of Science Biomedical Sciences

The Master course is open to professionals in Life Sciences or Natural Sciences, holding a higher academic degree with a minimum 3 years of academic full time training (180 ECTS; see below). Candidates are expected to have at least 1 year of working experience in a relevant field.
The medium of instruction is English. Proficiency in reading and speaking English is required (TOEFL (550 paper / 213 computer / 72 - 94 online), IELTS (5+), DAAD (a, b or c in all categories), GER-Level B2 or more).
20 participants will be accepted each year, drawn from a wide range of countries. We aim to achieve a balance in gender, discipline and between participants from industrialized and LMICs (Low and Middle Income Countries).

2.8. General information on structure

The MSc IMBS is a modular programme consisting of three major parts

Duration and ECTS: See duration of the core module and advanced modules in Table 2

2.8.1 Study performance

The various elements of a module consist of formal contact time (lectures, tutorials, discussions, practical exercises, lab research methods and others), assessment (preparing and completing assignments and examinations) and self-studies.

2.8.2 Examination regulations

To pass examinations associated with the different modules participants need to achieve at least the grade 4.0 (sufficient).
The final grade is calculated from the grade for the taught modules (core module and advanced modules 1 to 3 where the arithmetic mean of the core and advanced modules represent the overall grade for taught modules) and the master module (oral examination and master thesis). The taught courses count for 60% and the master module for 40% of the overall grade. Grades are awarded according to the German grading scale (1-5) specified in Table 1.

ECTS system	German system	Definition
A	1	very good
B	2	good
C	3	satisfactory
D	4	sufficient
F	5	fail

Table 1: Grades according to the German and ECTS grading system and their definition.

To award credit points the following requirements are needed:

- Students take active part in each course/seminar/hands-on of the module and in its course.
- Self-study and independent preparation and reworking of the lectures and reading materials
- Completing the examinations during and after the sub-modules, presentation at seminars and participation at discussions.

Methodologies: Each module starts usually with an introductory lecture. All modules will use a mixture of teaching lectures, seminars, group work and a major part in practical training and work in research methods for biomedical sciences. Self-studies are included mostly during and after a module and partially in preparation for a module.

The International Master of Science Biomedical Sciences programme starts in February. The courses offered within this programme are repeated annually. This fulltime programme leads participants to a Master‘s degree usually in two years (for more details see the document “study- and examination regulations”).

3. Study Schedule

Nr	MODULES	Type of course	Credit points	Semester	Type of exam
	University of Buenos Aires (43 ECTS)				
	Intensive Spanish Language Course	V+Ü	3	1	SL: written
I	Biophysics, Bioenergetics (Ia), Biochemistry and Molecular Biology (Ib)	V+U+Pr	5	1	SL: report PL: written test
II	Physiology (IIa), Pathophysiology (IIb), Cellular and Molecular Immunology (IIc)	V+Ü+Pr +S	5	1	SL: oral PL: written test
III	Pharmacology (IIIa) and Toxicology (IIIb)	V+Ü+Pr	5	1	SL: oral PL: written test
IV	Virology (Iva) and Microbiology (IVb)	V+Ü+Pr	5	1	PL: oral
V	Neurobiology	V+Pr+S	5	1	PL: written test
VI	Pathology	V+Pr+S	5	1 and 2	PL: oral
VII	Clinical Medicine	V+Pr+S	5	2	PL: oral
VIII	Molecular Oncology (VIIIa), Biostatistics and Experimental Models (VIIIb)	V+Pr+Ü	5	2	PL: written test
	Subtotal		**43**		
	Albert Ludwigs University of Freiburg (47 ECTS)				
	Intensive German Language Course	V+Ü	3	2	SL: written
	Introduction into research methods and scientific communication	V+Ü+Pr	5	2	SL: oral
I	Biostatistics (Ia) and Bioethics (Ib)	V+Ü+S	5	2	PL: written
II	Pharmacology, Toxicology (IIa), Materials and Microsystems (IIb)	V+S+Pr	5	2	PL: oral and written test
III	Molecular Oncology (IIIa) and Cardiology (IIIb)	V+S+Pr	5	2	SL: oral PL: written test
IV	Molecular and Cellular Biology (IVa), Immunology and Pathology (IVb)	V+S+Pr	5	2	PL: written test
V	Labor Research	Pr	19	2 and 3	SL: lab protocol PL: presentation
	Subtotal		**47**		
	University of Freiburg or University of Buenos Aires (30 ECTS)				
	Master Module		30	3 and4	SL: lab protocol PL: Master thesis PL: Master Thesis Defense
	Subtotal		**30**		
	TOTAL Creditpoints		**120**		

Type of course: V= lecture, S= Seminar, Ü= Exercise, PR= practical work
Creditpoints = ECTS: 1 Creditpoint according to ECTS = 25 hours of workload
PL = Prüfungsleistung (grades included in final mark)
SL= Studienleistung (no grades, but has to be passed)

Study Progress	
Time frame / Locations	2 years full time master program consisting of three parts: 8 months – in Argentina, University of Buenos Aires (UBA) 8 months – in Germany, University of Freiburg (ALU) 8 months – either at ALU or at UBA for the Master thesis
Content	Interdisciplinary knowledge transfer and practice in research methods in biomedical sciences on an international and intercultural level **UBA:** Acquaintance of basic knowledge in lectures, seminars and exercises with first insights into methodologies **ALU:** Consolidation of basic knowledge in practical modules and in lab research **Master Thesis Research Project:** Obtaining data and learning methods on a specific own research project. Learn good scientific practice, how to write and present data
Outcomes	Two master degrees, a Master in Biomedical Sciences from UBA and a Master of Science (M.Sc.) Biomedical Sciences from ALU (involving the same number of ECTS points mutually accredited to each degree).
Examinations	Each module at UBA and ALU is completed with an oral or written exam or a lab report which is graded. After the lab rotation at ALU the students present their future master topic in a 20-min talk in front of ALU and UBA professors in the end of May in Freiburg. Successful presentation and acceptable grades from the 8 months ALU modules will entitle them for a Diploma of Advanced Studies (DAS). The DAS is provided by the Freiburg Academy of Continuing Education (FRAUW). After completing the master thesis the students defend their work in a 30 min presentation followed by a 30 min discussion. The defense will either take place at ALU or UBA depending on where the master thesis was performed. It always involves the evaluation by professors from both universities. In addition to the oral presentation, the students submit the written form of their master thesis, which will be evaluated and graded.

4. Part I: Modules in Buenos Aires

Usually the curriculum starts in February each year at UBA with a 1-month intensive language course (Spanish). In the subsequent 7 months the students will continue language training on a weekly basis leading to a final Spanish certificate. Concomitantly, they will attend the following modules: Biophysics, Bioenergetics and Biological Oxidations, Virology, Cellular and Molecular Immunology, Microbiology, Physiology, Pharmacology, Toxicology, Pathology, Biochemistry and Molecular Biology, Neurobiology, Molecular Oncology and Clinical Medicine. The modules primarily consist of lectures and are completed by seminars, conferences and methodological and/or practical courses. In total, 43 ECTS points are awarded for the 8 months course (February to September) at UBA.

Nr	MODULES	Type of course	Credit points	Semester	Type of exam
	University of Buenos Aires (43 ECTS)				
	Intensive Spanish Language Course	V+Ü	3	1	SL: written
I	Biophysics, Bioenergetics (Ia), Biochemistry and Molecular Biology (Ib)	V+U+Pr	5	1	SL: report PL: written test
II	Physiology (IIa), Pathophysiology (IIb), Cellular and Molecular Immunology (IIc)	V+Ü+Pr +S	5	1	SL: oral PL: written test
III	Pharmacology (IIIa) and Toxicology (IIIb)	V+Ü+Pr	5	1	SL: oral PL: written test
IV	Virology (Iva) and Microbiology (IVb)	V+Ü+Pr	5	1	PL: oral
V	Neurobiology	V+Pr+S	5	1	PL: written test
VI	Pathology	V+Pr+S	5	1 and 2	PL: oral
VII	Clinical Medicine	V+Pr+S	5	2	PL: oral
VIII	Molecular Oncology (VIIIa), Biostatistics and Experimental Models (VIIIb)	V+Pr+Ü	5	2	PL: written test
	Subtotal		**43**		

Intensive Spanish Language Course

Lecturers	External company
Duration	Intense for 1 month, then regularly once a week during 8 months
Academic performance	Lectures, exercises, group work, practice with different media
Workload	**Total workload of 75h** ***Presence: 18,75 h/week during 1 months***
Creditpoints	3
Content	Spanish Language training at Level A1 and A2 by using diverse communicative methods which are highly interactive and dynamic to suit different types of learners. The methods emphasize on listening & speaking skills, extension of vocabulary, the understanding and application of Spanish grammar. Teaching material and content will additionally support the awareness, understanding and a good handling of the cultural diversity and the new environment.
Learning Outcomes	Students can demonstrate on an Advanced Low level of Proficiency in Spanish in speaking, writing, listening and reading ■ Speaking: students are able to handle a variety of communicative tasks. They are able to participate in most informal and some formal conversations on topics related to school, home, and leisure activities. They can also speak about some topics related to employment, current events, and matters of public and community interest. ■ Writing: students are able to meet basic work and/or academic writing needs. They demonstrate the ability to narrate, describe and express viewpoints about familiar topics in major time frames with some control of aspect. ■ Listening and Reading: students are able to understand short conventional narrative and descriptive texts (spoken and/or written) such as descriptions of persons, places, and things, and narrations about past, present, and future events with a clear underlying structure though their comprehension may be uneven. They can understand the main facts and some supporting details. Comprehension may often derive primarily from situational and subject-matter knowledge. ■ Students are able to communicate in Argentina in order to organize their daily life and academic matters and are able to network
Academic test	SL: Written test (which leads to a Certificate)

4.1. Module I: Biophysics, Bioenergetics, Biochemistry and Molecular Biology

Module I	Biophysics, Bioenergetics and Biological Oxidations (Ia) & Biochemistry and Molecular Biology (Ib)
Lecturers	Prof. Dr. Mónica Galleano, Prof. Dr. Fernando Dominici
Duration	4 weeks
Academic performance	Lectures, Exercisesand Practical work
Workload	Total workload: **126 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars 2 h/day lab work or exercises ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	SL: Report on virtual activities PL: Written exam

Module Ia	Biophysics: Bioenergetics and Biological Oxidations
Lecturer	Prof. Dr. Mónica Galleano
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 63 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars, exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	Bioenergetics: first and second law of thermodynamics applied to living systems. Gibbs free energy. Chemical equilibrium. Redox reactions. Chemical kinetics. Mechanisms of reaction. Photochemistry, fluorescence and oxygen excited states. Catalysis: relevance for biology and biochemistry. Biological membranes. Mitochondria: structure and compartmentalization. Electron transport chain: components of the respiratory chain: proton translocation, superoxide and hydrogen peroxide production. Chemiosmotic theory. Electron transfer and electrochemical potential. Chemistry and biochemistry of free radicals. Free radical-mediated alterations in cell redox state and cell signaling. Antioxidants in biological systems: thermodynamic and kinetic aspects. Nutrients and cell signaling. Free radicals and antioxidants in human physiology and pathology. **Lab work:** Animal calorimetry. Free radicals and antioxidant effects measurement by Electronic Paramagnetic Resonance (EPR). Measurement of oxygen consumption in isolated mitochondria. Detection of mitochondrial complexes.
Learning Outcomes	■ The students can define the laws of thermodynamics as applied to living systems. ■ The students can describe the membrane structure and its function. ■ The students can measure animal calorimetry. ■ The students can measure free radicals and antioxidant effects by Electronic Paramagnetic Resonance (EPR). ■ The students can write a laboratory report. ■ The students can isolate mitochondria and measure mitochondrial oxygen consumption. ■ The students can critically analyze scientific publications on mitochondrial inner membrane potential.

Module Ib	Biochemistry and Molecular Biology
Lecturer	Prof. Dr. Fernando Dominici
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 63 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars, exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	Manipulation of proteins, DNA, and RNA. Fractionation of cells. Ultracentrifugation for separation of organelles and macromolecules, chromatography for protein separation, affinity chromatography, SDS-Polyacrylamide-gel electrophoresis, 2-D-gel electrophoresis, selective cleaving for identification, mass spectrometry. Analysis of protein structure and function with various methodologies. Study of gene expression and function. Random and site-directed mutagenesis. Genetic screening and reporter genes. Overexpression and purification of membrane proteins. Expression systems. Expression of membrane proteins fused to GFP. Visualizing enzyme function in living cells. Membrane structure and transport. Intracellular components and protein sorting. Cell communication: signal transduction. General principles of G-protein linked receptors: signaling pathways and activation consequences. Enzyme-linked receptors. NFkB-signaling. Cancer and gene expression control. Prokaryotic regulation of gene expression: operon lac. Eukaryotic regulation of gene expression: steroid transcription factors. Th1/Th2 paradigm. **Lab work:** Determination of phosphorylation levels of the enzyme Akt/PkB after acute *in vivo* insulin stimulation to rats.
Learning Outcomes	■ The students can define the elements of cell communication and signal transduction. ■ The students can determine *in vivo* insulin-induced phosphorylation of the serine/threonine kinase Akt/PkB. ■ The students can detect and quantify proteins by western blotting. ■ The students can write a laboratory report. ■ The students can critically analyze scientific publications on cell communication and signal transduction.

4.2. Module II: Physiology, Pathophysiology, Cellular and Molecular Immunology

Module II	Physiology (IIa), Pathophysiology (IIb), Cellular and Molecular Immunology (IIc)
Lecturers	Prof. Dr. Analia Tomat, Prof. Dr. María Inés Vaccaro, Prof. Dr. Emilio Malchiodi
Duration	4 weeks
Academic performance	Lectures, Seminars, Exercises and Practical work
Workload	Total workload: **126 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars, exercises 2 h/day lab work ***Self-Study: 6,5 h or 6h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	SL: Oral presentation PL: Written exam

Module IIa	Physiology
Lecturer	Prof. Dr. Analia Lorena Tomat
Duration	1 week
Academic Performance	Lectures, Seminars, Exercises and Practical work
Workload	**Total workload: 31,5 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars, exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	1.25
Content	Arterial blood pressure regulation and hypertension. Experimental models of hypertension. Endothelial function and dysfunction. Evaluation of renal, cardiac and metabolic function. Renin-angiotensin system. Morphological evaluation of renal, cardiovascular, hepatic and adipose tissues.
Learning Outcomes	■ The students can integrate physiological and molecular aspects of health and disease. ■ The students can describe the cardiovascular, renal, and metabolic regulations. ■ The students can understand the essential physiological events that maintain the health and develop disease in humans. ■ The students can apply laboratory techniques to the study of physiology and molecular physiopathology.

Module IIb	Pathophysiology
Lecturer	Prof. Dr. María Inés Vaccaro
Duration	1 week
Academic Performance	Lectures, Seminars, Exercises and Practical work
Workload	**Total workload: 31,5 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars, exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	1.25
Content	Molecular and cellular pathology. Cellular response to disease. Mechanism of survival, adaptation, and cell death. Selective autophagy and cell death associated with autophagy: molecular mechanisms, involved genes, and mediators. Simple cellular models, genetic models and pharmacological inducers of autophagy. Cellular response to metabolic, inflammatory, ischemic, and neurological diseases. Mechanisms of cell death and survival in diabetes. Pancreatitis and pancreatic cancer.
Learning Outcomes	■ The students can describe the cellular and molecular mechanisms underlying the phenotypical changes of mammalian cells during disease. ■ The students can apply research techniques to study these mechanisms. ■ The students can recognize the adaptation and cell death mechanisms triggered by the cells in the state of disease. ■ The students can identify causes of cell injury, oxidative stress, ischemia, and metabolic stress. ■ The students can recognize the autophagy process and analyze the underlying molecular, cellular, and tissue mechanisms and their consequences in inflammatory, infectious, and degenerative disease.

Module IIc	Cellular and Molecular Immunology
Lecturer	Prof. Dr. Emilio Malchiodi
Duration	2 weeks
Academic Performance	Lectures, Seminars, Exercises and Practical work
Workload	**Total workload: 62 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day seminars, exercises 2 h/day lab work ***Self-Study: 6 h/week*** 1,2 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	Innate immunology. Antigen recognition by B cells. Generation of diversity. MHC antigens. Antigen recognition by T cells. Antigen presentation to T cells. T cell development and B lymphocyte traffic. Mucosal immunity. Regulation of the immune response. Vaccines against *Trypanosoma cruzi*. Super antigen interaction with receptors and T cell antigen and MHC-II molecules recognition. Interaction of NK cell receptors with cellular and viral molecules. Mechanisms of cell death and survival in tumors: implications in immune evasion and therapy. T cells, NK cells, and Cancer. Interaction of *Brucella sp*. with cells and relevance to human infection. Applications of flow cytometry and Surface Plasmon Resonance (SPR) to immune diagnosis and determination of affinity constants. **Lab work:** Cell cultures, flow cytometry, Surface Plasmon resonance (SPR), protein separation by SDS-PAGE and blotting, titration by ELISA, and protein structure modelling with Pymol.
Learning Outcomes	■ The students can recognize the immune response to diverse pathogens including virus, bacteria, and parasites. ■ The students can identify the function of cellular and humoral components of the innate and acquired immune response. ■ The students can characterize super antigens. ■ The students can describe the mechanisms used by virus, bacteria, and parasites to evade the immune response. ■ The students can understand the advances in vaccines against infectious disease. ■ The students can apply various molecular techniques to study the immune response. ■ The students can model a protein structure. ■ The students can critically analyze scientific publications on infections and immune response.

4.3. Module III: Pharmacology and Toxicology

Module III	Pharmacology (IIIa) and Toxicology (IIIb)
Lecturer	Prof. Dr. Christian Höcht, Prof. Dr. Carlos Damin
Duration	4 weeks
Academic performance	Lectures, Exercises and Practical work
Workload	Total workload: **126 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	SL: Oral presentation PS: Written exam

Module IIIa	Pharmacology
Lecturer	Prof. Dr. Christian Höcht
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 63 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day , exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	The regulation of transcription in eukaryotic cells. General and specific transcription factors and signal integration. Mechanisms of control: epigenomics and translational control, microRNAs and RNAbp. Potential pharmacological targets. Mechanisms involved in mRNA stability and processing. Study and identification of potential mechanisms involved in drug action. Description and analyses of techniques aimed to determine mRNA processing. Basic concepts and relevance of pharmacokinetics. Pharmacokinetic models and parameters. Use of computational programs for pharmacokinetic parameters calculation. Interpretation of pharmacokinetic parameters. Use of microdialysis for the evaluation of drug tissue distribution. Clinical pharmacokinetics and translational research. Design and optimizations of dosage regimen. Therapeutic Drug Monitoring (TDM) and its role in HIV treatment.
Learning Outcomes	■ The students can understand the basic concepts of pharmacodynamics and pharmacokinetics. ■ The students can apply research methodology to study the pharmacokinetics and pharmacodynamics of therapeutic agents. ■ The students can estimate pharmacokinetics and pharmacodynamics of therapeutic agents. ■ The students can use computational programs for pharmacokinetic parameters calculation.

Module IIIb	Toxicology
Lecturer	Prof. Dr. Carlos Damin
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 63 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	Alcohol and drugs interaction in liver and brain. Mechanisms of liver and central nervous system damage induction. Molecular biology of portal hypertension and portal systemic encephalopathy. Hepatic encephalopathy: Neurobiology of ammonia. Low grade or subclinical hepatic encephalopathy, the early molecular changes and its consequences. Mitochondrial dysfunction. Practice in the onset of experimental portal hypertension. Epidemiological view of cancer markers. Breast and prostate cancer, frequent cause of death, advances in early diagnosis, molecular and image analysis. Overview of PET/CT. Central and peripheral regulation of the hepatic function by atrial natriuretic peptides and endothelins. An *in vivo* and *in vitro* (cultured hepatocyte) approach. Effect on bile flow and composition, and its relationship with the autonomic nervous system. Effect on the major transporters involved in bile formation. Intracellular signaling pathways and receptors involved. Pathophysiological implications. Multidrug resistance receptors in drug toxicity: Paracetamol metabolic pathways. DNA and RNA implication. Different experimental models reflect de ABC binding cassette relationship.
Learning Outcomes	■ The students can identify and evaluate the physiopathological effects of toxicology. ■ The students can analyze the toxicity and detoxification of the most common drugs and their consequences for the liver and CNS. ■ The students can characterize the injury mechanisms and changes in the involved receptors. ■ The students can define appropriate experimental models to study biological and pharmacological toxicities.

4.4. Module IV: Virology and Microbiology

Module IV	Virology (IVa) and Microbiology (IVb)
Lecturers	Prof. Dr. Viviana Mbayed, Prof. Dr. Diego Flichman, Dr. Marta Mollerach, PhD
Duration	4 weeks
Academic performance	Lectures,Exercises and Practical work
Workload	Total workload: **126 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	PL: Oral exam

Module IVa	Virology
Lecturers	Prof. Dr. Diego Flichman, Prof. Dr. Viviana Mbayed
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 63 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	Introduction to Virology. Viral structure and taxonomy. Virus replication strategies. Viral evolution. Molecular mechanisms of genetic variation of viruses. Virus-cell interaction. Innate and adaptive immune response to viruses. Pathogenesis of viral infections. Molecular epidemiology. Diagnostic of viral infections. . Immunization against viral diseases. Antiviral agents. Emergence of viral diseases. **Lab work:** Eukaryotic cell culture, viral grown, biological characterization of viruses, and phylogenetic analyses of viral genomes from an outbreak.
Learning Outcomes	■ The students can acquire knowledge on viral evolution, pathogenesis, epidemiology, antivirals, and vaccines. ■ The students can manipulate cell cultures, infect cells in culture, and obtain a viral stock. ■ The students can understand the principles of virology and acquire practical skills required in the virology lab. ■ The students are able to perform and comprehend a basic phylogenetic analysis from viral genomic sequences. ■ The students can critically analyze scientific publications in virology.

Module IVb	Microbiology
Lecturer	Dr. Marta Mollerach, PhD
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 63 h** ***Presence: 25 h/week*** 1 h/day lectures 2 h/day exercises 2 h/day lab work ***Self-Study: 6,5 h/week*** 1,3 h/day: data analysis, documentation, and reading
Credit points	2.5
Content	Mechanisms of pathogenicity and host-parasite interaction. Molecular basis of microbial pathogenicity. Mechanisms involved in adhesion, multiplication, nutrient acquisition, inhibition of the phagocytic process, evasion of the immune response, direct damage, and indirect host mediated immunopathological processes. Emerging and re-emerging bacterial diseases. Bacterial envelopes, metabolism, and cell division as targets for drugs with antimicrobial activity. Mechanisms of action and resistance to antibacterial drugs. Resistant organisms and emerging pathogens. Epidemiology of hospital infections. Biomarkers used in outbreak characterization and criteria used to evaluate typing systems. Analysis of results by applying bioinformatics techniques. Detection without culture as a tool in the diagnosis of selected bacterial diseases.
Learning Outcomes	■ The students can discuss theoretical concepts and recent advances in bacterial pathogenesis. ■ The students can describe the bacterial pathogenesis process from the molecular and structural assessments. ■ The students can define the bases of antimicrobial therapy based on laboratory assays and theoretical concepts of antimicrobial resistance. ■ The students can handle the most common emerging microorganisms that cause community and nosocomial infections.

4.5. Module V: Neurobiology

Module V	Neurobiology
Lecturer	Prof. Dr. Juana Pasquini
Duration	3 weeks
Academic Performance	Lectures, Seminars and Practical work
Workload	**Total workload: 126 h** ***Presence: 35 h/week*** 2 h/day lectures 3 h/day seminars 2 h/day lab work ***Self-Study: 7 h/week*** 1,4 h/day: data analysis, documentation, and reading
Credit points	5
Content	Morphology of the nervous system: Neurons, macroglia (astrocytes and oligodendrocytes), and microglia. Myelin synthesis. Histochemical and immunohistochemical techniques. Chemical signaling in the nervous system: Neurotransmitters and neuromodulators. Metabotropic and ionotropic receptors. Cholinergic receptors. Neurotrophins and neurosteroids. Second messengers. Neurodegeneration and meuroplasticy. Molecular basis of neurodegeneration. Cell death in neurodegenerative diseases. Charcot-Marie-Tooth and related neuropathies. Use of animal models: Wobbler mouse, Alzheimer´s disease. Peripheral nervous system. Schwann cell differentiation. Demyelination and re-myelination mechanisms. Studies using explants and neurospheres. Neural trauma. Differential reactions to trauma of the PNS and CNS. Spontaneous and intrinsic repair mechanisms (i.e. neuroplasticity, compensatory plasticity). Potential therapeutic interventions: stem cells.
Learning Outcomes	■ The students can differentiate cellular subtypes of the central nervous system. ■ The students can analyze the structure, metabolic pathways, receptors, signaling pathways, and neuromodulators of the CNS. ■ The students can discuss the biochemical and molecular bases of the major CNS pathologies. ■ The students can underscore the importance of animal models in the etiopathogenic study of the main CNS pathologies. ■ The students can apply the methodologies commonly used in neurobiology. ■ The students can describe the traditional and new pharmacologic treatments of neuropathology. ■ The students can critically discuss the key publications in the area of neurobiology.
Academic test	PL: Written exam

4.6. Module VI: Pathology

Module VI	Pathology
Lecturer	Dr. Manuel Rodriguez, MD
Duration	3 weeks
Academic Performance	Lectures, Seminars and Practical work
Workload	**Total workload:126 h** ***Presence: 35 h/week*** 2 h/day lectures 2 h/day seminars 7 h/day lab work ***Self-Study: 7 h/week*** 1,4 h/day: data analysis, documentation, and reading
Credit points	5
Content	Ischemia and ischemia-reperfusion. Myocardial ischemia-reperfusion injury. Myocardial stunning. Mechanisms of cardio protection: preconditioning; post conditioning; adenosine; statins. Experimental models of ischemia-reperfusion. Myocardial infarction. Cardiac Hypertrophy. Heart failure. Cardiomyopathies. Experimental models of hypertrophy and heart failure. Glomerular histophysiology. Hematuria. Nephrotic syndrome. Hemolytic uremic syndrome. Experimental models of hemolytic uremic syndrome. Neoplasms: Characteristics, morphological study, immunohistochemical and molecular analysis. Bone neoplasms and pathology of renal tumors: classification, morphological study, immunohistochemical and molecular analysis.
Learning Outcomes	■ The students can analyze the traditional knowledge and the current molecular and cellular advances in cardiovascular, nephrology, and neoplasia pathologies. ■ The students can explain the morphology and physiopathology of these pathologies. ■ The students can handle experimental models and understand their relevance in the study of these pathologies. ■ The students can characterize neoplasia on its morphological, immunohistochemical, and molecular bases. ■ The students can indicate the steps and materials involved in the experimental models used.
Academic test	PL: Oral exam

4.7. Module VII: Clinical Medicine

Module VII	Clinical Medicine
Lecturer	Prof. Dr. Gabriela Berg
Duration	3 weeks
Academic Performance	Lectures, Seminars and Practical work
Workload	**Total workload: 126 h** ***Presence: 35 h/week*** 2 h/day lectures 2 h/day seminars 3 h/day lab work ***Self-Study: 7 h/week*** 1,4 h/day: data analysis, documentation, and reading
Credit points	5
Content	Mitochondrial diseases: Congenital and acquired diseases. Mitochondrial dynamics. Mitochondrial Protein import. Obesity. Clinical obesity. Experimental model of obesity: ob/ob mice. Metabolic Syndrome and Diabetes: Insulin resistance and mitochondrial dysfunction. Immune markers for autoimmune diabetes. Regulation of body water: Disorders of water homeostasis. Cerebral Edema. Neurodegeneration: Parkinson's and Alzheimer's Disease. Physiopathogenesis. Systemic inflammatory response syndrome (SIRS): Mechanisms of multi-organic dysfunction: role of microcirculation. Toll-like receptors in SIRS. Respiratory cycle: Mechanisms of pulmonary injury in Pneumonitis and respiratory dysfunction. Respiratory insufficiency. Myocardial energetics: Myocardial ischemia. Pathophysiology and evaluation. Pharmacoresistance. ABC transporters. Epilepsy.
Learning Outcomes	■ The students can integrally approach various pathologies to identify risk factors, diagnosis, and therapeutic alternatives. ■ The students can discuss the biochemical and molecular bases of complex disease. ■ The students can provide ideas for the development of early diagnosis or treatment options of the main Occidental diseases. ■ The students can understand the relevance of animal models and human studies in the context of translational clinical biochemistry and medicine. ■ The students can interpret the main scientific publications on the studies pathologies.
Academic test	PL: Oral exam

4.8. Module VIII: Molecular Oncology, Biostatistics and Experimental Models

Module VIII	Molecular Oncology (VIIIa), Biostatistics and Experimental Models (VIIIb)
Lecturers	Prof. Dr. em. Roland Mertelsmann, Prof. Dr. Alicia Brusco
Duration	3 weeks
Academic performance	Lectures, Exercises and Practical work
Workload	Total **workload**: **125 h** ***Presence: 35 h/week*** 2 h/day lectures 2 h/day exercises 3 h/day lab work ***Self-Study: 7 h/week*** 1,4 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	PL: Written exam

Module VIIIa	Molecular Oncology
Lecturer	Prof. Dr. em. Roland Mertelsmann
Duration	2 weeks
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 75 h** ***Presence: 30 h/week*** 2 h/day lectures 1 h/day exercises 3 h/day lab work ***Self-Study: 7,5 h/week*** 1,5 h/day: data analysis, documentation, and reading
Credit points	3
Content	Molecular mechanisms involved in the initiation, promotion, and progression of cancer. Cellular transformation, tumor cell characteristics, MET (mesenchymal-epithelial transition), migration, invasion, metastatic cascade, signal transduction pathways of tumor stratification. Radiological aspects: positron emission tomography (PET). Introduction to chemotherapy: Classification, advantages and disadvantages. Collateral effects. Development of new therapies. Introduction to radiobiology and radiotherapy. Clinical aspects of radiotherapy. Systemic radiotherapy. Introducing surgery, modern techniques. Immunotherapy in melanomas. Role of viruses in cancer. Most frequent tumors: breast cancer, urogenital tumors, lung cancer, and colon cancer.
Learning Outcomes	■ The students can describe the main molecular characteristics of a cancer cell. ■ The students can understand the molecular biology of the more frequent tumors, diagnostic methods, and treatments. ■ The students can analyze the utility of tumoral biomarkers in the diagnosis, prognosis, prediction, and assessment of the response to the treatment. ■ The students can distinguish the concepts of precision medicine and targeted medicine.

Module VIIIb	Biostatistics and Experimental Models
Lecturer	Prof. Dr. Alicia Brusco
Duration	1 week
Academic Performance	Lectures, Exercises and Practical work
Workload	**Total workload: 50 h** ***Presence: 45 h/week*** 2 h/day lectures 1 h/day exercises 3 h/day lab work ***Self-Study: 5 h/week*** 1 h/day: data analysis, documentation, and reading
Credit points	2
Content	The use of animals in biomedical research. International legislation and regulations related to laboratory animals care and use. Bioethics in animal research. Handling and restriction of rats and mice, drug administration ways, sexing, and age recognition. Animal welfare: 3 Rs and 5 freedoms. The bioethical principles of Russel and Burch. Descriptive Statistics. Numerical and graphical statistical summaries. Probability models for discrete and continuous random variables. Statistical inference. Hypothesis testing. Comparison groups. An introduction to statistical linear models and contingency tables for quantitative and qualitative variables. Biological bases of learning and memory. Experimental results of the study of memory and learning using animal models. Bio mathematical analyses of cell proliferation organization in the developing CNS. Characterization of deterministic and stochastic components and their morphogenetic roles. Animal models of brain injuries. A model of perinatal asphyxia in rats: Application of hypothermia as a therapeutic strategy against hypoxic-ischemic damage. An animal model of retinal degeneration induced by light. Effect of the perinatal exposition to CB1 Agonist in the development of the cerebral cortex. Mechanisms of intracellular movements in cellular models and their relevance in disease. Cell migration, extracellular matrix degradation of basal membranes: role in organogenesis and in pathological processes. Signaling molecules involved in regulating cell migration and extracellular matrix degradation. Cell differentiation.
Learning Outcomes	■ The students can apply biostatistics tools in biomedical research. ■ The students can handle laboratory animals. ■ The students can analyze biological imaging. ■ The students can compare different animal models used in biomedical research. ■ The students can describe and discuss the use of different experimental models to study the CNS.

5. Part II: Modules in Freiburg

In October of each year the master students fly to Freiburg and pass an 8 months module block at ALU (till May of the following year). It will start with a 1-month intensive language course in German and a short Intercultural Training. Again the language training will continue on a weekly basis yielding a German certificate. In parallel, 4 mostly practical modules providing a bench-to-bed side/translational training in Biomedicine shall deepen the theoretical knowledge acquired at UBA. The modules consist of Molecular and Cellular Biology, Immunology and Molecular Pathology, Pharmacology and Toxicology II, Molecular Cardiology, Molecular Oncology II, Genetics of Disease, Materials and Microsystems for Life Sciences, Biostatistics and Bioethics. The IMBS students then complete 5 months of intensive Laboratory Research to strengthen their experimental skills, to plan and realize experiments, and to learn critical thinking. Moreover, during this phase master students get familiarized with the various research topics that they can chose at ALU or UBA for their 8 months master thesis. Before starting their master thesis, the students must present the master topic in a 20 min talk in front of ALU and UBA professors in the end of May in Freiburg. Successful presentation and acceptable grades from the 8 months ALU modules will entitle them for a Diploma of Advanced Studies (DAS) (total of 30 ECTS points).

Nr	MODULES	Type of course	Credit points	Semester	Type of exam
	Albert Ludwigs University of Freiburg (47 ECTS)				
	Intensive German Language Course	V+Ü	3	2	SL: written
	Introduction into research methods and scientific communication	V+Ü+Pr	5	2	SL: oral
I	Biostatistics (Ia) and Bioethics (Ib)	V+Ü+S	5	2	PL: written
II	Pharmacology, Toxicology (IIa), Materials and Microsystems (IIb)	V+S+Pr	5	2	PL: oral and written test
III	Molecular Oncology (IIIa) and Cardiology (IIIb)	V+S+Pr	5	2	SL: oral PL: written test
IV	Molecular and Cellular Biology (IVa), Immunology and Pathology (IVb)	V+S+Pr	5	2	PL: written test
V	Labor Research	Pr	19	2 und 3	SL: lab protocol PL: presentation
	Subtotal		**47**		

Intensive German Language Course

Lecturer	External company
Duration	Intense for 2 weeks, then regularly once a week for 27 weeks
Academic performance	Lectures, group work, practice with different media
Workload	**Total workload of 75h** ***Presence: 18,75 h/week during one month***
Creditpoints	3
Content	German Language training at Level A1 and A2 by using diverse communicative methods which are highly interactive and dynamic to suit different types of learners. The methods emphasize on listening & speaking skills, extension of vocabulary, the understanding and application of German grammar. Teaching material and content will additionally support the awareness, understanding and a good handling of the cultural diversity and the new environment.
Learning Outcomes	Students can demonstrate on Advanced Low level of Proficiency in German in speaking, writing, listening and reading ■ Speaking: students are able to handle a variety of communicative tasks. They are able to participate in most informal and some formal conversations on topics related to school, home, and leisure activities. They can also speak about some topics related to employment, current events, and matters of public and community interest. ■ Writing: students are able to meet basic work and/or academic writing needs. They demonstrate the ability to narrate, describe and express viewpoints about familiar topics in major time frames with some control of aspect. ■ Listening and Reading: students are able to understand short conventional narrative and descriptive texts (spoken and/or written) such as descriptions of persons, places, and things, and narrations about past, present, and future events with a clear underlying structure though their comprehension may be uneven. They can understand the main facts and some supporting details. Comprehension may often derive primarily from situational and subject-matter knowledge. ■ Students are able to communicate in Germany (and Switzerland and Austria) in order to organize their daily life and academic matters and are able to network
Academic test	SL: Written test (which leads to a Certificate)

5.1. Introduction into research methods and scientific communications

Introduction into research methods and scientific communication	
Lecturer	External experts
Duration	Total of 1 week (introduction week) and then distributed over the time of the 8 months modules
Academic performance	Lectures, Courses, Training, Exercises, Self-Study, Preparation, practical work
Workload	Total workload of **125 h** **Introduction week: 50h and 75h during the 8 months** 40 h: Scientific writing, communication and presentation 50 h: Presentations – Work in progress including evaluation 20 h: Self study and knowledge transfer 10 h: Intercultural training 5 h : Evaluation of the program
Creditpoints	5
Content	Intense training during the introduction week and then monthly meetings with presentations. **Scientific writing, communication and presentation:** Lectures and training about methods, resources, citation, publishing and structure of scientific papers, abstracts and master thesis. Lectures, group work and training in poster and oral presentations including standard rules and tools in design, presentation and writing, rhetorical skills, professional use of voice, facial expression, gestures and body postures. Learning through practice and group feedback. **Intercultural competence:** Lectures, group work and training in following topics: definition of culture, cultural models and cultural identity including foreignness and its impact. With awareness of the own cultural imprint the training will focus on stereotypes, prejudices and cultural dimensions. Understanding different communication techniques, verbal and non-verbal, the training will lead to strategies of successful cultural interaction including German historical and temporary facts as well as practical information about does and don'ts for living in Germany.
Learning Outcomes	**Scientific communication:** ■ Presentation of Research projects orally, in writing, and as presentation ■ Label the components of a scientific paper and master thesis ■ Decide when it is appropriate to use the different types of scientific literature such as primary literature, reviews and textbooks ■ Identify thesis and development statements ■ Explain how scientific research is published (including the peer review process, open-access journals, and the embargo system)

	■ Use online research tools (e.g. databases, e-journals, Google Scholar, Web of Science) to collect relevant information (e.g. scholarly articles, websites, blog posts) on a particular topic ■ Cite different types of scientific literature appropriately ■ Use an outline to organize a scientific argument with a claim and supporting evidence ■ Read scientific literature and assess the quality of the claims and evidence used to support them ■ Defend the validity of an argument by evaluating evidence in a variety of genres, including popular media, websites and scientific journals ■ Write an abstract by using the standard structure Write and present a presentation by using the state of art **Intercultural competence:** Students will demonstrate knowledge and understanding of other cultures and their products. By the time they graduate from our program, they will be able to: ■ Being aware of their own cultural imprint and its impact on their way of thinking and acting ■ Examine the validity of one's own cultural beliefs, behaviors and norms by contrasting and comparing them with those of the target culture ■ Recognize and describe the historical, social, economic, and political forces that shape society in the target culture ■ Understand and respect cultural diversity and its impact ■ Choose adequate techniques to handle cultural diversity in daily life e.g. perform change of perspective adequately or handle the feeling of foreignness ■ Communicate appropriate in an intercultural environment ■ Perceive and value cultural diversity and reinterpret the place of the self as an identity culturally situated in the global context
Academic test	SL: Oral presentation

5.2. Module I: Biostatistics and Bioethics

Module I	Biostatistics (Ia) and Bioethics (Ib)
Lecturers	Prof. Dr. Mathias Kohl, Prof. Dr. Meike Burger, Prof. Dr. Hans-Peter Deigner, Prof. Dr. em. Roland Mertelsmann, Prof. Dr. Eberhard Schockenhoff, Dr. Philippe Merz, Dr. Ignacio Mastroleo, Felicitas Holzer MSc, MPhil
Duration	2 weeks
Academic performance	Lectures, Exercises and Practical work
Workload	Total workload: **125 h** ***Presence: 50 h/week*** 3 h/day lectures 3 h/dayexercises 4 h/day lab work ***Self-Study: 12,5 h/week*** 2,5 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	PL: Written exam

Module Ia	Biostatistics
Lecturers	Prof. Dr. Matthias Kohl, Prof. Dr. Meike Burger, Prof. Dr. Hans-Peter Deigner
Duration	1 week
Academic performance	Lectures, Exercises
Workload	Total workload of **62,5 h** ***Presence: 50h/ week*** 6 h/day: lectures 4 h/day: exercises ***Self-Study: 12,5h/week*** 2,5 h/day: self-study, case-studies
Creditpoints	2,5
Content	The second submodule deals with modeling and the application of statistical analysis methods in order to train the interpretation of the results. The course will teach the following: • Introduction into the statistical software R • Descriptive statistics, colors and diagrams • Probability distributions • Point estimation and confidence intervals • Statistical tests, multiple testing
Learning Outcomes	■ Students know the difference between descriptive and inferential statistics ■ Students can perform a descriptive statistical analysis of their data ■ Students know the most important probability distributions for biomedical research ■ Students can apply important inferential statistical methods ■ Students know how the results of their statistical analysis have to be interpreted ■ Students will get familiar with an open source statistical software for biostatistics and bioinformatics, i.e. the statistics software R (free, non-commercial implementation of statistical programming language S), using the statistical programming language R
Recommended Literature	■ Dalgaard (2008). Introductory Statistics with R. 2nd edition. Springer. ■ Dancey, Reidy, Rowe (2012). Statistics for the Health Sciences. Sage. ■ Kohl (2015). Introduction to statistical data analysis with R. bookboon.com. ■ Whitlock, Schluter (2015). The Analysis of Biological Data. 2nd edition. Roberts and Company Publishers.

Module Ib	Bioethics
Lecturers	Prof. Dr. Drs. em Roland Mertelsmann, Prof. Dr. Schockenhoff, Dr. Philippe Merz, Dr. Ignacio Mastroleo, Dr. Felicitas Holzer and others
Duration	1 week
Academic performance	Lectures, Seminars, Excercises
Workload	Total workload of **62,5 h** ***Presence: 50h/ week*** 4 h/day: exercises 3,5 h /day: lectures 2,5 h /day: discussions ***Self-Study: 12,5h/week*** 2,5 h/day: self-study, preparation presentation case-studies
Creditpoints	2,5
Content	Professors from Biology and Medicine but also from Philosophy, Theology from ALU and UBA will give seminars and interactive workshops about Human Health and Research Ethics, Dignity, Biodiversity and Science, Technology and Innovation Policy for an entire week. Given the rapid advances in biomedical technologies such as whole genome sequencing, organism cloning or the generation of inducible stem cells, future scientists will become increasingly exposed to bioethical issues. It is therefore crucial to discuss such issues with our master students as early as possible during their career path.
■ Learning Outcomes	■ Students learn the importance of considering ethical aspects in biomedical sciences ■ Understanding the principles of bioethical research and its practical implementation

5.3. Module II: Pharmacology, Toxicology, Materials and Microsystems

Module II	Pharmacology, Toxicology (IIa), Materials and Microsystems (IIb)
Lecturers	Prof. Dr. Klaus Aktories, Dr. Robert Mallmann, Prof. Dr. Jürgen Rühe, Dr. Oswald Prucker
Duration	2 weeks
Academic performance	Lectures, Seminars and Practical work
Workload	Total workload: **125 h** ***Presence: 50 h/week*** 3 h/day lectures 2 h/day seminars 5 h/day lab work ***Self-Study: 12,5 h/week*** 2,5 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	PL: Oral and written examt

Module IIa	Pharmacology and Toxicology
Lecturers	Prof. Dr. Dr. Klaus Aktories, Dr. Robert Mallmann
Duration	1 week
Academic performance	Lectures, Seminars, Practical Work
Workload	Total workload of **62,5 h** ***Presence: 50 h/week*** 4 h/ day: Lectures and seminars 2 h/day: preparation of oral presentation 4 h/ day: practical course ***Self-Study: 12,5 h/week*** 2,5 h/day: self-study
Creditpoints	2,5
Content	The first part of this module offers basic and advanced knowledge about pharmacological studies of interaction between drugs (chemicals of synthetic or natural origin) and organisms (biological systems). Students will understand pharmacodynamic actions of drugs with a focus on drug-induced interaction with membrane receptors and subsequent signaling events. They obtain deeper insights into GPCR signaling as these receptors are responsible for most drug actions. Knowledge of the principles of structure and function of GTP-binding proteins (small GTPases and heterotrimeric G-proteins), will allow to understand their fundamental roles as general switch proteins in signaling and metabolism. They will be able to integrate up-to-date views of structures, regulation and physiological functions of ion channels in a general concept of drug action. Principles of toxic effects (risks and hazards) and pathogenetic mechanisms of drugs will be delineated by presentation of various groups of bacterial protein toxins, which act with extremely high potency and efficiency on target cells and organs.
■ Learning Outcomes	■ Participants have knowledge of the mode of action of drugs and poisons, in order to allow a scientifically based, rational pharmacotherapy and treatment of poisoning. - Receptor tyrosine kinases - Bacterial toxins - GPCR Signaling - Voltage-gated ion channels - GTPases ■ Participants have the ability to get into specific topics of the field by reading current publications and to interpret and communicate the data, which should be applicable to other subjects in life science. ■ The students are able to design and perform experiments to unravel basic actions of drugs.

Literature	1. Selected parts of “Rang & Dale’s Pharmacology”, 8th edition 2. Aktories K. Bacterial protein toxins that modify host regulatory GTPases. Nat Rev Microbiol. 2011;9(7):487-98

Module IIb	Materials and Microsystems for the Life Sciences
Lecturers	Prof. Dr. Jürgen Rühe, Dr. Oswald Prucker
Duration	1 week
Academic performance	Lectures, Seminars, Practical Work
Workload	Total workload of **62,5 h** ***Presence: 50 h/week*** 6 hrs/day: laboratory work 4 hrs/day: lectures ***Self-Study: 12,5 h/week*** 2,5 hrs/day: self-study (journal club work)
Creditpoints	2,5
Content	Special knowledge and state of the art methods for the generation, use and characterization of biomaterials are of great importance in Biomedical Sciences. For example polymers are used for implants (heart valves, breast implants, artificial joints, retina implants) as well as for drug release or dental materials. Biointerfaces are also a key for the performance of bioanalytical devices (e.g. lab-on-disc or lab-on-CD devices). The lecture submodule will give the students a basic introduction into the field of biomaterials used in various biomedical applications and into methods used to characterize such materials. A special focus is placed on the use of polymeric materials in biomedical applications and on methods employed for the generation of tailor-made biointerfaces. The importance of surface interactions of biomolecules with surfaces in vivo and in vitro will be discussed. Additionally, models describing the interaction of biological cells with artificial materials will be presented. The laboratory submodule will explore 1) the generation and use of DNA-chips for the detection of bacteria 2) the measurement of protein adsorption to surfaces by surface plasmon spectroscopy. 3) Students will study cells on microstructured surfaces with the help of Atomic Force Microscopy (AFM) and they will learn how to probe surfaces with small tips. The literature submodule will consist of instructions on the performance of literature work. The CPI research lab organizes a journal club for all students to help them keep up with the literature produced by others who work in the biomaterial area. Taking part in the journal club helps participants to become familiar with the advanced literature and data in in the biomaterial area. This helps to rapidly improve the students' skills of understanding and debating current topics of active interest in this field.
Learning Outcomes	■ Students obtain basic knowledge about biomaterials and microsystems. ■ Students will obtain a basic understanding of the interaction of biomolecules with surfaces.

	■ Students will gain an impression on the generation and use of selected, modern bioanalytical devices. ■ Students gain individual laboratory skills. ■ Students will become acquainted with the assessment and evaluation of scientific literature and also with interdisciplinary work.

5.4. Module III: Molecular Oncology (IIIa) and Cardiology (IIIb)

Module III	Molecular Oncology (IIIa) and Cardiology (IIIb)
Lecturers	Pro. Dr. Ralph Wäsch, Prof. Dr. Andreas Zirlik, PD Dr. Heiko Bugger , Dr. Ingo Hilgendorf, Dr. Peter Stachon,
Duration	2 weeks
Academic performance	Lectures, Seminars and Practical work
Workload	Total workload: **125 h** ***Presence: 50 h/week*** 2 h/day lectures 2 h/day seminars 6 h/day lab work or exercises/ presentation ***Self-Study: 12,5 h/week*** 2,5 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	SL: Oral test PL: Written exam

Module IIIa	Molecular Oncology
Lecturer	Prof. Dr. Ralph Wäsch
Duration	1 week
Academic performance	Lectures, Group Work, Exercises, Practical Work
Workload	Total workload of **62,5 h** ***Presence: 50 h/week*** 3 h/day: lecture 3 h/day: seminar 4 h/day: presentation ***Self-Study: 12,5 h/week*** 2,5 h/day: data analysis, documentation, and reading
Creditpoints	2,5
Content	Current selected topics in cancer research and diagnostic techniques: 1. Relevance of the genetics, including chromosomal aberrations and mutations, in the pathogenesis, diagnosis and therapy of myeloid malignancies 2. Targeting RAS and PI3K signaling in cancer: A large subset of difficult-to-treat cancers including pancreatic, lung and colorectal cancer harbor activating mutations within the RAS and/or PI3K signaling pathways. The lecture discusses current approaches to target oncogenic signaling in these tumors and also highlights novel approaches to bypass drug resistance. 3. Cell cycle control in cancer and stem cells with a focus of the role of the ubiquitin-proteasome system on genomic instability of cancer cells, its function on differentiation in hematopoietic stem and progenitor cells and implications for therapy are discussed. 4. Molecular Diagnostics in Hematology/Oncology including a current overview of the most important molecular diagnostic methods with the focus on the FISH technology. Important molecular markers in hematology and the necessity and technique of cell selection is discussed. In a second, practical part the students perform the pretreatment of FISH method and do short analyses using a fluorescence microscope. 5. Flow Cytometry: This course is designed to familiarize students with the basic principles of flow cytometry. Students will learn the technical principles behind flow cytometry, as well as how to apply them at both the theoretical and practical levels. The morning session consists of a lecture and the afternoon includes a practical session showing basic usage of flow cytometry in an example experiment.
■ Learning Outcomes	■ Basic concepts and techniques in the field of molecular biology of cancer are understood. ■ Participants have the ability to get into specific topics of the field by reading current publications and to interpret and communicate

	the data, which should be applicable to other subjects in life science. ■ The lectures impart on principles of personalized cancer medicine by understanding targetable individual cellular aberrations in selected malignant neoplasms, which is key in current oncology. ■ The practical application of important techniques for the diagnosis and evaluation of treatment outcome of cancers will be learned.

Module IIIb	Molecular Cardiology
Lecturers	Prof. Dr. Andreas Zirlik, PD Dr. Bugger, Dr. Stachon, Dr. Hilgendorf
Duration	1 week
Academic performance	Seminars, Practical work
Workload	**Total workload of 62,5 h** ***Presence: 50 h/week*** 3 h/day: lecture 4 h/day: seminar 3 h/day: practical course ***Self-Study: 12,5 h/week*** 2,5 h/day: data analysis, documentation, and reading
Creditpoints	2,5
Content	This module is focusing on recent key aspects of translational research in cellular and molecular cardiology. The participants will learn about basic immunologic and inflammatory mechanisms promoting atherosclerosis, myocardial infarction, and the metabolic syndrome as well as about the fundamental processes governing cardiac metabolism and dysfunction. The will practice standard techniques of molecular biology and physiology related to cardiovascular disease.
■ Learning Outcomes	■ Participants define and describe underlying mechanisms of cardiovascular disease focusing on inflammatory and immune mechanisms in atherosclerosis, myocardial infarction, and the metabolic syndrome, as well as cellular and energetics-related mechanisms of heart failure. ■ Participants perform and interpret results of state-of-the art techniques of molecular biology and physiology related to cardiovascular disease research

5.5. Module IV: Molecular and Cellular Biology (IVa), Immunology and Pathology (IVb)

Module IV	Molecular and Cellular Biology (IVa), Immunology and Pathology (IVb)
Lecturers	Prof. Dr. Dr. h.c. Christoph Borner, Prof. Dr. Georg Alexander Häcker, Prof. Dr. Paul Fisch, Prof. Dr. Bodo Grimmbacher
Duration	2 weeks
Academic performance	Lectures, Seminars and Practical work
Workload	Total workload: **125 h** ***Presence: 50 h/week*** 2 h/day lectures 2 h/day seminars 6 h/day lab work or exercises/ presentation ***Self-Study: 12,5 h/week*** 2,5 h/day: data analysis, documentation, and reading
Credit points	5
Academic test	PL: Written exam

Module IVa	Molecular and Cellular Biology
Lecturers	Prof. Dr. Dr. h.c. Christoph Borner, Prof. Dr. Georg Alexander Häcker
Duration	1 week
Academic performance	Lectures, Seminars, Practical Work
Workload	**Total workload of 62,5 h** ***Presence: 50 h/week*** 1,5 h/day: seminar 8,5 h/day: working in the lab ***Self-Study: 12,5 h/week*** 1 h/day: data analysis & documentation 1,5 h/day: reading
Creditpoints	2,5
Content	In this module a variety of biochemical and cellular tools and methods will be used to quantify apoptosis in eukaryotic cells by various biochemical and cellular methods. The goal is to get experienced with culturing, handling and counting both suspension and adherent mouse cells, to induce apoptosis either by growth factor deprivation or genotoxic stress, to then prepare a cell extract, measure protein content and caspase-3 activity in an fluorescent-based enzymatic assay and determine the levels of active caspase-3 and members of the Bcl-2 family by Western blotting. In addition, cells are subjected to flow cytometry analysis (FACS) to determine the proportion of apoptotic cells, which have phosphatidylserine exposed on the surface (detected with FITC-Annexin-V) and necrotic cells, which have a permeabilized plasma membrane and therefore allow the entry of the red fluorescent dye propidium iodide. Finally, the students learn to fix cells on coverslips, incubate them with various primary and secondary fluorescent labeled antibodies and perform an immunofluorescence analysis to determine the amount and subcellular localization of Bcl-2 family proteins and cytochrome c (which is retained in mitochondria in healthy cells and released into the cytoplasm in apoptotic cells). In this way they learn to properly handle a fluorescent microscope and to use photo capturing and the software to produce nice fluorescence pictures of eukaryotic cells. The students are organized into working groups of 3 to max 4 people, but each student performs the experiments with his/her own hand. This course is therefore a really HANDS-ON practice module. Each group is supervised by a senior PhD student or postdoc who assists them with the practical work, gives advice and introduces each method in the form of a seminar. The students also learn to critically and statistically analyze their data and to write a scientific lab report with the data obtained, which will be critically evaluated by the supervisors. If not satisfactory, the reports have to be corrected (Studienleistung).
Learning Outcomes	At the end of the Module the students have:

	■ Knowledge of cellular and biochemical methods on eukaryotic cells ■ Knowledge of rules and safety measures of genetically modified organisms and hazardous substances and the ability to work accurately under sterile conditions ■ Statistical analysis of the data ■ Proper logging and lab reporting

Module IVb	Immunology and Pathology
Lecturers	Profs. Dr. Paul Fisch, Prof. Dr. Bodo Grimmbacher
Duration	1 week
Academic performance	Seminars, Lab work, student's presentation of case records on clinical immunodeficiency cases
Workload	**Total workload of 62,5 h** ***Presence: 50 h/week*** 4 h/day: lectures 3 h/day: seminars incl. student's presentation 3 h/day: lab work ***Study: 12,5 h/week*** 1 h/day: reading, data analysis and documentation 1,5 h/day: preparation of the own presentation
Creditpoints	2,5
Content	This module contains two submodules: Immunology and Molecular Pathology. "Immunology" comprises lectures on special topics in advanced cellular and molecular immunology. We will discuss techniques in cellular immunology such as chromium release, proliferation assays and ELISPOT. Students will learn about tumor immunology, antigens recognized on human tumors and recent developments in immunotherapy of cancer. Separate topics will be human γδ T cells and natural killer (NK) cells. We will give an introduction into the principles of "NK education", target cell recognition and role in graft-versus host disease. Other topics will be allergic contact dermatitis, the innate immune system, the role of neutrophils in acute GvHD, regulatory T cells in human disease and antigen presentation as well as immune tolerance in the intestine. Students will prepare short presentations on case reports in immunodeficiency diseases with a summary of the scientific background. The submodule molecular pathology will demonstrate methods and essentials in molecular pathology and hematopathology, such as somatic mutations in human cancer and clonality analysis of human lymphocytes. We will also include a short course of histopathology of malignant lymphomas and leukemias.

Learning Outcomes	Participants will get an overview of the following topics: ■ Understanding the role of different components of the immune system in human disease. ■ HLA System class I and class II ■ Human natural killer cells: NK receptors, role in tumor defense and stem cell transplantation. NK education ■ Human $\gamma\delta$ T-cells: Subsets, molecular biology and role *in vivo* ■ TCR and Ig: Composition and function ■ Primary and secondary immunodeficiencies ■ Malignant Lymphomas ■ Acute and chronic Leukemias ■ Hematopoetic cell transplantation: Immunological aspects ■ Tumor immunology ■ Analysis of clonality in B cells and T cells using conventional methods and next generation sequencing

5.6. Module V: Laboratory Research

Module V	Laboratory Research
Lecturers	All Faculty at ALU
Duration	5 months (22 weeks / 110 days)
Academic performance	Practical Work and Self Study
Workload	**Total workload of 475 h** ***Presence: 22 h/week*** 22 h/week: Laboratory work including documentation
Creditpoints	19
Content	Laboratory Research includes an intensive period of laboratory work including documentation, self-study and discussion about methods and results. Participants choose from the participating faculties either one lab for eight weeks, or two labs for four weeks each, where they experimentally work on a defined research project to get data, which are then analyzed and documented and in the end presented in the form of a 30 min oral seminar. The goal of this module is to learn as many techniques and methods possible, to accurately mine data at the bench using the right controls and a correct statistical analysis, to critically assess own data and the data of their lab mates, to participate in lab seminars to discuss science, to read and present the relevant literature and present the progress of the laboratory research in seminars in front of the research group or the institute. In most cases the research topic is continued in the same lab(s) for the subsequent master thesis. However, the students can change the topic and/or the research lab after the lab research and start with something entirely new for the master thesis.
Learning Outcomes	■ Participants learn in-depth about methods and documentation during hands-on ■ They should be able to adapt methods to specific questions ■ They understand all principles of laboratory work in the chosen laboratory/laboratories
Academic test	SL: lab protocoll PL: Oral presentation

6. Part III: Research Project and Master Thesis

The master thesis takes place from June to January each year. Usually Argentinian students go back to UBA because they are part of an integrated master/PhD program where the topic of the master thesis continues into the PhD. Others can choose their topic at any research lab at the Faculties of Biology, Medicine, Engineering, Chemistry and Pharmacy at ALU or Medicine, Pharmacy and Biochemistry at UBA.

Each master project in the IMBS program is co-supervised by a professor from ALU and a professor from UBA. The team accompanies the master student throughout his/her thesis and is regularly contacted by him/her for advice, reorientation of the project and other problems, which may arise during the thesis. The co-supervising team also assesses the written document of the master thesis before the defense and eventually asks for corrections or additions if not satisfactory. The jury for the master thesis defense consists of a member of the Faculty of Medicine and two other professors from UBA and ALU, who are not the same as the thesis co-supervisors. This ensures an independent assessment of the written thesis work and the oral presentation (defense) and is therefore a crucial in-built quality control of our IMBS program. Thanks to the co-supervision principle of the master theses, we have established intense collaborations between the research groups at both universities since 2008.

During the master thesis at ALU or UBA, we organize soft skill courses such as scientific writing, Intercultural competence, presentation techniques, project management, intellectual property rights, from translational research to real innovations, didactics and teaching as well as career mentoring for academia and industry (Appendix 1). Moreover, at both universities numerous transferable skill courses and activities such as sports, music, arts are available. At ALU this is mainly through the Spemann Graduate School of Biology and Medicine (SGBM) and the International Graduate Academy (IGA) as well as the University Centre for Sports and the Music Academy. Thanks to SGBM the IMBS students will also have access to numerous methods courses such as proteomics, genome sequencing, microscopy imaging techniques, animal handling, etc.

After completing the master thesis from June to January, the IMBS students defend their work in a 20-minute presentation followed by a 40-minute discussion (after a total of 24 months). The defense will either take place at ALU or UBA depending on where the master thesis was performed. It always involves the evaluation by professors from both universities and finally yields two master degrees, a Master in Biomedical Sciences from UBA and a Master of Science (M.Sc.) from ALU (involving the same number of ECTS points mutually accredited to each degree).

Nr	MODULES	Type of course	Credit points	Semester	Type of exam
	University of Freiburg or University of Buenos Aires (30 ECTS)				
	Master Module		30	3 und 4	SL: lab protocol PL: Master thesis PL: Master Thesis Defense
	Subtotal		**30**		
	TOTAL Creditpoints		**120**		

6.1. Master Module

Master Thesis Research, Master Thesis and Defense

Lecturer	All UBA and ALU Faculty
Duration	8 months (30 weeks)
Academic performance	Practical Work, Self-Study
Workload	**Total workload of 750 h** ***Presence: 30 h/week*** 25 h/week: Laboratory research 5 h /week: lab protocol ***Self-Study: 15 h/week*** 10 h/week: Master Thesis writing 5 h/week: preparation for the Master Thesis Defense
Credit Points	30
Content	For the first 6 months, the student practically works on a biomedical project in any of the research groups associated with the IMBS program. The project has to be designed in a way that the student learns a great variety of different methods. Moreover, it has to be based on preliminary data on which the student builds his/her experiments to get own results, which he/she can wrap up into a master thesis. During the practical work, the master student has to regularly present progress reports within the group and/or at the institute, is obliged to read the relevant literature and to regularly present research papers and participate at literature seminars. The master thesis has to be supervised by a professor of the master program who regularly meets the student for progress updates. In addition, a co-supervisor of the partner university is assigned for each master thesis project who can be contacted by the master student on demand and gets informed about the state of the experiments after 3 months in form of a written report and a teleconference between the student, the supervisor and the co-supervisor. At this time, all master students also need to present their progress to the IMBS professor team of the respective university. Moreover, a senior PhD student or postdoc shall supervise the practical work of the master student on a daily basis. He/she merely provides technical and methodological

	input and support and ensures that the master student uses the right controls and statistical analysis in his/her experiments. In the last 2 months of the thesis, the master student assembles the data and writes the master thesis in English. If possible part or all of the data shall be published in a scientific journal. The supervisor and the co-supervisor of the partner university have to read the thesis in advance to make sure that it is formally correct and can be submitted. In the end both write a report about the written master thesis, which will be graded (written exam). The master student then defends the thesis in a 60 min final colloquium (30 min. presentation and 30 min. discussion) at either ALU or UBA (oral exam)
Learning Outcomes	■ Acquisition of skills and experience in biomedical research, analysis, presentation and publication ■ Acquisition of skills and experience in biomedical research, analysis, presentation and publication
Academic test	SL: lab protocol PL: Master Thesis and Master Thesis Defense
Content	
	■

Annex: IMBS Teachers

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