

University of Tübingen

PHD PROGRAM EXPERIMENTAL MEDICINE





WHAT IS INSIDE?

Welcome from the Dean	3
The PhD program in a nutshell	4
Welcome	5
Components of the PhD program	6
Training components	7
Program schedule	8
Creating a research network	9
Selection and admission	10
Main Research Areas	11
Eligible modules in the PhD program	12
Infection medicine and microbiology	14
Immunology	16
Oncology	18
Neurosciences	20
Cardiology & vascular medicine	22
Imaging science	24
Biomedical engineering	26
Biometry	28
Support for international students	29
Eberhard Karls Universität Tübingen	30
The Faculty of Medicine	31
The town of Tübingen	32
How to reach us	34
What our students are saying	36
Good to know	37



WELCOME FROM THE DEAN

Society depends on dynamic and innovative research carried out by excellent, well-educated investigators. With the establishment of the PhD program *Experimental Medicine*, we have achieved a milestone for the promotion of a new generation of researchers committed to integrating science and medicine.

The Faculty of Medicine Tübingen is one of the top medical schools in Germany and is characterized by interdisciplinary, international and innovative research and teaching. We can look back at major advances in clinical and basic biomedical research, particularly in our primary research fields – neuroscience, immunology, oncology, infection biology, imaging science, biomedical engineering, diabetology and vascular medicine.

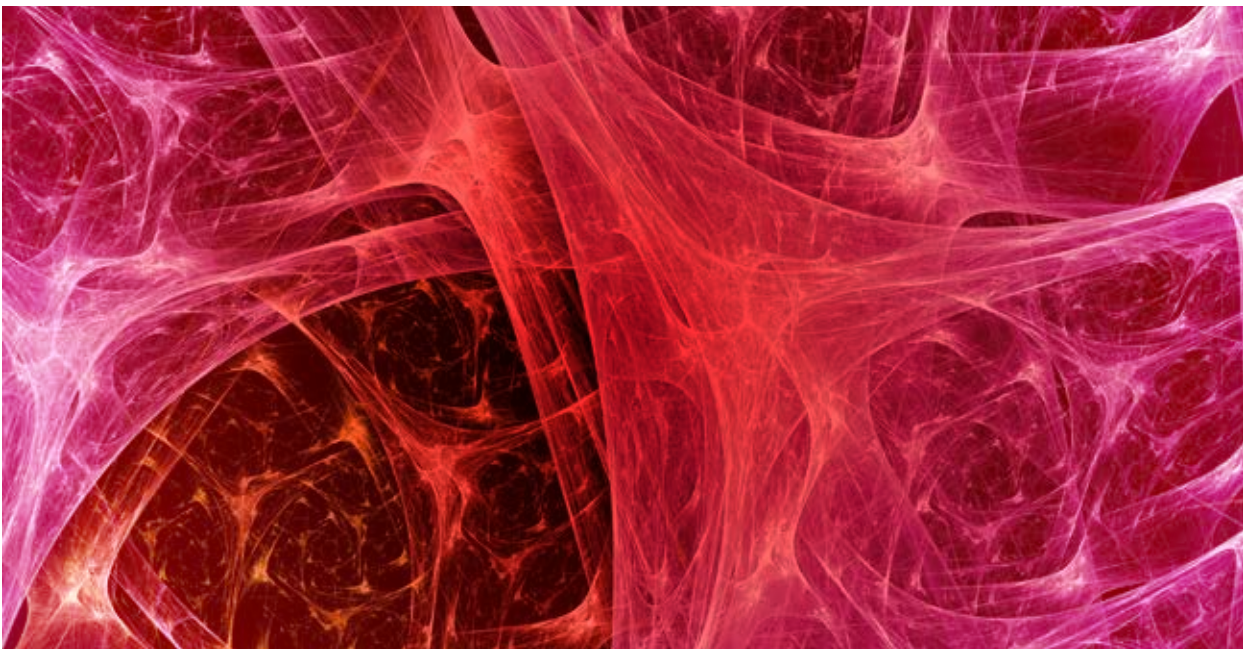
These achievements were reached by crossing the boundaries between basic and applied research and across subject areas to cover the entire field of the life sciences. We believe in the power of united resources and maintain alliances for research with internationally respected interdisciplinary centers and major institutions around the world. Intense collaborations with national research entities like Max Planck Institutes, Leibniz Institutes, Helmholtz Centers and Fraunhofer Institutes are important pillars in this network.

Furthermore, we believe that the strong collaboration between our research institutes and clinical departments have played a key role in many important advances in human medicine. By further expanding opportunities for active physician-scientists, we strive to keep this momentum going.

As part of this strategy, the PhD program was designed to enable you to graduate in basic medical science while providing medical doctors with the unique possibility to combine the required clinical internships with a profound, research-focused education.

Attracting the best students to our Faculty will support us in reaching our foremost aim of maintaining our status as Excellence University with international visibility and recognition and further consolidating our position as an internationally leading Faculty of Medicine.

Prof. Ingo Autenrieth
Dean of the Faculty of Medicine



THE PHD PROGRAM IN A NUTSHELL

VISION	To strengthen the link between science and applied medicine by preparing and equipping excellent students for a career in life science
OBJECTIVES	To provide excellent young researchers in medicine and the life sciences with advanced professional qualifications for a career in research
UNIVERSITY	Faculty of Medicine of the Eberhard Karls Universität Tübingen, Germany
REQUIRED DEGREE	Degree in medicine or a Master of Science in the life sciences or related disciplines
RESEARCH AREA	All areas of biomedical and clinical research, with a focus on infection medicine & microbiology, immunology, oncology, neurosciences, cardiology / vascular medicine, imaging science and biomedical engineering
DEGREE	PhD or MD/PhD double degree
TUITION FEES	None
BEGINNING	Winter semester (October) or summer semester (April)
PROGRAM DURATION	Six semesters (three years), with a possibility to combine the program with medical studies and/or medical residency
APPLICATION DEADLINE	Announced on the website
WEBSITE	www.medizin.uni-tuebingen.de/PhD
COMPONENTS	Individual research project under interdisciplinary supervision (150 ECTS) + academic training (30 ECTS) in compulsory and elective subjects
FUNDING	Doctoral students are usually financed through grants for their research projects or through scholarships. For more details see page 37



WELCOME

We welcome your interest in our international PhD program, which was established in 2012 with the primary goal of providing strongly motivated medical doctors and natural scientists with excellent professional qualifications for advanced career options in biomedical and clinical research.

With our program we have responded to the evolving demands of preparing tomorrow's medical science professionals, including state-of-the-art experience in a specialized research area, sound multidisciplinary proficiency, the establishment of networks with peers and collaborators and active participation in scientific discussions and communications.

We offer you a high-quality, personalized educational program and close supervision by internationally acknowledged scientists accompanying your individual PhD projects. Research is carried out in an international, interdisciplinary

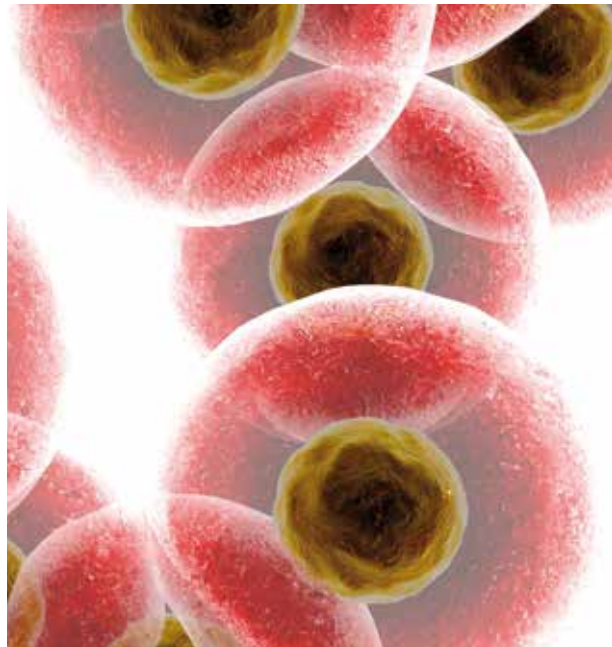
environment at the medical faculty of one of Germany's top-ranked universities. While focus is placed on the experimental work on your research project, this is complemented with in-depth training in various state-of-the-art methods as well as general professional skills ranging from statistics to grant-writing.

Our program is intended for the best international students in natural sciences and medicine. For medical doctors seeking an MD/PhD double degree, our program allows you to combine your drive to work as a clinical fellow (including the required internships) with your enthusiasm for active participation in clinical or basic medical research.

This brochure presents the different components of our program, gives some insights into the research projects and invites you to be part of this innovative vision.

Professor Dr. Bernd Pichler
Program Chair

COMPONENTS OF THE PHD PROGRAM



The three-year PhD program consists of three pillars: your research, your supervision and your training.

RESEARCH

The main component is the individual research project to be submitted in form of a doctoral thesis. Research projects are carried out in hospitals and institutes of the Faculty of Medicine or the Faculty of Science at the Eberhard Karls Universität Tübingen. These projects must promise a significant impact on medical research.

As a doctoral candidate, you will

- pursue your research project independently,
- solve defined scientific problems within a set period of time, using suitable methods
- develop new ideas
- acquire new skills, tools and knowledge
- cooperate with colleagues
- communicate your research questions and results.

Following the guidelines of good scientific practice, it is expected that important results will be published in peer-reviewed articles.

SUPERVISION

During your PhD study, you are supervised by a group of three excellent scientists from the Faculty of Medicine, the Faculty of Science or external research institutes. These supervisors form your doctoral committee and are appointed by the PhD board, an elected committee of 6 full time professors of our university.

During an annual report meeting between the candidate and the doctoral committee, your research and the course work is assessed. The purpose of this review is to

- encourage discussion between the candidate and the doctoral committee
- monitor progress
- highlight achievements
- identify problems
- set goals
- enable timely completion of the thesis.

TRAINING

Additional to the PhD research, an individual academic course program (lectures, seminars, laboratory training) is defined to equip you with useful knowledge and skills.

Training
(30 ECTS)

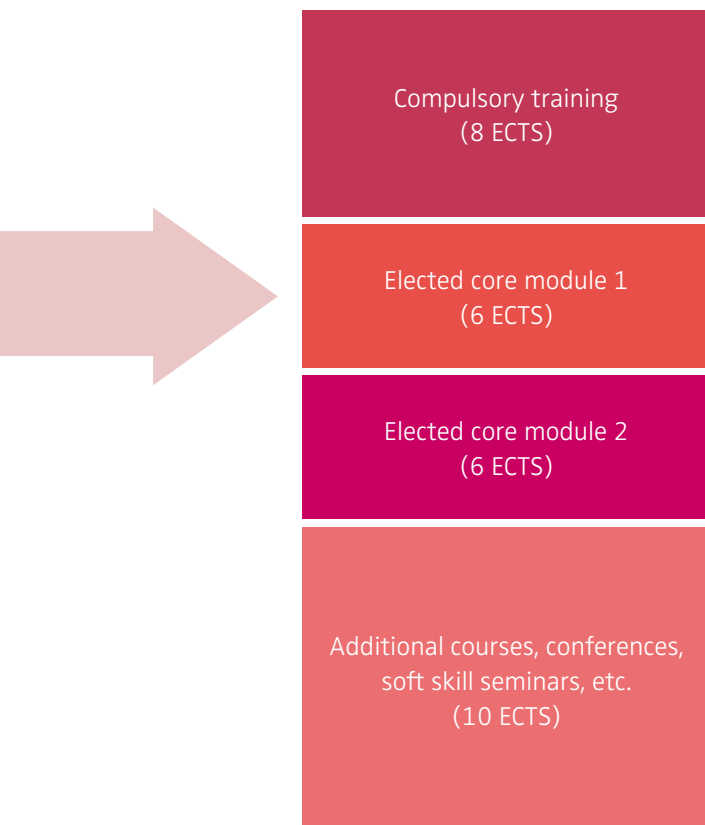
PhD thesis
(150 ECTS)



TRAINING COMPONENTS

Specialized courses and seminars – compulsory and elective – are taught in small groups to equip you with useful knowledge and skills. Your individual training plan is designed in collaboration between you and your doctoral committee and confirmed by the PhD board.

TRAINING



Compulsory components of your training include a lecture series where topics of broad interest like research funding, good scientific practice, animal care in research, data safety or “how to apply for a grant” are discussed. The annual off-site retreat is also part of the compulsory program.

Elective technical and practical modules are offered in the faculty’s main research focus areas. Training includes innovative teaching techniques like problem-based-learning courses, case studies and lab rotations. You select two core modules, in which you take 6 ECTS each.

Elective additional courses complementing your previous training qualify you for interdisciplinary research projects. A large catalog is available, including advanced seminars, courses in soft skills and professional skills, strengthened by the links between the PhD program and the central graduate academy of the university.

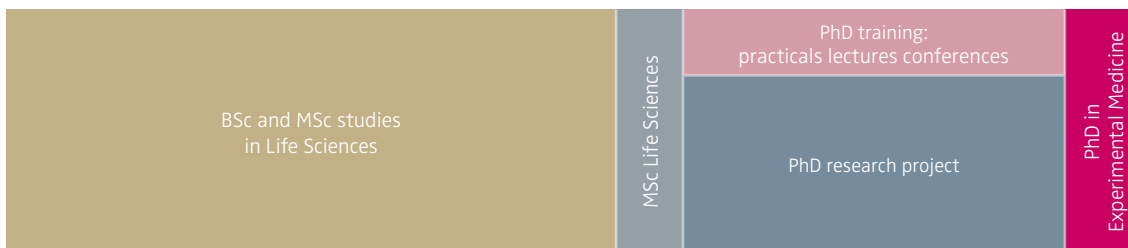
ANNUAL OFF-SITE RETREAT

We organize an annual off-site retreat for all PhD students. The program of each retreat is elaborated between the student representatives, the coordination office and the faculty. During the two-day event, students have the possibility to present their research plans and first results with a talk or a poster. Here you get feedback from an interdisciplinary audience, establish cooperations with other students or researchers from the faculty and spend a great time in the beautiful setting of a monastery in the Swabian Alps.

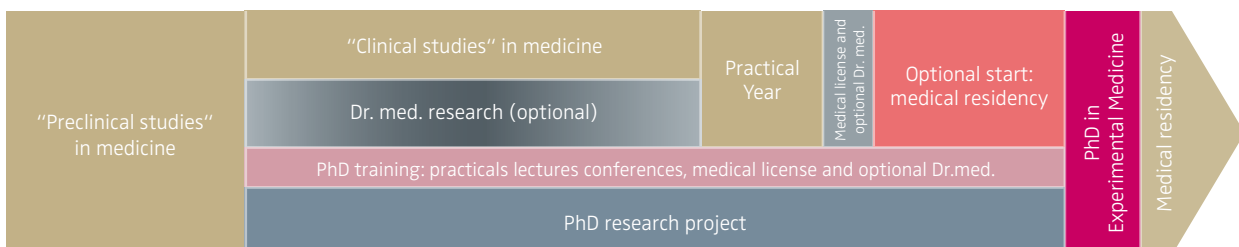


PROGRAM SCHEDULE

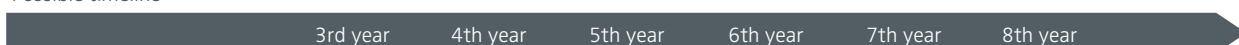
The PhD program is designed for 3 years. Nevertheless, the time schedule can be adapted individually. A “standard” schedule for a PhD candidate holding a MSc in Life Sciences would be as follows:



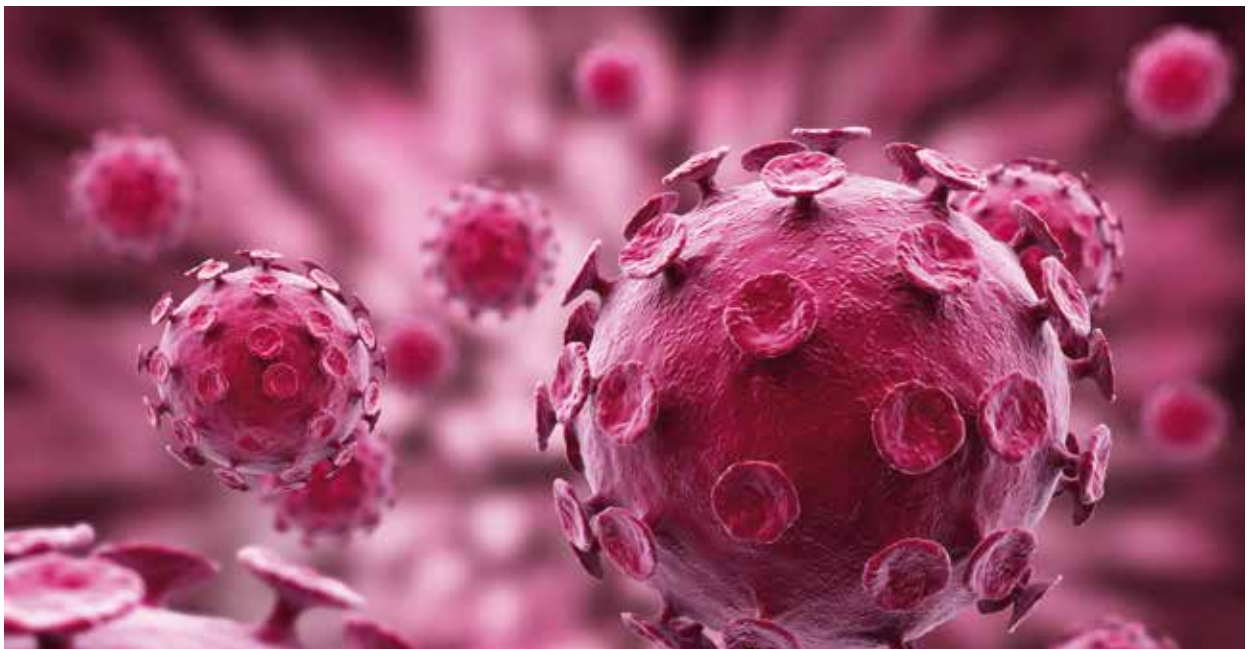
A special feature of our program is the possibility of receiving the double academic degree MD/PhD*. The double degree program is geared toward those students seeking a challenging, research-oriented medical education while acquiring in-depth scientific training at an early stage in their career. Its establishment pursues our strategic goal to strengthen the “bench-bed-side connection” through a second training line for those prospective physicians who want to focus on research and become qualified for a career in science. For these research-oriented physicians, we find individual solutions to allow them to combine medical education with PhD research.



Possible timeline



* In Germany, the academic title “Doctor in Medicine”, abbreviated with “Dr. med.” is acknowledged after the completion of medical studies and a research project culminating in a scientific dissertation. It is optional and in addition to the academic studies of medicine, however, in Germany it is highly recommended for your career and reputation as a physician.



CREATING A RESEARCH NETWORK

During your PhD study, you create a valuable research network for your future scientific career.





SELECTION AND ADMISSION

APPLICATION STEP BY STEP

Prerequisites for admission to the PhD program are:

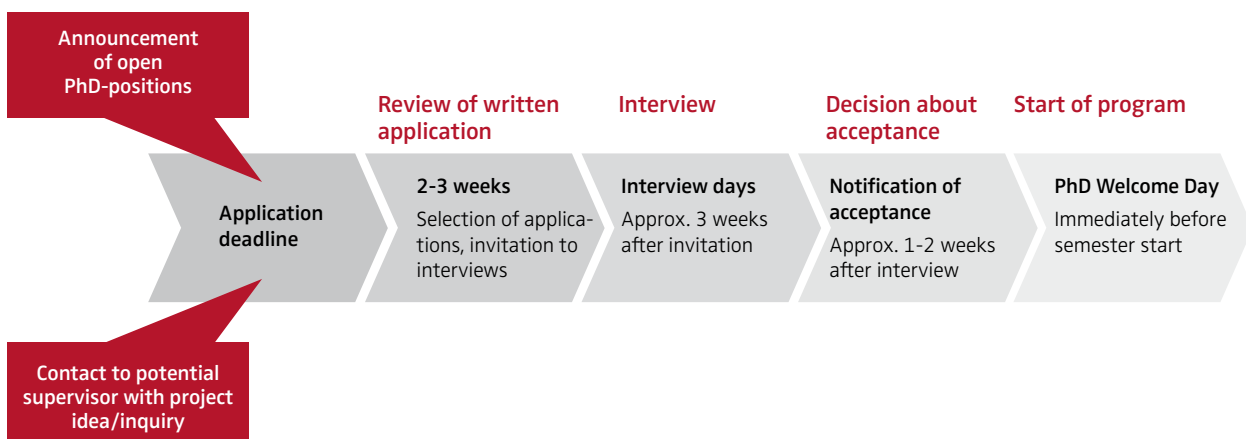
- a.) Graduation from medical school or a Master of Science or German diploma degree in the life sciences and related disciplines
- b.) Acceptance by an authorized academic supervisor at the Faculty of Medicine Tübingen
- c.) Excellent academic grades in previous studies and previous research experience.

There are two ways to start the application process: by applying to announcements of open PhD positions or by contacting a potential supervisor directly with your own project idea or inquiry.

Applications are subjected to initial screening by the PhD Board based on the academic qualifications of the candidate and the feasibility of the proposed PhD project. Promising candidates will be notified within 2-3 weeks after the application deadline with regard to their participation in a personal interview.

The purpose of the interview is to determine the motivation, special scientific qualifications and the suitability of the candidate for the planned research project. The selection board consists of three members faculty who will assess the applicant's academic career up to that point, as well as the quality and the feasibility of the planned research project.

The candidate will be expected to give a 10 min oral presentation in English about the proposed PhD project. The presentation is followed by a 15 min discussion where the candidate's qualifications and the proposed project will be evaluated in greater detail.



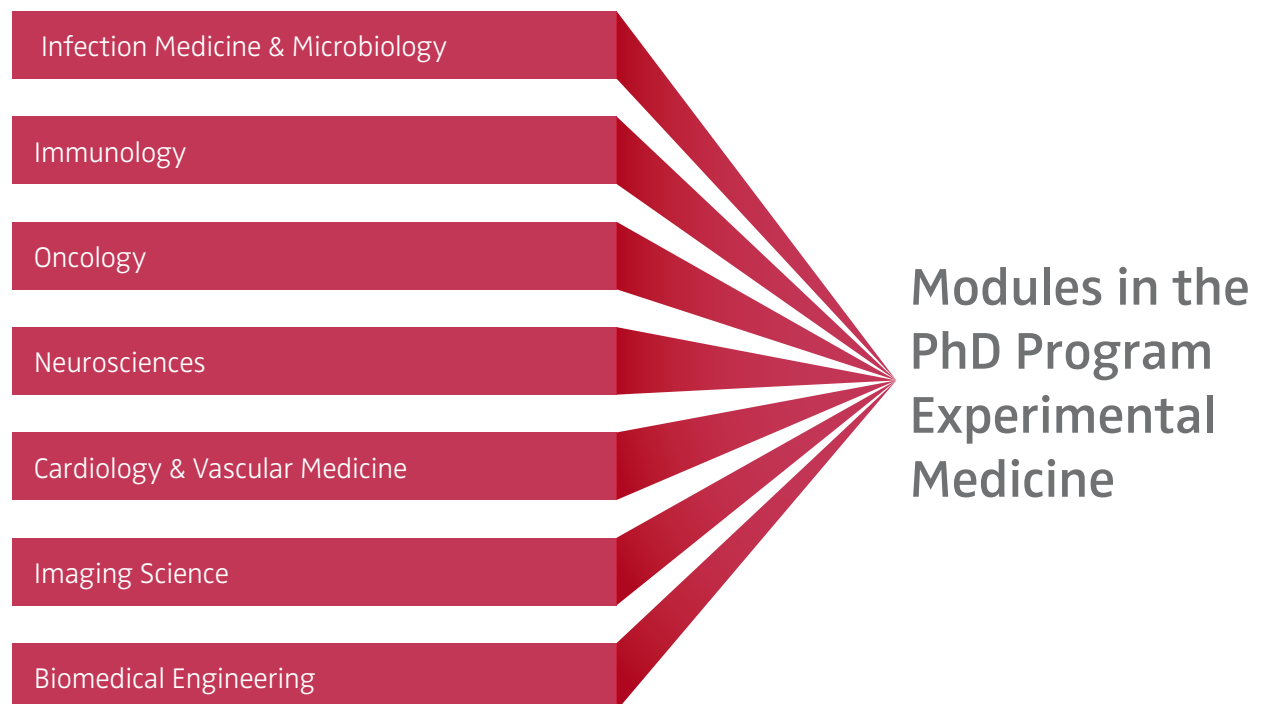


MAIN RESEARCH AREAS

The multidisciplinary training within the PhD program is offered by representatives and experienced teaching staff of the research focus areas of the Faculty of Medicine Tübingen. The elective program includes innovative techniques like

problem-based learning courses, case studies and lab rotations. Training is further strengthened by taking advantage of the diverse networks between the research areas and access to state-of-the-art research facilities.

The Eberhard Karls Universität Tübingen specializes in a number of innovative fields of research:



ELIGIBLE MODULES IN THE PHD PROGRAM

Infection Medicine & Microbiology

Immunology

Oncology

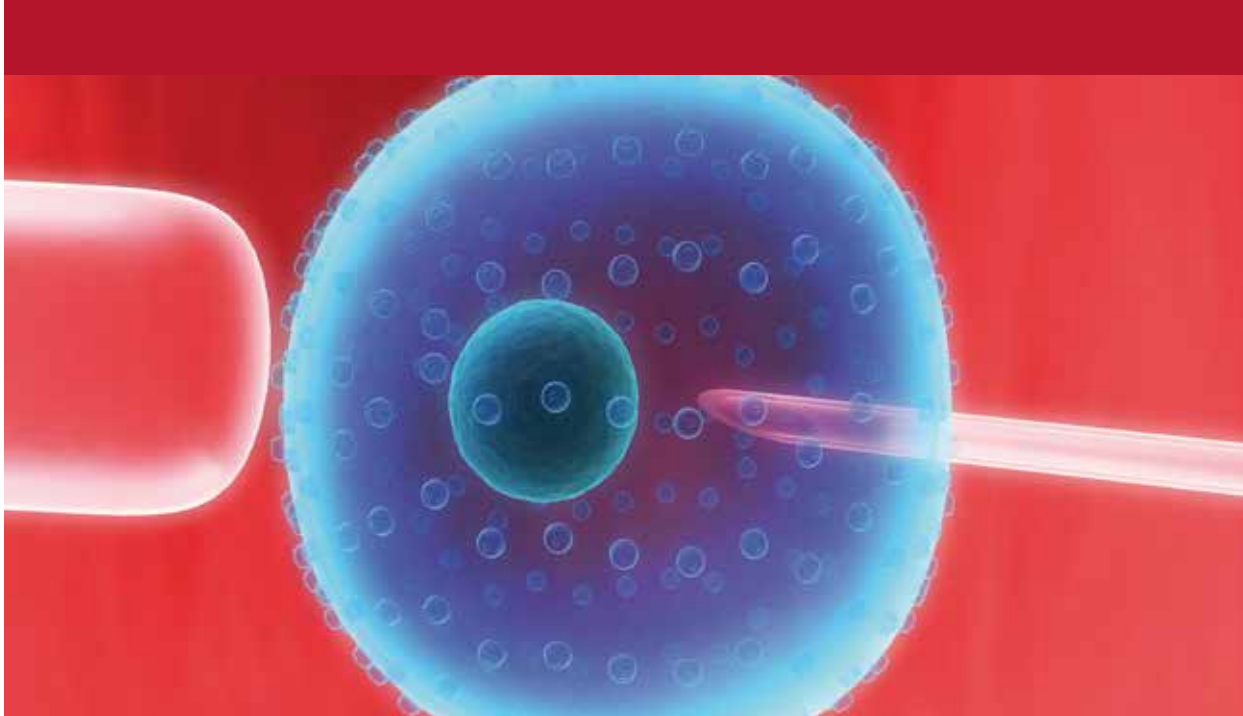
Neurosciences

Cardiology & Vascular Medicine

Imaging Science

Biomedical Engineering

Biometry



INFECTION MEDICINE & MICROBIOLOGY

Microbes play a pivotal role in the world we live in and have influenced and even shaped our lives through millions of years of co-evolution. While microbes have been domesticated for food processing since ancient times and were recognized as causative agents of infectious diseases by Koch and Pasteur in the late 19th century, we only now start to grasp the full complexity of the microbial life in and around us. Sequencing of the metagenomes of microbial communities has begun to reveal the fine balance between commensals and pathogens and their influence on obesity, diabetes, inflammatory bowel diseases, and even mental disorders.

The increase in information on microbial genomes has also greatly promoted our understanding of the spread and evolution of pathogens and of their traits of virulence, in particular concerning antibiotic resistances. Whilst not long ago, there was a great hope to control or even eradicate microbial infections, we now have to realize that many infectious agents persist or even re-emerge – even in industrialized countries. This is why the interplay between microbes and their human host is the subject of intensive investigation. Understanding that interplay at the molecular level is a prerequisite both for the much-needed development of novel anti-infectives and vaccines and for the establishment of probiotic therapy.

INFECTION MEDICINE AND MICROBIOLOGY IN TÜBINGEN

Research in microbiology and infection medicine is a cross-faculty focus area at the University of Tübingen and enjoys an outstanding international reputation. The University of Tübingen boasts a strong and dynamic translational research

community thanks to the close collaboration between first-class basic and clinical research units, in particular within the framework of the German Center for Infection Research (DZIF).

The module Infection Medicine and Microbiology is hosted jointly by the Interfaculty Institute of Microbiology and Infection Medicine Tübingen (IMIT) and the Institute of Tropical Medicine. Established in 2009, research at the IMIT focuses on infection biology, microbiomics, bacterial physiology, and antimicrobial compounds. The institute hosts the Collaborative Research Center 766 “The Bacterial Cell Envelope” and the TransRegio 34 “Pathophysiology of Staphylococci”, and it participates in the Priority Program 1656 “Intestinal Microbiota” of the DFG. The Institute of Tropical Medicine is one of Germany’s foremost centers for tropical medicine and translational research. It hosts the competence center for tropical medicine in southwest Germany and stands out with its international focus and expertise in clinical research on vaccines, drugs and diagnostics for malaria and other globally important infections. The Institute of Tropical Medicine and its African partner institution CERMEL (Centre de Recherches Médicales de Lambaréné) contributed to the development of most currently used antimalarials and plays an important role in malaria vaccine development

INFECTION MEDICINE AND MICROBIOLOGY IN THE PHD PROGRAM

Training within this research area is linked to the university’s Interfaculty Graduate School of Infection Biology and Microbiology (IGIM), which aims to provide a comprehensive and



multi-disciplinary structured education for post-graduate students. Among other things, the module Infection Medicine and Microbiology offers lecture courses with international speakers, literature seminars, and practical training courses in advanced microbial pathogenesis and clinical trials. Potential research projects for PhD students in this module cover mechanisms of staphylococcal colonization, metabolic adaptation, and fitness, functional principles of virulence-associated secretion systems, and the role of the intestinal microbiota in chronic inflammatory or infectious disorders. A focus on translational research is also possible. Clinical trials, performed in Tübingen and tropical countries open the opportunity for projects on drug and vaccine efficacy, safety, surrogate markers and diagnostics. In addition, students are always invited to bring their own suggestions for projects on related research topics.

PUBLICATIONS

RTS,S clinical trials partnership et al. (2012). A phase 3 trial of RTS,S/AS01 malaria vaccine in African infants. *N Engl J Med* 367:2284-95.

Peschel A, Otto M (2013) Phenol-soluble modulins and staphylococcal infection. *Nat Rev Microbiol.* 11:667-73.

Held J et al. (2013). Novel approaches in antimalarial drug discovery. *Expert Opin Drug Discov* 8:1325-37.

Diepold A & Wagner S (2014) Assembly of the bacterial type III secretion machinery. *FEMS Microbiol Rev* 38:802-22.

Gronbach K et al. (2014). Endotoxicity of lipopolysaccharide as a determinant of T-cell-mediated colitis induction in mice. *Gastroenterology* 146:765-75.

MODULE COORDINATOR



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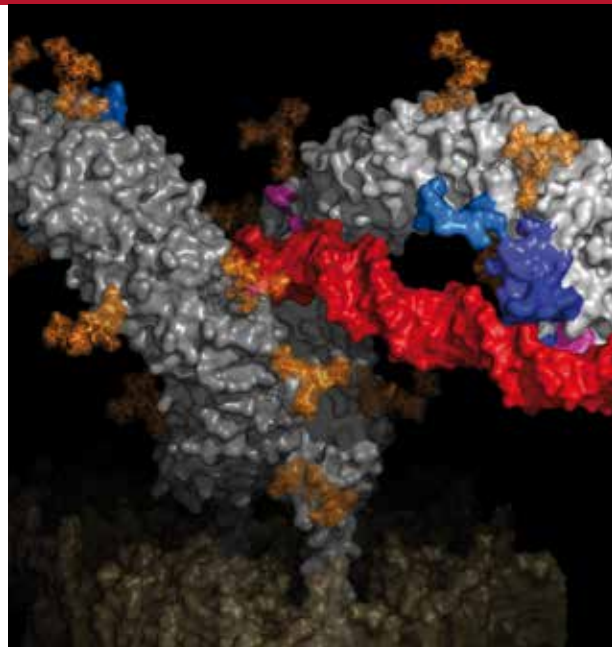
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IMMUNOLOGY

Immunology is one of the key research areas in current biomedical science. Immunological processes influence not only a wide-range of infection-related diseases, but also diseases not previously thought to be related to the immune system, such as neurodegenerative or metabolic disorders. In addition, immunology could be the key to a more effective therapy of cancer. Both basic research and therapy are increasingly dependent on an understanding of immunological processes in order to solve current problems in medical and life science research. Immunology is a highly dynamic, competitive and exciting research area, and a great many analytical and diagnostic techniques are based on immunological principles. A sound theoretical and practical background in the principles of immunology has become vital even for clinicians and for researchers in other life science disciplines.

IMMUNOLOGY IN TÜBINGEN

The University of Tübingen's Department of Immunology (Director: Prof. Hans-Georg Rammensee) has an outstanding track record in the field of adaptive and innate immunology, both in basic and translational research. Its expertise is backed by state-of-the-art infrastructure and confirmed in the successful acquisition of funding through German and European funding programs. Key research initiatives include the development of peptide-based vaccines for individualized immunotherapy of cancer and the concomitant immuno-monitoring of cancer patients. Peptides are identified on tumor cells by state-of-the-art mass spectrometry and whole genome sequencing. Both these peptides and the corresponding therapeutic anti-

bodies are synthesized in an in-house GMP facility and tested clinically in cooperation with the University Hospital Tübingen. Another important aspect of research within the Department of Immunology involves investigating the role of the pattern recognition receptors of the innate immune system and how this system of danger sensors is affected by inter-individual genetic variation. The latter research integrates biocomputational, biochemical, molecular biological, immunological and epidemiological approaches with the goal of developing diagnostic tools for patient stratification and disease prevention.

Close ties exist between the Department of Immunology and the University Hospital Tübingen, where immunological research is conducted in several departments such as the Department of Dermatology (Chair: Prof. Martin Röcken). The Department of Dermatology includes an allergy unit, a unit for sexually transmitted infectious diseases, a unit for autoimmune diseases, and a section for oncology, where clinical studies are carried out on patients with cancer, autoimmune disease or allergy. Its diagnostic laboratories have extensive experience in immune diseases and routinely perform skin histology, immunofluorescence, autoantibody testing, electron microscopy and molecular diagnostics. The research laboratories include units for tumor immunology, molecular cancer research, allergy, innate immunity (inflammasome research), adaptive immunity (T cell and dendritic cell research), autoimmune diseases and immunotherapies. A broad methodological spectrum is established covering cellular immunology, molecular immunology and experimental models. A cell sorter unit is also located at the Department of Dermatology.



IMMUNOLOGY IN THE PHD PROGRAM

Potential research projects for PhD students include molecular mechanisms of NLR Inflammasome activation, functional studies of disease-associated TLR genetic variants or the assessment of oncogenic TLR mutations in diffuse large B cell lymphoma and chronic lymphocytic leukaemia.

Sharing a common vision for excellence in graduate education, the Departments of Immunology and Dermatology jointly offer immunological training within the PhD Experimental Medicine program, either as a core module or in individually selected courses. These include seminars on the principles of innate and adaptive immunity to establish a broad yet thorough theoretical basis in multiple aspects of immunology, practical courses on immunological methods to equip students with basic immunological methods, journal clubs on innate immunity and pattern recognition receptors, applied immunology, and oncological immunology to help students stay abreast of the latest trends in the field, and colloquium series featuring scientists of international acclaim, giving students the chance to meet the experts and leaders in their fields.

PUBLICATIONS

Klimosch SN et al. (2013) Functional TLR5 genetic variants affect human colorectal cancer survival. *Cancer Res* 73(24):7232-42.

Eckert KJ et al. (2013) The Crystal Structure of Lipopolysaccharide Binding Protein Reveals the Location of a Frequent Mutation that Impairs Innate Immunity. *Immunity* 39(4):647-660.

Ghoreschi K et al. (2010) Generation of pathogenic Th17 cells in the absence of TGF- β signaling. *Nature* 467(7318):967-71.

Braumüller H et al. (2013) T helper 1 cell cytokines drive cancer into senescence. *Nature* 494(7437):361-5.

Gay NJ, Gangloff M, Weber AN (2006) Toll-like receptors as molecular switches. *Nature Reviews Immunology* 6:693-8.

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ONCOLOGY

Cancer is a major public health problem, but it is also an exciting field for research and innovation. The last decade has witnessed an explosion of knowledge about tumor development, genetic alterations, molecular mechanisms of therapy resistance including DNA repair processes and many other aspects of tumor biology. In most cases, however, these findings have yet to be translated into clinical practice. In addition, increasing knowledge about distinct genetic alterations and an amazing heterogeneity not only across different tumor entities but also across patients with similar tumors are strong arguments for the development of personalized targeted therapies that are adapted to the individual patient. This ambition of modern oncology means an increasing demand for medical doctors who command a thorough understanding of the molecular basis of both tumor development and targeted therapeutic regimens.

ONCOLOGY IN TÜBINGEN

Oncology is a major research focus of the Faculty of Medicine and the Faculty of Science. More than 25 departments in Tübingen pursue basic, translational and clinical oncology with a major goal of translating research findings into novel treatment approaches and innovative clinical trials.

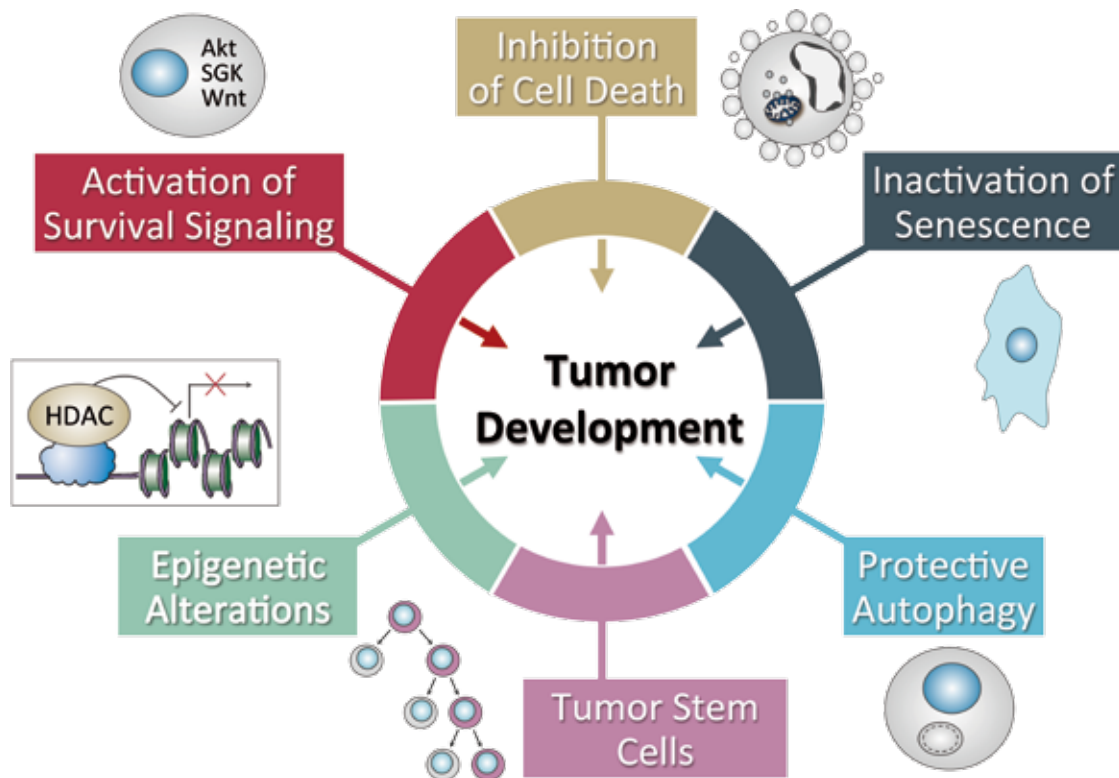
A central hub of our activities is the Comprehensive Cancer Center (CCC) Tübingen, which has been awarded the status of ‚Oncology Center of Excellence‘ as one of the first four cancer centers in Germany. The CCC provides multidisciplinary cancer diagnosis and treatment and carries out innovative clinical trials, competitive translational research programs

and many training activities that are continuously evolving and improving. In addition, owing to its cutting-edge cancer research, the University of Tübingen has been selected as a member of the German Consortium for Translational Cancer Research (DKTK), a long-term partnership of the German Cancer Research Center with seven German university sites, and it is involved in a number of research networks funded by national and European funding agencies.

Oncology research requires strong links to other disciplines such as immunology, imaging, pharmacogenomics and bio-informatics. The University of Tübingen is a world leader in the field of tumor immunology and the development of novel cancer immunotherapies. It also hosts the DFG-funded Collaborative Research Center dedicated to the biology of T cell differentiation and the interplay of immunogenicity and tumor immune escape. Functional genomics to unravel new mechanisms of therapy resistance and the study of intracellular signal transduction mechanisms – focusing on autophagy and senescence - are other core research areas. Additional emerging fields of our research include cancer stem cells, drug development, oncolytic virotherapies, DNA repair mechanisms and high-precision image-guided radiotherapies.

ONCOLOGY IN THE PHD PROGRAM

Potential research projects for PhD students include shRNA screens for the detection of novel targets to overcome radiation resistance of gastrointestinal tumors, the role of SDF-1/CXCR4 for calcium signaling and radiation-induced migration of glioma cells and preclinical evaluation of multiparametric



models for individualised prescription of radiation dose in head and neck cancer using metabolic imaging and gH2AX-foci assay. Students are also invited to make their own suggestions for related research topics.

Our training program is dedicated to providing students with the highest quality education in the diverse areas of cancer and radiation biology, translational oncology and clinical oncology. It encompasses assignments to all cancer-relevant departments. Students will undergo an intensive training embracing all practical and theoretical aspects of tumor biology, including cancer genetics and epigenetics, metabolism, oncogenic pathways, cancer stem cells, mechanisms of drug resistance, radiobiology, molecular targeted therapies or novel approaches to personalized cancer medicine. Training quality is ensured by the tight interaction between basic, translational and clinical researchers. The program consists of several lecture and seminar series as well as journal clubs on novel aspects of basic and clinical oncology. In addition, hand-on training is offered in practical modules and intensive methodological lab courses.

PUBLICATIONS

Zender S et al. (2013) A critical role for notch signaling in the formation of cholangiocellular carcinomas. *Cancer Cell*. 23(6):784-95.

Braumüller H et al. (2013) T-helper-1-cell cytokines drive cancer into senescence. *Nature* 494(7437):361-5.

Zips D et al. (2012) Exploratory prospective trial of hypoxia-specific PET imaging during radiochemotherapy in patients with locally advanced head-and-neck cancer. *Radiother Oncol*. 105(1):21-8.

Toulany M et al. (2012) Akt promotes post-irradiation survival of human tumor cells through initiation, progression, and termination of DNA-PKcs-dependent DNA double-strand break repair. *Mol Cancer Res*. 10(7):945-57.

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NEUROSCIENCES

The scope of neuroscience has broadened and expanded enormously, from molecular and cellular studies of individual nerve cells to imaging of sensory and motor tasks in the living brain. The Neuroscience module of the Experimental Medicine program in Tübingen aims to reflect the current increase in knowledge, offering courses and lectures covering the wide spectrum of the modern neurosciences.

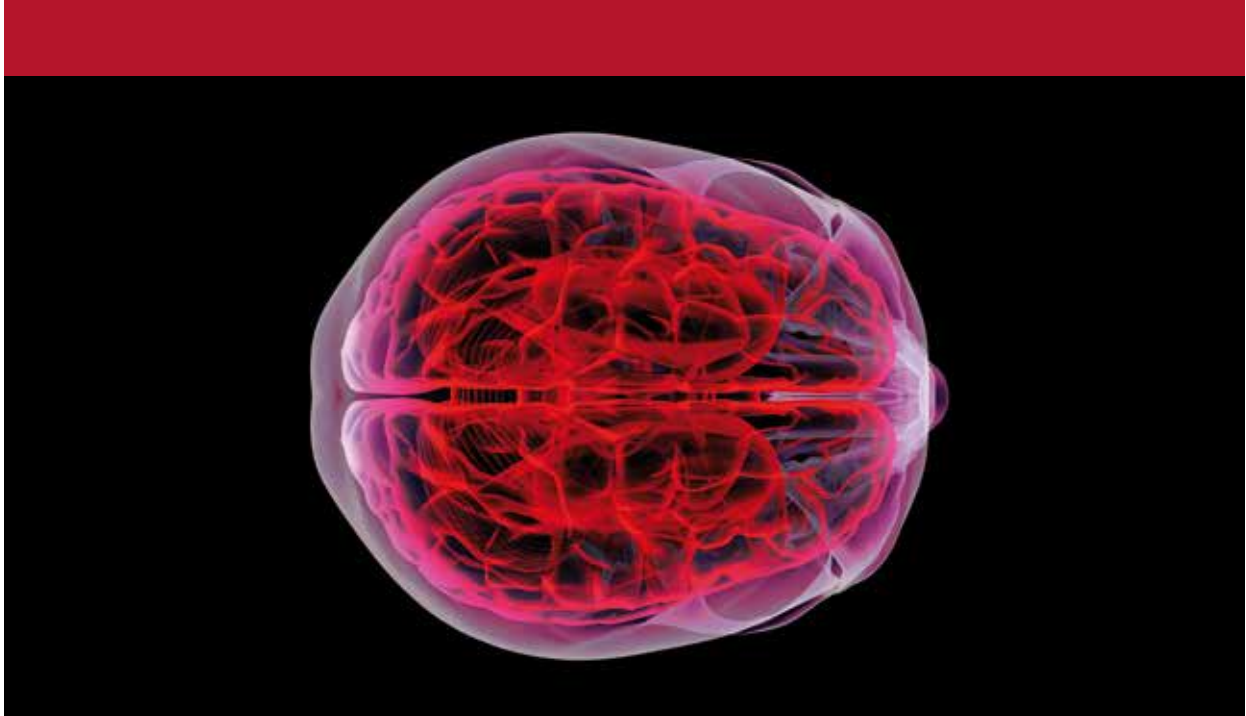
NEUROSCIENCE IN TÜBINGEN

Neuroscience is one of the key research areas at the University of Tübingen. A large variety of research groups interested both in basic and applied science are brought together in established research institutions including the Hertie Institute for Clinical Brain Research (HIH), the Werner Reichardt Centre for Integrative Neuroscience (CIN), the Center for Neurosensory Systems (ZfN), the German Center for Neurodegenerative Diseases (DZNE), the Interdisciplinary Center for Clinical Research (IZKF), etc., but are also found as independent groups throughout the campus. Neuroscience in Tübingen focuses on problems such as the analysis of task specificity and the embodiment of cognitive services, the assessment of the molecular and cellular implementation of selected brain functions and their impairments through diseases, the enhancement of modern imaging techniques, and the development of “neuro-protheses” to replace functions lost through accidents or disease. Collaboration and active networking between different local, national and international research entities and the hospitals ensures interdisciplinary, state-of-the-art research and enables the translation of new findings and developments into clinical application.

NEUROSCIENCE IN THE PHD PROGRAM

Reflecting the breadth of the research area and the large number of research groups involved, a huge variety of research topics can be offered within the framework of the training program. Potential PhD projects can be aimed, for example, at understanding age-dependent alterations of sensory transmission (visual, auditory, olfactory, mechanical) or assessing age-related alterations in the genome and proteome of sensory systems.

Training offers are structured in the following components: A solid foundation in cellular and systems neuroscience is assured by the annual seminar series “Principles of Cellular Neuroscience”. Furthermore, Students acquire a detailed understanding of sensory systems in the lecture series “Sensation and Sensory Processing”, which is given by members of the Center for Neurosensory Systems and covers recent research topics in the fields of hearing, vision and olfaction as well as processing of sensory signals. Practical training is provided by four different weekly courses dedicated to modern methods of data acquisition and analysis. The courses are devoted to electrophysiology, molecular biology, high-resolution optical imaging of living tissue and experimental diagnostics, highlighting the advantages and limitations of each of these techniques.



PUBLICATIONS

Jaumann M et al. (2012) cGMP-Prkg1 signaling and Pde5 inhibition shelter cochlear hair cells and hearing function. *Nature Medicine* 18(2):252-9.

Vogt A et al (2013) Isotope coded protein labeling coupled immunoprecipitation (ICPL-IP): a novel approach for quantitative protein complex analysis from native tissue. *Mol Cell Proteomics* 12(5):1395-1406.

Thestrup T et al (2014) Optimized ratiometric calcium sensors for functional in vivo imaging of neurons and T lymphocytes. *Nature Methods* 11(2):175-82.



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CARDIOLOGY & VASCULAR MEDICINE

Cardiovascular diseases are the leading cause of death worldwide. In response, cardiovascular medicine has been revolutionized in the last decade, making it all the more important to provide young PhD students with state-of-the-art training in molecular and cellular biology as well as in genetics. The application of modern molecular approaches to problems in cardiovascular science has begun to yield novel and important insights into cardiovascular development, biochemistry and physiology. Understanding the basic biology of heart muscle function and using this knowledge to develop novel methods of treating heart muscle disorders will have a major impact for patients with a variety of cardiovascular disorders, including cardiomyopathies, myocarditis, heart rhythm disorders and coronary artery disease.

CARDIOLOGY & VASCULAR MEDICINE IN TÜBINGEN

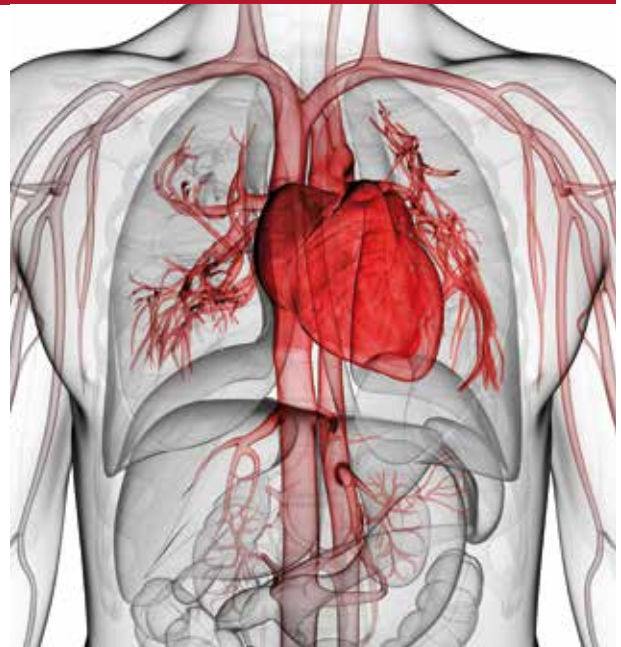
The research focus of the Department of Cardiology and Vascular Medicine lies in the prevention of thrombosis and myocardial defects (Prof. Dr. M. Gawaz), the inflammatory reaction in atherosclerosis and myocardial infarction (PD Dr. Seizer), the analysis of complex biological systems and spontaneous heart failure (PD Dr. Zuern), electrophysiology and arrhythmia (PD Dr. J. Schreieck), molecular imaging (Prof. Dr. B. Bigalke) and cardioimmunology (Prof. Dr. H. Langer). The Department of Cardiology and Vascular Medicine cooperates closely with the Department of Molecular Pathology (Prof. Dr. K. Klingel and Prof. Dr. R. Kandolf) in basic and clinical research on the pathogenesis, diagnosis and treatment of inflammatory cardiomyopathy. Within the framework of the DFG-funded Clinical Research Unit "Platelets – Basic Mecha-

nisms and Clinical Applications" (KFO 274), research projects on the molecular mechanisms and translational aspects of thrombocytes are offered to students in cooperation with the Interfaculty Institute for Biochemistry, Institute of Physiology, Radiology Department (all located in Tübingen) and the Dr. Margarete Fischer Bosch Institute for clinical Pharmacology in Stuttgart.

CARDIOLOGY & VASCULAR MEDICINE IN THE PHD PROGRAM

In the Department of Cardiology and Vascular Medicine, PhD students will find a rich, interdisciplinary research environment with a broad spectrum of different research topics and the opportunity to work in an integrated research network. Aspects of medicine, biology, biochemistry, veterinary medicine and chemistry play a crucial role in cardiovascular research. Research concepts include established animal models for different cardiovascular diseases as well as clinical studies. One goal is to understand the molecular mechanisms of cardiovascular diseases in order to develop new approaches to patient treatment. Examples of current research projects and applied techniques include the study of atherosclerosis as a complex chronic inflammatory disease, focusing on the interaction between platelets and dendritic cells.

The major research focus of the Department of Molecular Pathology is the investigation of virus-associated chronic diseases such as cardiomyopathies and myocarditis, with a focus on virus- and host-specific modulations of the immune surveillance system.



High-quality interdisciplinary training can be offered in this module thanks to the longstanding cooperation between the Departments of Cardiology and Vascular Medicine and Molecular Pathology. PhD students interested in clinical and/or basic research on cardiovascular topics are integrated in our regular laboratory routine. We provide outstanding training in lab techniques, sample processing, analysis and planning of experiments to enable the PhD student to carry out experimental work on his or her own. Practical work is complemented by lectures and seminars on different topics in cardiology and vascular medicine.

PUBLICATIONS

Langer, HF et al. (2007) Platelets recruit human dendritic cells via Mac-1/JAM-C interaction and modulate dendritic cell function in vitro. *Arterioscler. Thromb.Vasc.Biol.* 27:1463-70.

Steinke K et al. (2013) Coxsackievirus B3 modulates cardiac ion channels. *FASEB J.* 27:4108-21.

Klingel K et al. (2014) The activating receptor NKG2D of natural killer cells promotes resistance against enterovirus-mediated inflammatory cardiomyopathy. *J Pathol.* 2014 May 5. Epub ahead of print.

MODULE COORDINATOR



Harald Langer, Dr.med.

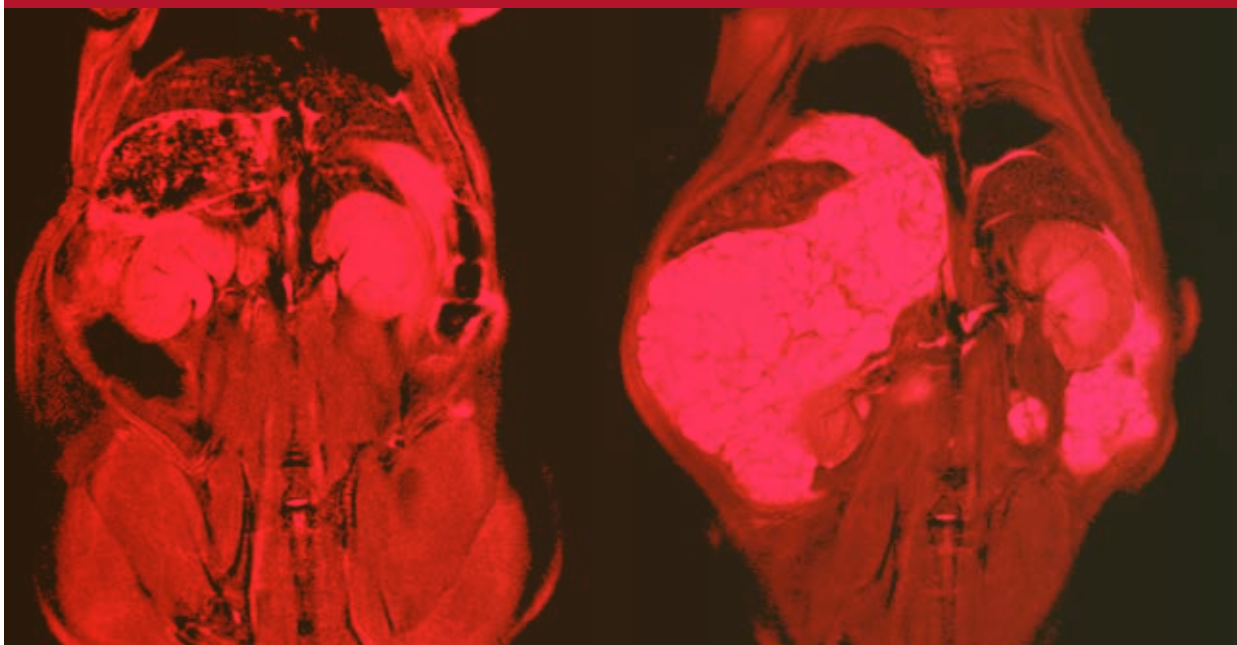
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IMAGING SCIENCE

Modern imaging technology like positron emission tomography (PET), magnetic resonance imaging (MRI), computed tomography (CT) or combined systems such as PET/MRI or PET/CT are indispensable for clinical diagnosis. At the same time dedicated small animal imaging modalities have become important biomedical research tools. They reveal detailed information about morphology but also allow the quantitative measurement of specific biomarkers or imaging probes.

IMAGING SCIENCE IN TÜBINGEN

Imaging science is a major pillar of the Medical Faculty at the University of Tübingen. The Department of Radiology has five individual sub-departments: Diagnostic and Interventional Radiology, Nuclear Medicine and Clinical Molecular Imaging, Diagnostic and Interventional Neuroradiology, Pre-clinical Imaging and Radiopharmacy, and Biomedical Magnetic Resonance.

Scientists encounter a vibrant, interdisciplinary environment with researchers from a variety of fields such as medicine, biology, biochemistry, chemistry, physics, mathematics, and engineering. The latest imaging equipment (7T MRI, microPET, microSPECT/CT, optical imaging and microPET/MRI) and three state-of-the-art molecular biology labs are complemented with high-end radiopharmacy labs including a cyclotron and GMP synthesis labs with 18 hot cells for radiotracer labeling. This infrastructure allows cutting-edge basic research and provides an exceptional platform for translational and clinical studies. The Department of Radiology offer the full range

of options for investigator-driven clinical research projects in the realm of oncology, neurology, cardiology, immunology and infectious disease. Tübingen was the first clinical center world-wide to use PET/MRI in humans, and its researchers contributed to major developments in PET/MRI. The Department is associated with the Max Planck Institutes in Tübingen and offers a world-class environment with a 9.4 T human MRI and a 14 T preclinical MRI.

IMAGING SCIENCE IN THE PHD PROGRAM

PhD students can become part of our research team, working on topics like multiparametric tumor imaging, imaging and "omics", PET/MR imaging of brain metabolism, imaging of aspergillus infection, neurogenetics and imaging, cardiovascular imaging, and imaging in immunology, to name just a few. They are also invited to propose their own projects related to our preclinical and clinical research fields.

If you are interested in the latest developments in imaging science, select our training module, which offers a rich program of practical courses, lectures and seminars focusing on preclinical molecular, translational and clinical imaging. This includes hand-on training in our research labs, radiopharmacy division and clinical departments.



PUBLICATIONS

Wehrl HF et al. (2013) Simultaneous PET-MRI reveals brain function in activated and resting state on metabolic, hemodynamic and multiple temporal scales. *Nat Med.* 19:1184-9.

Wehrl HF et al. (2013) Multimodal elucidation of choline metabolism in a murine glioma model using magnetic resonance spectroscopy and ¹¹C-choline positron emission tomography. *Cancer Res.* 73:1470-80.

Jansen NL et al. (2013). Dynamic ¹⁸F-FET PET in newly diagnosed astrocytic low-grade glioma identifies high-risk patients. *J Nucl Med.* 2014 Feb;55(2):198-203.

Nance JW Jr et al. (2012). Incremental prognostic value of different components of coronary atherosclerotic plaque at cardiac CT angiography beyond coronary calcification in patients with acute chest pain. *Radiology* 264(3):679-90.

Bisdas S et al. (2013). Intravoxel incoherent motion diffusion-weighted MR imaging of gliomas: feasibility of the method and initial results. *Neuroradiology* 55(10):1189-96.

MODULE COORDINATOR



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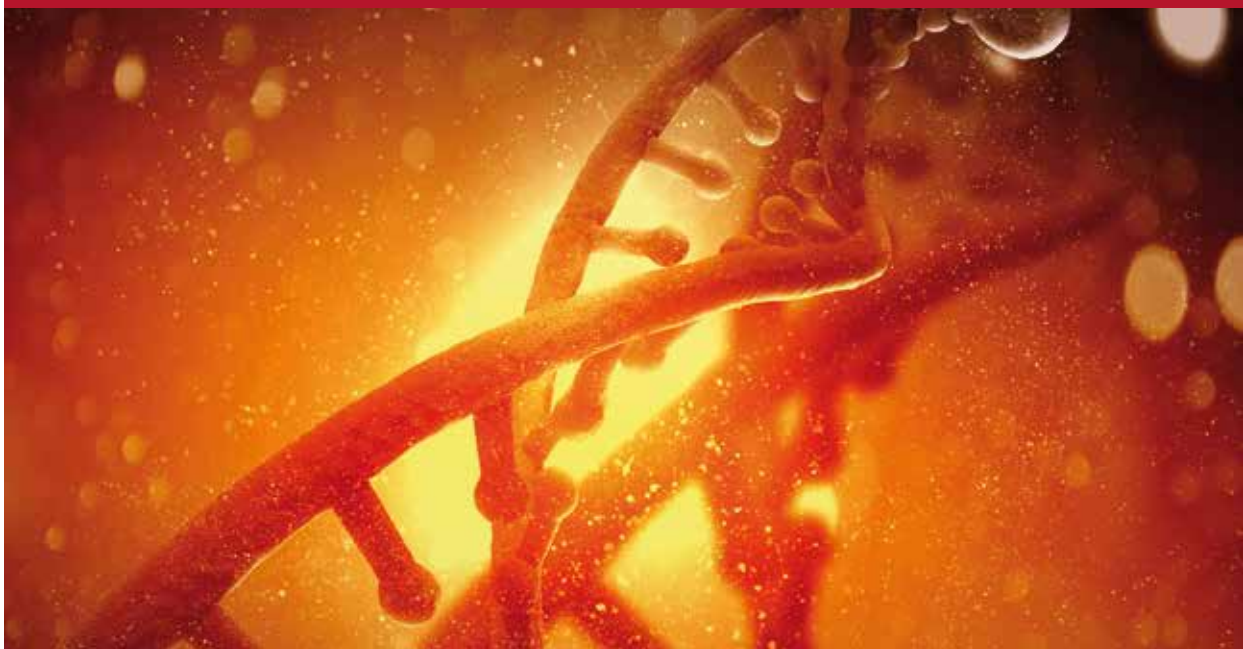
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BIOMEDICAL ENGINEERING

Biomedical Engineering is a rapidly evolving field in medical research. It covers a huge range of research areas and is interconnected with many disciplines, like cellular and molecular biology. Prominent topics in the field of biomedical engineering include gene therapy, stem cell biology and the investigation of epigenetic influence on aging and regeneration, all of which are becoming increasingly important in our society. Therapies are constantly improving, but permanent and safe “healing” strategies are still in high demand.

BIOMEDICAL ENGINEERING IN TÜBINGEN

Gene therapy studies at the Department of Pediatrics focus on the investigation of delivery modes for functional proteins, since standard routes are often ineffective and alternatives like the frequently used viral vectors have their own limitations. Gene transfer based on mRNA has emerged as an attractive option for the potential treatment of genetic disorders or anti-tumor vaccination and is a core research topic in our department. The second line of research, gene correction through editing of the endogenous gene, is a promising alternative to gene addition and transcript replacement approaches and has the potential to be completely curative in several diseases, such as the severe inherited monogenetic lung diseases surfactant protein B (SP-B) deficiency and cystic fibrosis (CF). With our extensive expertise in therapeutic approaches for these diseases and close cooperation with renowned experts in the field, we focus on therapeutic options using modified messenger RNA as a tool for both ex vivo and in vivo gene correction. Cooperation with the company CureVac, with its

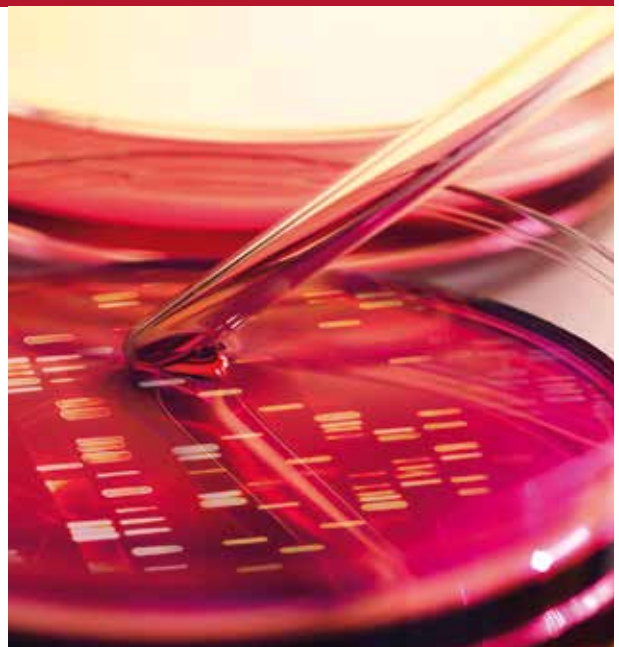
license to produce GMP grade mRNA, makes Tübingen a great place for studying mRNA-based methods and watching first-hand how new knowledge is translated into clinical practice.

The Siegfried Weller Institute for Trauma Research of the Department of Traumatology focuses on the improvement of bone healing. Different approaches to the promotion of bone regeneration and the impact of negative factors like chronic diseases or age are analyzed in depth, drawing on input from different disciplines in the natural sciences.

With the biomechanical approach, the influence of defined electromagnetic fields and the use of novel types of dynamic screws for the junction of bones are investigated in the context of their ability to promote healing. The cellular approach comprises the use of stem cells to heal broken bones. The establishment of methods to improve cell culture, like the use of bioreactors allowing the three-dimensional culture of cells, promotes stem cell research by providing a better representation of the in vivo situation than conventional two-dimensional culture methods. A third approach to enhancing bone regeneration focuses on the molecular level and includes the analysis of the aging process of cells and their regulating genes.

BIOMEDICAL ENGINEERING IN THE PHD PROGRAM

Potential research projects for PhD students incorporate exciting new developments in gene therapy. The role of diabetes type 2 in bone remodeling is investigated and the question of how small molecules influence the aging and differentiation of MSCs in bone regeneration is tackled.



The Biomedical Engineering module offers a rich program of lectures and practical courses focusing on state-of-the-art developments in the area of in vivo gene correction. You will learn about viral vectors, non-viral vectors, transcript replacement therapy, and ex vivo and in vivo gene manipulation, enabling you to perform genetic manipulation using site-specific endonucleases encoded by modified mRNA in combination with the corresponding repair templates. Other components of the module introduce the basics of cellular and molecular biology. Some courses offer training in the use of bioreactors as a promising technique in the field of cell culture and in the application of epigenetics and its pivotal role in the research on the effects of aging on the regeneration and recovery of organs and bones. Additional training components address the interesting field of biomechanics, with a focus on the restoration of broken legs and the rehabilitation of the complete range of motion in humans.

PUBLICATIONS

Yan X et al. (2014) 5-Azacytidine Improves the Osteogenic Differentiation Potential of Aged Human Adipose-Derived Mesenchymal Stem Cells by DNA Demethylation. PLoS ONE 9(3): e90846.

Hochrath K et al. (2014) Modeling hepatic osteodystrophy in Abcb4 deficient mice. Bone 55:501-11.

Kormann MSD et al. (2011) Expression of therapeutic proteins after delivery of chemically modified mRNA in mice. Nat. Biotechnol. 29(2): 154-7.

Mays LE et al. (2012) Modified mRNA encoding Foxp3 protects against allergic asthma in mice through an IL-23/IL-17A-dependent mechanism. J. Clin. Invest. 123(3):1216-28.

MODULE COORDINATORS



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BIOMETRY

Biometry is the implementation of statistical methods in life sciences. Nearly every student is facing the challenge during his or her PhD, to choose and apply these methods correctly. The fact that in many studies statistical training is subordinately treated explains that students frequently fail to implement statistics in a proper manner.

BIOMETRY IN TÜBINGEN

The Institute of Epidemiology and Biometry in Tübingen consists of an interdisciplinary team (mathematicians, statisticians, biologists, social scientists and physicians) and supports members of the Medical Faculty in the planning and evaluation of scientific experiments and studies. Our research focus follows the concrete needs of our medical partners and lies in the development of new methods for the planning and analysis of clinical and experimental studies. Recently, a new focus on genetic epidemiology/analysis of high dimensional data is established in cooperation with other departments of the University. Further projects focus on health care research.

BIOMETRY IN THE PHD PROGRAM

Our Institute offers several courses, of which "Analysis of Variance" and "Biometry in Clinical Studies" are especially relevant for PhD students in Experimental Medicine. Moreover, individual advises in statistics are offered by the institute.

Beside these services, the institute supervises PhD projects, e.g. on the development of new methods of survival analysis in the combination of clinical and demographical data. You are also welcome to come up with own ideas.

PUBLICATIONS

Martus P, Ebert N, van der Giet M, Jakob O, Schaeffner ES. An efficient approach for glomerular filtration rate assessment in older adults. *Br J Clin Pharmacol*. 2014 Aug;78(2):384-92.

Maia LF, Kaeser SA, Reichwald J, Hruscha M, Martus P, Staufienbiel M, Jucker M. Changes in amyloid- β and Tau in the cerebrospinal fluid of transgenic mice overexpressing amyloid precursor protein. *Sci Transl Med*. 2013 Jul 17;5(194):194.

Martus P. Diagnostic studies with molecular biomarkers--individualized medicine comes under scrutiny. *Dtsch Med Wochenschr*. 2013 May;138(19):987-8.

MODULE COORDINATOR

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SUPPORT FOR INTERNATIONAL STUDENTS

During your application and admission process after arrival, the coordination office of the PhD program helps you with many different issues, such as the individual organization of the PhD study, your enrolment at the University of Tübingen and the organization of your training plan.

At the start of each semester, a welcome event for new PhD students is organized, where the coordination office invites you to an introduction to the program. At this event, module coordinators give an overview of their training offers, and student representatives are at your disposal to introduce you to the group of PhD students and take you to a first social gathering.

For day-to-day issues, the Welcome Center of the Faculty of Medicine Tübingen and the Welcome Center of the University of Tübingen provide international scholars with the support they need to get started in Tübingen, including a welcome package with information material and checklists for arrival. In addition, numerous orientation activities are available for students of the university and the Faculty of Medicine. Tips in finding accommodations can be provided by the Welcome Center, so please contact them as soon as possible. A number of rooms are reserved in university dormitories for PhD students in Experimental Medicine.

USEFUL LINKS

PhD Experimental Medicine

➤ www.medizin.uni-tuebingen.de/phd

Faculty of Medicine Tübingen

➤ www.medizin.uni-tuebingen.de

Organization of medical student representatives in Tübingen

➤ www.fachschaftmedizin.de

Welcome Center of the University of Tübingen

➤ www.uni-tuebingen.de/en/international/international-scholars

General information for PhD students

(German Academic Exchange Service DAAD)

➤ www.research-in-germany.de

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EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Founded in 1477, the University of Tübingen is an excellent location for academic studies and research. A full range of disciplines and high standards of research both in the sciences and humanities contribute to its international reputation. Recently, its institutional strategy was successfully selected for funding in the Excellence Initiative sponsored by the German federal and state governments, making Tübingen one of Germany's eleven universities distinguished with that title of excellence.

Tübingen has also proven its status as a leading research university in many national and international competitions – in key rankings Tübingen is listed among the best universities for the humanities and social sciences as well as for natural sciences and medicine.

The university offers a wide range of cross-disciplinary events and sponsors many cultural highlights in the city. Today, 28,000 students (3,500 of whom are international) are enrolled in approx. 60 degree programs.

The University's excellence in research offers optimal study conditions to students who come to Tübingen, combined with the opportunity to emphasize individual interests along the way. The attractive study environment is reinforced by many additional services, such as the Language Center, interdisciplinary lectures in the Studium Generale and the state-of-the-art University Library. The University motto speaks for itself: attempto – I dare!





THE FACULTY OF MEDICINE

... one of the top-ranking medical faculties in Germany

The Faculty of Medicine Tübingen is one of the top-ranking medical faculties in Germany and provides an excellent environment for graduate studies due to well-equipped research laboratories, up-to-date core facilities and Tübingen's active community of outstanding scientists in the Faculty of Medicine, the Faculty of Science, the Max Planck Institutes and Helmholtz Research Units.

... our interdisciplinary research focus areas

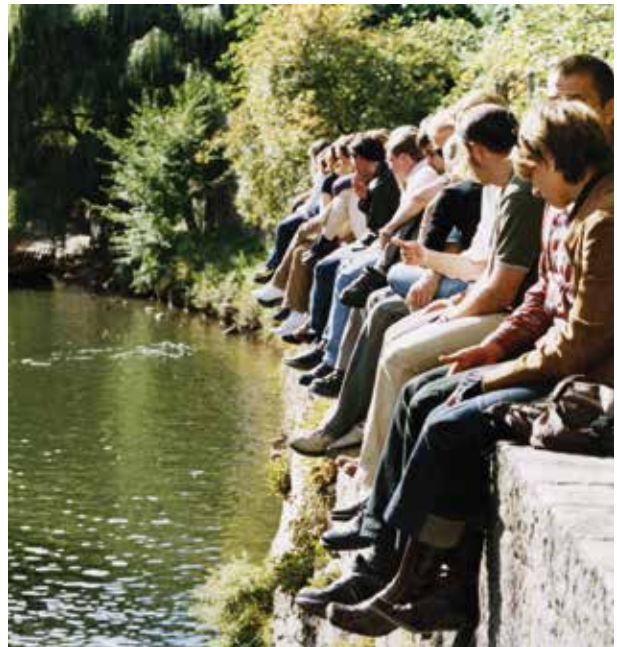
Research at the Faculty of Medicine is characterized by a concentration on nationally and internationally competitive, interdisciplinary research focus areas. These research focus areas include the neurosciences, oncology and immunology, infection research and vascular medicine with diabetes research. Innovative biomedical technology and imaging science act as a bridge connecting the focus areas, as do internal core facilities and the interdisciplinary research networks (collaborative research centers, clinical research groups and research centers). In addition, independent research sections are integrated in a large number of clinical departments.

... core facilities with modern cutting-edge technology

Our central service facilities for research, the so-called "Core Facilities", provide you with the opportunity to acquire both up-to-date service support and the latest scientific know-how. Modern technology and services which would otherwise demand an extremely long and intensive period of training, are the mainstay of the core facilities. During our lecture series and seminars, all PhD students are introduced to these methodological opportunities, including Microarray GeneChip, Transgenic Animals, Flow Cytometry, Laser Dissection, In situ Hybridization and Proteomics, as well as good manufacturing practice (GMP). A center for clinical studies supports all processes involved in clinical studies, from the design of a study to the conduct of trials.

... national and international research collaborations

National and international research collaborations often lay the foundation for innovative and successful research. For this reason, numerous research groups in the Faculty of Medicine Tübingen participate in national and international research consortia and networks. We maintain active collaborations with many universities worldwide.



THE TOWN OF TÜBINGEN

Tübingen is a traditional historic university town situated on the river Neckar, 40 km southwest of Stuttgart on the fringes of the Swabian mountains and in close proximity to the Black Forest. The city officially first appears in records in 1191, but the local castle has records back to the year 1078.

Nowadays, Tübingen is a small town with 85,000 inhabitants and 28,000 students, making Tübingen the city with the youngest average population in Germany. Life in the city is dominated by its many students, combining the flair of a lovingly restored medieval center of town with the colorful bustle and typical atmosphere of a young and cosmopolitan students' town.

The active cultural scene offers events, museums and collections as well as festivals, concerts, stage plays and readings with poets of international reputation.

Numerous parks, gardens, and forested areas invite explorations by foot or bicycle. The immediate surroundings of the town provide an outstanding environment for outdoor activities such as swimming, cycling and hiking, or cross-country skiing in the winter.

➤ www.tuebingen.de



STUTTGART

The closest major city to Tübingen is Stuttgart, located 40 km northeast from Tübingen. Stuttgart, the capital of Baden-Württemberg, provides all the shopping possibilities and cultural lifestyle of a large city. It has a wide range of cultural offerings including several museums, theaters and an opera.

➤ www.stuttgart-tourist.de



The city of Stuttgart



Schlossplatz in the center of the city

© Stuttgart-Marketing GmbH

SWABIAN MOUNTAINS (SCHWÄBISCHE ALB)

Situated close to Tübingen are the Swabian mountains, a high plateau with the highest mountain (Lemberg) reaching up to 1015 m. The spectacular landscape and magnificent natural environment make it attractive for hiking and cycling. Also worth a visit are the numerous castles, churches and monasteries as well as caves and places of discovery of important fossils and historical findings.

➤ www.schwaebischealb.de



Castle Hohenzollern near Hechingen



Albtrauf near Moessingen

© Schwäbische Alb Tourismusverband e.V.

BLACK FOREST (SCHWARZWALD)

The Black Forest starts about 40 km west of Tübingen. It offers several opportunities for sporting activities such as hiking and cycling as well as great nature and cities that are worth a visit. With mountains up to 1,493 m (Feldberg) it is also a popular skiing region in winter.

➤ www.blackforest-tourism.com



Aerial photo: "Guetenbach" near Freiburg



Winter landscape near Schluchsee

© Schwarzwald Tourismus

Tübingen innovative
interdisciplinary
international
since 1477

HOW TO REACH US

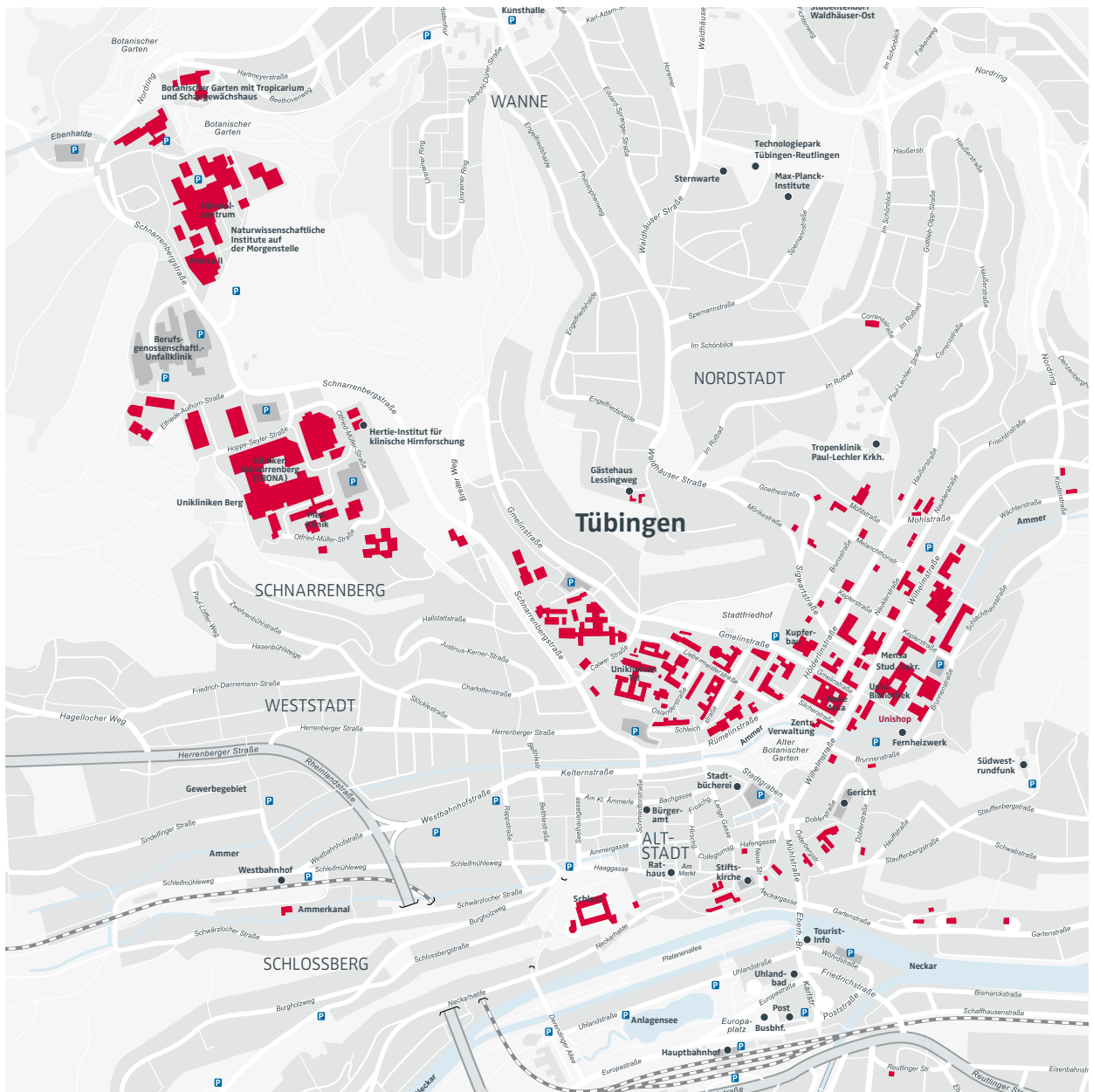
Situated in the heart of Europe, Tübingen is reached easily by plane, train or car:

By plane: The nearest international airport is Stuttgart (code: STR). From the airport, you can reach our lab within 20 min by car or taxi.

By train: You can reach our office from Tübingen Main Station in 10 min by taxi, or by bus line No. 5 in 7 min to the stop "Uni-Kliniken Tal".

By car: From the Autobahn A8 (Munich-Stuttgart or Karlsruhe-Stuttgart) via the exit "B27" near Stuttgart or from Autobahn A81 (Stuttgart-Singen) exit to Tübingen via "B28".





“TÜBINGEN DOESN'T HAVE A UNIVERSITY, TÜBINGEN IS A UNIVERSITY.”

The map shows the location of the university facilities inside the city, spanning a net through Tübingen.

CLOSE PROXIMITY OF OUR FACILITIES

The university hospitals and research institutes are all in close proximity. The city center of Tübingen can be reached easily from all facilities by bike and bus, and most are even within walking distance. The Faculty of Medicine is concentrated in two locations: the hill campus “Unikliniken Berg” (complex of buildings on the middle left side of the map) and the valley campus “Unikliniken Tal”.

The location of all buildings is found on the website:

➤ www.uni-tuebingen.de/de/707

WHAT OUR STUDENTS ARE SAYING



... lab rotations and practical courses in small groups are very nice, you can learn a lot of practical stuff



... the program gives good possibilities to create a network at the university



... very well organized and structured program with easy and fast contact to the coordination



... the lectures on Wednesday touch topics of broad interest and give an overview of possibilities for state-of-the-art methods in Tübingen



... the interdisciplinary and independent supervision is very supportive and stimulating



GOOD TO KNOW

OVERVIEW OF OPEN PHD POSITIONS

Open PhD Positions and scholarships are announced on our website www.medizin.uni-tuebingen.de/phd. Please note that not all possibilities will be announced here and candidates are encouraged to get in touch directly with researchers in their specific field of interest about possible doctoral projects.

Applications are generally welcome. They should show the specific interest in the selected field of research and suitable qualifications and background of the candidate. Once you have decided on a potential supervisor, you can apply directly to the professor in question. In your application, you should provide information regarding your academic education (CV, university degree, grades), prior research experience and the subject area in which you wish to specialize.

FUNDING

Funding is mostly arranged by the student (applying for scholarships) or the research group (through project funding). Useful information on funding a PhD study in Germany is supplied by the German Academic Exchange Service (DAAD, see below). Orientation on the different funding possibilities is also given by the coordination office of the PhD program.

GSSP SCHOLARSHIPS FROM THE GERMAN ACADEMIC EXCHANGE SERVICE

Our PhD program has been awarded several GSSP scholarships. Candidates are elected by the DAAD after nomination by the PhD Board. Eligible are students from outside Germany who graduated no longer than 6 years before nomination.

FUNDING FOR STUDENT-ORGANIZED SUMMER SCHOOLS AND WORKSHOPS

The University of Tübingen accepts proposals for the implementation of Summer Schools or workshops with invited external speakers organized by students.

PHD FAIR

Once a year, a PhD fair is organized by the faculty and the student representatives' office. The PhD program presents open PhD positions and facilitates contacts and discussions between faculty members and prospective PhD students.

STUDENT FEES

do not apply for the PhD program.



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