TUM School of Life Sciences
Technische Universität München

Module Catalog

M.Sc. Nutrition and Biomedicine

TUM School of Life Sciences
Technische Universität München

www.tum.de/
www.ls.tum.de/ls/startseite/

Module Catalog: General Information and Notes to the Reader

What is the module catalog?
One of the central components of the Bologna Process consists in the modularization of university curricula, that is, the transition of universities away from earlier seminar/lecture systems to a modular system in which thematically-related courses are bundled together into blocks, or modules.
This module catalog contains descriptions of all modules offered in the course of study.
Serving the goal of transparency in higher education, it provides students, potential students and other internal and external parties with information on the content of individual modules, the goals of academic qualification targeted in each module, as well as their qualitative and quantitative requirements.

Notes to the reader:

Updated Information
An updated module catalog reflecting the current status of module contents and requirements is published every semester. The date on which the module catalog was generated in TUMonline is printed in the footer.

Non-binding Information
Module descriptions serve to increase transparency and improve student orientation with respect to course offerings. They are not legally-binding. Individual modifications of described contents may occur in praxis.
Legally-binding information on all questions concerning the study program and examinations can be found in the subject-specific academic and examination regulations (FPSO) of individual programs, as well as in the general academic and examination regulations of TUM (APSO).

Elective modules
Please note that generally not all elective modules offered within the study program are listed in the module catalog.

Index of module handbook descriptions (SPO tree)

Alphabetical index can be found on page 115

Required Courses | Pflichtmodule

Module Description

WZ3235: Advanced Metabolism | Advanced Metabolism [Adv. Metabolism]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Written exam (Klausur, 120 min). In the exam the students have to demonstrate that they have achieved a deep understanding of various anabolic and catabolic processes and will be able to classify and reflect their cell- and organ-specific regulation. The students should be able to outline and analyse complex metabolic pathways, to assess their main function and logically connect them to the central pathways presented in the module Basics Nutrition and Food. The students will be able to elaborate on various mechanisms that control physiological processes and analyse and interpret typical pathophysiological situations in case studies,

Repeat Examination:
Next semester

(Recommended) Prerequisites:
It is essential that the students have previously visited the module Basics Nutrition and Food. Many of the materials presented in Advanced Metabolismbuild upon and logically connect to the contents of the module Basics Nutrition and Food.

Content:
The aspects covered in this lecture will include
biosynthesis and degradation of fatty acids, phospholipids, phospholipid-derived hormones
biosynthesis of sphingolipids and sterols
degradation of ethanol, sugar alcohols and the carbohydrates fructose, galactose and lactose
generation of lactose, glycolipids, proteoglycans and glycoproteins
protein synthesis and degradation, oxidation of amino acids, amino acids as metabolic precursors
hormones and the regulation of physiological processes

classical hormones originating from the hypothalamus, pituitary gland, thyroid gland, adrenal gland
hormones originating from the gastro-intestinal tract, adipose tissue and the musculature
physiology and nutritional relevance of growth hormones

Intended Learning Outcomes:
In the lecture Advanced Metabolism,the students will understandthe various levels of metabolic regulation processes and of inter-organ metabolism. This includes an in-depth understanding of biological signal transduction processes that are triggered by hormones that are produced in many different tissues and have a plethora of diverse consequences on human physiology. After successful participation the students will also appreciate the complexity of chemical reactions that constitute human metabolism, such as the biosynthesis of cholesterol, triglycerides and membrane lipids. They will understand in detail how dietary carbohydrates other than glucose are metabolized and how their carbon skeletons are introduced into central biochemical pathways. The students will understand that carbohydrates have additional functions such as building materials in the extracellular matrix or in the synthesis of glycoproteins and glycolipids. Altogether, the lecture has many links to Basics Nutrition and Foodbut brings the participants to a higher level of complexity and understanding.

Teaching and Learning Methods:
The main body of the module consists of PowerPoint presentations. The lectures will include time for questions to clarify or deepen individual aspects.

Media:
PowerPoint presentations.

Reading List:
Jeremy M. Berg, Lubert Stryer, John L. Tymoczko and Gregory J. Gatto: Biochemistry (8thedition, 2015)Stipanuk, MH and Caudill, MA: Biochemical, Physiological, and Molecular Aspects of Human Nutrition. Elsevier/Saunders, 2013.Bender, David A: Introduction to Nutrition and Metabolism, Boca Raton: CRC Press, 2014.

Responsible for Module:
Uhlenhaut, Nina Henriette; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ3201: Basics Nutrition and Food | Basics Nutrition and Food [Basics]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 30	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
A Klausur (written examination, 120 min) is offered in presence (WZ3201). If required by the pandemic situation, this can be supplemented by a simultaneous electronic written distance examination. (Online exam: WZ3201o).

The progress of the students will be tested in a Klausur (written exam, 120 min) roughly six weeks after the end of the lecture. Because of the “crash course” character of the lecture no grade will be given for the exam (course work). Passing of the exam will require a broad overview over the subjects presented in the lectures, rather than remembering all the details. Students need to demonstrate that they have acquired all the skills that are necessary for a successful continuation in the master program. These skills include, for example, the correct use of the scientific vocabulary, the recognition of the chemical structures of molecules that line the main metabolic pathways and the foundations of how energy is generated and used in biological systems and the classes and chemical structures of nutrients and other biomolecules. In the exam, students are allowed to bring a calculator (for simple calculations) and a dictionary (English into their mother tongue).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Formally, this course is at the very entry level for the MSc program Nutrition and Biomedicine. Students are strongly advised to refresh their knowledge from relevant subjects (cell biology, physiology, biochemistry, human anatomy) from their BSc studies.

Content:
The individual aspects covered include:

anatomy and function of the nervous system, the gastrointestinal tract, the adipose tissue, muscles, the liver and the kidneys
• basic function of the immune system
• use of macronutrients as energy source, energy metabolism inter-conversion between macronutrient classes
• regulation of metabolism after a meal / in hunger / during exercise
• vitamins and their relevance for enzymatic processes as precursors of cofactors

Intended Learning Outcomes:
Learning outcomes will be a deeper understanding of metabolic pathways related to nutritional sciences, their regulation and also a comprehensive understanding of the function and interplay of individual organs. The students will achieve a basic understanding of metabolic and physiological processes that are relevant to the area of nutrition. They will also be able to define and correctly apply technical terms as applicable to the area of nutrition and will be able to critically reflect information on diverse aspects of nutrition from scientific and non-scientific sources. The intention of this module is to bring all students to a similar level of understanding, which is considered the prerequisite for all modules that will follow.

Teaching and Learning Methods:
This module is designed to level the students, who come from various scientific and cultural backgrounds and to provide a first glance into the broad field of nutrition and biomedicine. The main body of the module is a lecture in PowerPoint format given by several lecturers. That covers the first two weeks of the winter term. No other lectures will be held in this time so that the students can entirely focus on this lecture. The lecture covers basic knowledge from biological and nutritional sciences in a compressed form. It is a primer that is intended to bring all students to a similar entry level for the other lectures to come. The lecture will be complemented by a tutorial that takes place in smaller groups in the time between the lecture and the exam. Here, senior students of Nutrition and Biomedicine will be available for questions that may have appeared during the self study time. The tutorial provides additional space for interaction with other students and helps to identify areas that need more attention.

Media:
The lecture will mainly be based on PowerPoint presentations. There is time for questions and discussions during the lectures. A blackboard or whiteboard may be used in the exercises to explain individual aspects in greater depth

Reading List:
Stipanuk, MH and Caudill, MA: Biochemical, Physiological, and Molecular Aspects of Human Nutrition. Elsevier/Saunders, 2013.
Bender, David A: Introduction to Nutrition and Metabolism, Boca Raton: CRC Press, 2014.

Responsible for Module:
Stolz, Jürgen; PD Dr. rer. nat. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Basics Nutrition And Food (Vorlesung, 4 SWS)
Stolz J [L], Bader B, Bast-Habersbrunner A, Fromme T, Haller D, Klingenspor M, Michel K, Schnabl K, Spanier B, Stolz J
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3226: Basics in Computational Biology | Basics in Computational Biology

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The learning outcome will be verified in a written exam (Klausur, 90 min) where the student has to demonstrate that she/he knows the appropriate tools to address bioinformatics problems, can apply and combine these web-based analysis tools to solve the respective problems, and can also interpret the results delivered by these tools. Students may use their lab notebooks to solve the problems in the exam. For example, students may be asked to download specific gene sequences from online databases, generate alignments, identify identity and similarity, find cleavage sites for restriction enzymes, select primer pairs for PCR experiments, develop cloning strategies, or construct phylogenetic trees using a set of protein sequences and interpret the results obtained.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
none

Content:
Public databases (Ensemble, UniProt, PDB) open source (Clustal Omega, Phylip, MEGA, Benchling) and commercial software (Genomatix) for the analysis of sequences related to nutritional biomedicine and biological sciences. Topics: Genomes, sequence archives, alignments, polymerase chain reaction, cloning, molecular phylogeny, primary structures of proteins, functional domains und 3D-structures, promoter analysis, polymorphisms.

Intended Learning Outcomes:
Students have acquired basic skills in biological computing. At the end of the module they can apply basic knowledge in bioinformatics to solve new problems related to nutrition science and biomedical research. They are able to use their knowledge to solve practical problems occurring

in everyday life of a molecular biologist in the laboratory. Students will be able to run the required software on their own computer, and can apply the software in their research internship and master thesis.

Teaching and Learning Methods:
The lecture provides the theoretical basics and hands-on instructions to apply selected methods in computational biology. Students write lab notebooks to protocol step-by-step procedures in computational biology. To recapitulate the practical parts, exercise sheets are distributed regularly. The correct answers will be released on the learning platform and discussed in the course. Exercises in Computational Biology are offered to solve the exercise sheets with support of student tutors. For the successful completion of exercises, self-study hours are required to get familiar with web-based bioinformatics tools and to explore different analytical options without social pressure.

Media:
Presentations with PowerPoint, exercise sheets, web links available on Moodle platform.

Reading List:
The lecturer recommends textbooks covering molecular genetics, biochemistry and evolutionary biology at start of term. Initial sequencing and analysis of the human genome (409;860-921; Nature 2001) Initial sequencing and comparative analysis of the mouse genome (420;520-562; Nature 2002)

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ3210: Disease Pathologies and Nutrition | Disease Pathologies and Nutrition

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 150	**Contact Hours:** 90

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module is two-part and conducted for the lecture as a written exam (Klausur, graded examination) on the lecture subjects and for the seminar as coursework in the form of a presentation (assessed as „pass“ or „fail“).
The students’ overall achievements in the module are assessed by a graded written exam (Klausur, 120 min). The exam tests the students’ understanding of the lecture subjects on the basics in pathophysiologies, their underlying molecular and metabolic mechanisms and whether they can apply their theoretical knowledge. The exam questions can be a mixture of ‘open questions’, comprehensive questions and ‘closed questions’ (multiple choice) dependent on the respective lecturer. The grade of the written exam equals the final grade for the module, since the examination of seminar part work is non-graded („pass“ or „fail“). Moreover, to gain 8 credit points for the module the student has to pass both the exam on the lectures and the seminar, i.e. for the module there is no splitting of the credits.
For the seminar groups of 2 to 5 students preparing (self-study) their respective group coursework presenting it as oral presentation (PowerPoint presentation approx. 40 min) in the seminar followed by the discussion (approx. 20 min) with the seminar audience. Each coursework comprises the analysis of specific published disease/nutrition-related human studies and/or animal models by the group members. The coursework is non-graded („pass“ or „fail“). In the seminar the students should learn to apply the knowledge from the lectures in combination with self-studies to prepare and present their course work, but also to be an interactive part in the audience asking questions and/or commenting the presentations.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in nutrition, metabolism, physiology and nutritional medicine.

Content:
The module deals with the pathophysiology of selected common nutrition-related chronic diseases such as obesity, diabetes type 2, cardiovascular diseases, allergy, inflammatory bowel disease, cancer (colorectal cancer, breast cancer, alcohol-associated cancer) and neurodegenerative diseases among others.
In the lectures, presented by different lecturers (see above), the understanding of specific pathologies, their causes and the underlying molecular and metabolic mechanisms of the disease processes are taught, and nutritional influences (e.g. diets, nutrients, nutritional components, active ingredients) are particularly addressed.
For the seminar students have to analyze (self-study hours) published data from original scientific publications. Specific topics on chronic diseases are chosen that build on the theoretical knowledge of the students. For example, how nutrition relates to the potential cause of, or contribution to, the disease and the efficacy of specific diets or nutrients for the prevention or treatment of a disease. In the seminar the groups present their work as oral presentation and discuss the results of their analysis with the students in the audience.

Intended Learning Outcomes:
Upon successful completion of the module students are able to understand the basic pathophysiology of nutrition-related chronic diseases, their underlying molecular and metabolic mechanisms and the correlations between nutrition and pathological processes. The students can apply their theoretical knowledge to analyze published studies and concepts on the prevention and treatment of nutrition-related chronic diseases using evidence-based medical standards. Furthermore, the students are able to present complex scientific studies in a concise way. They can lead a scientific debate and defend their standpoint in a scientific discussion.

Teaching and Learning Methods:
Lecture:
lecturers will give their oral presentations on their topics by means of PowerPoint presentations
Seminar:
individual students receive specific original publications (e.g. research articles, observational and prospective studies, systematic reviews or meta-analyses) to be analyzed and presented in the seminar
the students transfer their theoretical knowledge to actual medical cases and practical scientific research
students search for additional literature where it is necessary for their analysis and presentation
the groups present their work as oral presentation (approx. 60 min) using PowerPoint followed by the discussion (approx. 20 min) with the students in the audience

Media:
PDFs from the PowerPoint presentations of the lecture and seminar, as well as other study materials (PDFs from publications) and informations are distributed via TUM-Moodle.

Reading List:
Specific original literature and publications will be appointed to each student individually by the lectures.

Responsible for Module:
Bader, Bernhard, Dr. rer. nat. Klinische Ernährungsmedizin bernhard.bader@tum.de http://www.em-tum.de/

Courses (Type of course, Weekly hours per semester), Instructor:
Disease Pathologies and Nutrition (Vorlesung, 4 SWS)
Bader B [L], Annahazi A, Bader B, Fromme T, Haller D, Schnabl K, Pfluger P, Skurk T, Traidl-Hoffmann C, Witt H

Seminar Disease Pathologies and Nutrition (Seminar, 2 SWS)
Bader B [L], Bader B
For further information in this module, please click campus.tum.de or here.

Module Description

LS40012: Energy Balance and Regulation | Energy Balance and Regulation

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:**	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module is conducted in the form of a written exam (Klausur, 120 min). The written exam will assess whether the student has attained an advanced level of knowledge and understanding of the theoretical background in energy balance regulation. In preparation for the exam students will be provided with an original research article dealing with a specific aspect of energy balance regulation that was discussed in the module. The exam will test whether they have understood the science behind the paper, can recapitulate the applied methods, identify the main outcomes, are able to evaluate the impact of the study and identify findings contrasting to state-of-the-art knowledge presented in the lecture. In particular, the questions will test whether the student can
- repeat and classify elements of energy balance physiology in the correct context.
- apply this knowledge to a new problem in this field of research.
- evaluate the influence of genetic and environmental factors on energy balance.
- predict the outcome of defined experimental interventions altering energy intake, energy storage or energy expenditure.
They may use an English-German Dictionary or Thesaurus and a hardcopy of the original research paper which is subject of the examination. The final grade for the module depends exclusively on the written exam.

In addition, there is the option of taking a voluntary mid-term assignment as course work in accordance with APSO §6, 5. For this, a presentation (10 min) has to be given reporting the results of their group work and discuss these results in the plenum. These presentations train the students' capability to apply the theoretical knowledge addressed in the lecture on actual scientific research results. In the presentation and discussion, the students acquire skills to present complex scientific data in a concise way and to explain it to their peers. Furthermore, the oral presentation addresses relevant issues related to experimental design of research, methodology, graphical display and statistical analyses of data, interpretation of results and identification of strengths and

weaknesses of the study. The students develop their ability to answer questions from their peers and defend their standpoint in a rigorous scientific debate.
The module grade can be improved by 0.3 by passing the course work if this better characterizes the student's performance level on the basis of the overall impression and the deviation has no influence on passing the examination. No repeat date is offered for the mid-term performance. When retaking a failed module examination at the next possible examination date, successfully passed mid-term assignments will be taken into account.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge in mammalian physiology, cell biology, biochemistry, genetics and molecular biology.

Content:
In the context of energy balance, the module conveys advanced knowledge in metabolic physiology, endocrinology, neurobiology and molecular genetics. In particular the following topics are covered:
1. Components of energy homeostasis
2. Exogenous factors (diet, exercise, ambient temperature, photoperiod)
3. Endogenous factors (allelic variation, neuronal and endocrine communication, metabolites)
4. Body composition and impact on energy storage and energy expenditure.
5. Biochemical mechanisms of thermogenesis
6. Gastrointestinal nutrient sensing in the control of food intake
7. Neuroanatomy and neuroendocrine regulation of food intake and energy expenditure
8. Orexigenic and anorexigenic signaling in the brain
9. Neuropeptides and transmitters
10. Nutrient sensing in the brain
11. Chronobiology of energy balance

Intended Learning Outcomes:
After successful completion of the module, students have acquired an advanced level of understanding of established and novel concepts in integrative energy balance physiology. They gained a solid foundation of exo- and endogenous factors that influence energy balance regulation in a (patho-)physiological context. They know the biochemical basis for sensing and signaling of food intake and energy consumption as well as energy storage. Students are able to elaborate open questions and unsolved problems in this discipline of life sciences. They know how to address these questions according to experimental design and applied methodology. They are able determine the essential biological parameters required for these experiments and select adequate methods for valid measurement and statistical assessment of these parameters. The students are able to critically assess state of the art research on energy balance regulation in animal models and humans. They can weigh the positives and negatives of experimental design, address limitations in study designs, data presentation as well as data interpretation.

Teaching and Learning Methods:
The lecture part conveys the scientific foundation for the work on actual research during the seminar part. Using beamer presentations and white board illustrations landmark research findings and their impact on the incremental advance of understanding are presented. Review articles and textbook chapters on animal and human physiology round up the theoretical background of energy balance regulation.
The seminar translates the theoretical knowledge into actual state-of-the-art research. Students are independently analyzing and interpreting research findings reported in original research articles and discuss the assigned scientific publications in groups. These articles are preselected to match and expand on the topics of the lecture. Thereby, knowledge presented in the lecture is consolidated and extended. The students learn to dissect research articles in a stepwise manner, starting with understanding the methods applied for the research, identifying the most relevant research results, and understanding and evaluating the interpretation of results as presented by the authors in the discussion section of their article. Students are encouraged to search for other original research articles with confirmatory or conflicting results. Furthermore, they will present the results of their group work to the plenum. Dissemination of their results to the plenum triggers discussions of the topic within the groups as well as in the plenum. These discussions serve to deepen the knowledge of students in energy balance regulation, identify the strengths and weaknesses of scientific research. Most importantly, the students practice scientific debate in front of a peer group audience.

Media:
PowerPoint presentations; additional reading of original research papers and reviews; case studies; all materials are made available on Moodle; occasional white board illustrations;

Reading List:
Original Research and Review Articles are made available on the Moodle platform.
Textbooks for background in Energy Balance Physiology
Biochemical, Physiological, and Molecular Aspects of Human Nutrition. Martha H. Stipanuk and Marie A. Caudill, Elsevier
Introduction to Nutrition and Metabolism. David A. Bender, CRC Press
Metabolic Regulation – A Human Perspective. Keith N. Frayn, Blackwell Publishing

Responsible for Module:
Martin Klingenspor (mk@tum.de)

Courses (Type of course, Weekly hours per semester), Instructor:
Energy Balance and Regulation (Seminar, 2 SWS)
Bruder J, Schnabl K

Energy Balance and Regulation (Vorlesung, 2 SWS)
Klingenspor M
For further information in this module, please click campus.tum.de or here.

Module Description

LS40013: Food and Health | Food and Health

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 8	**Total Hours:** 240	**Self-study Hours:** 150	**Contact Hours:** 90

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam will be a written examination (120 min) either with pen and paper or in electronic format. The exam will usually be taken in presence. If required by the pandemic situation, this can be supplemented by a simultaneous electronic written distance examination. The students have to show detailed knowledge about the functionality of food, food components and different forms of nutrition on the human health and nutrition-related diseases. Students should show that they understand the functional interrelation of the food components and certain diseases that they are able to transfer their knowledge to exemplary pathologies. For the exam, no supporting material is allowed.
In addition, there is the option of taking a voluntary mid-term assignments as course work in accordance with APSO §6, 5. For this, a presentation (50 min, PowerPoint) has to be given. The module grade can be improved by 0.3 by passing the course work if this better characterises the student's performance level on the basis of the overall impression and the deviation has no influence on passing the examination.
In the presentation and the following debate, the students must demonstrate that they are able to investigate independently the legal and scientific substantiation of a new functional or medical food by literature research. They have to show, that they are able to defend their results in a subsequent discussion.
No repeat date is offered for the mid-term performance. When retaking a failed module examination at the next possible examination date, successfully passed mid-term assignments will be taken into account.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge of the biofunctionality of food and food components as well as nutritional science.

Content:
The lecture series “Food and Health” gives an overview about functional-, medical- and novel food. It deals with the interplay of food and food components like polyphenols, antioxidants, folates and different types of diets (e.g. ketogenic diet, vegan lifestyle) with health benefits and nutrition-related diseases. Additionally, biomedical background knowledge will be taught. The main focus is on how functionality can be proven by clinical studies.
The seminar, which consists of a practical exercise (teamwork), deepens the knowledge communicated in the lecture series. Here, the students have to hypothetically develop a new functional- or medical food and have to go through the regulations on the scientific requirements for health claims related to e.g. oxidative damage, cardiovascular health, immune system or the areas of the gastrointestinal tract.

Intended Learning Outcomes:
After successful completion of the module, students will comprehend the effects of food, bioactive food components and different forms of nutrition on the human health and the development, prevention or treatment of nutrition-related diseases. At the end of the module students are able to evaluate clinical studies and put them into a scientific context. Additionally, students are able to independently acquire information needed to apply for health claims. They can present the results of their investigation in a concise way to their peers and defend their point of view in a rigorous scientific debate.

Teaching and Learning Methods:
The theoretical part of the course will be taught in the lecture series. In the seminar, students will work in teams (4-5 students) to deepen their knowledge by developing a new functional or medical food on their own. By independent literature research students have to show the scientific substantiation necessary to obtain a health claim or get approval for the European market

Media:
PowerPoint presentations; original research papers and reviews

Reading List:
Register of nutrition and health claims made on foods (European Commission).
Various scientific Opinions on the substantiation of health claims related to various food(s)/food constituents(s) (published by EFSA).

Responsible for Module:
Dirk Haller Dirk.haller@tum.de 2.Dozent Ingrid Schmöller Ingrid.schmoeller@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Food and Health (Seminar) (Seminar, 2 SWS)
Haller D [L], Haller D, Ren S, Schmöller I
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3205: Integrated Lab-Course | Integrated Lab-Course [ILC]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 180	**Contact Hours:** 120

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module is conducted in the form of a laboratory assignments.
In total, the students participate in 13 practical courses. Each practical course starts with a colloquium in which the lecturer confirms that students have acquired the theoretical background to conduct the lab work in a safe manner. Students that do not fulfill this safety requirement cannot not participate in the course and can repeat the course on another day. Students are required to protocol the experimental steps during the course. For this purpose, each student will have a personal lab notebook. Based on their notes and the data collected, students generate a protocol of each lab course. At the start of the lab course, all students receive instructions in the writing of experimental lab protocols and receive a written guideline. Lecturers evaluate and grade the protocols in due time, and provide criticism and recommendations to the students. The grading of the protocol is based on the knowledge in the colloquium and hands-on performance of students during the lab course (20%) and the quality of the lab protocol (80%).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Principles of laboratory safety and good laboratory practice; basics in physics and biochemistry; basics innutrition and food science, basic scientific writing skills.

Content:
Students acquire practical knowledge in a broad spectrum of experimental methods applied in research laboratories for nutrition and food science and in biomedical research:
A. Western blot (Dr. B. Bader) (LS Molekulare Ernährungsmedizin, Prof. Klingenspor)
B. Flowcytometry for cell cycle studies (Dr. I. Schmöller) (LS Ernährung und Immunologie, Prof. Haller)

C. PCR genotyping for mouse molecular genetics (Marika Friano, Marion Schweiger) (LS Metabolische Programmierung, Prof. Uhlenhaut)
D. Functional genomics in animals (LS Tierphysiologie und Immunologie, Prof. Zehn)
E. Stratification and quantification of immune cells (Prof. Zehn) (LS Tierphysiologie und Immunologie, Prof. Zehn)
F. LC-MS-Analysis of plant extracts (Dr. T. Hoffmann) (FG Biotechnologie der Naturstoffe, Prof. Schwab)
G. Investigation of peptide transporters (Dr. B. Spanier) (LS Metabolische Programmierung, Prof. Uhlenhaut)
H. Personalized Nutrition (Prof. Gedrich) (ZIEL Institut, Prof. Gedrich)
I. Mitochondrial respiration (Alina Peteranderl, Mia Hasic) (LS Molekulare Ernährungsmedizin, Prof. Klingenspor)

Intended Learning Outcomes:
After successful completion students know a broad spectrum of methods in molecular biology, analytical biochemistry, cell biology and physiology applied innutrition and food sciences and biomedical research (e.g. PCR genotyping, functional genomics, protein analytics, chromatography and mass spectrometry of metabolites, mitochondrial bioenergetics, tumor models). They are familiar with the theoretical background, technical details and potential pitfalls of these methods, and have first hands-on experience in their application. Students are able to generate laboratory protocols of their experimental work, documenting data acquisition, processing and analysis. They can evaluate results obtained in a self-contained manner. Students understand the principles of experimental design and apply suitable methods in the framework of a research project.

Teaching and Learning Methods:
For each individual lab course, students mustdownload and study the specificlab instructions from Moodle in advance. Students must read and understand these lab instructions before they attend the practical course. In particular, they need to attend the safety instructions. Practical training in laboratory skills and techniques takes place in small groupsduring the course.
The two-semester delivery of the module is driven by the learning outcomes and can be didactically justified.

The combination of teaching theoretical and practical knowledge of methods as well as the efficient and safe execution of experimental work requires the continuous laboratory work of the students extending over two semesters. The accompanying protocol work, the continuous training in scientific documentation, writing, evaluation and interpretation in this interdisciplinary and complexly interwoven field of knowledge requires a step-by-step competence transfer over two semesters to be able to ensure the internalization of scientific working methods and approaches at an advanced level.

Media:
Experimental instructions will be made available onMoodle.

Reading List:
In their lab instructions, lecturers specify text books and other literature sources required to prepare for the course.

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Integrated lab-course I (Übung, 4 SWS)
Bartelt A, Bruder J, Friano M, Gedrich K, Hoffmann T, Schmöller I, Spanier B, Wagner A, Wurmser C, Zehn D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3207: Nutrition and Microbe-Host Interactions | Nutrition and Microbe-Host Interactions

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination requirements of the module "Nutrition and Mirobe-host Interactions" consist of a written examination on any content of the module (Klausur 90 min, open questions and up to 70% multiple choice questions) either with pen and paper or in electronic format. The exam will usually be taken in presence. If required by the pandemic situation, this can be supplemented by a simultaneous electronic written distance examination. The written exam will assess whether the student has attained an advanced level of knowledge about the diversity and functions of the mammalian gut microbial ecosystem and the role of dietary and microbial triggers in regulation of host health. No supporting material is allowed.
In addition, there is the option of taking a voluntary mid-term assignment as course work in accordance with APSO §6, 5. For this, a report (PowerPoint presentation of data analysis, 4-6 pages) must be submitted. The module grade can be improved by 0.3 by passing the course work if this better characterises the student's performance level on the basis of the overall impression and the deviation has no influence on passing the examination. No repeat date is offered for the mid-term performance. When retaking a failed module examination at the next possible examination date, successfully passed mid-term assignments will be considered. The mid-term assignment will assess the ability of the students to apply microbial profiling data analysis to describe and interpret bacterial community profiles on the provided datasets.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in physiology, microbiology, bio functionality and immunology.

Content:
This lecture and seminar series teaches deep insight into the diversity and functions of the mammalian gut microbial ecosystem (intestinal microbiota) in close interaction with the host and with dietary factors. Particular attention will be drawn to the development of the microbiota throughout life as well as underlying cross-talk mechanisms with the mucosal immune system with a particular focus on chronic inflammatory disorders, enteric infections and metabolic disorders.

Intended Learning Outcomes:
After successful participation in the module, students comprehend the diversity and functions of the mammalian gut microbial ecosystem and are able to estimate the role of dietary and microbial triggers in regulation of host health. Students will gain a deeper understanding of microbe-host interactions, as well as the link between the microbiome and disease. Using this knowledge, students will be able to critically assess recent studies and findings. The students will be able to carry out and interpret a range of analyses on 16S rRNA gene sequencing data for microbial profiling.

Teaching and Learning Methods:
Lectures will be held to teach the students the content of the module in a classroom environment. On top of this, students are expected to deepen their understanding of the content by studying independently. The seminar will consist of hands-on analysis workshops as well as independent analysis by the students, to allow for the practical implementation of theoretical knowledge that has been taught during the module.

Media:

Reading List:
Microbial Inhabitants of Humans: Their Ecology and Role in Health and Disease. Cambridge University Press, 2005, ISBN: 0 521 84158 5

Responsible for Module:
Haller, Dirk; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Microbe-host interaction and nutrition in health and disease (seminar) (Seminar, 2 SWS)
Haller D [L], Coleman O, Haller D, Metwaly A, Ren S, Riva A, Schmöller I

Microbe-host interaction and nutrition in health and disease (lecture) (Vorlesung, 2 SWS)
Haller D [L], Haller D, Schmöller I
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3204: Recent Topics | Recent Topics [RT]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module is conducted in the form of a research paper.
The students will write scientific abstracts on one of the topics presented in the module(written and graphical abstracts, one page each). The topics will be randomly assigned to the students at the end of the summer term. Their task is to search and select recently published work from peer-reviewed journals for their abstracts. Ideally, they identify papers with opposing opinions or conflicting results / conclusions. In their abstract they provide a short introduction to the topic highlighting the research goal, describe the applied experimental approaches and methods, present the main results of the selected publications with a focus on novelty aspects, and discuss and interpret the relevance of these findings in the context of state-of-the-art in nutrition and biomedicine. Distinct guidelines for the abstracts are provided determining format, length, number of characters, requirements for figures and tables and references. Moreover, the catalogue of criteria for the assessment of the abstracts by the examiner are delivered to the students prior to assignment of the essay. The abstracts must be submitted within 4 months after assignment of the topic. The abstracts must be delivered in electronic format (PDF) and as a hardcopy. A new topic will be assigned if the student fails to meet this deadline.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
No prerequisites. Participation in the examination requires that students have passed the module Basics in Nutrition and Food

Content:
The lecture communicates the relevance of interdisciplinary knowledge in the area of nutrition and biomedical research. Students are exposed to a selection of current research topics. In preparation of each lecture they are provided with original research articles and reviews dealing

with the topic of the day. The students gain practical experience in the evaluation and discussion of scientific matters with experts in nutrition and biomedicine. Original papers addressing most recent developments in nutritional biomedicine research are discussed and evaluated.
The two-semester delivery of the module is driven by the learning outcomes and can be didactically justified. The interdisciplinarity as well as the qualification profile of the study program require not only a deepening and broadening of the specialized knowledge of nutritional sciences, but also a deepening and broadening of the knowledge in medically relevant topics. The transfer of competence of this interrelated and interdisciplinary knowledge requires the two-semester duration of the module Recent Topics.

Intended Learning Outcomes:
Students have gained insight into current research topics in nutrition science and biomedical research at the TUM campus and beyond (external guest lecturers). They can apply their abilities in reading and understanding of original research papers as well as in the critical assessment of data. They can discuss and evaluate research results together with their peers. In a self-contained manner, they identify unsolved scientific questions and can outline new research ideas. They are able to apply this knowledge in short scientific abstracts. In an abstract writing exercise the students have improved their proficiency to solve a scholarly complex task by applying scientific methods independently based on the knowledge and skills acquired in the course of their master study course Nutrition and Biomedicine.

Teaching and Learning Methods:
Lectures with subsequent discussions

Media:
- PowerPoint presentations
- Review articles and original research papers provided beforehand on Moodle

Reading List:
Topics of this module change annually, scientific literature is individually appointed to each student.

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Recent Topics I (Vorlesung, 2 SWS)
Bartelt A, Behrens M, Klingenspor M, Krahmer N, Netzel M, Ocvirk S, Ren S, Wagner A, Zang E, Zehn D
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3225: Research Methods | Research Methods

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam will be a written examination (120 min) either with pen and paper or in electronic format. The exam will usually be taken in presence (WZ3225). If required by the pandemic situation, this can be supplemented by a simultaneous electronic written distance examination. (Online exam : WZ3225o).

The exam at the end of the winter term is a written test (Klausur, 120 min). This exam will check if the students can use the correct technical terms and are familiar with the advantages and disadvantages of the various lab techniques, experimental strategies and model organisms that are commonly used. The students need to identify mistakes in experimental strategies, evaluate data and make suggestions on how to design an experiment to gain the desired answers. The students will have to demonstrate that they know the current standards of how to make a clinical investigation and how to categorize and critically evaluate results of observational and interventional studies based on the study design. To this end, the students will be confronted with experimental results for critical assessment of the research strategy, data interpretation and a possible improvements of the research strategy.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
For the lecture Research Tools some basic knowledge in the core biological areas cell biology, classical genetics, molecular biology and biochemistry and in some classical analytical methods (such as SDS-PAGE, Western Blot, Northern Blot), is necessary. This is partially covered in the module Basics Nutrition and Food.
For the lecture Clinical Studies the pathophysiology of important metabolic disorders (e.g. diabetes mellitus type 2, dyslipidemia) is necessary. Also, basic statistical knowledge is

necessary for calculating effect size and power of the study, etc. Basic principles of “Good Clinical Practice” (GCP) should be known.

Content:
Research Methods is comprised of two parts, both held in winter term.
The lecture Research Tools (2 SWS) will cover
- the (molecular) biology of model organisms used in nutrition research
- the advantages and disadvantages of the individual model organisms for research
- gene expression analysis by DNA arrays and sequencing approaches
- basics in human genetics and association of genetic variation with phenotypic traits such as disease susceptibility
- detection and functional analysis of genetic variation (coding and non-coding variants)
- techniques for proteome analyses and their limitations when applied to biomedical problems
- techniques for metabolome analyses, limitations encountered in the analysis of body fluids
- approaches for the analysis and visualization of complex data.
The lecture Clinical Studies (1 SWS)
- exemplifies how a study protocol is developed
- provides definitions of study inherent activities
- explains the differences between the different study designs and their advantages and limitations
- covers legal and ethical aspects that need to be considered when human subjects are studied
- outlines dissemination strategies of scientific results and their use for guideline development
- covers standardization of literature search strategies, publications and authorship
- introduces basics in quality management and evidence based medicine

Intended Learning Outcomes:
The exam at the end of the winter term is a written test (120 min). This exam will check if the students can use the correct technical terms and are familiar with the advantages and disadvantages of the various lab techniques, experimental strategies and model organisms that are commonly used. The students will have to demonstrate that they know the current standards of how to make a clinical investigation and how to categorize and critically evaluate results of observational and interventional studies based on their design.

Teaching and Learning Methods:
The module uses lectures to familiarize the students with the materials and concepts. The PowerPoint presentations include data from original publications for discussions as well as recaps. Exercises will be used to strengthen the students use of the correct technical wording. Templates will be used for discussion to provide knowledge on study protocol development and study application with relevant authorities and the ethical commission.

Media:
PowerPoint presentations, use of topical publications, white board. Contents of teaching will be exemplified with case studies; computer work supports their application.

Reading List:
Basis for the development of clinical studies are legal tests as the „Good Clinical Practice” – guideline.
https://ec.europa.eu/health//sites/health/files/files/eudralex/vol-10/3cc1aen_en.pdf

Responsible for Module:
Stolz, Jürgen; PD Dr. rer. nat. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Clinical Studies (Vorlesung, 1 SWS)
Skurk T [L], Brandl B, Skurk T

VL Research Methods 1 (Vorlesung, 2 SWS)
Stolz J [L], Bader B, Ludwig C, Spanier B, Stolz J, Wagner A, Witting M (Grallert H)
For further information in this module, please click campus.tum.de or here.

Elective Modules | Wahlmodule

Research Internships | Research Internships

Module Description

LS20011: Research Internship Internal (10 CP) | Research Internship Internal (10 CP)

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 120	**Contact Hours:** 180

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is completed by the completion of the 8-week research internship (full-time, 37,5 h/wk)
The examination of the module is conducted in the form of a report.

The student's performance is evaluated, as documented in the lab notebook and the internship report (max. 25 pages, including tables, figures and references), by the following criteria:
- understanding of the research question
- overview of the published scientific literature related to the research question
- ability to learn and apply new methods
- skillfulness in research tasks
- precision and accuracy in data acquisition and data management
- data analyses and evaluation
- ability to study and work autonomously
- clarity of scientific writing

Repeat Examination:

(Recommended) Prerequisites:
Module Research Methods
Module Basics in Computational Biology Module Integrated Lab Course

shedule:

The students search for themselves one TUM internal supervisor from the given list of classes. They do so by contacting a chair of TUM School of Life Sciences that already has a class connected to each one of the offer-nodes within the module-node of LS20011 in TUMonline. If a preferred supervisor's classes and exam is already listed a topic or supervisor needs no further approval by the Examination Board.
If there should be another potential TUM internal supervisor whose chair is not yet part of the list of classes and/or exams, the students can ask for an extension of the list by the preferred supervisor writing a conclusive e-mail to recognition.co@ls.tum.de.

Content:
The scientific questions addressed by laboratories on the TUM campus deal with nutrition-related research, either on the fundamental or applied level, in the fields of biochemistry, molecular biology, nutrition physiology, metabolism, microbiology, food chemistry, nutrition medicine, genetics, clinical studies, epidemiology and public health. The internship is an opportunity for our students to apply their theoretical and practical knowledge acquired during the first two semesters to a specific research question in the framework of a project in the host laboratory.

The research internship consists of 240 hours of attendance or of working time (e.g. in the laboratory) and 60 hours for the internship follow-up (report). The internship period should thus comprise 8 weeks (37.5 h/week). In order to ensure continuous processing of the topic, the attendance time should be provided as continually as possible with a weekly working time of at least 20 hours and should not exceed the internship time of 15 weeks in part-time.

Intended Learning Outcomes:
After successful finalization of the module, students have acquired initial theoretical and practical skills to tackle a scientific question predefined by a supervisor and conduct research tasks under guidance by this supervisor. They have gained first hands-on experience in the design of experiments in life science laboratories, or the development of study protocols in clinical study units. They are experienced in sensible and reproducible application of selected methods, understand the technical background and limitations of the applied technologies. They gained insights into quality control procedures in scientific research. They have learned to document the day-by-day progress of their work in a comprehensible manner that allows independent recapitulation of the applied methods, the acquired data and the results obtained. In a structured written report, accompanied by a day-by-day protocol, they can (1) explain the scientific context and define the goal of their research project, (2) describe the application of methods in comprehensive technical notes, (3) document and analyze the acquired data, (4) judge upon the reliability and reproducibility of the results, and (5) evaluate and interpret these results in relation to published work. They are trained to explain the goals, experimental design and essential outcome of their research internship to their peers and supervisor in short and concise oral presentations.

Teaching and Learning Methods:
The internship is composed of three elements with theoretical and practical aspects: Phase 1- Developing and planning of a scientific project, Phase 2- Implementation of a research plan devised in Phase 1, and Phase 3– writing a scientific report about the research project. In the

practical course, students are trained to scrutinize a research question related to nutrition science and biomedicine as predefined by the supervisor. The research internship embeds in a defined research context at the respective chair/laboratory/department hosting the student. High intensity supervision of students by experienced scientific personnel supports the training success. Students document their research work in a dedicated lab notebook, with a focus on detailed description of applied methodologies, data acquisition and data analyses. They report to their supervisor on the progress of their work in regular meetings and summarize the goals of their research project and the main findings in short oral presentations, using PowerPoint, or equivalent presentation tools. Within this setting, the project progress and plans to further develop the project are discussed.

Media:

Reading List:
Review articles and original research articles related to the topic of the research internship. The supervisor assists the student to find the relevant papers and recommends specialized textbooks.

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Internal (8 weeks) Plant Proteins and Nutritions (Prof. Weisz) - Master (Forschungspraktikum, 12 SWS)
Bittner R, Etzbach L, Weisz U, Zöllner M

Research Internship Internal (8 weeks) Food Process Engineering (Prof. Först) - Master (Forschungspraktikum, 12 SWS)
Först P [L], Gruber S, Hilmer M, Kalinke I, Reiter M, Reitmaier M

Research Internship Internal (8 weeks) Food & Health (Prof. Gedrich) - Master (Forschungspraktikum, 12 SWS)
Gedrich K [L], Gedrich K

Research Internship Internal (8 weeks) Clinical Microbiome (Prof. Gerner) - Master (Forschungspraktikum, 12 SWS)
Gerner R

Research Internship Internal (8 weeks) Exercise, Nutrition and Health (Prof. Köhler) - Master (Forschungspraktikum, 12 SWS)
Köhler K

Research Internship Internal (8 weeks) Biothermodynamics (Prof. Minceva) - Master (Forschungspraktikum, 12 SWS)

Minceva M [L], Buchweitz V, Falconieri M, Luca S, Minceva M, Pajnik J, Sibirtsev S, Sönnichsen C, Yildiz C, Yin J
For further information in this module, please click campus.tum.de or here.

Module Description

LS20012: Research Internship Internal (5 CP) | Research Internship Internal (5 CP)

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 60	**Contact Hours:** 90

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is completed by the completion of the 4-week research internship (full-time, 37,5 h/ week).
The examination of the module is conducted in the form of a report.

The student's performance is evaluated, as documented in the lab notebook and the internship report (max. 12 pages), by the following criteria:
- understanding of the research question
- overview of the published scientific literature related to the research question
- ability to learn and apply new methods
- skillfulness in research tasks
- precision and accuracy in data acquisition and data management
- data analyses and evaluation
- ability to study and work autonomously
- clarity of scientific writing

Repeat Examination:

(Recommended) Prerequisites:
Module Research Methods
Module Basics in Computational Biology Module Integrated Lab Course

shedule:
The students search themselves one TUM internal supervisor from the given list of classes. They do so by contacting a chair of TUM School of Life Sciences that already has a class connected to each one of the offer-nodes within the module-node of LS20012 in TUMonline. If a preferred

supervisor's classes and exam is already listed a topic or supervisor needs no further approval by the Examination Board.
If there should be another potential TUM internal supervisor whose chair is not yet part of the list of classes and/or exams, the students can ask for an extension of the list by the preferred supervisor writing a conclusive e-mail to recognition.co@ls.tum.de.

Content:
The scientific questions addressed by laboratories on the TUM campus deal with nutrition-related research, either on the fundamental or applied level, in the fields of biochemistry, molecular biology, nutrition physiology, metabolism, microbiology, food chemistry, nutrition medicine, genetics, clinical studies, epidemiology and public health. The internship is an opportunity for our students to apply their theoretical and practical knowledge acquired during the first two semesters to a specific research question in the framework of a project in the host laboratory.

The research internship consists of 120 hours of attendance or of working time (e.g. in the laboratory) and 30 hours for the internship follow-up (report). In full-time, the internship period is therefore 4 weeks (37,5 h/week). In order to ensure continuous processing of the topic, the attendance time should be provided as continually as possible with a weekly working time of at least 20 hours and should not exceed the internship time of 8 weeks in part-time.

Intended Learning Outcomes:
After successful finalization of the module, our students have acquired initial theoretical and practical skills to tackle a scientific question predefined by a supervisor and conduct research tasks under guidance by this supervisor. They have gained first hands-on experience in the design of experiments in life science laboratories, or the development of study protocols in clinical study units. They are experienced in sensible and reproducible application of selected methods, understand the technical background and limitations of the applied technologies. They gained insights into quality control procedures in scientific research. They have learned to document the day-by-day progress of their work in a comprehensible manner that allows independent recapitulation of the applied methods, the acquired data and the results obtained. In a structured written report, accompanied by a day-by-day protocol, they can (1) explain the scientific context and define the goal of their research project, (2) describe the application of methods in comprehensive technical notes, (3) document and analyze the acquired data, (4) judge upon the reliability and reproducibility of the results, and (5) evaluate and interpret these results in relation to published work. They are trained to explain the goals, experimental design and essential outcome of their research internship to their peers and supervisor in short and concise oral presentations.

Teaching and Learning Methods:
The internship is composed of three elements with theoretical and practical aspects: Phase 1- Developing and planning of a scientific project, Phase 2- Implementation of a research plan devised in Phase 1, and Phase 3– writing a scientific report about the research project. In the practical course, students are trained to scrutinize a research question related to nutrition science and biomedicine as predefined by the supervisor. The research internship embeds in a defined

research context at the respective chair/laboratory/department hosting the student. High intensity supervision of students by experienced scientific personnel supports the training success. Students document their research work in a dedicated lab notebook, with a focus on detailed description of applied methodologies, data acquisition and data analyses. They report to their supervisor on the progress of their work in regular meetings and summarize the goals of their research project and the main findings in short oral presentations, using PowerPoint, or equivalent presentation tools. Within this setting, the project progress and plans to further develop the project are discussed.

Media:

Reading List:

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship Internal (4 weeks) Molecular Nutritional Medicine (Prof. Klingenspor) - Master (Forschungspraktikum, 6 SWS)
Bruder J, Fromme T, Klingenspor M, Wagner A

Research Internship Internal (4 weeks) Food Process Engineering (Prof. Först) - Master (Forschungspraktikum, 6 SWS)
Först P, Gruber S, Hilmer M

Research Internship Internal (4 weeks) Food Chemistry and Molecular Sensory Science (Prof. Dawid komm.) - Master (Forschungspraktikum, 6 SWS)
Heidenkampf J

Research Internship Internal (4 weeks) Exercise, Nutrition and Health (Prof. Köhler) - Master (Forschungspraktikum, 6 SWS)
Köhler K

Research Internship Internal (4 weeks) Biothermodynamics (Prof. Minceva) - Master (Forschungspraktikum, 6 SWS)
Minceva M [L], Buchweitz V, Falconieri M, Luca S, Minceva M, Pajnik J, Sibirtsev S, Sönnichsen C, Yildiz C, Yin J

Research Internship Internal (4 weeks) Plant Proteins and Nutritions (Prof. Weisz) - Master (Forschungspraktikum, 6 SWS)
Weisz U (Bittner R), Bittner R, Etzbach L, Zöllner M
For further information in this module, please click campus.tum.de or here.

Module Description

LS20013: Research Internship External (10 CP) | Research Internship External (10 CP)

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 10	**Total Hours:** 300	**Self-study Hours:** 300	**Contact Hours:** 0

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is completed by the completion of the 8-weeks research internship (full-time; 37,5 h/ week).
The examination of the module is conducted in the form of a report.

The student's performance is evaluated, as documented in the lab notebook and the internship report (max. 25 pages), by the following criteria:
- understanding of the research question
- overview of the published scientific literature related to the research question
- ability to learn and apply new methods
- skillfulness in research tasks
- precision and accuracy in data acquisition and data management
- data analyses and evaluation
- ability to study and work autonomously
- clarity of scientific writing

Repeat Examination:

(Recommended) Prerequisites:
Module Research Methods
Module Basics in Computational Biology Module Integrated Lab Course

shedule:

The students search themselves one TUM internal supervisor from the given list of classes no matter if the planned research Internship is going to be TUM internal or TUM external. They do

so by contacting a chair of TUM School of Life Sciences that already has a class connected to each one of the offer-nodes within the module-node of LS20013 in TUMonline. If a preferred supervisor's classes and exam is already listed a topic or supervisor needs no further approval by the Examination Board.
If there should be another potential TUM internal supervisor whose chair is not yet part of the list of classes and/or exams, the students can ask for an extension of the list by the preferred supervisor writing a conclusive e-mail to recognition.co@ls.tum.de.

Content:
The scientific questions addressed by laboratories at external research facilities hosting the master students for the research internship deal with nutrition-related research, either on the fundamental or applied level, in the fields of biochemistry, molecular biology, nutrition physiology, metabolism, microbiology, food chemistry, nutrition medicine, genetics, clinical studies, epidemiology and public health. The internship is an opportunity for our students to apply their theoretical and practical knowledge acquired during the first two semesters to a specific research question in the framework of a project in the host laboratory.

The research internship consists of 240 hours of attendance or of working time (e.g. in the laboratory) and 60 hours for the internship follow-up (report). The internship period should thus comprise 8 weeks (37.5 h/wk). In order to ensure continuous processing of the topic, the attendance time should be provided as continually as possible with a weekly working time of at least 20 hours and should not exceed the internship time of 15 weeks in part-time.

Intended Learning Outcomes:
After successful finalization of the module, our students have acquired initial theoretical and practical skills to tackle a scientific question predefined by a supervisor and conduct research tasks under guidance by this supervisor. They have gained first hands-on experience in the design of experiments in life science laboratories, or the development of study protocols in clinical study units. They are experienced in sensible and reproducible application of selected methods, understand the technical background and limitations of the applied technologies. They gained insights into quality control procedures in scientific research. They have learned to document the day-by-day progress of their work in a comprehensible manner that allows independent recapitulation of the applied methods, the acquired data and the results obtained. In a structured written report, accompanied by a day-by-day protocol, they can (1) explain the scientific context and define the goal of their research project, (2) describe the application of methods in comprehensive technical notes, (3) document and analyze the acquired data, (4) judge upon the reliability and reproducibility of the results, and (5) evaluate and interpret these results in relation to published work. They are trained to explain the goals, experimental design and essential outcome of their research internship to their peers and supervisor in short and concise oral presentations.

Teaching and Learning Methods:
The internship is composed of three elements with theoretical and practical aspects: Phase 1- Developing and planning of a scientific project, Phase 2- Implementation of a research plan

devised in Phase 1, and Phase 3– writing a scientific report about the research project. In the research internship, students are trained to scrutinize a research question related to nutrition science and biomedicine as predefined by the external supervisor. The research internship embeds in a defined research context at the respective external host institution. Experienced scientific personnel at the external host institution supports the training success of students. Students document their research work in a dedicated lab notebook, with a focus on detailed description of applied methodologies, data acquisition and data analyses. Upon request they report to their TUM supervisor on the progress of their work and summarize the goals of their research project and the main findings in short oral presentations, using PowerPoint, or equivalent presentation tools. Within this setting, the project progress and options to further develop the project are discussed.

Media:

Reading List:
Review articles and original research articles related to the topic of the research internship. The supervisor assists the student to find the relevant papers and recommends specialized textbooks.

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship External (8 weeks) Food Process Engineering (Prof. Först) - Master (Forschungspraktikum, 1 SWS)
Först P, Gruber S, Hilmer M

Research Internship External (8 weeks) Food & Health (Prof. Gedrich) - Master (Forschungspraktikum, 1 SWS)
Gedrich K [L], Gedrich K

Research Internship External (8 weeks) Exercise, Nutrition and Health (Prof. Köhler) - Master (Forschungspraktikum, 1 SWS)
Köhler K

Research Internship External (8 weeks) Biothermodynamics (Prof. Minceva) - Master (Forschungspraktikum, 1 SWS)
Minceva M [L], Minceva M, Sönnichsen C

Research Internship External (8 weeks) Metabolic Programming (Prof. Uhlenhaut) - Master (Forschungspraktikum, 1 SWS)
Spanier B

Research Internship External (8 weeks) Plant Proteins and Nutritions (Prof. Weisz) - Master (Forschungspraktikum, 1 SWS)
Weisz U
For further information in this module, please click campus.tum.de or here.

Module Description

LS20014: Research Internship External (5 CP) | Research Internship External (5 CP)

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 150	**Contact Hours:** 0

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is completed by the completion of the 4-week research internship (full-time, 37,5 h/wk).
The examination of the module is conducted in the form of a report.

The student's performance is evaluated, as documented in the lab notebook and the internship report (max. 12 pages), by the following criteria:
- understanding of the research question
- overview of the published scientific literature related to the research question
- ability to learn and apply new methods
- skillfulness in research tasks
- precision and accuracy in data acquisition and data management
- data analyses and evaluation
- ability to study and work autonomously
- clarity of scientific writing

Repeat Examination:

(Recommended) Prerequisites:
Module Research Methods
Module Basics in Computational Biology Module Integrated Lab Course

shedule:
The students search themselves one TUM internal supervisor from the given list of classes no matter if the planned research Internship is going to be TUM internal or TUM external. They do so by contacting a chair of TUM School of Life Sciences that already has a class connected to

each one of the offer-nodes within the module-node of LS20014 in TUMonline. If a preferred supervisor's classes and exam is already listed a topic or supervisor needs no further approval by the Examination Board.
If there should be another potential TUM internal supervisor whose chair is not yet part of the list of classes and/or exams, the students can ask for an extension of the list by the preferred supervisor writing a conclusive e-mail to recognition.co@ls.tum.de.

Content:
The scientific questions addressed by laboratories at external research facilities hosting the master students for the research internship deal with nutrition-related research, either on the fundamental or applied level, in the fields of biochemistry, molecular biology, nutrition physiology, metabolism, microbiology, food chemistry, nutrition medicine, genetics, clinical studies, epidemiology and public health. The internship is an opportunity for our students to apply their theoretical and practical knowledge acquired during the first two semesters to a specific research question in the framework of a project in the host laboratory.

The research internship consists of 120 hours of attendance or of working time (e.g. in the laboratory) and 30 hours for the internship follow-up (report). In full-time, the internship period is therefore 4 week (37,5 h/week)s. In order to ensure continuous processing of the topic, the attendance time should be provided as continually as possible with a weekly working time of at least 20 hours and should not exceed the internship time of 8 weeks in part-time.

Intended Learning Outcomes:
After successful finalization of the module, our students have acquired initial theoretical and practical skills to tackle a scientific question predefined by a supervisor and conduct research tasks under guidance by this supervisor. They have gained first hands-on experience in the design of experiments in life science laboratories, or the development of study protocols in clinical study units. They are experienced in sensible and reproducible application of selected methods, understand the technical background and limitations of the applied technologies. They gained insights into quality control procedures in scientific research. They have learned to document the day-by-day progress of their work in a comprehensible manner that allows independent recapitulation of the applied methods, the acquired data and the results obtained. In a structured written report, accompanied by a day-by-day protocol, they can (1) explain the scientific context and define the goal of their research project, (2) describe the application of methods in comprehensive technical notes, (3) document and analyze the acquired data, (4) judge upon the reliability and reproducibility of the results, and (5) evaluate and interpret these results in relation to published work. They are trained to explain the goals, experimental design and essential outcome of their research internship to their peers and supervisor in short and concise oral presentations.

Teaching and Learning Methods:
The internship is composed of three elements with theoretical and practical aspects: Phase 1- Developing and planning of a scientific project, Phase 2- Implementation of a research plan devised in Phase 1, and Phase 3– writing a scientific report about the research project. In the practical course, students are trained to scrutinize a research question related to nutrition science

and biomedicine as predefined by the external supervisor. The research internship embeds in a defined research context at the respective at the host institution. Experienced scientific personnel at the external host institution supports the training success of students. Students document their research work in a dedicated lab notebook, with a focus on detailed description of applied methodologies, data acquisition and data analyses. Upon request they report to their TUM supervisor on the progress of their work and summarize the goals of their research project and the main findings in short oral presentations, using PowerPoint, or equivalent presentation tools. Within this setting, the project progress and options to further develop the project are discussed.

Media:

Reading List:
Review articles and original research articles related to the topic of the research internship. The supervisor assists the student to find the relevant papers and recommends specialized textbooks.

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Research Internship External (4 weeks) Molecular Nutritional Medicine (Prof. Klingenspor) - Master (Forschungspraktikum, 1 SWS)
Bader B, Fromme T, Klingenspor M, Pearson S, Stolz J

Research Internship External (4 weeks) Food Process Engineering (Prof. Först) - Master (Forschungspraktikum, 1 SWS)
Först P [L], Gruber S, Hilmer M

Research Internship External (4 weeks) Food Chemistry and Molecular Sensory Science (Prof. Dawid komm.) - Master (Forschungspraktikum, 1 SWS)
Heidenkampf J

Research Internship External (4 weeks) Exercise, Nutrition and Health (Prof. Köhler) - Master (Forschungspraktikum, 1 SWS)
Köhler K

Research Internship External (4 weeks) Biothermodynamics (Prof. Minceva) - Master (Forschungspraktikum, 1 SWS)
Minceva M [L], Minceva M, Sönnichsen C

Research Internship External (4 weeks) Plant Proteins and Nutritions (Prof. Weisz) - Master (Forschungspraktikum, 1 SWS)
Weisz U
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3061: Applied Food Law | Applied Food Law

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The oral examination takes 20 min for each student and will take place in groups of 2-3 students. The students apply their knowledge by evaluating product samples presented to them and discussing the related legal questions. The legal texts can be used. The individual performance of the examinees is assessed by answering questions independently, examining practical examples and showing in a discussion that they have thought through the subject matter in an argumentative way.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Food law lecture in B.Sc. study recommended, but no prerequisite

Content:
Law of the EU: Principles, general food law, jurisdiction, categories of products, use of substances, food safety, novel food, GMOs, labeling, consumer information, responsibility, advertising, health and nutrition claims. Independent working with law texts, understanding of the principles of food law.

Intended Learning Outcomes:
At the end of the module, students are able to apply the principles of food law. Especially, they are able to evaluate the use of ingredients in food and the advertising for foodstuffs. The students examine the various legal prerequisites for the marketing of different categories of food, e.g. novel food, food supplements and eco food, including their specific labelling requirements.

Teaching and Learning Methods:
The module consists of a lecture, including expert input. Product samples are presented, learningns from authorization procedures. Surveillance measures and the jurisdiction of the courts discussed.

Media:
Presentations with PowerPoint

Reading List:
Meisterernst, Lebensmittelrecht, C.H. Beck 2019; Textsammlung Lebensmittelrecht, R&W Verlag

Responsible for Module:
Meisterernst, Andreas; Prof.

Courses (Type of course, Weekly hours per semester), Instructor:
Applied Food Law (Vorlesung, 2 SWS)
Meisterernst A
For further information in this module, please click campus.tum.de or here.

Module Description

LS40014: Basics of Metabolomics | Basics of Metabolomics

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module is conducted in the form of a project work.

The examination consists of an oral presentation of up to 5-7 minutes per person (60% of final mark) and submission of a maximum 6 page long research paper (40% of final mark) on the project work focusing on a specific experimental/theoretical problem related metabolomics experiments. The research paper is a mean to measure the overall understanding of the stated problem in metabolomics workflows and their ability to solve them, analyze the current state-of-art and develop novel solutions in order to improve current shortcomings in metabolomics. The oral presentation allows students to present their results to a wider auditory and subsequent discussion is a mean to measure their understanding of the scientific subject. The discussion includes justification in the selection of the analytical methods (mass spectrometry, nuclear magnetic resonance, type of chromatographic separation, etc) as well as overall understanding of the metabolomics workflow

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
- basic knowledge of biochemistry
- basic statistical knowledge, e.g. t-test, etc.
- basic laboratory skills

Content:
Biochemical, analytical and data analytical basics of metabolomics are illustrated using relevant examples.
The following individual topics are covered:

biochemical basics
- Definition of systems biology and its disciplines (omics)
- Definition and aims of metabolomics and its role in systems biology
- relation of metabolomics to other omics-technologies

analytical basics
- basics of mass spectrometry (MS) and coupling of chromatographic methods
- application of MS in metabolomics
- basics of nuclear magnetic resonance (NMR) and its application in metabolomics

Metabolomics experiments
- experimental design
- sample preparation
- implementation of measurements
- quality control
- interpretation of results
- metabolite identification

data analytical basics
- basic statistical evaluation, e.g. HCA, PCA, PLS
- bioinformatic approaches

relevant applications
- in medicine, nutrition, food chemistry
- to model organisms
- in plant research and biotechnology

Intended Learning Outcomes:
The students are able to define the term of systems biology and to state its different disciplines. Furthermore, they know different omics technologies and can separate them from each other.
The students are able to compare analytical methods used in metabolomics based on their advantages and disadvantages and select a fitting method to solve a specific scientific question. Moreover, they are able to apply basic statistical data analysis methods on a given dataset and interpret the results in biochemical context. Additionally, students are competent to perform problem-based literature research in relevant media.
On the basis of selected problems, students are able to question the current status of metabolomic research and state possibilities for improvement. They can draft plans and execution of metabolomics experiments, are able to comment on them and present results in a scientific setting.

Teaching and Learning Methods:
The module consists of a lecture, including expert input, single- and group work, case studies and student
presentations.

Media:
Script; slides

Reading List:
Metabolomics in Practice - Successful Strategies to Generate and Analyze Metabolic Data, 2013, 1. Auflage,
Wiley-VCH, ISBN: 9783527330898
- The Handbook of Metabonomics and Metabolomics, 2007, 1. Auflage, Elsevier, ISBN: 978-0-444-52841-4
- verschieden Original- und Übersichtsarbeiten

Responsible for Module:
Witting, Michael; PD Dr. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ0219: Chemosensory Perception | Chemosensory Perception

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In the written examination (90 min) students demonstrate by answering questions without helping material the theoretical knowledge of the biology of taste, smell, and chemesthetic perception as well as extra-sensory processes involving chemoreceptors. To answer the questions, own wordings are necessary and sketches of biomolecules and signaling pathways.

In addition, there is the option of taking a voluntary mid-term assignments as course work in accordance with APSO §6, 5. For this, a report on a scientific publication (1 page plus summary graphic) is to be prepared. This is supplemented by a presentation to test the communicative competence in presenting the contents to an audience.
Passing the course performance will improve the module grade by 0.3 if, based on the overall impression, this better characterizes the student's performance level and the deviation has no influence on passing the examination. No retake date will be offered for the mid-term performance. In case of a repetition of the module examination, a mid-term performance already achieved will be taken into account.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in molecular bilogy, biochemistry, cell biology and physiology is required.

Content:
The basics of aroma- and taste recognition, evaluation, and analysis on a molecular level are communicated.

In detail, the following topics are discussed:- basics of human taste recognition (molecules,anatomy, morphology and function of gustatory and olfactory structures, receptors, genetic variability and its influence on sensory sensitivity, establishment of preferences and aversions, the connection between sensory perception and food preferences, extra-sensory functions of taste and odorant receptors, oral somatosensory perception, basic taste modalities, signal transduction).

Intended Learning Outcomes:
Upon completion of the module, students understand the molecular bases of taste and smell perception. The students will be able to separate those percepts from other chemosensory cues such as chemesthesis or pheromone detection. Moreover, students are familiar with the putative physiological relevance of extra-sensory chemosensory stimuli. The importance of the chemical senses for food preferences and consumption is known.

Teaching and Learning Methods:
The content of the lecture is presented by means of powerpoint presentations. Students are motivated to broaden their knowledge by reading complementary literature relevant to the topic.

The seminar will give the students the chance to follow the rapid development of chemosensory research directly by reading and discussing recent publications. Students will choose a paper and critically present it to their peers. Additional literature research for a solid introduction into the field of research is requested. The fellow students are motivated to discuss the presentations. This will deepen the understanding of the contents presented during the lecture and enable the students to critically evaluate novel results.

Media:
PowerPoint presentations will be used. The content of the lectures will be made available for download as pdf-files.

Reading List:
not specified

Responsible for Module:
Behrens, Maik; Dr. rer. nat. habil.

Courses (Type of course, Weekly hours per semester), Instructor:
Chemosensory Perception (Seminar, 2 SWS)
Behrens M

Chemosensory Perception (Vorlesung, 2 SWS)
Behrens M
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3223: Design and Analysis of Experiments | Design and Analysis of Experiments

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is only offered in odd years. In even years see LS40016 or WZ3224 Health Behaviour and Health Promotion.

The learning outcome from this module is evaluated based on a 30-minute oral group examination with two examinees. Students demonstrate their abilities to discuss pros and cons of various experimental concepts in relation to predefined scientific problems; to understand general statistical concepts; to understand concrete statistical problems; to develop proper approaches for solving predefined statistical problems; to analyze given data sets applying the computer software R and suitable descriptive as well as inferential statistical approaches; to evaluate the obtained statistical output in a correct manner; to communicate statistical information in comprehensible fashion using proper terminology. In the group examination, students are individually asked questions and given statistical tasks to be completed, while the respective other student is given the chance to supplement or comment given answers leading to a scientific discussion. Students may use a sheet of paper with personal notes as auxiliary means (1 sheet of paper, max. page size DIN A4, double sided).

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basics in statistics

Content:
Design of experiments: principles, randomization, statistical power and sample sizes, completely randomized designs, block designs, factorial designs; Analysis of variance: prerequisites, analysis

of residuals, contrasts, posthoc-test, Non-parametric alternatives, bootstrapping; Correlations: Pearson, Spearman, Kendall, partial correlation; Linear Regression

Intended Learning Outcomes:
Upon successful completion of the module, students are able to discuss pros and cons of various experimental concepts in relation to predefined scientific problems; to understand general statistical concepts; to understand concrete statistical problems; to develop proper approaches for solving predefined statistical problems; to analyze given data applying the computer software R and suitable descriptive as well as inferential statistical approaches; to evaluate the obtained statistical output in a correct manner; to communicate statistical information in comprehensible fashion using proper terminology.

Teaching and Learning Methods:
Lecture, group work, discussions, exercises, examples, demonstrations, computer hands-on training, student presentations, homework, students' self-dependent study of relevant literature

Media:
The following media will be used as and when required:
Reader, (white)board, exercise sheets, PowerPoint, Moodle online course, Zoom online sessions

Reading List:
Collins C & Seeney F (1999): Statistical Experiment Design and Interpretation. Chichester etc. : Wiley Crawley MJ (2005): Statistics - An Introduction using R. West Sussex : Wiley
Crawley MJ (2007): The R Book. West Sussex : Wiley
Field A & Hole G (2003): How to Design and Report Experiments. Los Angeles etc. : Sage
Field A, Miles J & Field Z (2012): Discovering Statistics using R. Los Angeles etc. : Sage
Hatzinger R, Hornik K & Nagel H (2011): R - Einführung durch angewandte Statistik. München etc. : Pearson Studium Hinkelmann K & Kempthorne O (2008): Design and Analysis of Experiments. Volume 1 - Introduction to Experimental Design.
2nd ed. New York etc. : Wiley
Kirk RE (2013): Experimental Design. 4th ed. Thousand Oaks etc. : Sage
Rasch D, Pilz J, Verdooren R, Gebhardt A (2011): Optimal Experimental Design with R. Boca Raton etc. : CRC Press Ryan TP (2007): Modern Experimental Design. New Jersey : Wiley
Ugarte MD et al. (2009): Probability and Statistics with R. Boca Raton : CRC Press

Responsible for Module:
Gedrich, Kurt, Apl. Prof. Dr. oec. troph. habil. kgedrich@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

LS40015: Experimental Immunology and Pathology | Experimental Immunology and Pathology

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 75	**Contact Hours:** 75

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module is conducted in the form of a laboratory assignment with a written report.
Students have to hand in the report (appx. 20 pages) covering all topics presented in the lab course including mouse dissection, histopathology, genotyping, immune phenotyping, gene expression analysis and microbiological analysis. Each student will have to write a separate report for each topic mention above, in the format of a thesis (scientific background on the mouse model and its relevance, material and methods, analysis of the data and results, discussion of the obtained results and perspectives including literature references). The students demonstrate with the reports that they have gained deeper knowledge and understanding of the specific methodologies, lab equipment and measurement methodologies and can analyse data with the use of appropriate software tool as well as statistics. They show that they are able to complete extensive laboratory tasks, know how to evaluate and interpret data and results and identify possible sources of error.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge in immunology

Content:
The practical lab course demonstrates the use of an animal model of intestinal inflammation in biomedical research. Starting with mouse dissection, different techniques and methodologies to analyze disease-associated alterations at the organ- and cellular level are applied including: histopathology, genotyping, immune phenotyping, gene expression analysis and microbiological analysis.

Intended Learning Outcomes:
Students acquire detailed and differentiated knowledge on the laboratory work with animal models of diseases and are able to assess the possibilities and limits of these techniques. They apply relevant research methodologies and are able to link scientific questions on disease outcomes to research technologies and immunological/ physiological alterations.
Upon completion of the module, students have improved their practical laboratory working and scientific writing skills.

Teaching and Learning Methods:
Prior to the practical work, students will attend lectures (each approx. 60min) presenting all topics and respective methods (mouse dissection, histopathology, genotyping, immune phenotyping, gene expression analysis and microbiological analysis). Each student will receive a detailed script presenting the scientific background and methodologies with regard to the mouse model and applied lab techniques and protocols, as a permanent informational and reference tool. Where appropriate, videos and online content will be provided for students to access via Moodle for additional support. Before the end of the module, each topic will discussed in a question and answer session, allowing student to clarify any uncertainties and deepen their knowledge. Each topic will be supervised by a different lecturer, who will also be the direct person of contact for the respective topic during the entire course and writing phase, maximizing the availability for questions from students. Within the practical lab course the students work in teams two, however each student will write their own report.

Media:

Reading List:

Responsible for Module:
Dirk Haller Dirk.haller@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Experimental Immunology and Pathology (Übung, 5 SWS)
Haller D [L], Aguanno D, Kisling S, Krammel T, Omer H, Ren S, Riva A, Schmöller I, Schwamberger S, Smith K
For further information in this module, please click campus.tum.de or here.

Module Description

WZ2404: Introduction to Mammalian Cell Culture | Einführung in die Kultivierung von Säugetierzellen

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 75	**Contact Hours:** 75

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Das Modul setzt sich aus den Lehrveranstaltungen "Praktikum" und "Seminar" zusammen.
Die Prüfungsleistung der LV „Praktikum“ erfolgt anhand einer Laborleistung, die sich aus einem Testat (30 Minuten), einer Präsentation (10 Minuten) sowie der Bewertung der praktischen Arbeit zusammensetzt. Die Bewertungskriterien der praktischen Arbeit umfassen die Fortschritte bei den praktischen Fähigkeiten, Motivation und Kenntnisse über den Praktikumsablauf. Die Gewichtung der drei Teilnoten erfolgt 1:1:1.

Mit der erfolgreichen Ablage der Prüfungsteile weisen die Studierenden die Befähigung nach, das erlernte Wissen zu strukturieren und die wesentlichen Aspekte darzustellen. Sie sollen die erarbeiteten Informationen beschreiben, interpretieren, sinnvoll kombinieren und auf ähnliche Sachverhalte übertragen können. Das Manuskript zum Praktikum dient zur Vorbereitung für das Praktikum.

Zusätzlich zum Praktikum werden mit den Studierenden Seminare durchgeführt, in denen sie mittels Literatur praktische Themen der Kultivierung von Säugetierzellen erarbeiten und präsentieren müssen. Die Prüfungsleistung im Seminar umfasst eine Präsentation (15 Minuten).

Gewichtung Laborleistung:Präsentation = 6:4.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Bachelor-Abschluss in Biologie bzw. Molekulare Biotechnologie

Content:
Im Rahmen des Praktikums werden Grundkenntnisse über die Isolierung, Charakterisierung und genetische Manipulierung von Säugetierzellen vermittelt. Inhalte sind u.a.: Steriles Arbeiten, Mikroskopie, Kulturbedingungen, Etablierung und Konservierung von Zelllinien und Primärkulturen, Bestimmung von Zellzahlen, Transfektionsmethoden, Isolierung und Expansion von Zellklonen, Anwendung und Detektierung von Markergenen.

Im Seminar werden insbesondere die Hintergründe und theoretischen Kenntnisse zu den durchgeführten Experimenten vermittelt. Im Rahmen des Praktikums werden grundlegende Methoden zu praktischen Arbeiten mit Säugetierzellen vermittelt. Im zugehörigen Seminar stellen die Studierenden relevante Literatur bezüglich Zellkultur vor.

Intended Learning Outcomes:
Nach der Teilnahme an den Modulveranstaltungen besitzen die Studierenden das grundlegende theoretische Verständnis und Fachwissen für die Kultivierung und genetische Manipulierung von Säugetierzellen. Weiterhin haben sie grundlegende zellbiologische Arbeitstechniken erlernt und geübt. Sie verstehen zellbiologische Fragestellungen und Arbeitstechniken und können das erworbene Wissen auf vertiefte Fragestellungen anwenden.
Die Studierenden haben weiterhin Fähigkeiten zum Lösen von Problemen entwickelt, sowie Einblicke in die Zellbiologie und zellbiologische Problemen erworben.

Teaching and Learning Methods:
Veranstaltungsform/Lehrtechnik: Praktikum, Seminar
Lehrmethode im Praktikum: Anleitungsgespräche, Demonstrationen, Experimente, Partnerarbeit, Ergebnisbesprechungen.
Lehrmethode im Seminar: Vortrag
Lernaktivitäten: Studium von Skripten, -mitschrift, Praktikumsskript und Literatur; Üben von labortechnischen Fertigkeiten und zellbiologischen Arbeitstechniken; Zusammenarbeit mit Praktikumspartner; Anfertigung von Protokollen und Präsentationen.

Media:
Präsentationen mittels PowerPoint,
Praktikumsskript (Downloadmöglichkeit für Vorlesungsmaterial) Publikationen zu zellkulturspezifischen Themen

Reading List:
Es ist kein Lehrbuch verfügbar, das alle Inhalte dieses Moduls abdeckt.
Als Grundlage oder zur Ergänzung wird empfohlen:
Sabine Schmitz; Der Experimentator: Zellkultur;
R. Ian Freshney: Culture of Animal Cells: A Manual of Basic Technique

Responsible for Module:
Schusser, Benjamin; Prof. Dr.med.vet.

Courses (Type of course, Weekly hours per semester), Instructor:
Einführung in die Kultivierung von Säugetierzellen (Zellkultur - Praktikum) (Praktikum, 3 SWS)
Bak A, Bauer B, Fischer K, Flisikowska T, Pauli T

Zellbiologische Fragestellungen (Zellkultur - Seminar) (Seminar, 2 SWS)
Fischer K
For further information in this module, please click campus.tum.de or here.

Module Description

WZ5050: Development of Starter Cultures | Entwicklung von Starterkulturen

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 60	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Regelmäßige, aktive Teilnahme an der Vorlesung wird erwartet. Die in der Vorlesung zu erlernenden Sachkenntnisse und Kompetenzen werden durch eine mündliche Prüfung (20 min) geprüft. Hierbei demonstrieren die Studierenden, ob sie in der Lage sind, das erlernte Wissen strukturiert darzulegen und die wesentlichen Aspekte darzustellen.

Die mündliche Prüfung beinhaltet Sach-, Verständnis-, und Transferfragen über alle Themen, die in der Vorlesung angesprochen und ausgeführt wurden. Die Studierenden sollen die erarbeiteten Informationen beschreiben, interpretieren, sinnvoll kombinieren und auf ähnliche Sachverhalte übertragen können. Hierbei dient die Foliensammlung nur als Grundlage. Prüfungsgegenstand ist das gesprochene Wort. Die mündliche Prüfung dient der Überprüfung der in der Vorlesung erlernten theoretischen Kompetenzen.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
keine

Content:
Gegenstand des Moduls "Entwicklung von Starterkulturen" sind:
Allgemeine Sicherheit und Anforderungen an Starterkulturen, Nachweis und Identifizierung von Starterstämmen, Analyse und Verfolgung der Mikrobiotadynamik in Lebensmittelfermentationen, Biochemie der Milchsäurebakterien und Hefen, Stoffwechsel von Kohlenhydraten, Citrat, Malat, Aminosäuren, Bildung von Exopolysacchariden, Rolle der Bakteriophagen in fermentierten Lebensmitteln, Bakteriozine und weitere besondere Eigenschaften von Milchsäurebakterien und deren Bedeutung für die Anwendung in Lebensmitteln.

Intended Learning Outcomes:
Nach der erfolgreichen Teilnahme an diesem Modul besitzen die Studierenden ein grundlegendes theoretisches Verständnis und Fachwissen zur Entwicklung von Starterkulturen. Sie haben die Fähigkeit zur Bewertung der Eignung von Milchsäurebakterien und Hefen für bestimmte Anwendungen in fermentierten Lebensmitteln, kennen Kriterien für die Auswahl von Starterstämmen, und können den Einfluss des Stoffwechsels von Milchsäurebakterien und Hefen auf deren Wettbewerbskraft, Aromabildung und Textureffekte in Lebensmitteln und Getränken, sowie Rolle des Redoxhaushalts auf die Metabolitbildung in Milchsäurebakterien bewerten. Sie sind in der Lage makroskopisch und sensorisch wahrnehmbare Eigenschaften fermentierter Lebensmittel durch biochemische Grundlagen und Stoffwechselvorgänge in Starterkulturen zu erklären.

Teaching and Learning Methods:
Die Inhalte der Vorlesung werden mittels einer Powerpoint-Präsentation vermittelt, auf der umfassende Erläuterungen basieren. Die Studierenden werden angehalten selbständig Vorlesungsmitschriften anzufertigen sowie die Foliensammlung und geeignete Literatur zu studieren. Sie werden angehalten, die Vorlesungsinhalte in Lerngruppen zu diskutieren und dadurch ihre Fähigkeiten zur mündlichen Darstellung von Sachverhalten zu üben.

Media:
Für diese Veranstaltung steht eine digital abrufbare Foliensammlung zur Verfügung, welche maßgeblich prüfungsrelevant ist.

Reading List:
Wissenschaftliche Literatur zu diesem Themenbereich ist nur in Originalpublikationen und Review Artikeln verfügbar.

Responsible for Module:
Hutzler, Mathias, Dr.-Ing. m.hutzler@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Entwicklung von Starterkulturen (Vorlesung) (Vorlesung, 2 SWS)
Hutzler M [L], Hutzler M, Hohenester M
For further information in this module, please click campus.tum.de or here.

Module Description

WI000948: Food Economics | Food Economics

Version of module description: Gültig ab summerterm 2021

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students prove their achievement of learning outcomes in an oral exam of 25 minutes. The exam is designed to test whether students understand the discussed topics and publications, whether they can describe and explain them in a meaningful and exact way, and whether they can critically reflect on assumptions, methodology, results, and political and societal implications of research in food economics. An oral exam is the most suitable format to account for the discursive and reflective nature of the abilities examined.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
The course applies microeconomic theory to study questions of food demand and supply. Students should feel comfortable with the material in microeconomic courses at introductory level.

Content:
The course is intended to provide students with in-depth coverage of food economics with an emphasis on trends and phenomena of food markets and value chains, food labelling, food safety, food consumption, nutrition and food policy. Taking examples from these domains the course introduces a variety of economic models that are being used in food-economic research.

Intended Learning Outcomes:
At the end of the module, the students are able to (1) outline important trends and phenomena in food markets in Germany, Europe and the world, (2) analyse consumer and firm behavior in food markets based on economic theory, (3) assess the effectiveness of food policy instruments, (4) acquaint themselves with scientific literature in the area of food economics and discuss and evaluate crucial assumptions, choice of methodology and implications of results.

Teaching and Learning Methods:
The module is designed as an interactive lecture where both lecturers and students provide input for discussion. In order to set up a common basis for participants, lecturers present information on major features and trends on food markets and economic concepts used to analyze them. To familiarize themselves with economic research, students read selected journal articles from the field of agricultural and food economics and prepare a short presentation of 15 minutes and a short report of about 2 pages once per semester, summarising the main hypotheses, methods applied, results obtained and implications derived. Subsequent discussions in classroom on assumptions, limitations of data and methods, as well as on different ways to interprete results deepen students' understanding of the potential and restrictions of research in food economics.

Media:
Slides, textbooks, journal articles, blackboard, collection of summaries of publications.

Reading List:
Lusk, J. L., Roosen, J, & Shogren, J. F. (eds.) (2011). The Oxford handbook of the economics of food consumption and policy. Oxford University Press: New York.
Additional references are provided in the course.

Responsible for Module:
Roosen, Jutta; Prof. Dr. Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
Food Economics (WI000948, englisch) (Vorlesung, 4 SWS)
Roosen J, Menapace L
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3231: Food Design and Food Industry | Food Design and Food Industry

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The final grade will be based on a written exam which will include both, open and multiple-choice questions (≤10%). The written examination will be 120 minutes with pen and paper and will be conducted without the use of learning aids. The examination will be roughly 6 weeks after the final lecture.
Passing of the exam will require a broad overview of the Food Industry and food design presented in the lectures. Students need to demonstrate that they have acquired all the skills that are necessary for a successful continuation in the master program. These skills include, for example, distilling out and remembering the salient facts on how science and consumer behaviour underpins the economic performance of the Food Industry. Students will be able to demonstrate by answering questions:
- a practical knowledge of the Food Value Chain (Farm to Fork), economic performance as well as the challenges driven by environmental pressures, trends in society and consumer behaviour;
- the ability to describe the complexities involved in designing food products that meet consumer demands for safe, legally compliant, convenient, healthy and affordable food that must above all, taste good;
- they have understood the analysis of the various case studies on how different Food Companies have (and continue to work) with Governments, Non-Government Organisations (NGOs) and academia to address the challenges facing the Food Industry.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
The fundamentals of food chemistry/engineering and nutrition science plus a basic understanding of statistics

Content:

The course gives an overview on the role of the Food Industry both in society and as a major player in ensuring food security as described by “farm to fork”.
The impact of the Food Industry on the ecological footprint and how “Circular Systems” are being applied to address the sustainability challenge.
The size, structure, and strategies of the major players in the Industry’s Value Chain (Agri-Food, manufacturers, retail trade and quick service restaurants) are reviewed.
The methods used in product development and commercialization are described. Case studies are used to illustrate consumer driven product design in the context of business expectations and trends in society.
The impact of legislation regarding product labelling and health claims is reviewed and illustrated by examples.

Intended Learning Outcomes:
This module is designed for students with various scientific and cultural backgrounds and gives the students a holistic understanding of the Food Industry - Food Value Chain, economic performance as well as the challenges driven by environmental pressures, trends in society and consumer behaviour.
The students will analyse various case studies on how different Food Companies have (and continue) to work with Governments, Non-Government Organisations (NGOs) and academia to address these challenges. The students will be able to draw conclusions as to whether these challenges were resolved.
In addition, students will be able to describe the complexities involved in designing food products that meet consumer demands for safe, legally compliant, convenient, healthy and affordable food that must above all, taste good.
Finally, the students will be able to compare the roles played by Food Companies and academia in the Food Industry. They will be able to apply this knowledge when considering possible internships and future career prospects.

Teaching and Learning Methods:
Lectures using PowerPoint with commentary giving examples of practical experience in the Food Industry. Case studies are integrated into the lectures to illustrate and analyse how various methods are used in consumer driven product design.
During the lectures the students will be encouraged and given time to discuss and critique the various topics to enhance their comprehension of the subject.
Tutorial sessions will be available to the students as required

Media:
PowerPoint presentations will be used for the lectures. Links to the relevant scientific, commercial and literature are included on the PowerPoint slides. The material for the lectures will be posted on the Moodle platform 2 days before the lecture date.

Reading List:
Links to the relevant literature are included on the PowerPoint slides and will be highlighted during the lectures.

Responsible for Module:
Pearson, Stephen

Courses (Type of course, Weekly hours per semester), Instructor:
Food Design and Food Industry (Vorlesung, 4 SWS)
Klingenspor M [L], Pearson S
For further information in this module, please click campus.tum.de or here.

Module Description

WZ0306: Genomics | Genomik und Gentechnik

Version of module description: Gültig ab winterterm 2012/13

Module Level: Bachelor	**Language:** German/English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 3	**Total Hours:** 50	**Self-study Hours:** 20	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Examination duration: 60 minutes

Repeat Examination:
Next semester

(Recommended) Prerequisites:
basic knowledge of genetics and biochemistry

Content:
The modul Genomik consists of the lecture Genomics (V02, 3CP)
Topics of the lecture are

Sequencing strategies,
Genome Projects,
Data base resources,
Transcriptomics,
Proteomics,
Metabolomics,
Quantitative Genetics,
Association-Mapping,
Model systems.

Intended Learning Outcomes:
The students got insight into modern genetic concepts. The students are familiar with modern methods in genetics.

Teaching and Learning Methods:
Lecture; materials available within the download-area on the web sites of the involved institutions.

Media:

Reading List:
will be announced by the lecturer

Responsible for Module:
Monika Frey monika.frey@mytum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

LS40016: Health Behaviour and Health Promotion | Health Behaviour and Health Promotion

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module is only offered in even years. In odd years see WZ3223 Design and Analysis of Experiments.

The learning outcome from this module is evaluated based on a 30-minute oral group examination (with two examinees) and a research paper (approx. 10 pages per student) completed by a presentation (approx. 10 minutes per student plus discussion).
In the oral examination, students prove their abilities to understand important theories of health behaviour; to apply those theories for understanding consumers' health behaviours;
to evaluate advantages and disadvantages of various health systems.
In the group examination, students are individually asked questions, while the respective other student is given the chance to supplement or comment given answers leading to a scientific discussion.

The research paper and the respective presentation are both conducted as coursework. They provide students the opportunity to demonstrate that they are able
to understand a given scientific problem related to health behaviour and health promotion;
to use respective scientific literature;
to make use of a variety of behavioural theories when evaluating given strategies in disease prevention and health promotion w.r.t. a specific type of health compromising behaviour (e.g. smoking, diet, sedentary lifestyle);
to develop promising health promotion concepts;
to report their insight in a concise and well-comprehensible manner.
Overall, students show their ability to discuss scientific matters of health behaviour and health promotion using proper terminology in oral as well as in written form.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Students may benefit from basic insights into Economics and Public Health

Content:
Health behaviour from the perspective of Health Psychology: Models of health, health behaviour and health
education;
Health behaviour from the perspective of Behavioural Economics: Prospect Theory;
Health behaviour from the perspective of Health Psychology: Models of health, health behaviour and health education;
Health behaviour from the perspective of Behavioural Economics: Prospect theory and time discounting;
Economics of Health and Health Care: stakeholders in health care systems, measures of cost containment, quality of health services;
Health Promotion: exemplary evaluation of strategies in disease prevention and health promotion.

Intended Learning Outcomes:
Upon successful completion of the module, students are able to understand important theories of health behaviour;
to apply those theories for understanding consumers' health behaviours;
to evaluate pros and cons of various health care systems;
to understand a given scientific problem related to health behaviour and health promotion;
to make use of a variety of behavioural theories when evaluating given strategies in disease prevention and health promotion w.r.t. a specific type of health compromising behaviour (e.g. smoking, diet, sedentary lifestyle);
to develop promising health promotion concepts.

Teaching and Learning Methods:
Lecture, group work, discussions, examples, demonstrations, student presentations, homework, students' self-dependent study of relevant literature

Media:
The following media will be used as and when required:
Reader, (white)board, PowerPoint, Moodle online course, Zoom online sessions

Reading List:
Antonovsky A (1996): The salutogenic model as a theory to guide health promotion. Health Promotion International : 11(1), 11-18
Bartholomew LK et al. (2006): Planning Health Promotion Programs. 2nd ed. Jossey-Bass
Folland S, Goodman AC, Stano M (2001): Economics of Health and Health Care. 3rd ed. Prentice-Hall

Gedrich K (2003): Determinants of nutritional behaviour – a multitudes of levers for successful intervention? Appetite 41, p. 231-8
Kahneman D & Tversky A (1979): Prospect theory: An analysis of decision under risk. Econometrica 47/2, 263-291 van Lange PAM, Kruglanski AW & Higgins ET (Eds.) (2012): Handbook of Theories of Social Psychology. Vol. 1.
Sage
Naidoo J, Wills J (2009): Foundations Health Promotion : Foundations for Practice. 3rd ed. Baillière Tindall (Elsevier) Taylor SE (2003): Health Psychology. 5th ed. McGraw-Hill
Tversky A & Kahneman D (1981): The framing of decisions and the psychology of choice. Science 211, 453-458 Tversky A & Kahneman D (1986): Rational choice and the framing of decisions. The Journal of Business 59, 251-278

Responsible for Module:
Gedrich, Kurt; Prof. Dr. oec. troph. habil.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

SG810001: Health and Society | Health and Society

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
A written exam assesses the students' ability to understand sociological theories and social dimensions of health and illness as well as social aspects of prevention and health promotion. In a given time (90 min) they have to demonstrate their ability to summarize their level of knowledge by answering a combination of closed-ended and open-ended questions. Students have the opportunity to contribute to the exercises in form of student-led classes. This mid-term assignment will serve for grade improvement by 0.3.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Basic knowledge of social and health sciences

Content:
- History of social medicine and the sociological approach towards health and illness
- Illness as social deviance
- Medicalization and the social construction of health and illness
- Professionalism and professionalization in health care
- Diversity and health
- Functional health and (dis-)ability
- Sociology and the body
- Assistive technologies in health care
- Social conditions, contextual factors and social determinants of health
- Salutogenesis and health promotion
- Globalization and the WHO perspective on global health
- Sociological critiques of health promotion

Intended Learning Outcomes:
After successfully completing the module, students will be able
- to understand social conditions, contextual factors and social determinants of health
- to comprehend sociological approaches towards health and illness
- to understand and discuss processes of the social construction of health problems
- to critically assess health discourses and dynamics of medicalization
- to identify social inequalities in health-related matters
- to have thorough knowledge of gender- and diversity-sensitive aspects in prevention and health promotion
- to understand resource-based approaches, following a salutogenic model

Teaching and Learning Methods:
The module consists of 2 classes with blended learning components. The lectures take place on campus (lecture hall HS3). In the exercise, students will work in small groups, reading and discussing literature that deepens the understanding of the lecture's contents. Discussions will be initiated via student presentations.
Student-led exercises
The course covers different Health and Society topics each week, which will presented in the lecture and further discussed in the exercise classes. From week 3, two to three students will lead the exercises each week. An introduction on how to prepare and structure a student-led exercise will be given in week 1 and 2. Furthermore, the exercise lecturers are available to provide advice on class planning and presentation. It is important to remember that student-led exercises are not presentations and, instead, should focus on group work, interactive tasks, and discussions.
For each week, there will be one compulsory readings, which must be read by all students. The topics of the exercise should follow the lecture topic and the main reading of each week. Students leading the exercise do not have to present the content of the papers in detail, but the topic of the exercise should be based on the main reading. You are welcome to use additional articles from the reading list or choose other relevant literature.
Topics and formats of the seminars can include debates, quizzes, short videos, group work, discussion of current issues related to the topic, newspaper articles, case studies…
Each group should prepare about 60-80 minutes for their seminar. Please leave at least 10 minutes at the end for feedback.

Course convenors and contact details:
• Andrea Goettler, andreagoettler@tum.de (lectures and exercises)
• Prof Matthias Richter, richter.matthias@tum.de (lectures)
• Dr. Julia Roick, julia.roick@tum.de (group 1 exercise)
• Dr. Laura Hoffmann, hoffmann.laura@tum.de (group 2 exercise)
Please contact via e-mail or through the moodle forum.

Media:
PowerPoint, video clips, reader, Moodle

Reading List:
Germov J. (2009). Second opinion: an introduction to health sociology. 4th Edition. Oxford University Press.
Further literature is listed for each lesson.

Responsible for Module:
Richter, Matthias; Prof. Dr. rer. soc.

Courses (Type of course, Weekly hours per semester), Instructor:
Health and Society (Übung, 2 SWS)
Camargo da Rosa P, Hoffmann L, Richter M, Roick J

Introduction to Health and Society (Vorlesung, 2 SWS)
Camargo da Rosa P, Richter M
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1414: Hot Topics and Techniques in Metabolism Research | Hot Topics and Techniques in Metabolism Research

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The type of assessment is a presentation complemented by a brief written precis.
Students will be evaluated based on their presentations (oral presentation of their topic, format of their choice, 50%) and a written abstract on their topic to be handed in at the end of the semester (50%). The presentation consists of the oral presentation plus discussion (in total 30 minutes). The students will have to show that they are able to prepare a computer-based (PowerPoint) presentation and to demonstrate competence in critical evaluation and focused aggregation of a topic. The students also will have to reveal their expertise in open-minded handling of feedback and discussion in an audience.
The written abstract should be one Word doc page long and is structured like “News & Views” or “Highlights” in scientific journals. It is accomplished by a one page graphical abstract that summarizes the take home message in a graphical way. Both formats are regularly used in scientific journals, and the students gain competence in evaluating scientific publications. Furthermore, they will have to demonstrate their knowledge and understanding in the selected scientific topic in form of a focused and precisely written abstract text.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge of molecular biology, biochemistry and metabolism, genetics. No other modules are required.

Content:
This module will cover the latest developments in ‘omics’ techniques (genomics, proteomics, metabolomics, lipidomics, bioinformatics) applied to current areas of investigation in metabolic signaling. We will cover novel NGS techniques to interrogate the genome (RNA-Seq, ChIP-Seq,

ATAC-Seq, single cell sequencing...) with actual protocols and publications. We will discuss GWAS and other types of human genetics studies as well as mammalian model organisms. Other hot topics include metabolic signaling and nutrient sensing pathways (such as mTOR), epigenetics and histone modifications (DNA methylation, histone acetylation, methylation and recently discovered novel modifications), adipose tissue plasticity (beiging or browning of white adipocytes), cancer metabolism, immunometabolism, circadian rhythms, posttranslational modifications and proteomes, obesity genetics and 'hot molecules' (such as lactate, alpha ketoglutarate, GDF15,…).

Intended Learning Outcomes:
Upon completion of this course, students will have gained a broad overview of both experimental techniques and methods, as well as open areas and unsolved puzzles, which are currently being used and addressed in metabolism research. Students are able to
- understand basic principles and methodologies (genomics, proteomics, metabolomics, lipidomics, bioinformatics, RNA-Seq, ChIP-Seq, ATAC-Seq, single cell sequencing, etc.) applied when testing scientific hypotheses and designing experiments.
- recognize and critically evaluate the latest scientific literature.
- present their critical evaluation and focused aggregation of a topic in computer-based (PowerPoint) presentation.
- discuss their results with an audience in an open-minded handling.
- describe their results in a structured way like "News & Views" or "Highlights" in scientific journals.
- use a graphical abstract that summarizes the take home message in a graphical way.
- independently inform themselves and evalute new developments in the field of cellular signaling pathways, epigenetics, cancer and immune-metabolism.
- apply the tools learned in this course and prepare themselves best in respect of scientific topics and methods for job interviews, Master's or PhD theses as well as for different career paths.

Teaching and Learning Methods:
This is a student-centric format! Participants will receive relevant materials, which they prepare during independent study and research, and which they will then present and 'teach' to the other students in the course. This will be followed by an interactive discussion and explanations as well as specific examples, protocols and problems to be solved by the students.

Media:
PowerPoint, Pubmed, Peer-reviewed publications, Whiteboard.

Reading List:
Articles and publications will be provided to you during the course. No textbook is required.
To get an idea of the type of publications to be analyzed, please check out:
https://www.nature.com/natmetab/news-and-comment

Responsible for Module:
Uhlenhaut, Nina Henriette; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Hot Topics and Techniques in Metabolism Research (Seminar, 4 SWS)
Greulich F [L], Friano M, Greulich F, Spanier B, Uhlenhaut N
For further information in this module, please click campus.tum.de or here.

Module Description

LS20007: Introduction to Computational Neuroscience | Introduction to Computational Neuroscience

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 7	**Total Hours:** 210	**Self-study Hours:** 120	**Contact Hours:** 90

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
In a graded final 20 minute presentation (slides, e.g. with Power Point) the students present their project work, where they aim for reproducing results from a scientific paper with methods of computational neuroscience, that are taught in the lecture and practiced in the tutorials. In addition, the students should synthesize the relevant findings of the paper and critically discuss the modeling choices of the authors, following examples that are given throughout the lecture.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Previous exposure to python is helpful, but not required.
Basic knowledge of neuroscience/neurophysiology is recommended.

Content:
Introduction to programming with python

The concepts and implementation in python of:
Neuroelectronics - Cable Properties, different neuron models and synaptic conductances
Network models - Feed-forward and recurrent models with spiking and rate-based neurons
Plasticity and Learning - spike time dependent and rate based plasticity rules and synaptic normalization
Neural Codes - Mutual information, Spike trains and receptive fields
Machine Learning - Dimensionality reduction, Model fitting, Generalized Linear Models, Reinforcement learning

Intended Learning Outcomes:
Upon completion of the module students will be able to
• describe the field of computational neuroscience and its sub-disciplines, like dynamical systems, machine learning, stochastic processes and information processing.
• understand the different levels of, and approaches to modeling of biological processes
• understand general concepts of model fitting, like mean squared error, maximum likelihood estimate and the variance/bias trade-off
• implement classical but still relevant models of computational neuroscience (e.g. Leaky Integrate and Fire, Hodgkin-Huxley, Wilson-Cowan, Hopfield), compare their level of description and analyze their strength and weaknesses.

Finally, they will be able to deconstruct computational neuroscience papers into the components taught in the lecture.

Teaching and Learning Methods:
The students learn the basic concepts of computational neuroscience in the lecture and can solidify the learned material in hands-on tutorials with peer-programming tasks and interactive notebooks. Furthermore, they will apply the learned concepts from the lecture and the tutorials in a group-project, that consists of a mix of self-study and guided sessions and leads to a final presentation; where the students present their findings and how they relate to the learned concepts.

Media:
The lecture consists of a PowerPoint presentation.
The tutorials consist peer-programming sessions with the use of interactive notebooks. The project work consist of self-study sessions and guided sessions and a Power Point presentations prepared by the students.

Reading List:
Dayan, P., & Abbott, L. F. (2005). Theoretical neuroscience: computational and mathematical modeling of neural systems. MIT press.
Bear, M., Connors, B., & Paradiso, M. A. (2020). Neuroscience: Exploring the Brain, Enhanced Edition: Exploring the Brain. Jones & Bartlett Learning.
MacKay, D. J., & Mac Kay, D. J. (2003). Information theory, inference and learning algorithms. Cambridge university press.

Responsible for Module:
Gjorgjieva, Julijana, Prof. Ph.D. gjorgjieva@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Introduction to Computational Neuroscience – Lecture (M.Sc.) (Vorlesung, 2 SWS)
Gjorgjieva J

Introduction to Computational Neuroscience – Exercise (M.Sc.) (Übung, 2 SWS)

Gjorgjieva J [L], Ferreira Castro A

Introduction to Computational Neuroscience – Project Work (M.Sc.) (Projekt, 2 SWS)
Gjorgjieva J [L], Ferreira Castro A
For further information in this module, please click campus.tum.de or here.

Module Description

WZ0479: Introduction to Anthropology of Food | Introduction to Anthropology of Food [AnthroFood]

Version of module description: Gültig ab winterterm 2021/22

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination will consist of a 20-minute oral discussion of one of the topics presented during the module, and its relative literature. Critical approach and personal understanding of the matter will be considered as the achievement of a deeper knowledge. The final evaluation will result from the examination (70%) and the in-class reports about specific literature that students are assigned during the seminars (30%).

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:

Content:
Eating and drinking are universal needs for human beings, but the uncountable representations and practices that relate to those needs are culturally and socially defined. Even taste is not only the product of biochemical interactions between our gustative receptors and food's taste molecules: as anybody may experience, it is also the result of historical, socio-cultural, and even economic and political factors. This module aims to furnish the students with the rudiments of cultural anthropology, and signally the basic knowledge of anthropology of food. The lessons and the suggested bibliography will shed light on the cultural and even symbolical dimension of food as well as on its strict relation with both local and global social dynamics.

Lecture topics:
1. Introduction to cultural anthropology.
2. Food as a cultural object.
3. How taste is culture-informed.

4-5. Food as a symbol of socio-cultural identity.
6-7. Food and religion.
8. Non-religious food taboos and prescriptions.
9. Food, memory, and tradition.
10. Local food as a product of globalization.
11. What is ethnic in ethnic cuisine?
12. Taste, snobbery, and social distinction.
13. “Cultural Orthorexia” and dietary fads.
14. Globalizing kosher food in Italy: a case study.
15. Summary and conclusions.

Intended Learning Outcomes:
Upon successful completion of this module, students will be able to understand food as a social and cultural object, to apply basic anthropological tools in order to analyze the diversity of representations and practices related to food in different human contexts, and evaluate the symbolical and identitary contents of foodways.

Teaching and Learning Methods:
The lectures will be conducted by the lecturer through oral and visual presentations about the topics, but they will be open to students’ critical discussion. The seminars will involve actively the students, both individually and as working groups: they will be assigned to report and comment about specific readings of original literature.

Media:
PowerPoint Presentation; Video projection

Reading List:
Fox, Robin. 2014. “Food and Eating: An Anthropological Perspective”. Social Issues Research Centre. (online). http://www.sirc.org/publik/foxfood.pdf
Mintz, Sidney W., and Christine M. Du Bois. 2002. “The Anthropology of Food and Eating”. Annual Review of Anthropology 2002 31(1): 99-119.
Douglas, Mary. 1972 “Deciphering a Meal”. Daedalus 101 (1): 61-81.

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WI100311: Food & Agribusiness Marketing | Lebensmittelmarketing und Agribusiness-Marketing

Version of module description: Gültig ab winterterm 2020/21

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module grade is based on a research paper (10-15 pages, 50%) and a presentation (35-40 minutes, with 15-20 minutes per single student, 50%).
Groups of students work on questions related to the Argribusiness Marketing.
In the research paper students demonstrate their ability (1) to perform a market definition, (2) to outline an exemplary scientific market research study while using market research methods, and (3) execute examples for applying marketing instruments.
Students present and discuss partial results of the single parts (1-3) during the semester. The students integrate the feedback from the discussions into their research paper.
By presenting their results students show their ability to present scientific topics in a clear and comprehensible manner. By working in a team students demonstrate that they are able to solve the given task by constructively and conceptually collaborating in a team.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Marketing; Marketing Research

Content:
The module covers examples of agricultural marketing from agricultural management and marketing research. It discusses the following topics:

- market structure of agricultural and food economics;
- determination of objectives and strategies in agricultural marketing;
- management of brands, also store brands;
- communication in agribusiness marketing (advertising, cooperative advertising);

- price policy in agribusiness marketing;
- product- and quality-management in agribusiness marketing (effect on cooperation and integration);
- innovation und product differentiation;
- distribution, especially in food retailing.

Intended Learning Outcomes:
At the end of the module, students are able to develop marketing management and strategic considerations in marketing in the agribusiness sector. Students will be able to a) define essential characteristics of agricultural products and b) argue their consequences for commercialization.
In addition, they can assess microeconomic models for describing and analyzing marketing strategies in agribusiness. Moreover, students are able to evaluate current research in the field of agribusiness marketing.
Furthermore, the students will be able to develop a conceptual design for a practical problem in agribusiness marketing. They are able to judge the success of a marketing strategy by using current marketing literature.
Students are able to solve a given task by constructively and conceptually collaborating in a team.

Teaching and Learning Methods:
The module is held in the form of a seminar, where students in groups develop a marketing concept for an example product. Students are guided to research the suitable scientific literature and data for their example. They present their results to the other workshop participants and receive feedback in the discussion that they then integrate into their report. A workshop is the best way for the students to illustrate a marketing concept by means of a case study.

Media:
Presentation, scientific papers, textbook chapters

Reading List:
Meffert, H., Burmann, C., Kirchgeorg, M. (2015). Marketing: Grundlagen marktorientierter Unternehmensführung Konzepte - Instrumente – Praxisbeispiele, 12. Auflage. Wiesbaden: Springer-Gabler.

Responsible for Module:
Roosen, Jutta; Prof. Dr. Ph.D.

Courses (Type of course, Weekly hours per semester), Instructor:
Lebensmittelmarketing und Agribusiness-Marketing (WI100311, deutsch/englisch) (Limited places) (Seminar, 4 SWS)
Roosen J [L], Benninger N
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1993: Laboratory Animal Science | Laboratory Animal Science [VTK]

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The module examination consists of a written exam (Klausur, 90 min) in which students have to answer various questions on laboratory animal science topics without any aids. Answering the questions partly requires students to formulate their own answers and partly requires them to mark multiple answers.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Fundamentals of Anatomy, Physiology, Laboratory Animal Science, BSc Biology/Life Sciences, BSc Molecular Biotechnology, BSc Agricultural and Horticultural Sciences, BSc Nutritional Sciences

Content:
The following topics are covered in the module:
- Laws relating to animal testing
- Exposure assessments and score sheets
- Alternative methods to animal testing
- Blood collection and application techniques
- Genetics and breeding in animal experiments
- Biotechnological techniques in pigs and chickens
- Poultry as laboratory animals
- Bats as laboratory animals
- Snakes as laboratory animals
- Monitoring of animal testing facilities
- Neurology and behavior of small rodents
- Handling of small rodents

- Injections (s.c., i.p. i.m. i.v.)
- Blood sampling techniques
- Oral application of substances

Intended Learning Outcomes:
After successfully attending the module courses, students will be able to name various procedures, relevant laws and methods of laboratory animal science. Students will be able to understand and apply these regulations after completing the module. Students will be able to assess the different interpretations and applications of laws, methods and animal models and actively support the planning of animal experiments. After completing the module, students will be able to carry out initial handling of laboratory animals such as mice, rats and rabbits and perform injections and blood sampling under supervision.

Teaching and Learning Methods:
The module consists of a seminar (2 SWS) and an exercise (2 SWS).
The seminar provides basic knowledge on the topics described. PowerPoint presentations are used to illustrate the most important aspects of the respective topics to the participants and are critically scrutinized in a subsequent discussion.
As part of the exercise, the handling of these rodent species is practiced using mouse, rat and rabbit models and blood sampling, as well as injections and applications of substances are practiced.

Media:
Presentation (PowerPoint), blackboard work, practical exercises

Reading List:
Lecture notes, legal texts, LAS-online course

Responsible for Module:
Schusser, Benjamin; Prof. Dr.med.vet.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

ME2453: Molecular Pathology and Organ-Specific Carcinogenesis | Molekulare Pathologie und organspezifische Karzinogenese

Version of module description: Gültig ab winterterm 2022/23

Module Level: Master	**Language:** German/English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Die regelmäßige Teilnahme an den Vorlesungen "Molekulare Pathologie" und "Organspezifische Molekulare Karzinogenese" ist erforderlich. Zwei Klausuren (jeweils 90 min, Single choice, benotet) dienen der Überprüfung der in den Vorlesungen erworbenen theoretischen Kompetenzen.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
The basic knowledge of molecular biology and genetics acquired during the bachelor's program should be sufficient for understanding the lectures. Attending other modules is not required.

Content:
The lecture "Molecular Pathology" teaches methodological basics of tissue analysis on the highest scientific level and deals with interdisciplinary aspects of pathological processes. Special emphasis is placed on oncogenes and tumor suppressor genes, cell adhesion and metastasis, signal transduction, cell cycle and apoptosis, angiogenesis, environmental carcinogenesis and cancer stem cells. This will provide an understanding of the molecular mechanisms of oncogenesis. In the lecture "Organ-Specific Molecular Carcinogenesis", basic tumor classifications are explained and organ-specific carcinogenesis is explained in detail and in an understandable way for carcinomas of the stomach, colon, liver, pancreas, mamma, lung and urogenital tract. In addition, leukemias and lymphomas, brain tumors, and endocrine tumors are covered. In addition, leukemias and lymphomas, brain tumors and endocrine tumors are treated.

Intended Learning Outcomes:
After attending the two lectures, the students will have basic knowledge of molecular pathology, molecular pathological working techniques and organ-specific molecular carcinogenesis. They should have learned to understand molecular pathological questions and working techniques and to develop solutions independently, to understand molecular mechanisms of oncogenesis and to recognize interrelationships and particularities of carcinogenesis of different organs. The module should provide an insight into human pathology and arouse interest in the diagnosis and therapy of cancer.

Teaching and Learning Methods:
Course type/teaching technique: Lecture, teaching method: lecture; learning activities: study of lecture material, lecture notes and literature

Media:
Presentations via Powerpoint,
Script (download option for lecture material)

Reading List:
There is no textbook available that covers all contents of this module. It is recommended as a basis or as a addition:
C. Wagener, O.Müller (Hsg.) Molecular Oncology, Georg Thieme Verlag, Stuttgart, 2010.

Responsible for Module:
Luber, Birgit; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Molekulare Pathologie (Vorlesung, 2 SWS)
Luber B [L], Azimzadeh O, Dreyer T, Härteis S, Luber B, Mörtl S, Rosemann M, Schüffler P, Steiger K, Wirth J

Organspezifische Molekulare Karzinogenese (Vorlesung, 2 SWS)
Luber B [L], Azimzadeh O, Dreyer T, Luber B, Mörtl S, Muckenhuber A, Nawroth R, Neff F, Sarker R, Schicktanz F
For further information in this module, please click campus.tum.de or here.

Module Description

WZ2402: Microbial Toxins in Food | Mikrobielle Toxine in der Nahrung

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Die Studierenden weisen in einer benoteten Klausur (60 min) nach, dass sie in der Lage sind in begrenzter Zeit und ohne Hilfsmittel ihr Fachwissen über mikrobielle Toxinbildner, deren Habitaten und Toxinen darzustellen. Zudem sollen sie grundlegende toxikologische Arbeitstechniken beschrieben sowie toxikologische Probleme mikrobieller Herkunft in ihrer Bedeutung für die Lebensmittelsicherheit einordnen können.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Grundkenntnisse in Anatomie, Physiologie und Biochemie.

Content:
Vermittlung toxikologischer und analytischer Grundlagen. Darstellung relevanter Bakterien-, Pilz- und Algentoxine: Ökologie der Toxinbildner; biochemische und pathophysiologsiche Wirkungen der Toxine; Vorkommen in der Nahrungskette ("carry over"); Prophylaxemaßnahmen, gesetzliche Reglementierungen.

Intended Learning Outcomes:
Nach der Teilnahme an den Modulveranstaltungen besitzen die Studierenden das grundlegende theoretische Verständnis und Fachwissen über mikrobielle Toxinbildner, deren Habitaten und deren Toxine. Weiterhin haben sie grundlegende toxikologische Arbeitstechniken (z.B. Zellkulturversuche, LC-MS/MS) erlernt und geübt. Sie können toxikologische Probleme mikrobieller Herkunft analysieren und bewerten.
Das Modul soll weiterhin Fähigkeiten zum Lösen von Problemen entwickeln helfen, sowie das Interesse an mikrobiellen Toxinen und deren Bedeutung für die Lebensmittelsicherheit fördern.

Teaching and Learning Methods:
Vorlesung und Übungen im Labor

Media:
PowerPoint

Reading List:

Responsible for Module:
Meyer, Karsten, Dr. agr. karsten.meyer@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Analytik mikrobieller Toxine (Übung, 2 SWS)
Meyer K [L], Meyer K

Mikrobielle Toxine in der Nahrung (Vorlesung, 2 SWS)
Meyer K [L], Meyer K
For further information in this module, please click campus.tum.de or here.

Module Description

WZ2496: Molecular and Medical Virology | Molekulare und Medizinische Virologie

Version of module description: Gültig ab winterterm 2011/12

Module Level: Master	**Language:** German	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 6	**Total Hours:** 180	**Self-study Hours:** 120	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Die Modulprüfung besteht aus einer Klausur (90min, benotet) in der die Studierenden grundlegende und vertiefte Kenntnisse der Virologie abrufen und anwenden sollen.
Die Prüfungsleistung wird am Ende des 2. Vorlesungssemesters (SS) erbracht. Die Wiederholungsklausur findet in der vorlesungsfreien Zeit zu Beginn des darauf folgenden WS Semesters statt.
In der Prüfung soll nachgewiesen werden, dass Grundlagen der Virologie inkl. molekularer und medizinisch relevanter Aspekte verstanden und wichtige funktionelle Zusammenhänge der Virus-Wirt-Interaktion analysiert werden können.
Das Beantworten der Fragen erfordert teils eigene Formulierungen und teils Ankreuzen von vorgegebenen Mehrfachantworten. Es sind keine Hilfsmittel erlaubt.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Kenntnisse der Molekularbiologie und Grundkenntnisse in Zellbiologie und Immunologie

Content:
Allgemeine Themen der molekularen Virologie (z.B. Viruseintritt in Wirtszellen, Replikationsstrategien von RNA und DNA Viren, Expressionskontrolle, Virusassembly), Virusfamilien (z.B. Toga-, Flavi, Herpes-, Myxo, Hepatitis-, Retroviren); medizinische Aspekte der Virologie (z.B. angeborene und adaptive Immunreaktionen gegen Viren, Immunevasion, Impfungen, Emerging viruses, onkogene Transformation, virale Vektoren)

Intended Learning Outcomes:
Nach dem Besuch des Moduls versteht der Studierende die grundlegenden Prinzipien der Virologie, kennt die Merkmale bedeutender Virusfamilien und die wichtigsten Mechanismen der Virus-Wirt-Beziehung

Teaching and Learning Methods:
Vorlesungen mit Unterstützung durch PowerPoint Präsentationen, die Folien werden zum Download bereitgestellt

Media:

Reading List:
Flint et al., Principles of Virology I and II, ASM Washington
Modrow et al., Molekulare Virologie, Spektrum Verlag 2010

Responsible for Module:
Protzer, Ulrike; Prof. Dr.med.

Courses (Type of course, Weekly hours per semester), Instructor:
Molekulare und medizinische Virologie (Teil 1 und 2) (Vorlesung, 2 SWS)
Protzer U [L], Protzer U, Bauer T, Deng L, Ebert G, Kosinska A, Möhl-Meinke B, Pichlmair A, Vincendeau M, Wettengel J
For further information in this module, please click campus.tum.de or here.

Module Description

WZ2662: Modern Topics in Evolutionary Biology | Modern Topics in Evolutionary Biology

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The exam is a Klausur (180 min) in the form of a written essay. The essay consists of up to 7 pages (without references). The students have to answer one question at the interface between ecological and evolutionary processes. Several articles, empirical studies and general reviews, are provided before hand for the students to prepare at home. The students will need to 1) develop an introduction with adequate definitions and framing of the topic and the question, 2) develop a well argued answer to the question using as basis the empirical studies provided as well as other studies in the literature, and 3) provide a conclusion answering the topical question. In order to develop a convincing argument and provide a solid and robust answer, the students may have to explain the necessary concepts of evolutionary biology, (epi)genetics, and ecology, as well as evaluate critically the findings of the cited empirical studies.

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
Basic knowledge in Evolution and Genetics

Content:
1) Cooperation: evolution of cooperation, adaptive dynamics, evolutionary stable strategy, cooperation and insect society.
2) Host-parasite coevolution: infectious diseases, epidemiology, evolution of virulence, genetic and epigenetic bases of interactions.
3) Life history traits: evolution and consequences. Dormancy and quiescence, evolution of aging, aging and demography in an ecological context.
4) Epigenetics: Molecular basis of epigenetics, epigenetic inheritance, epigenetics and evolution.
5) Essay writing: structure, plan, developing arguments, building a well argued reasoning.

6) Seminars: cooperation and cancer, cancer and epigenetics, cooperation in human societies and relevance for climate change, epigenetics and cooperation in insect societies, vaccine and virulence evolution of viruses, dormancy in bacteria/fungi/insects, dormancy in human parasites, epigenetics and aging, epigenetics and dormancy/quiescence.

Intended Learning Outcomes:
The students have a profound understanding of four fundamental topics in Ecology and Evolution: cooperation, coevolution between species, evolution of life-history traits and aging, and the role of epigenetics in evolution. For example, the students can explain what cooperation is, how it evolves and what is a stable evolutionary strategy for cooperation.
The students understand the principles of host-parasite interactions and disease epidemiology and the (epi)genetic mechanisms underpinning host-parasite coevolution. They can build basic mathematical models and implement them in R to perform simulations and analyze their behavior.
The students are able to describe the cause and consequences of the evolution of life history traits such as dormancy and aging. To do so, the students are able to build and analyze simple codes in R modelling these ecological and evolutionary mechanisms and processes.
The students can also describe the neutral and selective forces driving the evolution of dormancy and aging.
The students can describe the molecular bases of epigenetics and the role of epigenetic inheritance in evolution.
The students can integrate these ecological and evolutionary aspects and explain their relevance for agriculture and medicine. The seminar part of the course focuses on the analysis of state of the art publications linking these topics. Finally, the students will learn how to write a structured scientific essay to answer a question.

Teaching and Learning Methods:
The lectures and exercises are intermixed during the sessions. Typically, a first part of lecture introduces the concepts and the mathematical models. Then students will implement the model in R and perform simulations under different parameters. Thereby, they gain a direct understanding of the behavior and outcome of the mathematical model. The exercises are done by the whole group, and students are encouraged to discuss their results with their colleagues, before a summary is presented by the lecturer. There is also a seminar session, where students by groups present a research paper (an empirical study) linking several topics of the lectures together. The students perform a PowerPoint presentation of this study and afterwards discuss it with the lecturer and the other students. The aim of the presentation is to describe, analyze, interpret and critically evaluate the results of the study. The students will learn how to write an essay.

Media:
PowerPoint, computer program R, whiteboard, published articles

Reading List:
Mark Ridley, Evolution, Oxford University Press 2011; Pigliucci M. and G.B. Mueller, Evolution: The extended Synthesis, MIT Press, 2010; Maynard-Smith J. and Szathmary E., The Major transitions in Evolution, Oxford University Press 1995; Otto and Day, A Biologist's Guide to Mathematical

Modeling in Ecology and Evolution (2007); Charlesworth and Charlesworth, Evolution: a very short introduction, Oxford University Press 2017.

Responsible for Module:
Tellier, Aurélien, Prof. Dr. aurelien.tellier@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Modern topics in Evolutionary Biology (Seminar, 2 SWS)
Tellier A [L], Clin P, Tellier A

Modern topics in Evolutionary Biology (Vorlesung, 2 SWS)
Tellier A [L], Tellier A
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3230: Mitochondrial Biology | Mitochondrial Biology

Version of module description: Gültig ab summerterm 2024

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The students will demonstrate their acquired knowledge on mitochondrial biology during a graded, oral examination of 20 minutes. The ability of the student will be examined (1) to describe the underlying concepts of mitochondrial functional units as covered by the course, (2) to apply this knowledge in a novel context, e.g. to explain a primary dataset or the consequences of a disease mutation and (3) to integrate knowledge into recent scientific advance as
covered by the seminar.

Repeat Examination:
Next semester / End of Semester

(Recommended) Prerequisites:
Basics in Nutrition and Food, Energy Balance Regulation

Content:
The course covers the entire spectrum of mitochondrial involvement in cellular homeostasis and metabolism. This includes oxidative phosphorylation, membrane potential, thermogenesis, anaplerotic reactions, apoptosis, calcium homeostasis, reactive oxygen species, mtDNA mutations in the phylogeny of human origin, evolution and the endosymbiotic theory, fusion and fission, protein import, solute transport, and mito-ER association.

Intended Learning Outcomes:
The students will have broadened their understanding of mitochondria from mere ATP producers to their complex role as integrative hubs in multiple metabolic and signaling pathways. They will be familiar with the state of the art and thus be able to participate in ongoing research projects studying mitochondrial function with little further training on scientific background or typically employed technology. Due to the integrative nature of mitochondrial function

within a plethora of other pathways, students will have acquired the ability to place seemingly self-contained knowledge fields into a greater cellular context. Students will be able to understand and integrate recent and future literature into this complete framework of mitochondrial function.

Teaching and Learning Methods:
Basic knowledge will be provided in the form of lectures (2 SWS). The corresponding seminar (2 SWS) will allow
students to both practice their presentation skills of original literature and convey highlights of current research in
the above fields.

Media:
presentation slides, whiteboard

Reading List:
‘Bioenergetics 4’ by David Nicholls, ISBN: 9780123884251
‘Mitochondria’ by Immo Scheffler, ISBN: 0471194220

Responsible for Module:
Fromme, Tobias; PD Dr. rer. nat. habil.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

WZ3232: Molecular Oncology | Molecular Oncology

Version of module description: Gültig ab winterterm 2024/25

Module Level: Master	**Language:** English	**Duration:** two semesters	**Frequency:** winter/summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 120	**Contact Hours:** 30

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
This modul is composed of two courses distributed over two semesters: Molekulare Onkologie 1MED (MolOnc 1) and Molekulare Onkologie 1 HA (MolOncHA).

The module examinations consists of a written exam (Klausur, 90 min, 60 min in pandemic emergencies, graded, weighted with 100%) and the examination of the homework (Report, typically 20-25 pages) for the subsequent semester. The homework is ungraded, but has to be passed to pass the module.

The lecture of MolOnc 1 is recommended to be continuously visited for those students aiming at excelling in the written final exam (free questions, graded), which serves to test the knowledge and competence acquired with the help of the lectures. There are no aids allowed in the final exams. The questions can be based on any subject of the lectures. By answering the questions correctly, the students demonstrate their skills and competence to reproduce facts from the lecture (approx. 70%, associate different facts presented during the lecture (approx. 20%), and employ their ability of transfer thinking (approx. 10%) evolving from the understanding and postprocessing of the lectures, which is supported by regular question-sessions. Furthermore, the students demonstrate their competence to answer the questions in a concise and clearly written way supported by drawings. The questions are in English and German, the answers can be given in one or the other of these languages. The passing of the exam is prerequisite for allowance for MolOncHA.

MolOncHA is a homework written in English.
With the completion of the homework the successful (passed) students show that they have gained the competence to study on his/her own, compare and appreciate his/her notes with the pertinent literature in all ten fields covered in the lecture (see below in content), can work and complete the work in a given time-frame, follow constructions and put all their research in a given format. This way, the students will have the competence to meet basic expectations of a science-associated/ related job. Assessment criteria are the correctness of the expected formats, suitable and fitting

choice of literature, and sufficiently correct topic-related content. The homework assignment has to be submitted as ppt and pdf-converted file. In addition, a pdf-file containing the used original papers has to be submitted.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
basics of biochemistry, molecular biology, genetics. Other modules are not a pre-requisite.

Content:
Topics
1.) Introduction to Molecular Oncology, Terminology, Problems in Tumor Biology Research;
2.) Tissue Homeostasis, Causes of Tumorigenesis, Maintenance of Genomic Stability;
3.) Oncogenes (Oncogene Discovery Methods, Definitions, Classes of Oncogenes, Oncogenic Mode of Action);
4.) Tumor Suppressor Genes (Discovery and Examples, Mode of Action);
5.) Epigenetics (Definitions, Histone and DNA Modifications, CpG Islands);
6.) The Microenvironment of the Cell (Components of a Tumor, Tumor Stroma as TherapeuticTarget, Structure and Function of Major Molecules of the Extracellular Matrix, Cell/ECM Interaction, Cell/Cell Interaction);
7.) Mechanisms of the Metastasis Cascade (Steps of the Cascade, Angiogenesis, Angiogenic and Metabolic Switch, Invasion
Tumor-Associated Inflammation, Epithelial-Mesenchymal Transition, Seed and Soil Hypothesis, Pre-Metastatic Niche);
8.) Proteases/ and Protease Inhibitors (Physiological and Patho-physiological Functions of Proteases and Protease Inhibitors, Clinical Trial Concept of Pharmacological Intervention, Regulation of Proteases, sproteases as Prognostic Marker, Development of Synthetic Protease. Inhibitors, Optimization of Synthetic Protease Inhibitors,);
9.) Specific Methodology in Molecular Oncology (in vivo Models, Biochemical/Molecular Detection Methods of Proteases and Protease Inhibitors, Zymography, Genetically Engineered Mouse Models of Cancer, in vitro Migration and Invasion Models);
10.) TIMP-1 (Structure and Functions in Cancer and other Inflammatory Diseases, TIMP-1 as a Cytokine). Problems of tumor research.

Intended Learning Outcomes:
Upon completion of the module, students are able to understand the research and to know the principle questions and implications addressed in upcoming publications in the field of Molecular Oncology. They are also able to judge the evolution of knowledge as they get insight into the history of major discoveries in the field, which is meant to boost their self-confidence as future graduate students and researchers. Specifically, the students are able not
only to reproduce facts but are trained to associate pieces of knowledge and transfer this to unknown problems. The students acquire knowledge of a set of experimental procedures allowing them to design relevant experiments.

This, together with the problem-oriented in-depth analyses of topic-related problems will enable them to be well-prepared for job-related questions even in other research fields in the life sciences.

Teaching and Learning Methods:
First part: Lecture-talk supported by power point slides, partly including the development of schemes at the blackboard. Study of the script and, importantly, the notes taken from what is said, suggested follow-ups in the literature.
Second part: In depth work and literature research on specific topics in the homework. Reiteration and extension of topics of the lecture by studying independently.

For the homework the students will work independently with specific instructions given by the lecturer at the beginning of the semester in which the students are qualified for MolOnc1HA. Specific instructions include the topic, the aim, the content, the format, and on how and when to file-in the homework. The research encompasses the selection of one original paper per topic from a certain publication year given at the beginning of the semester. The students will ask and answer three questions to quotes or terms from the respective paper. The levels of the questions are: 1. Reproduction (can be answered on the basis of the lecture notes and/or script); 2. Association (can be answered on the basis of the understanding of the lecture notes and/or script); and 3.) Transfer (can be answered when knowledge from the lecture is applied to a new problem within the topic). The question should be in English and German, the answers in English or German. The homework should be done in the subsequent semester after MolOnc1.

Media:
Topics will be developed with the help of power point presentations. The script is made available beforehand.

Reading List:
No text books are necessary to pass the exam. Additional information can be obtained from:Cell and Molecular Biology. G. Karp. Wiley Verlag, 4. Auflage, ISBN: 0-471-65665-8
The Biology of Cancer. R. A. Weinberg. Garland Science, 2. Auflage, ISBN: 978-0-8153-4528-2

Responsible for Module:
Krüger, Achim; Apl. Prof. Dr.

Courses (Type of course, Weekly hours per semester), Instructor:
Molekulare Onkologie 1MED (Vorlesung, 2 SWS)
Krüger A [L], Krüger A

Molekulare Onkologie I Hausarbeit (Seminar, 2 SWS)
Krüger A [L], Krüger A
For further information in this module, please click campus.tum.de or here.

Module Description

MHP00002: Project Week: Sensors and Wearables for Automated Detection of Nutrition, Physical Activity, and Sleep | Project Week: Sensors and Wearables for Automated Detection of Nutrition, Physical Activity, and Sleep

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 4	**Total Hours:** 120	**Self-study Hours:** 80	**Contact Hours:** 40

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
research paper
After completion of the project week, students will submit an extended research abstract (1,500 words excluding references, including one figure or table) summarizing their small-scale pilot study. Consistent with open science principles, students will also make their (anonymized) raw data, statistical analyses, and code available.
The abstract will be graded and counts for 100% of the final grade of this module.

Repeat Examination:

(Recommended) Prerequisites:
Student should have
• Interest in learning about cutting-edge methods for the assessment of diet, PA, and sleep
• Basic knowledge of research methods and study design
• Basic knowledge of data manipulation and statistical analysis using Microsoft Excel, R, Python, and/or MATLAB.

Content:
The project week will consist of theoretical and practical parts. Theoretical input will comprise of brief introductions to nutrition, physical activity, and sleep, their role for health and well-being, and an overview of traditional assessment methods and their limitations. Furthermore, an overview of sensors and wearables used for the automatic detection and assessment of these concepts will be provided, followed by a detailed introduction to the modalities available for the project as well as use-cases and future outlooks from a variety of fields, including:

• Sleep-wake detection using wrist-worn sensors
• Principles of sleep scoring using EEG
• Holistic health monitoring including physical activity, exercise, stress, sleep and recovery
• Export and analysis of raw and aggregated data for remote participant monitoring
• From wearable sensors to visual signals - using video data for PA detection
• Wearable sensors in telemedicine
• Use of sensors in neurodegenerative diseases

Intended Learning Outcomes:
After successfully completing the module, students will be able to
• Understand the relevance of diet, PA, and sleep for human health and well-being
• Understand the challenges of traditional assessment methods
• Provide an overview of different sensors and wearables used to assess the concepts
• Comprehend the limitations of the different approaches
• Use different sensors and wearables to automatically detect EB, PA, and sleep
• Integrate and analyze data collected with different modalities.

Teaching and Learning Methods:
The project week will consist of theoretical and practical parts, which will be delivered asynchronously (video lectures, text materials via Moodle) and synchronously (Zoom and in person).
Planning and completion of a group project are the core elements of the project week.

Media:
PowerPoint, Zoom, Moodle, video lectures, scientific articles

Reading List:
• Bell BM, Alam R, Alshurafa N, Thomaz E, Mondol AS, de la Haye K, et al. Automatic, wearable-based, in-field eating detection approaches for public health research: a scoping review. Npj Digit Med. 2020 Dec;3(1):38.
• Wang L, Allman-Farinelli M, Yang JA, Taylor JC, Gemming L, Hekler E, et al. Enhancing Nutrition Care Through Real-Time, Sensor-Based Capture of Eating Occasions: A Scoping Review. Front Nutr. 2022 May 2;9:852984.
• Hassannejad H, Matrella G, Ciampolini P, De Munari I, Mordonini M, Cagnoni S. Automatic diet monitoring: a review of computer vision and wearable sensor-based methods. Int J Food Sci Nutr. 2017 Aug 18;68(6):656–70.

Responsible for Module:
Köhler, Karsten; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:
Projektwochen: Sensors and Wearables for Automated Detection of Nutrition, Physical Activity, and Sleep (Übung, 3 SWS)
Biller A, Höchsmann C, Köhler K

For further information in this module, please click campus.tum.de or here.

Module Description

SOT10081: Project Weeks: Communicating Curiosity - A Science Outreach Pop-Up Exhibition | Projektwochen: Neugier vermitteln - Eine Pop-Up-Ausstellung zur Wissenschaftskommunikation [SOPE]

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 75	**Contact Hours:** 75

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Students will be assessed based on a written assignment to be handed in after the end of the project (min 1000 words). This assignment should summarize the class discussions, group work, challenges and progress for each day of the course, and contain a section at the end where students reflect on the project after its conclusion and develop ideas for related future projects. With the assignment, students demonstrate their ability to engage critically and creatively with the research encountered during the class, chronicle their experience with the project and discuss its aims, development and outcome, and assess their own role and contributions to the exhibition.

Repeat Examination:

(Recommended) Prerequisites:
English language fluency

Content:
"Communicating Curiosity - A Science Outreach Pop-Up Exhibition" is a project week aimed at fostering scientific curiosity within the community, Students will collaborate to design, plan and execute an engaging pop-up exhibition centered around the theme of curiosity in science. The exhibition will feature interactive displays, hands-on activities, and informative presentations. As part of the course, students will (1) decide on the contents of the exhibition and the formats for presenting them in an accessible and engaging way, (2) actually implement the components of the exhibit, (3) plan the event logistics, (4) present the exhibition in public spaces in Munich and present to and interact with visitors, and (5) reflect their role in the project as well as potential future projects. The project week consists of 8 days of preparation across the span of 4 weeks in February and March 2025, 1 day of putting on the pop-up exhibition, and 1 day of summarizing and

reflecting on the experience. Students are expected to be present for the full day (9.30-17.30) on the following dates: 27.2., 28.2., 6.3., 7.3., 13.3., 14.3., 20.3., 21.3., 22.3., 27.3.

Intended Learning Outcomes:
At the end of the module, students will have designed and implemented a mobile exhibition on the topic of curiosity. They will have gained practical experience in project management and teamwork, honed their skills in planning and executing an event, and applied their creativity, leadership and problem-solving abilities. As the aim of the module is to put together a science outreach event, students will have learned how to engage and connect with the local community and communicate research findings in an accessible way, by which they will also have gained experience in public speaking and presentation.

Teaching and Learning Methods:
Powerpoint lecture presentations, educational videos, student presentations, group work

Media:
Powerpoint lecture presentations, Moodle for interaction with the group and sharing materials, interactive demonstrations (computer & tablet), various media for the exhibition (to be decided by the students)

Reading List:

Responsible for Module:
Schlingloff-Nemecz, Laura; M.A.

Courses (Type of course, Weekly hours per semester), Instructor:
Projektwoche: Communicating Curiosity – A Science Outreach Pop-Up Exhibition (Projekt, 5 SWS)
Schlingloff-Nemecz L [L], Schlingloff-Nemecz L, Ruggeri A, Serko D, Bonalumi F
For further information in this module, please click campus.tum.de or here.

Module Description

WZ2580: Protein Engineering | Protein-Engineering

Version of module description: Gültig ab summerterm 2023

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 105	**Contact Hours:** 45

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Eine Klausur (90 min) bildet den Abschluss des Moduls und dient der Überprüfung der erlernten Kompetenzen. Die Lernenden zeigen in einer Klausur, dass sie die erarbeiteten Informationen beschreiben, interpretieren und auf ähnliche Sachverhalte übertragen sowie die unterschiedlichen Informationen zu einem neuartigen Ganzen verknüpfen können. So weisen die Studierenden beispielsweise nach, dass sie die grundlegenden Ansätze des Protein-Engineerings für die Entwicklung von biomedizinischen Wirkstoffen verstanden haben sowie gentechnische Methoden zur Entwicklung von Proteintherapeutika beschreiben und erläutern können. Darüber hinaus müssen Zusammenhänge zwischen Proteinstrukturen und daraus resultierenden anwendungstechnischen Möglichkeiten beurteilt und Strategien zur Optimierung von rekombinanten Proteinen für biotechnologische oder biomedizinische Anwendungen entwickelt werden.

Repeat Examination:
Next semester

(Recommended) Prerequisites:
Voraussetzungen für die erfolgreiche Teilnahme sind theoretische und praktische Kenntnisse von Grundlagen der Proteinbiochemie.

Content:
In diesem Modul werden die wissenschaftlichen Methoden und Arbeitstechniken des Protein-Engineerings auf theoretischer Grundlage diskutiert. Schwerpunkte sind die gentechnische Produktion von Proteinen in Bakterien (cytoplasmatisch und periplasmatisch), Verfahren zur ortsgerichteten Mutagenese, Herstellung von Genbibliotheken, Selektions- und Screening-Methoden sowie Verfahren zur Bestimmung der Affinität zwischen Proteinen (z.B. Antikörpern, Rezeptoren) und ihren Liganden oder Wechselwirkungspartnern sowie ggf. der enzymatischen Aktivität. Des weiteren wird im Modul das Potential gentechnisch hergestellter Proteine als neue

Generation von biologischen Arzneimitteln erläutert. Die pharmakologischen Eigenschaften (Affinität zu medizinisch relevanten Zielstrukturen, Effektorfunktionen, Plasma-Halbwertszeit) können durch Protein-Engineering wie auch mit proteinchemischen Methoden gezielt manipuliert werden. Anhand aktueller Fallbeispiele (Insulin, Wachstumsfaktor, humanisierte Antikörper usw.) wird die Entwicklung und Optimierung innovativer Biopharmazeutika mittels Protein-Engineering dargestellt.

Intended Learning Outcomes:
Nach der erfolgreichen Teilnahme an dem Modul sind die Studierenden in der Lage:
• den theoretischen Hintergrund des Protein-Engineerings zur Entwicklung von Proteinen als biomedizinische Laborreagenzien sowie als therapeutische Wirkstoffe wiederzugeben
• die Entwicklung moderner Proteintherapeutika auf molekularer Basis mittels gentechnischer Methoden nachzuvollziehen
• die Zusammenhänge zwischen Primärstruktur, Faltung und biochemischer Funktion von Proteinen aus anwendungsbezogener Perspektive zu verstehen
• die Bedeutung biophysikalischer Wechselwirkungen des biochemisch/pharmakologisch aktiven Proteins mit dem entsprechenden Liganden/Substrat zu beurteilen
• Strategien zur Optimierung von rekombinanten Proteinen für praktische Anwendungen in Biotechnologie oder Biomedizin zu entwickeln
• das ökonomische Potential von durch Protein-Engineering optimierten Biopharmazeutika zu beurteilen

Teaching and Learning Methods:
Veranstaltungsform/Lehrtechnik: Vorlesung/Präsentation; Lernaktivität: Literaturstudium; Lehrmethode: Vortrag Die regelmäßige aktive Teilnahme an der Lehrveranstaltung wird empfohlen.

Media:
Die Vorlesungen erfolgt mit graphischen Präsentationen (Projektor und PowerPoint). Die Folien werden den Studierenden in elektronischer Form zugänglich gemacht.

Reading List:
Wink, "Molekulare Biotechnologie: Konzepte, Methoden und Anwendungen", Wiley-VCH 2011.
Lottspeich et al., "Bioanalytik", Spektrum 2012.
Williamson & Williamson, "How Proteins Work", Garland 2011.
Walsh, "Biopharmaceuticals: Biochemistry and Biotechnology", John Wiley & Sons 2003.

Responsible for Module:
Skerra, Arne, Prof. Dr. rer. nat. habil. skerra@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Module Description

LS20052: Scientific Computing for Biological Sciences | Scientific Computing for Biological Sciences

Version of module description: Gültig ab winterterm 2024/25

Module Level: Bachelor/Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 3	**Total Hours:** 90	**Self-study Hours:** 30	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination consists of writing a report (10-15 pages) about a given project assigned by the lecturer, and giving a presentation on the project (10 minutes), followed by a 5 min discussion. In writing a report about their project the students will be asked to demonstrate their ability to analyze and plot data, interpret the data in the context of the biological problem and critically discuss the shortcomings of their chosen statistical method. They will be tested on their ability to summarise major factors and the conclusion of their results in a clear and concise manner. In the presentation the students will show their ability to present their results to an audience of peers and to stand a discussion about the presented content.
The final grade is an average from the written report (50%) and the presentation (50%).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:
MA9601, MA9602

Content:
The content is the workflow within scientific-oriented python programming from loading and plotting data, and learning to program functions in python. The students will learn about the use of variables and functions. They will learn elementary descriptive techniques like bar plots, scatter plots histograms and cumulative histograms. The students will learn to use libraries for statistical inference and apply these libraries to compare distributions and means on selected data sets and for fitting functions to data to detect correlations. Time permitting, the students will apply methods for fourier analysis, convolution, and filtering on selected data sets, as well as tools for dimensionality reduction such as principal component analysis. They will work with noisy biological data and learn how to interpret their results in the context of the data.

Intended Learning Outcomes:
The students will be able to handle biological data sets and are able to apply data analysis methods. The students are able to create plots for both analyzing and presenting data. The students will be able to handle python, a popular programming language, together with numerical and scientific analysis libraries, and are able to find the suitable functions for statistical inference and fitting of functions.
Possible extensions may include deciding when to use fourier analysis, convolution and filtering of data. They may also learn techniques for dimensionality reduction.

Teaching and Learning Methods:
The module is offered as lectures with accompanying practice sessions. In the lectures, the contents will be presented in a talk with demonstrative examples, as well as through discussion with the students. The lectures should animate the students to carry out their own analysis of the themes presented and to independently study the relevant literature. Corresponding to each lecture, practice sessions will be offered, in which exercise sheets and solutions will be available. In this way, students can deepen their understanding of the methods and concepts taught in the lectures and independently check their progress. At the beginning of the module, the practice sessions will be offered under guidance, but during the term the sessions will become more independent, and intensify learning individually as well as in small groups.

Media:
Case studies

Reading List:

Responsible for Module:
Gjorgjieva, Julijana; Prof. Ph.D. gjorgjieva@tum.de

Courses (Type of course, Weekly hours per semester), Instructor:
Scientific computing for Biological Sciences (VO) (Vorlesung, 2 SWS)
Gjorgjieva J [L], Fritz I, Getz M

Scientific computing for Biological Sciences (UE) (Übung, 2 SWS)
Gjorgjieva J [L], Getz M
For further information in this module, please click campus.tum.de or here.

Module Description

WZ1676: Sustainable Land Use and Nutrition | Sustainable Land Use and Nutrition

Version of module description: Gültig ab summerterm 2024

Module Level: Bachelor	**Language:** English	**Duration:** one semester	**Frequency:** summer semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 90	**Contact Hours:** 60

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
Building on competences gained in case-specific lectures (literature analysis, systematic assessments of concepts) the students participate in a written exam (Klausur) and give an own presentation in the context of an interdisciplinary workshop. By answering the questions in the examination, the students show that they know the multi-facetted challenges of sustainable land use and nutrition and that they consider the whole supply chain. During the workshop (usually Friday + Saturday), students dive deeper in a specific aspect of sustainable land use and nutrition. They learn here how to prepare a scientific presentation, including literature search and how to present the results to an international audience. Talks on specific topics comprise 10 min per student plus 5 min discussion und questions per student, while the topics are generated from the case studies introduced during the lectures. The students also demonstrate that they are able to analyze a given topic based on existing literature. In the written examination (90 min) at the end of the semester students demonstrate the theoretical knowledge of the various perspectives of sustainable land use and nutrition by answering questions under time limitations and without helping material.
The final grade is a combined grade from the written examination (40 %) and from the presentation (60 %).

Repeat Examination:
End of Semester

(Recommended) Prerequisites:

Content:
The module provides an overview on the various perspectives of sustainable land use and nutrition. An introduction establishes the structure of the module, which follows a supply chain: 1)

The production of commodities addresses: availability of soil resources; sustainable environmental systems; ecology and biodiversity; animal sciences in food security; integrative and optimized land-use concepts; production technology. 2) The distribution of commodities (transport, storage) is analyzed under the aspects of resource economics. 3) The distribution through trade and services discusses sustainable marketing concepts. 4) Finally, consumer affairs are addressed by food chemistry and health aspects in the context of global nutrition; food safety; new designed food.

Intended Learning Outcomes:
The students know about the great variety of sustainability aspects in land use and nutrition. They understand the preconditions to understand the complexity and interconnectedness of multiple sectors. Students can name the barriers to achieve sustainable land use and nutrition, but can also describe strategies to improve sustainability. They are able to reproduce sustainability concepts, analyze their appropriateness and develop them for application to new problems. They understand that only a comprehensive perspective will lead to sustainable concepts for land use and nutrition.

Teaching and Learning Methods:
Students learn and discuss along a supply chain about specific challenges to sustainable land-use and nutrition. Case-specific lectures are furnished with up to date case-study papers, the students have to analyse and interpret. Based on the competences gained, they prepare own studies/presentations on a selection of topics, which they then present on a 2-days workshop to their teachers and colleagues.

Media:
PowerPoint, research literature on moodle, Handouts

Reading List:
Each lecturer provides a list of articles regarding his/her topic on moodle and also during the lecture itself.

Responsible for Module:
Knoke, Thomas; Prof. Dr. rer. silv.

Courses (Type of course, Weekly hours per semester), Instructor:
Sustainable Land Use and Nutrition (Vorlesung, 4 SWS)
Knoke T [L], Eisner P, Hauner J, Henao Henao J, Just C, Knoke T, Langowski H, Leonhardt S, Regler F, Schad P, Sproten R, Stark T, Steinhoff-Wagner J, Zare M
For further information in this module, please click campus.tum.de or here.

Module Description

WZ3055: Transgenic and Stem Cell Biotechnology | Transgenic and Stem Cell Biotechnology

Version of module description: Gültig ab winterterm 2012/13

Module Level: Master	**Language:** German	**Duration:** one semester	**Frequency:** winter semester
Credits:* 5	**Total Hours:** 150	**Self-study Hours:** 150	**Contact Hours:** 0

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:

Repeat Examination:

(Recommended) Prerequisites:

Content:

Intended Learning Outcomes:

Teaching and Learning Methods:

Media:

Reading List:

Responsible for Module:

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

Master's Thesis | Master's Thesis

Module Description

WZ3212: Master's Thesis | Master's Thesis [THESIS]

Version of module description: Gültig ab winterterm 2023/24

Module Level: Master	**Language:** English	**Duration:** one semester	**Frequency:** winter/summer semester
Credits:* 30	**Total Hours:** 900	**Self-study Hours:** 750	**Contact Hours:** 150

Number of credits may vary according to degree program. Please see Transcript of Records.

Description of Examination Method:
The examination of the module Master's Thesis is done in form of a scientific paper.
By completion of the Master`s Thesis, students demonstrate that they are able to investigate defined scientific questions on their own, with support from an experienced supervisor. They show that they can analyze and evaluate state-of-the art knowledge, identify possible solutions and answers, and subsequently plan and conduct experiments / studies addressing the scientific question with appropriate research methods and techniques.

For the Master thesis, the student will conduct research on a scientific problem defined by the supervisor. Under his/her supervision, the student specifies the objectives and aims of the research to address this problem and generates a work plan (gant chart) for the required research tasks. The student is supported by the supervisor to carry out the research tasks in a largely self-sustained manner following good scientific practice (https://www.gs.tum.de/en/gs/doctoral-candidates/good-scientific-practice/) . The student actively participates in the examination colloquium to discuss the objectives, report on the progress and steer the work plan according to the feedback. She/he writes a master thesis (50-70 pages) which must be submitted within 6 months after start of the THESIS module. The master thesis is graded by the supervisor, taking into account in equal parts theoretical and hands-on practical skills as well as quality of the written thesis.

Repeat Examination:

(Recommended) Prerequisites:
Work on the master's thesis should commence after successful completion of all module examinations.

Content:
Research conducted by the institutions hosting our master students deal with nutrition-related science in different life science disciplines, including for example biochemistry, molecular biology, nutrition physiology, metabolism, microbiology, food chemistry, nutrition medicine, genetics, clinical studies and epidemiology. Within this framework, the supervisor assigns the student to a selected aspect of ongoing research in the host institution.

Intended Learning Outcomes:
After successful completion, the theoretical and practical training received in the THESIS module enables our
students to investigate defined scientific questions on their own, with support from an experienced supervisor.
Exposed to a scientific question, they can analyze and evaluate state-of-the art knowledge, identify possible
solutions and answers, and subsequently plan and conduct experiments / studies addressing the scientific question
with appropriate research methods and techniques. The students know the most important facts and theories
related to their research topic and can critically discuss and evaluate their own results in relation to the state-of-theart
knowledge. In conducting their art of science they follow the rules of good scientific practice.

Teaching and Learning Methods:
Theoretical and practical training by a scientific supervisor of the host institution. The master student is guided in comprehensive analyses and study of the available literature related to the research topic, establishment of a work plan, experimental design, acquirement of hands-on skills in specific methodology and techniques, documentation
and evaluation of data, scientific writing, description and critical discussion of results in relation to work published in the field. At start, the student and the scientific supervisor jointly develop the work plan of the master thesis and define goals achievable within the given timeframe of six months. In the course of the master thesis, pending results, the student and the supervisor mutually agree to adjust this work plan, accordingly. Students actively participate in the examination colloquium, which takes place in regular intervals and can be offered in different formats (seminar, lab meeting, individual discussions), following the conditions at different institutions. In the
colloquium, students get together with scientists at different levels of qualification to present progress reports and discuss with their peers and supervisors. In this forum, students train to talk about their research project, explain the question and goals, discuss experimental plans, present results and problems, and elaborate on the outline and
writing of their thesis.

Media:

Reading List:

Responsible for Module:
Klingenspor, Martin; Prof. Dr. rer. nat.

Courses (Type of course, Weekly hours per semester), Instructor:

For further information in this module, please click campus.tum.de or here.

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