After the first multidisciplinary block, students choose one of the following specialisations:

Genetics and Genomics
Biomedical Imaging
Inflammation and Pathophysiology
Neuromodulation
Nutrition, Physical Activity and Metabolism
Regenerative Medicine

Interested in the Master's Open Day? Sign up now!

Genetics and Genomics

Introduction
Genetics and genomics both play roles in health and disease. Genetics helps us understand how diseases are inherited, what screening and testing options or treatments are available. Genomics helps us to discover why some people get sick from certain infections, environmental factors, and behaviours, while others do not.

Is this the right specialisation for me?
This specialisation is developed in order to provide students with a strong foundation and expertise in the field of genetics. Main focus is on the application of genetics and genomics principles in scientific research and in the clinic with specific attention for cancer, cardiogenetics, neurogenetics, model systems, forensics and personalised medicine.

What will I learn?
You will:
- obtain knowledge about technologies for high-throughput collection of 'omics' data and about models used for genetic manipulation or complex human disorders;
- learn about the concepts and limitations of genetic testing, genetics diversity and the influence of epigenetics on the fundamental regulation of gene expression;
- analyse data and define ethical and societal issues concerning genetics and genomics;
- apply the concepts of molecular genetics in the context of research and treatment of diseases (cancer progression, cardiogenetics and neurogenetics);
- identify genetic and biological pathways in complex diseases; and

apply genetics and genomics in personal medicine.

What are my career prospects?
This specialisation prepares you for a research-oriented future in the field of genetics and genomics in academia, biomedical companies and in the clinic.

Programme
In the first course, the basic principles of genetics and genomics will be taught. This course serves as the basis for work in the second course, which focuses on translation and application of the knowledge obtained in the first course to solve challenging clinical problems.

Course 1: *Advanced Principles of Genetics and Genomics*
In this course, the molecular mechanisms of genetic and environmental influences on gene expression and protein function are being addressed. Additionally, the principles of several algorithms and the databases and analytical programmes available in the public domain are being addressed. Finally, the impact of genetics and genomics on research and society with respect to personalised medicine and ethical issues will be discussed.

Course 2: *Clinical and Applied Genetics and Genomics*
This course further elaborates on the application of genetics and genomics principles in scientific research and clinical applications with specific attention for cancer, cardiogenetics, neurogenetics, model systems, forensics and personalised medicine.

More information
For more information on admission, please contact our master admission office.

If you have questions about the content of this specialisation, you can send them to study-fhml[at]maastrichtuniversity[dot]nl Or better still, contact student ambassador Jaycey via her Instagram account (where she also posts about her life as a Biomedical Sciences student in at Maastricht University).

This video gives you an impression of the specialisation *Genetics and Genomics*. It is a show and tell by three people who are in one way or another involved in this specialisation: prof.dr Ronit Shiri-Sverdlov, student Jasper Germeraad and laboratory specialist in clinical Genetics at MUMC+ dr Bianca van den Bosch.

Master BMS, specialisation Genetics and Genomics

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Biomedical Imaging

Introduction
Imaging is increasingly and widely applied in biomedical studies and clinical practice. Imaging is the application of advanced visualisation tools to bridge the gap between the biomolecular pathways to human diseases. In this unique specialisation students are trained to apply advanced imaging techniques like Mass Spectrometry Imaging, Nanoscopy, Advanced Microscopy, PET and MRI in biomedical research.

With imaging, we are able to understand biological processes, support diagnosis, accessing effectiveness of current treatments and help in the development of new treatments. We have the unique opportunity to study organ function, such as movement of the heart. And we are able to follow a disease process in time, also before clinical symptoms occur.

As a biomedical scientist, specialised in imaging, you are a key person in solving physiological questions with novel imaging methods. You communicate with both clinicians and engineers and you apply state-of-the art imaging methods to clinical demands. You make sure that novel imaging methods can be directly applied in a (pre)clinical (research) environment.

Is this the right specialisation for me?
This specialisation is for students with a strong interest in the field of biomedical imaging and its wide application in the biomedical field. Together with experts in the fields, you focus on the application of a broad range of imaging techniques in biomedical and (translational) clinical research and use these techniques to answer specific questions related to oncology, neurology, cardiovascular disease, metabolic disordera, just to name a few applications.

During internships, you have the opportunity to contribute to projects related to cancer, neurodegenerative, cardiovascular and metabolic diseases. The excellence of imaging infrastructure and expertise at Maastricht UMC+ is recognised worldwide.

What will I learn?
Within this specialisation, you learn how to apply novel technologies to biomedical sciences to solve a biomedical research question. You also learn the basic principles of the imaging modalities, so you can make correct choices of imaging methods for specific questions. The focus is really on the biomedical problem and not so much on the underlying methodology/technology.

The courses within the specialisation offer interactive teaching to learn from expert researchers, hands-on experiments through practicals, lab visits, workshops, projects, interaction with clinicians, and internships in our research laboratories.

What are my career prospects?
The world needs highly skilled scientists to apply imaging to scientific research, and within the clinic. This specialisation prepares you for a career at a university, in different research institutes affiliated with academic organisations, companies (biomedical and pharmaceutical companies; medical devices) and university hospitals.

Programme
Course 1: *Pre-clinical Imaging*
This first course is focused on pre-clinical imaging, which ranges from ex vivo imaging of a single molecule to in vivo imaging of animal models. The course aims to give you insight into the basic principles as well as the biomedical applications of ex vivo and noninvasive in vivo imaging techniques. Imaging techniques that will be discussed are mass spectrometry imaging (MSI), electron

and light microscopy (EM and LM), ultrasonography, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), and nuclear imaging (Single Photon Emission Computed Tomography (PECT) and Positron Emission Tomography (PET).

You learn to prepare samples, acquire, transform, analyse and utilise various imaging modalities to visualise sub-cellular structures up to whole animal imaging. Combined, these preclinical research methods pave the way for new diagnostic approaches required for personalised and systems medicine.

Within this course you will design a project to learn how to solve a biomedical research question with advanced imaging. The distinctive (molecular) imaging infrastructure at the Maastricht UMC+ is available for students, who will have the opportunity to meet and interact with experts in the imaging field.

Course 2: *Clinical Imaging*
This second course in this specialisation focuses on the application of imaging to address physiological and pathological disease processes in man in a clinical (research) setting. Imaging technologies provide increasingly accurate detail on morphology, structure, function and dynamics of living systems. In life sciences and (translational) clinical research, the use of (diagnostic) imaging technologies has become increasingly widespread and has now also entered the area of prevention and therapy monitoring.

This course focuses on imaging in treatment decisions based on molecular clinical diagnostic information and patient images. Clinical imaging focuses on in vivo imaging, image-guided interventions/biopsies and molecular tissue pathology and morphology. This course addresses translational aspects from systems biology to in vivo imaging of the patient with MRI/MRS and other radiological methods.

You will be introduced to the concept of radiomics in which imaging features are extracted from medical images. Intraoperative diagnostics and image-guided surgery are studied as innovative approaches that put molecular analytical information in the hands of medical practitioners. This course teaches biomedical scientists to be the interface between imaging technology and the clinic. Moreover, this course provides a translational / clinical environment to teach students to work side-by-side with clinicians on innovations in systems medicine.

More information
For more information on admission, please contact our master admission office.

If you have questions about the content of this specialisation, you can send them to study-fhml[at]maastrichtuniversity[dot]nl Or better still, contact student ambassador Jaycey via her Instagram account (where she also posts about her life as a Biomedical Sciences student in at Maastricht University).

This video gives you an impression of the specialisation *Biomedical Imaging*. It is a show and tell by three people who are in one way or another involved in this specialisation: dr Tiffany Porta Siegel, student Rob Janssen and senior principal scientist at Janssen Pharma Rob Vreeken.

Master BMS, specialisation Imaging from Molecule to Man

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Inflammation and Pathophysiology

Introduction
Our aging society is facing many threats, including oncologic, neurologic and cardiovascular problems. Frequently, these problems are of inflammatory nature or are caused by infections. Therefore, this specialisation aims to develop a thorough, clinically relevant understanding of different mechanisms of development of disease. The specialisation also describes current relevant animal models.

Is this the right specialisation for me?
We aim to prepare you to contribute to the understanding of inflammation and pathological threads, and develop new treatment strategies. The development includes engineering of the immune system to develop cell therapies, antibody therapy, vaccination, drug development and gene therapy.

This is the specialisation for you:
if you are interested in manipulation of the immune system, and
if you wish to pursue a career either in industry (biotechnology) or academia.

What will I learn?
You will:
- learn pathophysiology of relevant organs,
- learn techniques for the study of molecules, cells and organisms,
- obtain clinically relevant understanding of different mechanisms of disease,
- learn to target immunological threads,
- create new therapeutic strategies targeting the immune system,
- get prepared for working in academy and industry,
- read and think in a critical way,
- design, conduct, analyse, explain and defend your research (via research papers, essays, presentations), and
- collaborate in small teams.

Goals of this specialisation are:
- to understand path·o·phys·i·ol·o·gy:
the study of structural and functional changes in tissue and organs that lead to disease;
- to evaluate different types of therapies, vaccination and immune system effector functions;
- to engineer the immune system, treatment of disease.

What are my career prospects?
This specialisation prepares you for a research career in the field of inflammation and pathophysiology in academia, hospitals, and industry (biomedical companies) et cetera (e.g. PhD, embedded scientists, R&D).

Programme
This specialisation combines an education in concepts with a sophisticated training in immunological techniques.

Course 1: *Inflammation and Pathophysiology*
learn sterile inflammation and other pathological threats leading to degeneration
explain hypersensitivity disorders
explain immunity to tumors
appraise immunity to microbes

Course 2: *Inflammation and Pathophysiology - Engineering the Immune System, Treatment of Disease*
explain and design antibody engineering
explain and design cell therapy
evaluate and design vaccination
discuss organ transplantation
appraise gene-therapy techniques
assess the potential of microbiome targeting

More information
For more information on admission, please contact our master admission office.

If you have questions about the content of this specialisation, you can send them to study-fhml[at]maastrichtuniversity[dot]nl Or better still, contact student ambassador Jaycey via her Instagram account (where she also posts about her life as a Biomedical Sciences student in at Maastricht University).

This video gives you an impression of the specialisation *Inflammation and Pathophysiology*. It is a show and tell by three people who are in one way or another involved in this specialisation: prof.dr Pilar Martinez, student Jan Gaede and dr. René Hoet (VP Biologics Research at Bayer AG and professor in Biopharmaceutics at UM).

Master BMS, specialisation Inflammation and Pathophysiology

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Neuromodulation

Introduction
Neuroscience has provided invaluable insights into the organisation of the central nervous system.

Building on decades of fundamental and clinical research, neuromodulation has recently emerged as a very promising field that has the potential to change the neuroscience landscape. Equipped with detailed knowledge of neuroanatomy and neurophysiology, a wide spectrum of invasive and non-invasive techniques has been developed that allows manipulation of the central nervous system from the micro to the macro level. This offers unprecedented opportunities for scientific research and opens the door for novel clinical applications in various diseases/disorders of the central nervous system. To illustrate, deep brain stimulation can target specific nuclei in the brain stem to instantly reduce tremor in Parkinson’s disease. Transcranial magnetic stimulation has proven efficacy in drug-resistant depression with virtually no side effects. Spinal cord stimulation can alleviate chronic pain symptoms. These and many more examples will be illuminated in this specialisation in neuromodulation.

Maastricht University has a strong tradition in neuromodulation research and application, across a wide spectrum of neuromodulation techniques. Embedded in this unique neuromodulation network, we offer this one of a kind specialisation as part of the master's in Biomedical Sciences. This specialisation is interdisciplinary in content and inter-departmental in structure, designed to offer cutting-edge theoretical and methodological training. Students will be able to choose between internships in research laboratories, and/or clinical placements, and/or industrial settings. Students will be prepared to unravel the mechanisms of the human brain and to unleash the full therapeutic potential of neuromodulation in various clinical fields.

Is this the right specialisation for me?
This specialisation is developed for students who are enthusiastic about the potential of neuromodulation in scientific research. We hope to attract curious and creative minds that are eager to learn the principles of neuromodulation, get inspired by current clinical applications, and then proceed to contribute to this highly interdisciplinary field.

What will I learn?
You will:
have essential knowledge about neuroanatomy and neurophysiology to understand the basic principles of current neuromodulation techniques,
have a comprehensive overview of state-of-the-art neuromodulation approaches and their current clinical applications,
understand how insights into the pathophysiology of the central nervous system can be translated into clinical applications of neuromodulation in neurology and psychiatry, and
be aware of current trends, developments, limitations, and future challenges in the field of neuromodulation.

What are my career prospects?
The field of neuromodulation is increasingly relevant in scientific research, clinical settings, and industry. There is a high demand for skilled experts who can further develop existing methodology, explore novel applications, and promote the implementation of neuromodulation approaches in clinical practice. This specialisation prepares you for a future in the field of neuromodulation at an academic organisation, clinical institution or biomedical company(e.g. PhD candidate, embedded scientists, R&D).

Programme
This specialisation offers a comprehensive overview of the fundamental principles and applications of current neuromodulation techniques.

Course 1: *Fundamental Neuromodulation*
The first course starts by providing essential knowledge about neuroanatomy and neurophysiology required to understand the basic principles of current neuromodulation techniques. Building on this foundation, various state-of-the-art neuromodulation approaches will be explored in detail, with a

particular focus on deep brain stimulation, spinal and sacral neuromodulation, and transcranial magnetic stimulation. Next to conventional neuromodulation techniques, the participants will be introduced to novel neuromodulation techniques including optogenetic, chemogenetic and wireless neuromodulation. At the end of this course, students will have a proper understanding of current neuromodulation techniques and they will be aware of recent trends and developments in the field.

Course 2: *Translational Neuromodulation*
The second course showcases how insights into the pathophysiology of the central nervous system can be translated into clinical applications of neuromodulation in neurology and psychiatry. Various novel treatment approaches using neuromodulation have emerged over the last few years and are increasingly used world-wide. Prominent examples include the application of deep brain stimulation in Parkinson's disease, and the treatment of depression using transcranial magnetic stimulation. These and many other examples will be discussed, revealing the potential of neuromodulation in clinical practice.

More information
For more information on admission, please contact our master admission office.

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This video gives you an impression of the specialisation *Neuromodulation*. It is a show and tell by three people who are in one way or another involved in this specialisation: researcher Alix Thomson, prof.dr Alexander Sack and prof.dr. Yasin Temel.

MSc Biomedical Sciences: specialisation Neuromodulation

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Nutrition, Physical Activity and Metabolism

Introduction
A lifestyle characterised by overnutrition of macronutrients and underconsumption of micronutrients, along with physical inactivity translates into derailments in metabolic health and ultimately into deteriorated function and health. A wide range of currently prevalent disorders in westernised societies find common ground in metabolism that goes awry.

The aim of this specialisation is to understand the physiology and the mechanisms underlying these

derailments to provide the basis for the ultimate design and optimisation of preventive and therapeutic nutritional and life-style interventions that improve metabolic health and alleviate the diseased state.

Is this the right specialisation for me?
If you have a genuine interest in how diet, physical activity and a sedentary lifestyle affect health…
If you are interested in the mechanisms (from molecule to man) governing the (mal)adaptive responses of the human body to changes in energy availability and demand…
If you would like to know the state-of-the-art on how exercise and physical activity interventions can promote health…
If you are eager to gain the knowledge needed to design novel life-style interventions to promote health…

Than this is the specialisation of your choice!

What will I learn?
In this specialisation you will study deeply into:
the integrative and interorgan physiology of key metabolic processes;
the biochemical and cellular basis for diet- and exercise-induced alterations in health;
the biochemical and cellular basis for the health threatening effects of a sedentary life-style;
how nutrition and physical activity affect non-communicable diseases;
identification of routes fundamental to the design of non-exercise related life-style interventions to promote energy turnover and health.

What are my career prospects?
To halt the progressive increase in prevalence of disorders that find common ground in disturbed metabolism, we need highly skilled people to identify potentially successful targets and routes for intervention via scientific research. This includes research in academia, hospitals and industry (ranging from biomedical and pharmaceutical companies to companies developing wearables to monitor health and physical activity). You can also apply the knowledge acquired in (academic) teaching or in public health settings to provide new scientific background to novel health promotion programmes.

Programme
Course 1: *Nutrition, Physical Activity and Metabolism: Fundamental Aspects*
This course will provide in-depth insight into the major systems of human nutritional and exercise physiology and metabolism. With basic knowledge on nutrient uptake across the gastrointestinal tract as the starting point, the course will focus on cell and organ specific routes for conversion of macromolecules into their oxidizable derivatives. Importantly, the pivotal role of intermediary metabolism, metabolites and small circulatory hormones like peptides in metabolic control and inter-organ cross-talk (muscle-liver-adipose tissue-cardiovascular system-brain) will be thoroughly studied in the fasted, post-prandial and exercised state. This course will provide the mechanistic basis to understand how aberrations in energy and substrate metabolism can be the common denominator in multiple highly prevalent disorders like Alzheimer’s disease, Parkinson, some types of cancer or metastases, COPD, sarcopenia, obesity, type 2 diabetes and related cardiovascular disorders. Alterations in energy status, energy sensing and energy turnover have all been associated with these disorders. These alterations may originate from compromised nuclear receptor signaling, post-transcriptional modulation via e.g. micro RNA’s, post-translational modification (acetylation, glycosylation, phosphorylation) hampering protein function and metabolic processes altering NAD+/NADH and ADP/ATP related energy status of the affected cells. With mitochondria being the subcellular hub in energy turnover, detailed knowledge on the dynamics of the mitochondrial network is considered an essential part of this course.

Course 2: *Lifestyle Interventions and Metabolism; a Translational Perspective*

In this course the role of diet and physical activity to prevent chronic disease in humans will be considered. Lifestyle factors modulating metabolism on a micro (cellular) and macro (organ) scale will be studied via a translational approach. This course will take conventional strategies to promote health (like nutritional and exercise interventions) to the next level by exploring the underlying mechanisms and how these interventions may prevent chronic diseases like cardiovascular disease, cancer, chronic respiratory diseases and diabetes. Interventions like weight loss, (nutritional) compounds, exercise, sedentary behaviour, sleep, stress management promoting metabolism will be topic of study. The basis for inter-individual differences in responsiveness, including genetics, will be studied in the light of personalised interventions to promote health and prevent disease.

More information
For more information on admission, please contact our master admission office.

If you have questions about the content of this specialisation, you can send them to study-fhml[at]maastrichtuniversity[dot]nl Or better still, contact student ambassador Jaycey via her Instagram account (where she also posts about her life as a Biomedical Sciences student in at Maastricht University).

This video gives you an impression of the specialisation *Nutrition, Physical Activity and Metabolism*. It is a show and tell by three people who are in one way or another involved in this specialisation: prof.dr Matthijs Hesselink, student Marvin Feldmann and nutrition and movement sciences researcher at UM Marlies de Ligt.

Master BMS, specialisation Nutrition, Physical Activity and Metabolism

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Regenerative Medicine

Introduction
An increasingly ageing population in the industrialised world is accompanied by a number of new challenges. For example, as ageing is combined with a more active lifestyle, the demand for treatments for damaged and diseased organs and tissues also increases.
The interventions that are used to successfully restore the function of damaged organs or tissues have also changed in the past decades. While some thirty years ago implants were used to passively take over the function of a poorly functioning tissue, nowadays the focus is on developing methods that temporary 'trigger' the body to repair or regenerate itself. Furthermore, such interventions need to be affordable, as the burden to our healthcare system is also growing.

To be able to develop successful and affordable regenerative strategies, knowledge must be integrated from different disciplines. An active collaboration between chemists, materials scientists, physicists, biologists, computational scientists and clinicians is required to make a true difference in the biomedical field.

Is this the specialisation for me?
This specialisation is developed for students with an interest in a multidisciplinary field aiming at creating solutions to restore structure and function of permanently damaged tissues and organs by using a combination of science and technology. Regenerative medicine (RM) is inherently translational and uses basic scientific knowledge to solve real clinical problems. Within this specialisation, topics will focus on both the molecular biological (including stem cell biology and gene therapies) and technological (including tissue engineering and bio-fabrication technologies) aspects, and the combination thereof within a clinical context.

What will I learn?
You will:
obtain an overview of the science and technology in the field of RM;
be exposed to the essence of multi-disciplinarity within RM;
understand the difference between basic science and translational science;
learn how to bring novel inventions within the field of RM to the market;
make the scientific journey from basic science and technology towards a clinical application; and
learn to communicate specialised knowledge to a group of scientists with different background and specialisations.

What are my career prospects?
This specialisation prepares you for a research-oriented future in the field of regenerative medicine in academia, biomedical companies, et cetera (e.g. PhD, embedded scientists, R&D).

Programme
In the first course the basic principles of RM are taught. This course serves as the basis for work in the second course, which focuses on translation and application of the knowledge obtained in course 1 to solve challenging clinical problems.

Course 1: *The Science and Technology of Regenerative Therapeutics*
This course is about exposure to the essence of multi-disciplinarity of RM. You will increase your level of knowledge on the technology and science behind regenerative medicine such as cell therapy, material science, fabrication technologies and combinations of these, within a clinical context.

Course 2: *Translating Therapies into the Clinic and onto the Market*
In this course, we will make the scientific journey from science and technology to the clinic and products. Using actual clinical challenges, you have to work out a new solution to that clinical problem supported by experts in the field. You will know where to put biomedical solutions in the Technology Readiness Level chain and you will learn how to take it a step further and learn to communicate specialised knowledge to a group of scientists from different disciplines.

More information
For more information on admission, please contact our master admission office.

If you have questions about the content of this specialisation, you can send them to study-fhml[at]maastrichtuniversity[dot]nl Or better still, contact student ambassador Jaycey via her Instagram account (where she also posts about her life as a Biomedical Sciences student in at Maastricht University).

This video gives you an impression of the specialisation *Regenerative Medicine*. It is a show and tell

by three people who are in one way or another involved in this specialisation: prof.dr Jan de Boer, student Daphne Eussen and entrepreneur Niloofar Tahmasebi.

Master BMS, specialisation Regenerative Medicine

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Additional specialisations

Hasselt University (Belgium)
Hasselt University offers two additional specialisations:
Bio-electronics and Nanotechnology, which focuses on biomaterials, the interface between biological and electronic systems, and the broad domain of biosensors.
Environmental Health Sciences, which focuses on the molecular interaction between the environment and cells, toxicology, and risk assessment.

Learn more about these specialisations on Hasselt University's website.

First year courses

Biomedical Sciences Year 1

Fac. Health, Medicine and Life Sciences

Biomedical Challenges

Full course description

Biomedical Science helps us understand living biological systems. The insight and lessons learned can be then used in designing medical interventions. Biomedical Science specifically translates knowledge from the natural sciences to medical applications. In this first course of the master programme students will be introduced to the diverse topics biomedicine deals with. The course will address the disease onset, progression, prevention, diagnostics, and therapies. The students will gain insight in diverse molecular processes that underlie diseases, the pathophysiology, risk factors and societal burden. Understanding of these fundamental principles is necessary to facilitate the development of diagnostics and therapies to better cope with the diseases.

Course objectives

The course's Intended Learning Goals (ILOs):

ILO1 Distinguish different mechanisms and factors behind molecular dysfunction in

1. Neuromuscular and mitochondrial disorders
2. Mental and neurodegenerative disorders
3. Metabolic disorders including obesity and diabetes mellitus
4. Disease of choice in the context of the group work

ILO2 For aforementioned disorders describe the current knowledge of

1. Etiology of disease including risk factors and lifestyle
2. Biomolecular basis of disease
3. Manifestation of the molecular dysfunction in the form of phenotype
4. Diagnostics (including molecular read-outs)
5. Innovative and personalized treatment options

ILO3 Elucidate challenges in aforementioned aspects of disease

ILO4 Work according to the scientific method

ILO5 Synthesize and present complex scientific information on state-of-the-art knowledge and challenges in biomedical field

ILO6 Explore future applications of biomedical knowledge

MBS1001

Period 1
2 Sep 2019
25 Oct 2019

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
R.J. Szklarczyk
Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), PBL, Presentations, Working visit(s)
Assessment methods:
Assignment, Attendance, Final paper, Participation, Presentation, Written exam
Keywords:
biomedical breakthroughs, biological systems, natural sciences, medical applications, disease

Fac. Health, Medicine and Life Sciences

Advanced Principles of Genetics and Genomics

Full course description

The genome is the fundament of life. In this course, various aspects of the composition of the genome will be addressed, such as unique vs repetitive DNA and transcribed vs non-transcribed segments. Another important aspect is the dynamic nature of the genome, especially in regard to epigenetic modification and of the various types of genetic variation. Epigenetic responses and genetic variation partly underlie complex traits and explain the individual susceptibility to influences from the environment.
In this course the molecular mechanisms of genetic and environmental influences on gene expression and protein function are addressed with special attention for deviation from Mendelian inheritance as well as complex regulatory mechanisms in case of both single-gene and multifactorial traits and disorders.
Considerable attention in this course goes to analytical methods for genomics and genetics. A technological revolution has taken place since the start of the unravelling of the human genome, leading to the development of techniques to rapidly sequence a complete genome, but also to perform functional analysis of gene expression and protein function and to incorporate the influence of genetic variation and epigenetic modification into these expression data.
These technological applications lead to huge amounts of data demanding specific algorithms for data analysis to be developed by researchers working in bioinformatics. Throughout the course students will obtain experience with several such algorithms, databases and analytical programs available in the public domain.
Finally, the large increase in knowledge on genomics and genetics together with the still growing potential of analytical possibilities impact research, society and the individual’s way of life. A time slot in the course will be reserved to discuss these developments.

Course objectives

In this course we address advanced principles of Genetics and Genomics according to specific Themes, which correspond with the Intended Learning Outcomes (ILOs). For each Theme there will be tutorial sessions, a journal club, an expert lecture and career-related sessions, in which researchers will explain the research that they are performing. During site visits students will go to some of the laboratories for genetics and genomics to get insight into the technological requirements for genetic and genomics in daily practice. In addition, several computer sessions are scheduled to introduce and train students in data handling and analysis. Finally, students are requested to write an essay on a specific topic of genetics or genomics. The ILOs of this course are:

- Describe human genetic diversity and its dynamics based on the principles of population genetics.- ILO1
- Integrate the influence of epigenetics with the fundamental regulation of gene expression. ILO2
- Explain the impact of genetic variation on gene expression and protein function.- ILO3
- Explain deviations from fundamental genetics in eukaryotes.- ILO4
- Apply advanced analytical methods of genetics and genomics. - ILO5
- Analyze data handling in genetics and genomics. - ILO6
- Define ethical and societal issues concerning genetics and genomics.- ILO7

Recommended reading

For this course specific book chapters and scientific articles will be used. Necessary literature will be timely made available through the student portal (EleUM).

MBS1101

Period 2
28 Oct 2019
20 Dec 2019

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
E.C.M. Mariman
Teaching methods:
Assignment(s), Lecture(s), Paper(s), PBL, Skills, Working visit(s)
Assessment methods:
Assignment, Final paper, Participation, Written exam
Keywords:
advanced genetics genomics bioinformatics epigenetics gene-environment interaction gene expression analytical techniques data handling/analysis ethical/societal issues

Fac. Health, Medicine and Life Sciences

Pathophysiology of Disease

Full course description

During the first week of the course, an introduction to normal immune system physiology will be given in the form of an overview lecture to ensure the same (bachelor) level of knowledge, whereas during weeks 2 to 7, the focus will be on understanding inflammation and pathophysiology. Every week has a different theme and the students will be challenged with different diseases where immune system dysregulation plays a role. Students will be given their weekly assignments at the beginning of each week, with a prediscussion session where the expected learning goals of the week will be outlined. Thereafter, they will start pre-discussing a case in smaller groups. During the week, they will have expert lectures, e.g. workshops, technical and practical/training skills and journal club discussions. Time will be given for self-study during the week, for both team and individual work. At the end of the week the students will discuss the case they have been working on and the practical/training skill assignment. Theme week 1 Introduction to the immune system: normal physiology.Theme week 2 Immunity to bacteria Theme week 3 Immunity to viruses Theme week 4 Sterile inflammation and other pathological threats Theme week 5 Immunity to tumors Theme week 6 Hypersensitivity disorders and autoimmunity Theme week 7 Microbe-host interactions in (immune) homeostasis Theme week 8 Project discussions, posters and exam

Course objectives

B-ILO1202.1 Explain immunity to microbes and viruses a) Recognize and compare innate and adaptive immunity to extracellular and intracellular bacteria and viruses. b) Explain immune evasion by extracellular and intracellular bacteria and viruses. c) Know how the functional output of the microbiota regulates metabolic and immune homeostasis d) Recognize microbial dysbiosis and its role

in immune-mediated disease predisposition b) Recognize the induction of (innate) immune responses by microbes at mucosal interfaces a) Discuss interplay between microbial colonization and the development of the immune system/induction of tolerance B-ILO1202.5 Explain microbe-host interactions in (immune) homeostasis c) Explain IgE and mast cell-dependent reactions and allergic reactions in humans: pathogenesis and therapy. b) Discuss immunological diseases, their pathogenesis and current therapy. a) Recognize diseases caused by antibodies against membrane receptors and extracellular antigens, immune-complex mediated diseases and disease caused by T-lymphocytes. B-ILO1202.4 Explain hypersensitivity disorders and autoimmunity d) The role of the immune system in promoting tumor growth/tumor progression. c) Effect of the tumor microenvironment on anti-tumor immune responses. b) Explain evasion of the immune response by tumors.a) Differentiate tumor immunity, tumor antigens and immune response to tumors. B-ILO1202.3 Explain immunity to tumors b) Discuss pathological threats such as neurodegeneration, atherosclerosis, and metabolic inflammation. a) Analyze the role of sterile inflammation in trauma and ischemia–reperfusion. B-ILO1202.2 Explain sterile inflammation and other pathological threats c) Discuss injurious effects of immune responses to extracellular bacteria: inflammation, septic shock.

Recommended reading

- Immunobiology Janeway and Travis 8th edition - Control of Metastasis by NK Cells, López-Soto A1, Gonzalez S2, Smyth MJ3, Galluzzi L4. Cancer Cell. 2017 Aug 14;32(2):135-154 - Exosomes in cancer: Use them or target them? Bastos N, Ruivo CF, da Silva S, Melo SA. Semin Cell Dev Biol. 2017 Aug 11 - Gut microbiota: Role in pathogen colonization, immune responses, and inflammatory disease. Pickard JM, Zeng MY, Caruso R, Núñez G. Immunol Rev. 2017 Sep;279(1):70-89. - Host-microbiota interactions and adaptive immunity. McCoy KD, Ronchi F, Geuking MB. Immunol Rev. 2017 Sep;279(1):63-69. - Regulation of inflammation by microbiota interactions with the host. Blander JM, Longman RS, Iliev ID, Sonnenberg GF, Artis D. Nat Immunol. 2017 Jul 19;18(8):851-860. - Understanding the Holobiont: How Microbial Metabolites Affect Human Health and Shape the Immune System. Postler TS, Ghosh S. Cell Metab. 2017 Jul 5;26(1):110-130. - Chan YK, Gack MU. Viral evasion of intracellular DNA and RNA sensing. Nat Rev Microbiol. 2016;14(6):360-73. - Christensen MH, Paludan SR Viral evasion of DNA-stimulated innate immune responses. Cell Mol Immunol. 2017;14(1):4-13. - Ivashkiv LB, Donlin LT Regulation of type I interferon responses. Nat Rev Immunol. 2014;14(1):36-49. - Orzalli MH, Knipe DM. Cellular sensing of viral DNA and viral evasion mechanisms. Annu Rev Microbiol. 2014;68:477-92. - Levinson W. Review of medical microbiology and immunology (12th ed., Lange medical books). Part II/VII - Benoit et al. J Immunol 2008. Macrophage polarization in bacterial infections - Mege et al. Curr Opin Inf Dis 2011. Macrophage polarization in bacterial infections - Netea et al. Science 2016. Trained immunity: a program of innate immune memory in health and disease. - Guilliams Nat Rev Immunol 2017. Does Niche competition determine the origin of tissue-resident macrophages? - de Oliveira et al. Nat Reve Immunol 2016. Neutrophil migration in infection and wound repair: going forward in reverse.

MBS1201

Period 2
28 Oct 2019
20 Dec 2019

Print course description
ECTS credits:
12.0
Instruction language:
English

Coordinator:
M.P. Martinez Martinez
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentations, Research, Skills, Working visit(s)
Assessment methods:
Assignment, Attendance, Final paper, Presentation, Written exam
Keywords:
Pathophysiology/Animal models Infections: virus, bacteria Sterile inflammation Microbiota Metastasis, tumor evasion Exosomes Innate/Adaptive immune responses Auto-antibodies/Autoimmunity Allergy

Fac. Health, Medicine and Life Sciences

Nutrition, Physical Activity and Metabolism; Fundamental Aspects

Full course description

This course aims to provide a solid fundament to understand the mechanisms underlying the metabolic aberrations that are commonly observed in many of the current no-communicable disorders. A proper understanding of these mechanisms is essential to design, optimize, apply and examine interventions that aim to alleviate the metabolic aberrations and to slow down disease progression. To this end this course will encompass studying the major systems involved in human (nutritional) physiology and metabolism. This ranges from the process of nutrient uptake across the gastrointestinal tract to cell and organ specific routes for conversion of macromolecules into their oxidizable derivatives.
The pivotal role of intermediary metabolism and (subcellular) energy sensing and of metabolites and small circulatory hormone like peptides (e.g., adipocytokines) will be studied. This course will, therefore, further deal with the important notion of inter-organ cross-talk and designates how to convey this knowledge to the development of whole body metabolic control. It will provide a basis for targeted treatment of aberrations in (energy) homeostasis, substrate metabolism, inter-organ cross talk as related to macronutrients (fat, carbohydrates, and protein) and specific nutritional components. Special attention will be given to the metabolic routes that are altered in acute and chronic metabolic disorders and the putative role of the biological clock herein. More specifically, these disorders are discussed in relation to the role of nutrition in preventing and treating these disorders.
Nutrients play a role in the regulation of gene transcription, translation, and signal transduction. This, of course, affects cellular pathways. If these pathways become disturbed, it may ultimately result in disease, which may require special dietary interventions. In this course, the molecular basis and cellular mechanisms by which nutrients affect metabolic control is studied at the cellular level.

Course objectives

1. Describe the function and interaction of the listed organs in nutritional physiology and physical activity: Liver, stomach and gut, adipose tissue, brain and muscle.
2. Explain and predict the uptake, storage, degradation, and the intermediary metabolism of nutrients and substrates on organ, cellular and subcellular level.
3. Characterize the transport, uptake and metabolism of macro- and micronutrients.

4. Explain competition and selection of nutrients and substrate flux in pre- and post -prandial states.
5. Explain competition and selection of nutrients, and substrate flux during rest and exhaustive exercise in a trained and untrained state.
6. Apply the concepts above to healthy and chronic disease scenarios.
7. Characterize metabolic aberrations in chronic disease and come-up personalized interventions for intervention.
8. Argue the translational aspects of nutritional and physical activity related model systems.
9. Argue the scientific basis for policy making on human nutrition, physical activity, and dietary guidelines.
10. Critically evaluate recent manuscripts discussing aspects of health related to nutritional status and physical activity.

MBS1301

Period 2
28 Oct 2019
20 Dec 2019

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
M.K.C. Hesselink
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentations
Assessment methods:
Assignment, Attendance, Final paper, Written exam

Fac. Health, Medicine and Life Sciences

Science and Technology of Regenerative Therapeutics

Full course description

This is the first course for the Regenerative Medicine (RM) specialization within the Biomedical Sciences (BMS) Master's program. This first block will provide the student with a solid foundation of knowledge in the interdisciplinary field of RM. At its core, RM aims to replace, engineer, or regenerate tissues and organs in order to establish normal function in the human body. Not falling completely within a traditional discipline, researchers and teams within RM combine fundamental physical and biomedical sciences with technology and engineering in order to discover novel methods of regenerating the body. With successes, scientists within RM must also be able to effectively translate this scientific knowledge into a useful clinical therapy. In this first course, students will learn the basics in not only the biological science of regeneration, including stem cell biology and pathophysiology, but also the technology behind RM, including materials science, chemistry, biofabrication, and computational modeling. This intensive course employs a variety of educational

forms in order to both give an overview of the field and allow students to dig into topics of interest. Students will learn to work in teams, to think critically utilizing the scientific method, and to communicate across the borders of traditional disciplines. Already in this first block, the acquired knowledge will directly be applied to propose new solutions for state-of-the-art RM case studies.

Course objectives

• Understand the molecular processes of wound healing and modulation of tissue homeostasis, and how these mechanisms can be leveraged in the development of regenerative therapies.
• Obtain working knowledge of both a cell's (or tissue's) immediate natural environment, and the current uses of biomaterials to provide artificial environments for tissue growth.
• Understand the successes and failures of current (stem) cell regenerative approaches.
• Understand the different applications of organoid technology for studying development, homeostasis, tissue repair, and diseases.
• Be able to describe the composition and organization of ECM (the original biomaterial) and understand the synthesis, structure, and degradation of therapeutic biomaterials.
• Be able to describe processing technologies used to fabricate biomaterials into 3D scaffolds for tissue engineering, and be able to identify what the important factors of scaffold design are.
• Understand the basics of microfabrication techniques and the working concepts of bioreactors and organ-on–a-chip.
• Understand the importance of the cell-material interface for tissue engineering, and be able to explain how Materiomics approaches can aid in the designing of this interface.
• Be able to critically assess the quality aspects of a research question, methodology, and results. Be able to make supported decisions when designing a regenerative medicine experiment.
• Be able to clearly present and discuss scientific research in the field of regenerative medicine to those within and outside of the field.

Recommended reading

The basic literature for the course:

• Clemens Van Blitterswijk and Jan de Boer (2015). Tissue Engineering, 2nd edition, ISBN 978-0-12-420145-3.
• Anthony Atala et al. (2011). Principles of Regenerative Medicine, 2nd edition, ISBN 978-0-12-381422-7
• Jan de Boer and Clemens van Blitterswijk (2013). Materiomics – High-throughput Screening of Biomaterial Properties, 1st edition, ISBN 978-1-10-701677-4

During the journal clubs the students will receive a number of publications related to the topic of the week.

The students are also encouraged to search for additional information using other resources (i.e. the internet), the quality of which will be discussed in the tutorial groups.

MBS1401

Period 2
28 Oct 2019
20 Dec 2019

Print course description
ECTS credits:

12.0

Instruction language:

English

Coordinator:

S.H. van Rijt

Teaching methods:

Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentations, Training(s), Working visit(s)

Assessment methods:

Final paper, Participation, Presentation, Written exam

Keywords:

Organ and tissue regeneration Biomaterials Tissue engineering Stem cell therapy Interdisciplinary Regenerative medicine

Fac. Health, Medicine and Life Sciences

Pre-clinical Imaging

Full course description

Imaging is increasingly and widely applied in biomedical studies and clinical practice. Imaging enables visualisation of key (molecular) players of health and disease at the molecular, cellular, tissue, and organ levels. Imaging also gives the unique opportunity to study animal models noninvasively at multiple time points and to obtain functional information (e.g. contraction of the heart and blood flow) in order to provide more insight in health and disease, to assess the effectiveness of treatment and to develop new treatments . This course focuses on pre-clinical imaging, which ranges from ex vivo imaging of a single molecule to in vivo imaging of animal models.
You will be prepared for a future in a multidisciplinary biomedical research environment. We will train the students as a key person, linking physiological questions to novel imaging methods. You will be able to communicate within an interdisciplinary team including clinicians and engineers. You will be able to apply state-of-the art imaging methods to biomedical research questions related to oncology, cardiovascular diseases, neuro sciences or metabolism. You will make sure that novel imaging methods can be directly applied in a preclinical research environment.
The course aims to give insight into the basic principles and the biomedical applications of imaging techniques. Techniques that will be discussed are mass spectrometry imaging (MSI), electron and light microscopy (EM and LM), ultrasonography, Magnetic Resonance Imaging (MRI), Computed Tomography (CT), nuclear imaging (Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET)) and hybrid and correlative imaging.
Students will be taught to acquire, analyze and utilize complex images at multiple spatial scales that originate from various imaging modalities. Combined, these preclinical research methods pave the way for new diagnostic approaches required for personalized and systems medicine.

Course objectives

The focus is really on the biomedical problem and not so much on the underlying physical methodology/technology. The main question is how we can use advanced imaging modalities to understand biomedical problems? Within this couse, students will learn how to apply novel technologies to biomedical sciences to solve a biomedical research question. You will learn the basic principles of the imaging modalities, to be able to make correct choices of imaging methods for specific questions.

This course offers interactive teaching, hands-on experiments through practicals, lab visits, workshops, project and interactions with experts.

In the region and the Netherlands, no other integrative courses on imaging for biomedical scientists exist. This is a unique course encompassing all type of advanced imaging techniques like Mass spectrometry imaging, Nanoscopy, Advanced Microscopy, PET and MRI imaging. All these technologies are used with the biggest emphasis on biomedical applications.

Within this course you will perform a project to learn how to solve a biomedical research question with advanced imaging.

Students have the opportunities to learn from expert researchers from each discipline and interact with professionals from the Maastricht University Medical Center. The unique molecular imaging infrastructure at the MUMC+ will be available for the students, who will have the opportunity to meet and interact with professionals and experts in preclinical imaging.

Recommended reading

• Kagadis, G., et al (Eds.). (2016). Handbook of small animal imaging: Preclinical imaging • Liu, X. et al. Anal Chem, 2015. 87(19): p. 9508-19. • Quanico, J., et al., Biochim Biophys Acta, 2017. • Fernandes, A.M., et al., J Am Soc Mass Spectrom, 2016. 27(12): p. 1944-1951. • Fernandes, A.M., et al., J Am Soc Mass Spectrom, 2016. 27(12): p. 1944-1951. • Santagata, S., et al., IProc Natl Acad Sci U S A, 2014. 111(30): p. 11121-6. • Anderson, D.M., et al., J Am Soc Mass Spectrom, 2014. 25(8): p. 1394-403. • Pol, J., et al., Eur J Mass Spectrom (Chichester), 2015. 21(3): p. 297-303. • Mascini, N.E., et al., Anal Chem, 2016. 88(6): p. 3107-14. • Mascini, N.E., et al., J Proteome Res, 2015. 14(2): p. 1069-75. • Jiang, H., et al., Chem Commun (Camb), 2017. 53(9): p. 1506-1509. • Ablonczy, Z., et al., Proteomics, 2014. 14(7-8): p. 936-44. • de Boer, P., et al, Nature Methods 12, 503–513 (2015) • http://ammrf.org.au/myscope/ • http://zeiss-campus.magnet.fsu.edu/ • Hartley CJ, et al, Am J Physiol Heart Circ Physiol. 2011 Aug;301(2):H269-78. • Hermans H, et al, J Appl Physiol (1985). 2014 Sep 1;117(5):563-71. • Clark DP, et al, Phys Med. 2014 Sep;30(6):619-34. doi: 10.1016/j.ejmp.2014.05.011. • Zanzonico P. Radiat Res. 2012 Apr;177(4):349-64. • Gammon ST, et al, Am J Physiol Lung Cell Mol Physiol. 2014 May 15;306(10):L897-914. • van Geuns R-J M et al, Progress in Cardiovascular Diseases. 1999; 42 (2): 149-156. • Vanhoutte L et al, Basic Res Cardiol (2016) 111:46 • Shah SN et al, Abdom Imaging (2015) 40:1358–1365

MBS1501

Period 2
28 Oct 2019
20 Dec 2019

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
M.E. Kooi
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentations, Skills, Working visit(s)
Assessment methods:

Assignment, Attendance, Observation, Participation, Presentation, Written exam

Keywords:

preclinical imaging, MSI, EM, LM, MRI, US, SPECT, PET, CT

Fac. Health, Medicine and Life Sciences

Biosafety

Full course description

This course is an introduction to the principles of biosafety, how to work safely with biological agents, microorganisms and genetic modified organisms in laboratory.
In Hospitals and (Biomedical) Science biological materials (micro-organisms, eukaryotic cells, tissues, body fluids, faeces…) are intensively used in both basic research and diagnostics. In many situations these biological materials are genetically modified or originated from genetic modified organisms. The biological materials can be pathogenic and therefore one should know the rules how to handle these material in a safe way to avoid any harm to yourself or the environment. For working with genetic modified organisms additional legislation applies. In this course the importance of working safely and responsibly with biological materials and genetically modified materials are stressed. Guidelines and regulation, decontamination and disinfection, disposal and sterilization, facility and equipment design will be discussed.
During the practical assignments the participants can train some basic biosafety principles for proper handling of microorganisms. In the case studies some realistic laboratory situations are depicted by which the participants are forced to think about how to handle these situations in a (bio) safe way.
If you have passed the course successfully you can perform microbiological work at Biosafety/Microbiological laboratory Level I (BSL-I/ML-I)

Course objectives

- know the principles of biosafety
- know the general biosafety rules and be able to work according to them
- know the legislation related to (genetic modified)microorganism
- know how to handle when spills/incidents occur

MBS1103

Period 3

16 Jan 2020

7 Feb 2020

Print course description

ECTS credits:

1.0

Instruction language:

English

Coordinator:

N. Kisters

Teaching methods:

Assignment(s), Lecture(s), Skills

Assessment methods:
Written exam

Fac. Health, Medicine and Life Sciences

Clininal and Applied Genetics and Genomics

MBS1102

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
E.J.M. Speel

Fac. Health, Medicine and Life Sciences

Engineering the Immune System; Treatment of Disease

Full course description

Building on the knowledge that has been gathered by the student in the MBS1201 course, MBS1202 course will follow roughly the same roadmap through the various fields of research and clinical medicine, in which immunology, inflammation and the pathophysiology of infectious and non-infectious disease are specifically involved in diagnosis and therapy. Attention will be given to experimental medicine approaches and technologies as well as to the more general translational aspects related to the topics that are relevant to fields of sterile and non-sterile (infectious) inflammation, neurodegeneration, atherosclerosis and vascular disease, autoimmunity and tumor development.

The goal of this course is to provide a basic understanding of several important techniques and technologies in the field and create an awareness of experimental and approved methods for treatment of immune-related disease.

Course objectives

The course will not use a single advised textbook on immunology/biochemistry/pathology, instead, recent scientific literature will be used. Given the wide variety of topics and relative fast developments in the field, the use of few textbook sources is not advised, nor is it sufficient. The literature as used in the preceding 1201 block, should be continued where general mechanisms are

concerned. Individual teachers and experts however are being encouraged to deviate from the basic knowledge from 1201, to extend this and present the lastest views and knowledge from the respective fields involved in this block. Moreover, students will themselves produce documents each week in expert groups, that collectively will serve as an additional source for reading, in preparation of the final course test. Good starting points for basic knowledge are: Janeways - Immunology (Garland Science) Peter Parham - The Immune System (Garland Science) Doan et al - Immunology - Lippincott's Illustrated Reviews (Wolters Kluwer/Lippincott Williams & Wilkins)

Recommended reading

The course will not use a single advised textbook on immunology/biochemistry/pathology, instead, recent scientific literature will be used. Given the wide variety of topics and relative fast developments in the field, the use of few textbook sources is not advised, nor is it sufficient. The literature as used in the preceding 1201 block, should be continued where general mechanisms are concerned. Individual teachers and experts however are being encouraged to deviate from the basic knowledge from 1201, to extend this and present the lastest views and knowledge from the respective fields involved in this block. Good starting points for basic knowledge are: Janeways - Immunology (Garland Science) Peter Parham - The Immune System (Garland Science) Doan et al - Immunology - Lippincott's Illustrated Reviews (Wolters Kluwer/Lippincott Williams & Wilkins)

MBS1202

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
G.A.F. Nicolaes
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentation(s), Skills
Assessment methods:
Assignment, Attendance, Final paper, Observation, Participation, Presentation, Written exam
Keywords:
Immunology Therapy Immune response Immune Disease Immune Modulation Immune suppression Immune therapy Pharmacotherapy Antibody therapeutics

Fac. Health, Medicine and Life Sciences

Practical Engineering the Immune System; Treatment of Disease

MBS1212

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinator:
G.A.F. Nicolaes

Fac. Health, Medicine and Life Sciences

Lifestyle Interventions and Metabolism; a Translational Perspective

Full course description

In this course, the central theme is the role of lifestyle changes in both health and disease. Lifestyle factors modulating human metabolism on a micro(cellular) and macroscale (organ) will be studied via a translational approach. This course will focus primarily on the more conventional strategies to promote health by exploring the underlying mechanisms and how these interventions may prevent various non-communicable diseases, including cardiovascular diseases, cancer, chronic respiratory diseases and diabetes. For this, effects of diet and physical activity on gene expression/cellular pathways, organ function and interorgan crosstalk will be studied in depth. However, the impact of lifestyle interventions may differ between individuals (e.g. responders vs. non-responders) indicating that successful lifestyle interventions may require a more personalized approach. Besides the more conventional strategies, the relevance of weight loss, specific (nutritional) compounds, exercise, sedentary behavior, sleep and stress management in affecting metabolism will be topic of study. Furthermore, core principles of potential interactions between lifestyle factors and drugs will be applied and students will critically evaluate the dietary and physical activity guidelines as defined by the Dutch Health council. The lectures/group meetings and journal club will be planned in the first seven weeks of the course. Throughout the course and in the last week, students will work in small groups on the Academic project. The setup for the academic project intends to promote a largely independent and self-directed form of education that ultimately results in a written report and an oral presentation. The objective of the academic project is that students select a preventable, age-related disease and study possible short term interventions to treat or prevent the disease in humans. Subsequently, students will need to formulate a focused research question to study (i) the most promising lifestyle intervention and (ii) relevant outcome parameters to assess potential treatment effects.

Course objectives

Course objectives 1. To explain the effects of diet and physical activity: - on cellular pathways involved in health and disease - on (mal)adaptive gene expression involved in health and disease - on (disturbed) organ function involved in health and disease - on (disturbed) interorgan crosstalk

involved in health and disease 2. To appreciate the bi-directional routes of how nutritional support can amplify the health and performance benefits of exercise 3. To explain the role of genetics in personalized approaches to prevent disease (responders vs. non-responders) 4. To recall differential effects of different forms of lifestyle interventions on metabolism involved in health and disease 5. To apply the core principles of interactions between lifestyle factors (diet and physical activity) and drugs 6. To argue the dietary and physical activity guidelines as defined by the Dutch health council 7. Critically evaluate recent manuscripts discussing lifestyle interventions in health and disease, also focusing on ethics, integrity and statistics

MBS1302

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
C.J.H. van der Kallen
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, Paper(s), PBL, Presentations, Research, Skills, Training(s), Working visit(s)
Assessment methods:
Assignment, Attendance, Final paper, Participation, Presentation, Written exam
Keywords:
Lifestyle intervention Metabolism Translation approach Personalized approach Diet Exercise

Fac. Health, Medicine and Life Sciences

Translating Therapies into Clinic and onto the Market

Full course description

Using often a combination of advanced microfabrication technologies, biomaterials, and (stem)cells followed by implanting or transplanting these into the patient. We will discuss and work out the latest advances in technology and medicine to replace tissues and organs damaged by disease or traumatic injuries and develop new potential therapies for previously untreatable conditions. Examples of chronic diseases(not exclusive) are type 1 diabetes, cardiovascular diseases, orthopedics, opthalmological diseases, and renal failure which will serve as starting points to work with the help of a research expert and clinicians in a dedicated team on a project proposal. This module is setup around different challenging clinical cases which need to be solved with your team members and by interaction with different experts using Regenerative medicine strategies. During the course you will get in depth knowledge on different aspects of Regenerative Medicine strategies and how to develop your new regenerative medicine research idea into a clinical viable therapy. There will be weekly

interactions during dedicated tutor sessions with your research tutor to work on different aspects of a research proposal. We will have expert lectures on "state of the art" scientific research regarding technology and regenerative medicine on a weekly basis. In addition, there will be special lectures on IP (patent related issues and regulations), Clinical trials and several companies will be invited to discuss what is required to bring an idea to the market and ultimately to patients.in vitro,, or growing tissues and organs in vivoVirtually any disease that results from malfunctioning, damaged, or failing tissues can potentially be cured through regenerative medicine therapies. Regerative medicine involves either regenerating the damaged tissues You are expected to have followed the precedeing module on Regenerative medicine in which the basic knowledge about the field is taught. You are expected to use the knowledge aqcuired in that module for solving the clinical case in this module The module will be graded on writing a research proposal, presenting your new idea during a minisymposium and professional behavior.

Course objectives

- Students should know how to present and defend a new project proposal
- Students should know how to design a translational biomedical study, and write a project proposal
- Students should know about the regulatory affairs involved in product development for biomedical applications (animal, human, GLP/GMP)
- Students should know about when and how to protect a new innovation and what is required to create a patent
- Students should be able to develop a new research strategy together with team members, to solve a clinical problem based on state of the art technology, biomaterials, biology and medical practice

MBS1402

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
A.A. van Apeldoorn
Teaching methods:
Assignment(s), Work in subgroups, Lecture(s), Paper(s), Presentations, Research, Working visit(s)
Assessment methods:
Assignment, Participation, Presentation

Fac. Health, Medicine and Life Sciences

Clinical Imaging

Full course description

This second course in the “Imaging from molecule to man” specialization will focus on the application of imaging to address physiological and pathological disease processes in man in a clinical (research)

setting. This course focuses on application of imaging in a clinical (research) setting. This means that all imaging modalities discussed during this course can be applied on humans. It is not the intention to go in depth on the physics principles of the imaging techniques, but we will focus on the application of the techniques in daily clinical routine/research. It is important for the student to learn what are advantages and disadvantages of the different imaging modalities, with the aim that students will be able to independently make a (grounded) choice for one or multiple imaging strategies to solve or answer clinical questions or questions arising in a (clinical) research setting.

Course objectives

After this course the student:

- identifies what imaging modalities are (regularly) being used at the moment in the typical clinical (research) setting and which methodology is state-of-the-art (and/or is being developed)
- knows what information is within an image and can extract this information from the image (image processing and analysis).
- imaging modalities in a clinical (research) setting.in vivo and ex vivo- specifies the opportunities and limitations of
- chooses the appropriate imaging modality/modalities (e.g. MRI/MRS, PET, CT, Ultrasound, microscopy) for specific use in a clinical (research) setting.

Recommended reading

1. Radiomics: extracting more information from medical images using advanced feature analysis.Lambin P, Rios-Velazquez E, Leijenaar R, Carvalho S, van Stiphout RG, Granton P, Zegers CM, Gillies R, Boellard R, Dekker A, Aerts HJ.; Eur J Cancer. 2012 Mar;48(4):441-6.
2. Next-generation scans: Seeing into the future. Peter Gwynne, Nature 2013; 502, S96–S97.
3. In Vivo NMR Spectroscopy, 2nd Edition. De Graaf. Literature will be provided to the students via Eleum.

It is expected that students will find further relevant literature themselves.

MBS1502

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
A.M. Blanchet - Smolinska
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups, PBL, Presentations, Research, Skills, Training(s), Working visit(s)
Assessment methods:
Assignment, Attendance, Oral exam, Participation, Presentation

Keywords:
Clinical imaging, MRI/MRS, CT, US, Radiomics, pathological imaging

Fac. Health, Medicine and Life Sciences

Biomedical Approaches

MBS1002

Period 4
9 Mar 2020
3 Apr 2020

Print course description
ECTS credits:
5.0
Instruction language:
English
Coordinator:
M. Gerards

Fac. Health, Medicine and Life Sciences

Practicals Biomedical Approaches

MBS1012

Period 4
9 Mar 2020
3 Apr 2020

Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinator:
M. Gerards

Fac. Health, Medicine and Life Sciences

Junior Practical Training

Full course description

This 12-week internship (JPT: junior practical training) period provides students with their first practical experience of setting up and conducting scientific research. It emphasises the exploration of new and relevant research techniques and methodologies. Students are introduced to and gain practical experience in several state-of-the-art techniques/methodologies. This also gives them the opportunity to get an overview over ongoing research lines. However, students may take their research project outside Maastricht University too.Students are encouraged to explore more than one experimental technique/methodology (e.g. recombinant DNA technology, gene expression analysis, protein analysis, western blotting, cell cultivation, immunohistochemistry, analysis of DNA variation, transfection, etc.). The period lasts 12 weeks and is supervised by a tutor/researcher, who acts as a supervisor for the entire internship. Passing the Biosafety course (MBS1103) is required to start with (and pass for) the JPT (MBS1003).

Course objectives

Set up experimental research/focused experiments 1.Get practical understanding of modern research techniques and methodologies (possibilities and limitations) 2.Participate in an ongoing research project 3.Get Exposure to the real-life research environment 4.Keep a laboratory journal (if applicable) 5.Participate in academic discussions in professional practice 6.Present and discuss newly acquired knowledge to the host research group 7.Write a report 8.

MBS1003

Period 5
6 Apr 2020
3 Jul 2020

Print course description
ECTS credits:
17.0
Instruction language:
English
Coordinator:
H.R. Gosker
Teaching methods:
Presentation(s), Research, Skills, Training(s)
Assessment methods:
Attendance, Final paper, Observation, Participation, Presentation
Keywords:
internship, placement, research project

Fac. Health, Medicine and Life Sciences

Historical Development and Ethics in Bio

Full course description

The course ‘Historical developments and ethics in biomedical science’ invites students to reflect on the emergence of normative frameworks associated with science as they progress through their biomedical curriculum. As part of the course, they will prepare a discussion of the research ethics connected to research they propose and plan themselves. While engaged in research activities, they will discussion and study conventions, standards and guidelines of research integrity. At the end of the year, students will have an active understanding of the frameworks of research ethics and research integrity and how they came into being. Grades are awarded to two written assignments students complete throughout the year, each contributing 50% to a P/F grade.

Course objectives

1. You have knowledge and understanding of research ethics principles, as well as of practices of evaluating and assessing research ethics;
2. You can discuss and reflect of the research ethics of research you design and/or propose;
3. You have knowledge and understanding of research integrity in its conventions, guidelines, and origins;
4. You can critically reflect on research integrity practices and cultures;
5. You are able to synthesize knowledge on research ethics and integrity and reflection on positions associated with them into a coherent discussion of actual research practices.
6. You can actively and constructively participate in exchanges on the normative frameworks in biomedical science.

MBS1004

Year
1 Sep 2019
3 Jul 2020

Print course description
ECTS credits:
1.0
Coordinator:
B. Penders
Teaching methods:
Assignment(s), Lecture(s), Work in subgroups
Assessment methods:
Assignment
Keywords:
Research Ethics Research Integrity Normative Frameworks Contributory expertise

Fac. Health, Medicine and Life Sciences

Fundamental Neuromodulation

MBS1601

Period 2
28 Oct 2019
20 Dec 2019

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
A. Jahanshahianvar

Fac. Health, Medicine and Life Sciences
Translational Neuromodulation

MBS1602

Period 3
6 Jan 2020
6 Mar 2020

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinator:
F. Dücker

Second year courses

Biomedical Sciences Year 2

Fac. Health, Medicine and Life Sciences
Designing Scientific Research

Full course description

Course summary
Eight-week course focusing on the various aspects of writing an academic research proposal.

Content
This theoretical course aims at familiarising students with setting up fundamental or applied research and writing an academic research proposal. The central theme of the second year of the master's programme is the practical application of the scientific process: hypothesis/problem

definition/experiment/result/interpretation/conclusions. The general point of departure is the setup of a follow-up study which relates to ongoing research at UM, or elsewhere (Internship abroad). This provides students with preparation for the senior practical training (course BMS2002), which concludes the master's programme.

Skills training
The course pays explicit attention to English academic writing (by way of practical exercises), presentation skills and valorisation potential of research ideas.

Course objectives

- Understanding of the scientific processo Ability to formulate a hypothesis to be tested and set up an executable research project using the concept of the scientific process
- Ability to draw up various research strategies to approach certain research questions
- Ability to formulate expected end results (preparation for course 2.2)
- Ability to defend a research proposal, and in doing so enter into academic discussions with colleagues and supervisors
- Ability to comment critically on other research proposals

Recommended reading

Science Research Writing: A Guide for Non-Native Speakers of English by Hilary Glasman-Deal Grant Writing For Dummies by Beverly A. Browning

BMS2001

Period 1
2 Sep 2019
25 Oct 2019

Print course description
ECTS credits:
12.0
Instruction language:
English
Coordinators:
R. Shiri - Sverdlov
J. Theys
Teaching methods:
Presentation(s), Training(s), Assignment(s), Work in subgroups, Lecture(s), Research, Paper(s)
Assessment methods:
Final paper, Presentation
Keywords:
designing research proposal, scientific english, epidemiology

Fac. Health, Medicine and Life Sciences

Historical Development and Ethics in Biomedical Sciences

BMS2003

Period 2
28 Oct 2019
12 Jun 2020

Print course description
ECTS credits:
1.0
Instruction language:
English
Coordinator:
B. Penders

Fac. Health, Medicine and Life Sciences

Thesis

Full course description

Course summary

During this 30-week internship, students participate in ongoing scientific research at UM , at other knowledge centres in the Netherlands/Belgium, or in other countries (see below). The internship is prepared during course 2.1. A practical, hands-on experience, it offers students a unique opportunity to gain experience in independently carrying out a research project which they personally designed. The length of the training period ensures the acquisition of valuable, in- depth experience, necessary for students' development into independent researchers.Internships can consist of subjects related to clinical diagnostics and therapy of chronic diseases, relationship between exogenous circumstances and chronic diseases, topics relating to cancer or developmental biology, depending on the speciality of the student and his/her interests.

Content

Students work individually and take part in ongoing research projects, supervised by a researcher. In this framework, they also participate in the regular meetings of the relevant research team. Further, they return to the university during the internship period to present their progress and comment on other students' projects. The internship period concludes with a final presentation at the Mosa Conference to the other students as well as supervisors/examiners/experts. The final internship report is prepared in the form of an extensive scientific paper, which constitutes the master's thesis. The optional courses are integrated into the internship period.

Course objectives

Objectives (Applying) knowledge and understanding:

- Ability to carry out a research project independently in a research environment
- Experience in adhering to a research plan (in terms of content and time management)
- Experience in problem solving during research
- Ability to revise or set up follow-up research (adjusted to the results obtained)
- Ability to process, interpret and report results
- Active participation in regular discussions in the research environment
- Ability to present and discuss interim and final results to and with colleagues and supervisors

Recommended reading

Science Research Writing: A Guide for Non-Native Speakers of English by Hilary Glasman-Deal
http://www.vsnu.nl/files/documenten/Domeinen/Onderzoek/Code_wetenschapsb
eoefening_2004_(2012).pdf (in Dutch)

BMS2002

Period 2
28 Oct 2019
12 Jun 2020

Print course description
ECTS credits:
47.0
Instruction language:
English
Coordinators:
R. Shiri - Sverdlov
J. Theys
Teaching methods:
Paper(s), Presentation(s), Research
Assessment methods:
Final paper, Participation, Presentation
Keywords:
practical lab work, research project

Fac. Health, Medicine and Life Sciences

Poster Presentation

Full course description

Present your research from the senior practical training for fellow students at the MOSA conference on a poster. Best abstracts will be selected for oral presentations. Posters will be scored and are part of the SPT mark.

Course objectives

making a poster, presenting your results, scientific discussion

BMS2102

Period 2
28 Oct 2019
21 Jun 2020

Print course description
ECTS credits:
0.0
Instruction language:
English
Coordinators:
R. Shiri - Sverdlov
J. Theys
Teaching methods:
Paper(s), Presentation(s)
Assessment methods:
Assignment, Attendance, Participation, Presentation
Keywords:
poster, oral, discussion

Fac. Health, Medicine and Life Sciences

Senior Practical Training - Internship

Full course description

A 30 week practical training period in a lab setting.

Course objectives

performing experiments, participating in a research group

Recommended reading

http://www.vsnu.nl/files/documenten/Domeinen/Onderzoek/Code_wetenschapsbeoefening_2004_(2012).pdf (in Dutch)

BMS2202

Period 2
28 Oct 2019
12 Jun 2020

Print course description
ECTS credits:

0.0

Instruction language:

English

Coordinators:

R. Shiri - Sverdlov

J. Theys

Teaching methods:

Research, Training(s), Paper(s)

Assessment methods:

Final paper, Attendance, Participation, Presentation

Keywords:

practical work full participation in research