Summaries and fact sheets
of English taught courses of the
Bachelor Biomedical Sciences
UMC Utrecht, Faculty of Medicine
Utrecht University

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INTRODUCTION

Dear exchange student,

In this document you will find a description of the courses offered in English at the bachelor’s programme Biomedical Sciences in Utrecht. The course levels are either 2 or 3. Level 2 is intermediate and level 3 is advanced. Please pay attention to the requirements for admission and the required previous knowledge needed to follow each course before you request to be enrolled in the course.

Each course is given in a time slot (AD or BC). A student can enroll in 2 courses each period, one course in each time-slot.

Once you have given us your preference of courses on the course selection form, you are applying for the courses. This application does not guarantee placement. You must meet the entry criteria for your preferred courses. We will do our best to make sure as many people as possible are assigned to the courses indicated as first choice, but this also depends on the number of available slots in each course.

Indicating your choices on the course selection form means you are committed to following the course that you are placed in. You must follow all the components!

It is not possible to switch courses at the last minute, as most courses are always fully booked. Requests for a change in course application can be made until 4 weeks before the start of the semester at the latest. We will see if it is possible to make changes in your course schedule, but cannot guarantee this.

The Research Project (RP) is full-time (15 EC) and takes up both time-slots, so you cannot follow any courses alongside the RP. The Research Project Plus (RP+) is an extended RP: 1 period full-time (so in both time-slots) and 1 period half time (so either AD or BC; total of 22.5 EC). In the first period of your RP+, you can follow a course alongside the RP+. Please be aware that you have to arrange the supervisor and lab for your Research Project yourself.

We hope you enjoy your stay in Utrecht!

On behalf of the Biomedical Sciences bachelor’s programme,

Wim Dictus
Programme Director
Bachelor’s Biomedical Sciences
Utrecht University/UMC Utrecht
ACADEMIC ENGLISH FOR THE SCIENCES

Credit load: 7.5 ECTS  
Course code: BMW32709
Coordinator: Rose Jansen, MSc  
Period: 2 (timeslot AD or BC)
Examiner: Hanneke van Nes  
Period: 3 (timeslot BC)
E-mail address: maatwerk@babel.nl  
Level: 2
Phone: +31 30 2270085

Content:
In an increasing number of bachelor’s programmes, the student is expected to have an excellent command of English, in writing and reading, as well as in giving presentations. The aim of the course is to improve these skills. With this in mind, the focus duly rests on acquiring communication skills in English. General techniques for presenting will be dealt with, which supplement the presentation skills acquired in year 1 of the bachelor’s programme. In addition, students will expand their (academic) vocabulary and put it to active use. This course helps you to improve your speaking and academic writing skills. The following subjects will be discussed:

- structure and vocabulary of a literature review, summarizing, grammar structures, verb tenses, formal and informal writing, wordiness, plagiarism, word choice, linkers, and punctuation;
- language use and structure of a (poster) presentation, visual support, voice use, audience interaction, dealing with questions, speaking at a seminar, posing questions, giving an opinion, and interrupting;
- formulating learning goals, self-reflection.

In this course, students will work with subjects from their own studies. A teacher from the sciences faculty or the UMC will provide support in terms of content.

Requirements for admission:
English on advanced (Common European Framework of Reference level B2 to B2+) level. Prior to the start of the course, students will be asked to do a digital placement test to determine whether their level of English meets the requirements of the course. Students who are enrolled for this course will receive information via e-mail regarding this test.

Learning outcomes:
Knowledge and insight
At the end of the course, the student will have:
- a larger academic vocabulary;
- insight into their strengths and weaknesses in English;
- insight into the structure of a presentation;
- insight into the ingredients of a review article.

Skills
After this course, the student will be better able to:
- write English on an academic level;
- give an effective English (poster) presentation;
- apply self-study strategies;
- give feedback in an appropriate manner;
- speak English with more confidence.

Teaching forms and contact time:
This course consists of workgroup meetings, group activities, and self-study. The total contact time is 45 hours: a maximum of 2 meetings of 3 hours a week. Attendance is compulsory: you have to attend 13 out of 15 meetings and score a pass for all assessments to be eligible for credits.

Method(s) of testing:
- ‘Vocabulary notebook’ (15% of the final grade);
- Exercises (15% of the final grade);
- Presentation (25% of the final grade);
- Paper (25% of the final grade);
- Active participation in the course (20% of the final grade).
Required material:

*More information about the CEFR can be found via this link: http://en.wikipedia.org/wiki/Common_European_Framework_of_Reference_for_Languages*
ADVANCED CELL BIOLOGY

Credit load: 7.5 ECTS  
Course code: BMW31305
Coordinator: P. van der Sluijs, PhD  
Period: 4
Examiner: P. van der Sluijs, PhD  
Timeslot: AD
E-mail address: p.vandersluijs@umcutrecht.nl  
Level: 3
Phone: +31 88 755 7578

Content:
Organelles of eukaryotic cells are distinct functional units that simultaneously execute many critical cellular functions such as protein folding, signal transduction, metabolism, etc. In this course we will discuss how compartments are generated, how they communicate with each other, and how compartmental integrity is maintained. Disruption of these processes often causes severe diseases because they typically serve household functions that are common to all cells. A number of examples will be discussed during the course.

The lectures (15) will be given by teachers that are experts in their fields as testified by publication of their papers in high profile journals. The definitive content of the theoretical part is determined by recent developments in the field. The lectures are interactive and 50% of the lecture time will be used by the students to discuss the papers they read.

When the lecture part is finished, students will be divided into 4 groups. Each of the groups will team up with a graduate student or postdoc and perform real research experiments within the project of their supervisors during a period of 8-9 days. This part of the course will be conducted in the research labs of the following group leaders within the Department of Cell Biology: P. van der Sluijs PhD, Prof. G. Strous, Prof. J. Klumperman, C. Rabouille PhD, F. Reggiori PhD and M. Maurice PhD. Each group will give a presentation of their project at the end of the practical part, where the results will be discussed as well as the follow-up experiments.

During the last week there are no planned activities, and this time is meant to serve to prepare the written exam at the end of the week.
Participation to all activities is compulsory.

Requirements for admission:
Students need to have successfully completed a biomedical sciences course which deals with the subjects 'Biomembranes' or 'Signal transduction' (level 2).

Learning outcomes:
Knowledge and insight
At the end of the course the student is able to:
• describe the cell biological principals of a number of diseases;
• explain how perturbations of cell biological principles can lead to disease.

Skills
• obtain practice in reading, and evaluating scientific papers in a short time;
• formulate and experimentally address a cell biological problem;
• execute scientific experiments by working together in a team;
• give a presentation of results obtained during the practical part.

Method(s) of testing:
Final grade is defined by grades of written exam (60%), active participation in theoretical part and homework (20%), and active participation in practical part (20%).

Required material:
• Alberts et al. Molecular Biology of the Cell (5th edition);
• A reader will be provided at the start of the course.
ADVANCED NEUROSCIENCE

Credit load: 7.5 ECTS
Course code: BMW30605
Coordinator: G.M.J. Ramakers, PhD
Examiner: G.M.J. Ramakers, PhD
E-mail address: g.m.j.ramakers@umcutrecht.nl
Period: 3
Timeslot: AD
Level: 3
Phone: +31 88 756 8413

Content:
The main topic of this course is “Plasticity”, and during this course neurochemical, neurophysiological, and molecular biological concepts and methods that play a role in the (patho)physiology of the nervous system will be addressed.
The focus will be on the multidisciplinary character of neuroscience research, on designing and conducting experiments independently, and on gaining experimental skills in neurobiological and neuropharmacological research.

Requirements for admission:
Students need to have completed for 15 ECTS in neurosciences courses (level 2). Basic knowledge of anatomy, physiology and pharmacology of the nervous system is required.

Learning outcomes:
At the end of this course, the student has gained:
• knowledge of and insight into the neurochemical, neurophysiological and molecular biological processes in the nervous system;
• knowledge of and insight into the pathophysiological consequences of distortions of these processes;
• skills on designing and conducting experiments to resolve a research question in neuroscience.

Teaching forms and contact time:
This course will consist of lectures (40 hours) and practical training sessions (120 hours), with a contact time of 60%. The practical training will be taken in couples and will be supervised by teachers and PhD-students (short internship).

Method(s) of testing:
Assessment will take place by means of an examination (70%), combined with written and oral presentation of practical work (30%) with the requirement that students have participated in all practical trainings.

Required material:
• Compulsory: Course manual (€ 5,00);
CARDIOVASCULAR BIOLOGY

Credit load: 7.5 ECTS  
Course code: BMW32407  
Coordinator: Prof. G. Pasterkamp, PhD  
Period: 2  
Examiner: Prof. G. Pasterkamp, PhD  
Timeslot: AD  
E-mail address: i.c.j.wilson@umcutrecht.nl  
Phone: +31 88 75 58654  
Level: 3

Content:
Heart- and coronary diseases are a major cause of death in Western society. The increase in diabetes and obesity will cause a further rise in cardiovascular diseases. This course deals with the pathogenesis and intervention of cardiovascular diseases. This course has a translational character, which means that the results from research will be translated into care for the patient. A lot of knowledge may never, or only in the late future, be of use for the patient. During the course, the subject matter will be dealt with in a way that triggers students to test knowledge for practical applications. The content will therefore not purely focus on cellular and molecular knowledge, but also on knowledge needed to put results of research into practice.

Blood clot formation because of arteriosclerosis is the pathological substrate of a coronary attack. It is of major importance to understand which plaques are the cause for blood clotting (unstable plaques). A lot of research is being conducted to investigate this, at molecular and cellular level, laboratory animals and humans. It is known that increased enzymatic degradation of collagen by proteases from inflammatory cells and the innate immune system plays an important role in destabilizing atherosclerotic plaques. After a coronary attack, the heart will undergo a lot of structural differences. Locally, inflammatory cells will try to remove necrotic tissue and collagen will be set down to close the wound. The contractile capacity of the heart will decrease because cardiomyocytes will have died. Insight in the molecular processes which are the basis of repair of the myocard is essential to develop new techniques for intervention. Several therapies are being developed to treat heart- and coronary diseases: mechanical (surgery), cellular (stem cells), and molecular (RNA interference). This course will discuss these therapeutic interventions and their molecular mechanisms.

Required knowledge:
Basic knowledge of physiology and immunology is required.

Learning outcomes:
Knowledge and insight
At the end of the course, the student is able to:
- describe the biological aspects of cardiovascular diseases, including therapeutic interventions;
- clarify the role of molecular and cellular processes in the development of vessel constriction and oxygen deprivation of the organ;
- explain the development of cardiovascular diseases from preclinical and clinical disciplines;
- describe possible therapeutic interventions.

Skills
At the end of the course, the student is able to:
- formulate a research proposal to solve a scientific cardiovascular problem;
- analyse and present a scientific problem, together with other students in a team;
- critically assess research proposals and research methods for their use in science and marketing.

Attitudes
At the end of this course, the student is able to:
- show a critical and inquisitive attitude towards the developments in research to cardiovascular diseases.

Learning activities and contact time:
The course consists of lectures, e-tutorials, group meetings and private study. To understand the pathogenesis of a syndrome, the student will formulate a hypothesis form a clinical problem and make plan
for research experiments. The practical part consists of demonstrations of experiments with laboratory animals, e.g. open-heart surgery and catheter interventions. Contact time is approximately 30%.

Method(s) of testing:
There will be an individual, written examination with open questions. The final grade is a combination of the grade obtained for the written examination (60%), discussion of an article (10%) and active participation during tutorials (30%). The tutorials will partly be web based.

Required material:
• Course manual can be purchased at Mebiose in UMC Utrecht.
CLINICAL IMMUNOLOGY

Credit load: 7.5 ECTS  
Course code: BMW31105
Coordinator: E.F. Knol, PhD  
Period: 3
Examiner: E.F. Knol, PhD  
Timeslot: BC
E-mail address: e.f.knol@umcutrecht.nl  
Level: 3
Phone: +31 6 5012 4843

Content:
The failure or hyperactivity of the immune system leads to a kaleidoscope of disorders that are genetically set or induced by infections or cancer therapies. During the first 4 weeks of the course, four important topics of clinical immunology will be addressed during lectures and tutorials:

- Immune deficiencies
- Transplantation of organs & bone marrow
- Tumor immunology / immunotherapy
- Autoimmune diseases + allergies

Furthermore, the programme will mainly consist of an in-depth project. Each group will write a research proposal on a certain subject. Another group will review this proposal in a formal way. A third group will study the proposal and the review and give an integrated presentation. Each group will gain experience in gaining primary data, commenting and presenting whilst working on three different subjects. Special attention will be given to the group process and giving feedback within the group.

Requirements for admission:
Students have to have successfully completed equivalent courses of 15 ects covering basic immunology (level 2). If students do not fulfill these requirements, the course coordinator can decide to assign additional study material.

Learning outcomes:
Knowledge & Insight
At the conclusion of this course, the student has the ability:

- to relate immunological principles, clinical consequences, therapies, & new developments of some disorders: Primary immune deficiencies & AIDS, Allergies & Autoimmune diseases (AID), Transplantations & Tumor immunology
- to render examples and principles of new therapies in rheumatic disorders & animal models applied to rheumatological research
- to describe the role of T cell subsets in allergies and autoimmune diseases, to explain the mechanisms of (some types of) chronic inflammatory reactions, to coherently describe the relationship between tumor and immune system of the host.

Skills
At the conclusion of this course, the student must be able (at the level of a (fledgeling) scientist):

- to come up with a sound research question and write a scientific grant application about it including among other things, a state-of-the-art literature survey, study design, methods and timetable
- to review a scientific grant application & to write an according comment incl. suggestions for improvement.
- to present, at the level of a (fledgeling) scientist a coherent, clearly structured, critical survey of one or more scientific articles, which discusses strong and weak points, and pro’s and con’s, of a methodological approach and/or a presented concept.

Attitudes
At the conclusion of this course, the student must be able to exhibit:
• a critical and inquisitive attitude towards claims concerning animal models and immunopathogenic concepts.
• a respectful and cooperative attitude towards those with whom the student prepares presentations and conducts discussions.

Teaching forms and contact time:
This course consists of lectures, tutorials, including presentations by students, and a project with a symposium. There will be an average of 7 contact hours each week. The successful outcome of the project depends on the active participation of all students. The students will be monitored for their active participation by the course coordinator.

Method(s) of testing:
Active participation in tutorials with presentations (10%); Midterm examination (20%); Assessment of the project by students and teachers (40%); Final examination (30%). The student has to get an average grade of 5.5 for the midterm and final examination. Not until this requirement is fulfilled, the assessment of the project and the tutorials are taken into account.

Required material:
CLINICAL TRIALS

Credit load: 7.5
Coordinator: Dr. G.C.M. van Baal
Examiner: Dr. G.C.M. van Baal
E-mail address: G.C.M.vanBaal@umcutrecht.nl
Phone: +31 88 755 9394

Course code: BMW30905
Period: 1
Timeslot: BC
Level: 3

Content:
“It is unethical to let human subjects participate in research that has not been designed carefully and sound”.

A sound methodological-statistical design is an essential condition for the reliability of the results of a (clinical) study. In the course we will pay attention to the most important aspects of the design of a phase III, randomised clinical trial (RCT) to compare two treatments of patients with the same disorder. These aspects are, amongst others, different ways of randomisation and stratification, determination of the necessary number of patients, the data processing and statistical analyses, the interpretation and publication of trial results.

In the course we will also discuss regulatory issues researchers will have to deal with in the design and execution of a comparative clinical trial. We will pay attention to skills necessary for the education to Clinical Research Associate and/or clinical investigator.

Students will write a research protocol in small groups coached by the teachers and a clinical investigator. One or more guest lecturers will present topics based on their own (practical) experience.

Requirements for admission:
Knowledge of introductory statistical methods is required (descriptive statistics, both graphical and quantitative; statistical tests for the comparison of two independent groups with dichotomous or continuous outcomes, such as a chi-square test, t-test, and non-parametric tests; statistical tests for paired dichotomous or continuous observations); knowledge of statistical software, preferably SPSS.

Learning outcomes:
Knowledge & Insight
After the course the student will be able to describe:

- the most important methodological concepts of clinical trials, such as randomisation, blinding, use of placebo, necessity of a control group, sample size en further aspects of the design of a phase III randomised clinical trial;
- to which organisational aspects a clinical trial will have to comply, such as Good Clinical Practice, Law on Medical Research with Humans, and which of these are important (responsibilities, side effects, drug accountability, monitoring, etc.).

Skills
The student will be able to

- apply the acquired theoretical knowledge by writing a research protocol for a comparative phase III clinical trial;
- calculate the sample size for the most frequent experimental designs and apply simple statistical analyses on the results of a phase III trial;
- phrase and explain the contents of the conceived research protocol.

Attitudes
The student will be able to:

- give a logical argumentation with respect to the ethical aspects of participation in a clinical trial.

Teaching forms and contact time:
In the self-directed learning time students will have to prepare the theory (reading a chapter in the textbook and/or a literature article) and work on the study protocol. During the contact time the studied theory will be discussed. In computer labs statistical analyses will be practiced.
Students will draft a research protocol for a clinical trial in small groups. The protocol will be presented towards the end of the course to their fellow-students, clinical investigators, epidemiologists and biostatisticians.

The course will have 30% of contact time at most. During the contact hours and computer labs students will have to be present.

Method(s) of testing:
The final grade is an average of the judgements based on the individual contribution to the theoretical discussions during the contact hours; the participation in the course; the presentation of a case study; the presentation of the study protocol and the response to questions about it; the judgement by the clinical investigator; the interim exam and the final, individual exam about the theory and the protocol.

Required material:
- The text book 'Fundamentals of Clinical Trials' (4th ed., 2010) by L.M. Friedman e.a. (can be borrowed on payment of € 15);
- The course manual (€ 10), in which practical information and literature is included;
- ‘Internationaal richtsnoer voor Good Clinical Practice voor onderzoek met geneesmiddelen (translation to Dutch)’, ICH guideline for Good Clinical Practice E6 and ‘Clinical research with medicinal products in the Netherlands. Instruction Manual’;
- Literature with respect to the contents of the study protocol.
CONCEPTUAL PATHOPHYSIOLOGY

Credit load: 7.5 ECTS  
Course code: BMW31505  
Coordinator: S. de Jong, PhD  
Period: 3  
Examiner: S. de Jong, PhD  
Timeslot: BC  
E-mail address: s.dejong-9@umcutrecht.nl  
Level: 3  
Phone: +31 30 253 8907

Content:
This course deals with the pathophysiology of heart, vessels, lungs and kidneys. This concerns in particular pathophysiological processes in one of the organs, or the incapability of organs to compensate for extreme aberrations of components of the milieu interior or exterior that leads to a serious disturbance of the homeostasis.

The first part of the course consists of 3 blocks of 2 weeks, and deals with heart rhythm failures, lung abnormalities, and physiological disturbances of homeostasis. Students will work in groups to discuss research questions concerning pathophysiology (from gene to organism), and present their outcomes in a presentation. In the second part of the course (4 weeks) each student will get an individual assignment that will lead to a thesis. This thesis will be evaluated by other students (peer-reviewing) and discussed during a final session.

Requirements for admission:
Basic knowledge of the construction and function of the heart, vessels, lungs and kidneys, and their physiological, physical, and chemical principles, is required.

Learning outcomes:
At the end of the course the student is capable of:
- understanding and discussing the principles of heart rhythm and conduction failures;
- understanding and discussing the principles of lung abnormalities during heart failures;
- understanding and discussing the principles of physiological disturbance of homeostasis.

Teaching forms and contact time:
The total contact time is ±34 hours, which is 15% of the course.

Method(s) of testing:
The end grade will be determined as follows: group presentations 3x20%, thesis 40%.

Required material:
Will be handed out during the course.
DEVELOPMENTAL BIOLOGY

Credit load: 7.5 ECTS  
Course code: BMW20705
Coordinator: A.A.M. Thomas, PhD  
Period: 4
Examiner: A.A.M. Thomas, PhD  
Timeslot: AD
E-mail address: a.a.m.thomas@uu.nl  
Level: 2
Phone: +31 30 253 3971

Content
This course addresses the normal development as well as disorders of development of the animal organism, and pays specific attention to the genetic, hormonal, and environmental variables that influence the proliferation and differentiation of cells.
Key words are: conception, cleavages, gastrulation, neurulation, formation of axes, Hox-genes, cell differentiation, sex determination and differentiation, reproduction, organogenesis, evolution and development, recombinant/knock-out/transgene animals, teratology.

Requirements for admission
Basic knowledge of transcription, translation, cell-cell-interaction, signal transduction, cell cycle control, embryogenesis is required. If a student does not fulfill the requirements for admission, the course coordinator can impose additional study material, which has to be completed before the course starts.

Learning outcomes
At the end of the course, the student is capable of:
• understanding embryonic development of the model systems used in developmental biology: mouse, zebrafish, Xenopus, Drosophila, and C. elegans;
• understanding how molecular and genetic information of DNA is translated into the developmental plan of an embryo, cell differentiation, formation of organs, growth of an embryo to a mature individual, and the relationship between developmental biology and evolution;
• explaining how disturbances of these processes can lead to a deregulation in cell growth or cell differentiation and to impairments of development;
• producing an essay based on three recent scientific papers on developmental biology.

Teaching forms and contact time
Lectures (28 hours), discussions (7), practical trainings (22) and computer-assisted instruction (7). The course will have a contact time of about 40%.

Method(s) of testing:
There will be three examinations spread throughout the course. The final assessment will be the result of the three examinations (80%) and an essay (20%). All students, also those who have done the course earlier, are obliged to attend the first lecture, practicals, and computer-assisted instructions.

Required material:
• Wolpert L, Principles of Development. 4th ed., Current Biology/Oxford University Press, 2011; (± €60);
• Course manual (± €20);
• Surgical knives;
• Lab coat;
• Coloured pencils.
DISEASES OF THE CENTRAL NERVOUS SYSTEM

Credit load: 7.5 ECTS  Course code: BMW31012
Coordinator: S.C. Bakker, PhD  Period: 4
Examiner: S.C. Bakker, PhD  Timeslot: AD
E-mail address: s.bakker-2@umcutrecht.nl  Level: 3
Phone: +31 88 755 6003

Content:
Psychiatric and neurological diseases originate from the most complex part of our body: the central nervous system (CNS). Through the CNS, we can perceive and interpret our environment and ourselves, learn from our experiences and plan our actions. Advanced research methods give insight into the biological basis of psychiatric and neurological disorders. This course deals with the diseases and research methods of the CNS and current knowledge of the biological basis of (ab)normal CNS function and behavior. The first week will give a general introduction to psychiatric and neurological syndromes and research methods that have increased knowledge about the pathophysiology. This is followed by one-week blocks, during which the student will learn about a specific disease, a system in the brain which is involved, and a research method that brought new insight into this disease. Before the lectures, students will gain background knowledge by studying the literature. An interview with a patient (live or video) will show the symptoms and effects of the disorder, followed by a discussion about the syndrome in more details. Biological systems or processes that play a prominent role in the syndrome will be presented. A leading researcher will discuss the results of a research technique involved in this disease. During the second half of the course, small groups of students will write a research proposal concerning a psychiatric or neurological disorder, which may involve any of the presented research techniques. Groups will be each other's reviewers, and at the end of the course, groups will present their results during a minisymposium (without any additional audience). The students will participate in a Journal Club, during which a relevant scientific article will be discussed under supervision of a lecturer. This will be alternated with short presentation by, and discussions with, PhD students in psychiatry and neurology, and visits to research facilities such as the neurophysiology lab.

Requirements for admission:
Knowledge of functional neuroanatomy and neurotransmission.

Learning outcomes:
Knowledge and insight
At the end of the course, the student is able to:
• describe the methods of brain research and their results;
• describe cognitive processes;
• explain the relation between brain functions and (abnormal) behavior;
• recognize the most abundant psychiatric and neurological syndromes;
• name the most important treatments for psychiatric and neurological syndromes.

Skills
At the end of the course, the student is able to:
• describe the outlines of a research proposal to investigate the biological basis of a psychiatric or neurological syndrome;
• discuss a scientific article in English.

Teaching forms and contact time:
Every week, there will be lectures (±8 hours per week) and a patient demonstration (live or video). Furthermore, students are expected to do private study (one afternoon per week), participate in an English Journal Club (10-12 students) under supervision of a lecturer, and perform literature research in small groups.
Method(s) of testing:
The final grade is based on the grade for the interim examination and final examination (multiple choice and essay questions), the preparation for and participation in the Journal Club, writing and reviewing a research proposal and participation in a mini symposium.

Required material:
- Additional literature can be downloaded via weblinks that will be distributed during the course.
Content:
Governments and universities are putting more effort into bringing academic knowledge into practice. This course is designed to prepare students to do so by offering basic insights of business and entrepreneurship from an academic standpoint. Small and medium enterprises form a large part of our economy and to improve its growth, entrepreneurship is stimulated. Entrepreneurship can be brought into practice in several ways. First, you can think of starting up new businesses. Second, there is a big demand within existing organizations, both for-profit and non-profit, for employees with an entrepreneurial attitude. Students are stimulated to come up with business ideas and will subsequently learn the difference between ideas and opportunities. Through lectures and the use of academic literature, the students will gain basic understanding of different aspects of business such as strategy, management, marketing, finance, human resources, social corporate responsibility, etc. These topics will be applied to life sciences. They come together in the course’s major assignment: students have to write a business plan for a biomedical company in small teams to put the theory into practice.

Requirements for admission:
This course is an elective for third-year students, studying in beta sciences.

Learning outcomes:
Knowledge & Insight
At the end of the course, the student:
- has basic knowledge of strategic, organizational and financial information that an entrepreneur needs in order to start and run a business;
- can name the purpose of the business plan and its content.

Skills
- has the capability of composing a business plan;
- is able to presenting the business plan both orally and in a written format;
- has improved his/her skills of effectively transferring information by presenting his/her work to others;
- has increased his/her cooperation skills by working together in small teams;
- has the ability to critically evaluate other business plans;
- is more comfortable in dealing with incomplete and uncertain information for the purpose of assessing a business opportunity;
- has learned to test assumptions by communicating with external stakeholders;
- lead a workshop about an academic article.

Teaching forms and contact time:
Lecture: once-twice a week (2-4 hours);
Tutorial: once-twice a week (2-4 hours). Cases and exercises will be discussed during these sessions. Students have to be present and well prepared at 80% of the meetings in order to meet the effort requirement.

Method(s) of testing:
Theory: exam and presentation academic article (50% of the final grade);
Application: business plan (40% of the final grade);
Presentation academic workshop (10% of the final grade).

**Required materials:**
### GENERAL PHARMACOLOGY

**Credit load:** 7.5 ECTS  
**Course code:** BMW30405  
**Coordinator:** J. Scheerens, PhD  
**Examiner:** Prof. D. J. de Wildt, PhD  
**E-mail address:** J.Scheerens@uu.nl  
**Phone:** +31 30 253 7352 / +31 30 253 7353

#### Content:
The student will learn the concepts of kinetics (*what the body does to the drug*) and the dynamics (*what the drug does to the body*) of pharmacology. In addition, the student will learn the basic principles of the neuro/psychopharmacology.

The course encompasses the following topics:

1. **the basic principles of pharmacokinetics:** pharmacology, transport of drugs over biological membranes, ways of administration, resorption, distribution, and elimination of drugs, pharmacokinetics (concentration-time relations), and variability in the reactions to drugs;
2. **the basic principles of pharmacodynamics:** signal-transduction, receptor-ligand (pharmacon) interactions, quantitative aspects of pharmacon-receptor interactions, dose-response curves, agonists, antagonists;
3. **the basic principles of neuropharmacology:** the effect of drugs on the peripheral and central nervous system, neurotransmitters in the peripheral and central nervous system.

#### Requirements for admission:
Knowledge of mathematics is required at the level of pre-university education (V.W.O.). Basic knowledge of anatomy, cell biology, physiology and biochemistry, in particular knowledge of receptors and signal transduction mechanisms, is essential.

#### Learning outcomes:
At the end of this course, the student is able to:

- describe the absorption, distribution, metabolism and elimination (ADME) of drugs;
- translate the ADME processes in a mathematical way to plasma concentrations of the pharmacon;
- describe the relation between the concentration and the effects of a pharmacon in a qualitative and quantitative manner;
- describe the properties of agonists, antagonists, partial agonists and inverse agonists in a qualitative and quantitative manner;
- describe and explain the functioning of the autonomous nerve system and the effects of drugs on the autonomous nerve system;
- understand the role of the central neurotransmitter systems with normal physiological function and behaviour;
- understand the working mechanisms and co-effects of relevant neuro- and psychopharmaca for several psychological and neurological diseases.

#### Teaching forms and contact time:
The student will need to create a mental view on complex pharmacokinetic and pharmacodynamic principles and their mathematical foundations. Tutorials, lectures, computer simulations and practical trainings will be used frequently. The course will have a maximum of 30% contact time.

#### Method(s) of testing:
The knowledge of pharmacology and the basic principles of neuro- and psychopharmacology will be assessed individually by interim examinations.

#### Required material:
GENES AND GENOMES

Credit load: 7.5 ECTS  
Course code: BMW20605  
Coordinator: Dr. B.P.C. Koeleman  
Examiner: Dr. B.P.C. Koeleman  
E-mail address: b.p.c.koeleman@umcutrecht.nl  
Phone: +31 88 756 8297  
Period: 3  
Timeslot: BC  
Level: 2

Content:
This course treats how genetic factors that influence human traits are identified. The traits we are focusing on will be human diseases, but the techniques can be applied to a wide field of subjects. We will teach the background knowledge necessary to understand and apply the different methods, the molecular laboratory techniques (theoretically) and the approaches to finding causal variants for human heritable diseases. Also, we will practice with using the vast number of databases containing human genetic information. The subjects can roughly be divided into two main groups:

Organisation and evolution of genomes and genes

General organisation of the genome of higher eukaryotes
- Comparative genomics and genome annotation. Special attention for gene structure, gene duplication, molecular phylogeny, genome analysis, species comparisons and useful software and databases.
- Functional genomics, including functional annotation of genes, gene expression, proteomics.
- We pay attention to how knowledge is obtained, and how information can be extracted from existing sources.

Identification of mutations that influence human diseases
- Linkage analysis in families with a monogenic disease to localise the causal variant up to a region of ca 15 cM/
- Laboratory aspects of DNA research: the techniques, their interpretation and the causes of artefacts
- Positional cloning/Prioritising genes within a defined region. Mutation analysis; the role of new technology.
- Molecular pathology: how mutations change phenotypes, and how to prove it.

Requirements for admission:
We require the students to have knowledge of the structure and organisation of DNA; the processes of meiosis and mitosis, including recombination; transcription and translation; gene expression. In addition we ask for some basic knowledge of laboratory techniques such as PCR, restriction enzymes and DNA-hybridisation. In case of deficiencies, contact the coordinator for background reading to be done before the start of the course.

Learning outcomes:

Knowledge & Insight
After completing this course, the student will be able to:
- Reproduce the organisation of the human genome in approximate numbers
- Explain how genome projects have contributed to our current knowledge of the influence of genes on traits
- Describe the steps with which genomes are characterized
- Describe approaches that help us understand the function of genes
- Understand the value and drawbacks of species comparisons in genetic studies
- Explain the principles of linkage analysis, and use this method for simple cases.
- Choose appropriate molecular techniques for different purposes
- Interpret the link between mutation and disease

Skills
After completing this course, the student will be able to:
- Use genome data, gene data and functional data from existing sources to interpret new data in the process of identifying a mutation that might be causing a disease
- Apply comparative genomics with the appropriate software
- Apply and understand the law of Hardy-Weinberg
Academic Skills
- Read academic articles with a critical mind
- Combine information from different sources
- Write a report according to academic standards
- Orally present your work, and formulate questions about other people’s oral presentations
- Collaborate in such a way that the best possible group effort is achieved

Teaching forms and contact time:
Knowledge and skills are mainly taught in three different forms: in lectures, during exercises and in the textbook. These three forms overlap only partially: information is often only presented in one form. During the first eight weeks, each week a new topic is introduced by a specialised teacher. In the fifth week, students start working in groups on an essay, which will be handed in on paper, as well presented orally. During the last two weeks, the students can devote all their time to this essay. The work on this essay will help processing and integrating the material presented during the course. It will also serve to practice academic skills.

On average, about six hours of contact time per week.

Method(s) of testing:
The final grade is composed of the results of two tests, a database assignment, the essay and the oral presentation of the essay. Passing the course requires: 5,5 as final grade, but also 5,5 as weighted average of the two tests.

Required material:
- Access to Blackboard
HEMOSTASIS AND THROMBOSIS

Credit load: 7.5 ECTS  
Course code: BMW32507
Coordinator: M. Roest, PhD  
Period: 4
Examiner: M. Roest, PhD  
Timeslot: AD
E-mail address: mroest@umcutrecht.nl  
Level: 3
Phone: +31 88 755 7769 / +31 88 755 6505

Content:
This course will elaborate the mechanisms responsible to prevent bleeding after injury (haemostasis) and the role of these mechanisms in the etiology of arterial and venous thrombosis. The biology of coagulation and the interaction between the vascular wall and circulating blood (cells) will be explained. Haemostasis is an essential process in the prevention of blood loss, but on the other hand, hyperactivity of the haemostatic system will increase the risk of thrombotic events. Haemostasis consists of multiple components, including platelets and plasma proteins that together make the coagulation cascade. Furthermore, endothelial cells covering the vascular wall surface release inhibitors that prevent platelet aggregation, express proteins that inhibit the coagulation system and synthesize components that stimulate the degradation of a fibrin clot. A well balanced haemostasis is essential for normal life. Inherited or acquired deficiencies may lead to an increased risk of bleeding or on the other hand to an increased risk of arterial and venous thrombosis.

In addition to basal biochemical sessions, the course will also contain special sessions on treatment, such as oral anticoagulants and thrombosis, state of the art developments and actual business such as the risk of thrombosis during air travel, thrombosis prevention with healthy nutrition and epidemiology of thrombosis for thrombosis prediction. The students will train their knowledge of thrombosis and haemostasis in workshops and students will get the opportunity to perform state of the art experiments in thrombosis and haemostasis research.

Required for admission:
Basic knowledge of cell biology and biochemistry.

Learning outcomes:
Knowledge & Insight
At the end of the course, the student will be able to:
- describe the mechanism of haemostasis, including the activation of blood platelets and blood coagulation;
- understand the disorders that lead to increased risk of bleeding or thrombosis and formulate advice for medication and therapy.

Skills
At the end of the course the student will be able to:
- plan and execute scientific experiments and give adequate interpretation of the results in a presentation;
- review the literature about an actual theme in the thrombosis and haemostasis research field and to report it;
- analyse and discuss a scientific report;

Teaching forms and contact time:
The course will consist of lectures (21 hours), practical training (24 hours), tutorials (30 hours) and an exam (2 hours). The practical training consists of experiments that will be executed under supervision of a PhD student or a technician. Novel scientific developments in the thrombosis and haemostasis will be discussed, summarized and reported in the workshops.

Methods of testing:
The final test is an individual written exam with "open end" and "multiple choice" questions. The final grade will be based on the assessment during practical training (20%), tutorials (20%) and the test (60%).

Recommended books

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HORMONES AND HOMEOSTASIS

Credit load: 7.5 ECTS  
Course code: BMW21405

Coordinator: J. van Doorn, PhD  
Period: 4

Examiner: J. van Doorn, PhD  
Timeslot: BC

E-mail address: J.vanDoorn@umcutrecht.nl  
Level: 2

Phone: +31 88 75 75348

Content:
This course deals with the integrative regulation of processes by hormones, in particular the regulation of energy, growth, stress, and reproduction. This course builds on the course “Organ systems” and is a good preparation for the course “Metabolism”. These three courses together cover the endocrine and metabolic processes and their regulation. Basic principles will be discussed first, such as homeostasis, hormonal axes, feedback mechanisms, biochemical structure of hormones, and structure and function of their receptors. Then the functional anatomy and histology of the endocrine organs are discussed, followed by the discussion of hormones that play a role in metabolism (including gut hormones and adipocytokines) and during growth, stress and reproduction. During this course, specific attention will be given to academic skills such as analysing a scientific research paper and writing a scientific paper.

Requirements for admission:
This course is open for students in Biomedical Sciences or Biology who have knowledge of molecular biology, cell biology and the structure and function of DNA, RNA and proteins. Students from other programs need to demonstrate that they meet the requirements for admission in an individual interview.

Learning outcomes:
Knowledge and understanding
At the end of this course, the student is able to:
• understand and demonstrate the concept of hormonal regulation of processes on the level of the organism;
• recognize (by anatomy and histology) the organs that are involved in the production of hormones and describe their function and their reaction to several stimuli;
• describe the endocrine regulation of physiological processes of the organism on a conceptual and molecular level;
• understand and describe the integrative regulation of homeostasis of energy, growth, reproduction and stress;
• understand how selected diseases connect with abnormalities in the development and endocrine regulation of the organism.

Skills
At the end of this course, the student is able to:
• generate and interpret endocrinological data (perform ELISA for growth hormone);
• write a report following the format of a scientific paper, using data obtained experimentally;
• critically read, analyse and discuss a scientific article.

Teaching forms and contact time:
• (Interactive) lectures, assignments for private study, tutorials, computer-assisted instruction, microscopy training, practical lab training, critical reading and interpreting;
• An assignment to write a report on the practical training.
The course will have approximately 40% contact time.

Method(s) of testing:
• Two exams (multiple choice and open questions): 40% each;
• Scientific report of practical work: 20%.
Required material:
- Human Physiology, an Integrated Approach, by D.U. Silverthorn et al. (6th edition, 2012);
- Review articles on selected subjects;
- Selected research papers.
This course addresses the metabolic regulation of the carbohydrate, lipid, and protein metabolism and the working of the hormones involved. Students will get acquainted with the following five topics, divided into 10 units, each consisting of two lectures, a tutorial and a home study:

1. Transport of macronutrients and endogenously synthesized substrates;
2. Enzyme activities and metabolic flux control;
3. Metabolic strategies, regulation of metabolism and metabolic characteristics of various organs;
4. Glucostasis;
5. Metabolic and bio-energetic adaptations.

Requirements for admission:
Basic knowledge of the individual processes (e.g. glycolysis, Krebs cycle) of the carbohydrate, lipid, and protein metabolism, and of several signal transduction cascades, is required.

Learning outcomes:
Knowledge and insight
At the end of this course, the student is able to:
- describe the specific absorption processes of digestive products of macronutrients by the GI-tract;
- explain lipoprotein-metabolism and cholesterol-homeostasis;
- explain the cross-talk between the pathways in carbohydrate, lipid, and protein metabolism and their hormonal regulation;
- explain the several ways of metabolic regulation, the most important points of regulation in metabolism and the metabolic specialization of the most important organs;
- describe the molecular mechanisms of defects in the essential pathways in carbohydrate, lipid, and protein metabolism;
- explain which organs, substrates and hormones are involved in glucostasis and which defects may occur;
- explain the effects of extreme conditions, such as nutrition, physical exercise, and environmental factors on the carbohydrate, lipid, and protein metabolism;
- describe the working mechanisms of pharmaceuticals used to treat aberrations in carbohydrate, lipid, and protein metabolism.

Skills
At the end of this course, the student is able to:
- conduct a literature review on the normal regulation of metabolism and the adjustment of metabolism to changing situations;
- critically analyse scientific data from relevant literature and make suggestions for new metabolic research, to apply laboratory techniques for metabolic research and to communicate the results both written and orally.

Teaching forms and contact time:
This course has 50% of contact time, which contains lectures (10%), tutorials (10%), one practical training, one project assignment and one micro-internship (together 30%). Time is scheduled for home study.

Method(s) of testing:
The final assessment is individual and written (and is 60% of the final grade). A diagnostic test will take place halfway through the theoretical part of the course, which is 20% of the final grade. The practical part of the course will be 20% of the final grade (assessment of active preparation, practical results and the written report).
Required material:
MOLECULAR PATHOLOGY

Credit load: 7.5 ECTS
Course code: BMW32607
Coordinator: R.A. de Weger, PhD
W.W.J. de Leng, PhD
Periode: 3
Timeslot: BC
Examiner: R.A. de Weger/W.W.J. de Leng
Level: 3

E-mail address: r.deweger@umcutrecht.nl
w.w.j.deleng@umcutrecht.nl
Phone: +31 88 755 9559 (secretary)

Content:
During this course, the student will get acquainted with the latest developments in the (diagnostic) molecular pathology (both in theory and in practice) and will gain insight in the molecular biological concepts of diseases. Specific themes will be used to describe the entire process from obtaining tissues until diagnosis. Histological and immunohistochemical techniques will be discussed, but the focus will be on molecular pathological approaches/techniques ((next generation) sequence analysis, proteomics, laser microdissection, tissue-arrays, etc.). The execution of these techniques by the students will be an important aspect of this course, as well as writing a scientific report. The course will start with a general introduction in the molecular pathology and accompanying genetic aspects, followed by specific themes on (1) Cardiovascular and transplantation pathology; (2) Laboratory animal models in molecular pathology; (3) Genetic and (4) Epigenetic aspects of tumor genesis.

Requirements for admission:
Students are recommended to have basic knowledge of cell biology, immunology, molecular biology and pathology.

Learning outcomes:
Knowledge and insight
At the conclusion of this course, the student is able to:
• describe the most important principles of molecular pathology;
• describe the role of molecular pathology in modern (tumor) diagnostics (personalized medicine);
• recognize and justify the use of experimental models for molecular pathological analysis.

Skills
The students is able to:
• choose the correct approach for the molecular analysis of specific diseases from a range of molecular biological techniques, and conduct these experiments independently;
• describe the experimental results in a scientific paper.

Attitudes
At the conclusion of this course, the student must be conscious of the ethical aspects and problems that are connected to the generation of molecular pathological data and the possible (prognostic) consequences for the patient.

Teaching forms and contact time:
There will be 6 introductory lectures, 2 practical trainings including demonstrations (3-4 hours), and a seminar (2 hours) every two weeks. During the seminars, the students will present a number of diseases by discussing a case or an article, during which the experimental approach for the molecular pathological analysis will be most important.
Total contact time is approximately 35-40%.

Method(s) of testing:
The presentations during the seminars and the participation during the discussion will be assessed by the group leaders. The reports of several practical trainings/demonstrations will also be assessed (20%). The results of two practical trainings must be described in a scientific article, which is an important part of the course (40%). There will be a final assessment (theoretical exam, 40%) which consists of 15 multiple choice questions and 6 essay questions of which 5 need to be answered.
The student has to get a grade of at least 5.0 for each of the assessments.
Books:
PERSONALIZED GENETICS

Credit load: 7.5 ECTS
Coordinator: R.B. van der Luijt, PhD
Examiner: R.B. van der Luijt, PhD
E-mail address: R.B.vanderLuijt@umcutrecht.nl
tel. nr.: +31 88 755 4090

Course code: BMW32913
Period: 2
Time slot: B+C
Level: 3

Content:
The human genome is extremely complex. It encodes numerous RNAs and proteins as well as regulatory elements which play a role in gene expression. Medical genetics translates this fundamental knowledge into clinically relevant genetic tests and genome diagnostic tools. Until recently, only monogenetic disorders were tested and screened for in the clinic. In the near future, however, whole genome sequencing will be technically and financially attainable. But can someone’s genome sequence tell us more about the chances they have of suffering from complex and multifactorial disorders? Which statistical correlations will be found and what does such a correlation tell us about what is actually happening in this person’s body? In this course the student will explore the edge of fundamental gene research as well as the contemporary practices in a clinical setting. The aim is to ascertain what remains unknown and what information is currently missing, allowing us to form a plan for the future of genetic testing and genome screening.

A lot of attention will also be paid to the ethical choices that arise with these new developments. These are personal choices such as “Do I want to know it if they find something unexpected?” but also societal choices such as “Should we offer everyone genetic screening as a preventive measure, also when there are no medical indications to do so?”

During this course, the student will explore the possibilities and the desirability of genetic testing and screening from a fundamental scientific point of view, taking into account that the nature of genetic information can be complex and uncertain.

Required background knowledge:
The student must have knowledge of complex relations between genetic information and the (dys)functioning of the body. The basis of the background knowledge is the molecular processes surrounding gene expression and gene regulation, as studied in the BMS bachelor courses Cells and Genome. The course Genes & Genomes is recommended, but not compulsory. Students will be able to review knowledge or gain missing knowledge in the first phase of the course through independent study.

Learning outcomes:
Knowledge and insight
At the end of the course the student will be able to:
analyze the recent scientific, technological and clinical developments in human genetics and relate these to one another;
explain how the terms complex and uncertain are applicable to genetic information;
relate the terms complex and unsure to the (im)possibilities and (un)desirabilities of genetic testing and screening.

Skills
At the end of the course the student will be able to:
write a dossier about a disease-related theme in the clinical genetics field;
based on the dossier, organize a workshop for fellow students where the scientific and ethical aspects of medical genetics are brought together;
write an essay about his/her insight on personal and societal dilemmas arising from developments in the medical genetics field.

Attitudes
At the end of the course:
the student recognizes the importance of knowledge and values as a basis for personal and societal decision-making on genetic testing;
the student is able to understand and discuss important issues surrounding genetic testing from the points-of-view of the different stakeholders involved in genetic testing and is able to keep in mind which considerations play a role in their decision-making.

Teaching forms and contact time:
In the first six weeks the focus will be on the scientific aspects of medical genetics. The students will work together in groups of six on writing a dossier about, for example, the genetics of cancer, heart failure or neurological disorders. There will also be interactive lectures, practical assignments and guided tours in the genetics laboratories. In the last four weeks the focus will be on the societal and personal implications of developments in the medical genetics field. There will be workshops and discussions with patients and guest lecturers. All the participants will also organize a workshop for three fellow students and a teacher. Finally, every participant will write an essay on the societal and personal implications of the developments in the field of medical genetics. When foreign students apply for this course, the course will be taught in English.

Method(s) of testing:
The grade will be given based on the dossier, the workshop, the essay and participation. All the individual sections need to be judged with a ‘pass’. The course does not have a written exam.

Required material:
During the course, recent (review) literature will be used. There is no course textbook. The students can use the readers from the courses Genome and Genes & Genomes as background information.
REGENERATIVE MEDICINE

Credit load: 7.5 ECTS
Coordinator: J. O. Fledderus, PhD
Examiner: J. O. Fledderus, PhD and Prof. N. Geijsen
E-mail address: j.o.fledderus@umcutrecht.nl
Phone: +31 88 75 59815

Course code: BMW33113
Period: 3
Timeslot: AD
Level: 3

Content:
Regenerative Medicine (RM) is a novel and broad area of research aiming to functionally restore tissue or organs upon damage caused by pathology or trauma. This can be achieved through stem cell transplantation, but also by external stimulation of resident stem cells in the damaged tissue. In some cases the transplanted cells need the support of synthetic scaffolds that mimic the function and 3D structure and optimize cellular growth and restoration.

In this course we will review several aspects of RM research both from a fundamental research perspective and the current state of clinical translational research. We will discuss the following topics:

- Adult stem cells, identification, isolation, culture and transplantation
- How are stem cells regulated – self-renewal vs. differentiation – the stem cell niche
- Epigenetic regulation of stem cells
- Stem cells in the hematopoietic system
- Endodermal stem cells and their (therapeutic) possibilities
- Pluripotent stem cells, differences with adult stem cells, sources, applications in research and clinic
- Tissue engineering, biomaterials and associated techniques (imaging), challenges and applications
- Ethical aspects of (stem) cell therapy

Requirements for admission:
Knowledge of anatomy, physiology, cell- and molecular biology is required.

Course participants
The maximum number of students is 32, of which 16 students of Life Sciences, 8 students medicine en 8 students veterinary medicine.

Learning outcomes:
At the end of the course the student is familiar with:
- Molecular and cell biological processes that regulate tissue homeostasis and their disregulation during pathogenesis
- Different stem cell types and their therapeutic possibilities/ limitations
- Tissue engineering techniques and their potential therapeutic applications
- Different approaches within the RM field to develop therapeutic applications

Teaching forms and contact time:
The course will consist of lectures, workshops, group discussion and self-study. In addition, some course topics will be illustrated with practical sessions where students will apply their knowledge in the lab. Contact time is approximately 30%.

Method(s) of testing:
Written exam. Final grade is a combination of exam score (70%), literature and (10%) and the participation in practical work and group discussions (20%).

Required material:
Syllabus will be distributed during the first lecture (10 euros).
REPRODUCTION

ECTS points: 7.5  
Coordinator: Dr. B. M. Gadella  
E-mail address: b.m.gadella@uu.nl  
Tel.nr.: 030 – 253 5386

Code: BMW30805  
Period: 3  
Time period: AD  
Level: 3

Content:
Topics covered by oral teaching by experts in the research field:
- Regulation of oogenesis & follicogenesis and processes involved in follicle development;
- The female hormonal cycle, regulation of ovulation, pathologies in the female cycle and intervention possibilities for the human species.
- The process of spermatogenesis, the functional concept of sperm cell, the importance of sperm maturation, transport, and activation (capacitation) for the fertilization;
- Recognition and mating behavior at estrus of animals;
- The physiology of copulation;
- Artificial Reproductive Techniques (ART);
- The development of zygote to blastocyst;
- Maternal recognition of the conception;
- Regulation of birth;
- Embryo and primary stem cells;
- Cloning and preparation of embryonal stem cells and the application of these techniques for production of organs and organisms;
- Reproductive ageing and degeneration of gonocytes;
- Ethical considerations in ART
- FISH and prenatal diagnosis of chromosomal aberrations;
- Principles of advanced detection techniques (flow cytometry, confocal microscopy) for detection of processes in living gametes and embryo’s (life imaging).

Mandatory experience:
The BMW–curriculum (or equivalent level).

Educational goals:
Knowledge and understanding
The student is able at the end of the course to:
- Describe processes that are involved in the generation of gametes;
- Name the way how fertilization takes place in mammals;
- Explain which ART are used in a modern IVF clinic to enhance the fertilization rate in in/sub-ferile couples;
- Describe the early embryogenesis and nestling of the embryo in the endometrium and how this results in off-spring;
- Explain how and why embryo materials can be used for genetic cloning;
- Work with, and describe analytical methods to study the process of fertilization;
- Describe the evolutionary diversity in reproductive strategies in the animal kingdom with special attention to mammals;
- Explain the evolutionary profit of sexual reproduction.

Technical skills
The student is able to:
- Use the techniques of FISH, ART, Life imaging in this type of research.

Type of education and contact time:
The education will be given in the form of oral communications given by docents (30 hrs) interactive communications between students and docents (25 hrs) and practicum (8 half day sessions) Total contact time is approx. 87 hours (45%).

Examinations:
• Presentation of a specific research topic (both oral and with a written thesis) (40%);
• Written examination (60%).

The course is successfully finished when the final note is > 5.50.

Materials:
• Reader and hand outs will be provided during the course (free of charge).
Content
1. The final product is an essay, with the outline of a scientific article. The essay needs to have a theoretical introduction which gives an overview of current relevant literature.
2. Performing a research cycle: study literature, formulate a hypothesis, design and conduct an experiment, analyze results, draw conclusions, report in writing;
The student will choose a laboratory or research group, where he/she will perform the research and write a report. This may be done together with a fellow student; if so, this part of the Research Project and the essay will be the same.

Please note: The student is responsible for finding a lab or research group! You can find possible groups via www.uu.nl/lifesciences or www.umcutrecht.nl/research.

The report has to be in English and has to give a literature overview of 15-25 primary articles, in approximately 15-25 pages. The introduction (literature overview) is similar to a Bachelor thesis or review. The literature overview is unique, and therefore cannot be similar to the review of a fellow student. The final product is usually a scientific article, with an adjustment for this course: the introduction is extended to a literature overview, which places the research in a context. The last part of the end product describes the research that is conducted and analyzed. This may be as a separate chapter, or integrated in the literature overview.

Requirements for admission
Considering the nature of the course, this course should be taken as late as possible during the Bachelor’s programme of a student. The student should have 150 ECTS and have attended two courses, for which the results are not yet known at the start of the Research Project.

Learning outcomes
The student is able to:
• argue at an academic level;
• analyze information, formulate a hypothesis and design a research plan;
• carry out medical-biological techniques, analyze and process research data;
• clearly summarize research results;
• produce a written report in English;
• deal with the gained knowledge in a scientific context.

Teaching forms and contact time
There is an introductory lecture in December and one in February/March about the aims and approach of the Research Project. In period 4 a tutorial and lecture will be given, which deal with how to make a working plan and writing tips. Handouts of these lectures are on the BMW/Research project site. A computer module (RefWorks) will be offered to students who want to manage their references electronically. Supervision time is approximately 20%. During the practical phase this is 50% for two weeks; during the preparatory and writing phases the contact time will be less.

A few weeks before the start of the course, the student needs to find a supervisor and laboratory.
Week 1: Read necessary literature. Make a working plan, including agreements with your supervisor and a well-defined aim of your literature study;
Weeks 2-3: Practical phase. In consultation with your supervisor, this may be done at a later stage;
Weeks 4-5: Read and make a plan for the writing phase; write first draft;
Weeks 6-8: Writing phase;
Weeks 8-9: Supervisor reads and corrects draft;
Week 10: Make final version; discuss final version with your supervisor.
Student and supervisor are allowed to decide on a different time schedule. The aim of the Research Project is that the assignment is executed correctly, rather than that the student writes a long article or reads many scientific articles.

**Method(s) of testing**
The final grade is determined by the direct supervisor and one other lecturer. The final grade consists of two grades: 20% of the final grade is assessment of the practical work, and 80% is assessment of the writing of an article. The final product has to be uploaded by the student in Ephorus via the Blackboard-site of the Research Project, in order to be able to exclude plagiarism.

**Required material:**
None.
RESEARCH PROJECT PLUS

Credit load: 22.5 ECTS
Coordinator: A.A.M. Thomas, PhD
Examiner: A.A.M. Thomas, PhD
E-mail address: a.a.m.thomas@uu.nl
Phone: +31 30 253 3971

Course code: BMW30110
Period: 1, 2, 3 or 4
Timeslot: BC/AD in one period, ABCD in the other period
Level: 3

The Research Project Plus is identical to the Research Project (BMW30105), except that:
• it entails approximately seven weeks of practical work instead of two;
• it can only be done after approval by the coordinator, after a motivation, CV, and the study results have been sent.

Content
1. The final product is an essay, written in English, with the outline of a scientific article. The essay needs to have a theoretical introduction which gives an overview of current relevant literature.
2. Performing a research cycle: study literature, formulate a hypothesis, design and conduct an experiment, analyze results, draw conclusions, report in writing;

The student will choose a laboratory or research group, where he/she will perform the research and write a report. The practical work may be done together with a fellow student; if so, this part of the Research Project and of the essay will be the same.

The report gives a literature review of 15-25 primary articles, in approximately 15-25 pages. The introduction (literature overview) is written as a scientific review and is similar to a Research Project thesis. The literature overview is unique, and therefore cannot be similar to that of a fellow student.

The end product usually is a scientific article, with an adjustment for this course: the introduction is extended to a literature overview, which places the research in a context. The last part of the thesis describes the research that is conducted and analyzed. This may be as a separate chapter, or integrated in the literature overview.

Requirements for admission
Considering the nature of the course, this course should be taken as late as possible during the Bachelor’s programme of a student. This course can only be taken after permission of the coordinator, after a motivation letter, a CV and a copy of study results have been sent to the coordinator.

Learning outcomes
The student is able to:
• argue at an academic level;
• analyze information, formulate a hypothesis and design a research plan;
• carry out medical-biological techniques, analyze and process research data;
• correctly and clearly summarize research results;
• produce a written report in English;
• deal with the gained knowledge in a scientific context.

Teaching forms and contact time
There is an introductory lecture in December that is repeated in February/March about aims and approach of the Research Project Plus. Handouts of these lectures are on the BMW/Research project site. A tutorial is held early in period 3, which deal with planning and writing, and on finding and defining a research subject. Early in period 4 a lecture is given on scientific writing. A computer module (RefWorks) will be offered to students who want to manage their references electronically. Supervision takes approximately 50% during the practical phase; during the preparatory and writing phases the contact time will be less.

Six to eight weeks before the start of the course, the student needs to find a supervisor and laboratory.

A possible planning is:
Week 1: Read necessary literature. Make a working plan, including agreements with your supervisor and a well-defined aim of your literature study;
Weeks 2-3: Read and make a plan for the writing phase;
Weeks 4-8: Write first draft;
Weeks 6-8: Writing phase;
Weeks 9-16: Practical phase. In consultation with your supervisor, this may be done at a different stage. Total approximately 7 weeks;
Weeks 17-18: Finish draft version and send it to supervisor.
Week 19: Supervisor reads and corrects draft.
Week 20: Make final version; discuss final version with your supervisor.
Student and supervisor are allowed to decide a different time schedule. The aim of the Research Project is that the assignment is executed correctly, rather than that the student writes a long article or reads a huge amount of scientific articles.

Grading
The final grade is determined by the direct supervisor and one other lecturer, most often another researcher from the same group. The final grade is the average of two grades: 50% of the final grade is assessment of the practical work, and 50% is assessment of the literature part. The final product has to be uploaded by the student in Ephorus (via the Blackboard-site of the Research Project), in order to check for plagiarism.

Required material
None.
The focus of this course is the application of biological knowledge in a business-oriented approach. Together with students from the University of Applied Sciences Utrecht (HU), you will work on a task provided by a biomedical company. A lot of attention will be paid to the sequence of events needed to set up a company. In small groups, you will also work on a business case. Using different cases, we want to give you insight in how an idea can lead to a product or service and how you can set up a business to sell that product or service. Protecting the idea, e.g. by patenting, will also be discussed.

**Research project and laboratory experiments**

Research projects have been written together with Life Sciences companies for you to work on in small groups. Think of projects entailing the development of new medication, the development of medical nutrition or the development of an analytical method. An example of such a project is examining the influence of medication and food on the permeability of the intestines; or studying the effects of certain medication on an unborn child; or studying the beginning of cancer.

An explicit goal of the course is to allow you to do your own experiments in the laboratory. Together with HU-students you will work on the company tasks. The research project you have to work on in groups of four will be supervised by a researcher from Utrecht University of from the University of Applied Sciences Utrecht, together with a representative from the company for which you are doing the research project. The companies we collaborate with during this course are large companies such as Roche, Danone Research, Glaxo Smith Kline and Dopharma, but also smaller companies such as Bioceros, BioDetection Systems and Winclove B.V. Many of the projects will be carried out in collaboration with institutes such as TNO, the Hubrecht Institute and the Dutch Institute of Public Health and Environment (RIVM). The research will take place partly in the laboratories at the HU and in some cases partly at the companies. The research projects will take up the majority of your time during this course.

**Learning outcomes:**

**Knowledge and insight**

At the end of the course the student can:
- Name the different sections of a well-written research report;
- Explain what the most important theoretical aspects are, which form the basis for the research project he/she is working on.

**Skills**

At the end of the course the student is able to:
- formulate concrete experimental questions based on a project proposal;
- set up a plan to develop, optimize and validate a research method;
- follow an experimental protocol;
- work in a team with HU-students on an actual research question;
- solve a short business plan;
• present experimental results during work discussions;
• write a research report for a company.

Teaching forms and contact time:
The total study load is 420 hours. The educational methods are a mix of lectures, tutorials, work discussions, lab work and independent study. The focus of the course will lie on the preparation and execution of the research projects, which will take up approximately 80% of the course time. The rest of the course will be spent on solving the business case.

Method(s) of testing:
Each group will need to deliver the following end products:
• a plan at the end of the second week, compulsory part of the project;
• an oral presentation at the end of the ninth week, 25% of the final grade;
• a business plan based on a case (to be handed in at the end of the course), 25% of the final grade;
• a succinct final report (to be handed in at the end of the course), 50% of the final grade.

Required material:
Course reader, which contains the primary literature on the background of your research project. All the necessary literature and course material will be distributed at the beginning of and throughout the course. No books are required for this course.
TOXICOLOGY

Credit load: 7.5 ECTS
Course code: BMW32106
Coordinator: M.B.M. van Duursen, PhD
Period: 1
Examiner: M.B.M. van Duursen, PhD
Timeslot: AD
E-mail address: M.vanDuursen@uu.nl
Phone: +31 30 253 5398
Level: 3

Content:
The founder of modern toxicology, Paracelsus (1493-1541), said: “What is there that is not poison? All things are poison and nothing is without poison. Solely the dose determines that a thing is not a poison.” In short, there are many potential toxic substances that may cause health damage in many ways. Human therapeutic drugs, cleaning products, pesticides, environmental agents and poisonous plants and animals may all be potential hazards. Not only the nature of the toxic substance, but also the exposure and the exposed individual, is important to determine the final toxic effect. A central topic in toxicology is understanding the working mechanism of a compound, which is crucial to making a risk analysis after exposure to a potential hazard. Furthermore, the toxicologist plays an important role in the communication of the risks of toxic substances to the general audience.

This course encompasses four main themes. The course will start with introductory lectures about basic principles in toxicology, followed by organ systems important for toxicology and the most occurring classes of toxins. Finally, the course will address the use of toxicology for humans and environment. In parallel, the students will work in small groups on a research proposal about a toxicologically relevant topic.

Requirements for admission:
Basic knowledge of cellular processes (e.g. signal transduction and gene transcription) and of (neural, immune and endocrine) organ systems is required.

Learning outcomes:
Knowledge and insight
At the end of the course, the students is able to:
- understand and apply the principles of toxicology, such as working mechanisms and dose-effect relationships;
- describe and explain the cellular and molecular processes which lead to organ-specific toxic effects;
- recognize the most occurring human intoxications and explain these from a mechanistic point of view.

Skills
At the end of the course, the student is able to:
- make a risk analysis of a toxic substance on the basis of scientific literature;
- communicate the scientific uncertainties with regard to risk analysis to non-scientists;
- formulate and present a research proposal on basis of theoretical knowledge and literature review.

Teaching forms and contact time:
The four main themes will be addressed in lectures (32 hours), tutorials (10 hours), and an assignment (20 hours). During the assignment, students will work in small groups (3-4 students) on a research proposal on a toxicologically relevant topic, under supervision of a teacher.

Examination:
There will be two theoretical examinations (A and B), which together will account for 66.7% of the final grade. Both exams have to be passed, i.e. a minimal score of 5.5 is required. The research proposal will be assessed by the supervisor and will account for 33.3% of the final grade.

**Required material:**
Caserett & Doull’s Toxicology, The Basic Science of Poisons (7th Edition).
Handouts will be provided at the start of each lecture and will be digitally available on Blackboard.