

# *Biology of Vitality and Ageing*

**MODULE BOOK**

*Master Vitality and Ageing*

*Course year 2023-2024*

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LUMC

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# *Preface*

The ageing of the population currently represents one of the biggest social and economic challenges worldwide. Although ageing is universally driven by deterioration of biological integrity over time, it manifests itself in different individuals at a different pace and by different (tissue/organ-specific) pathologies. The heterogeneity and complexity of the ageing process impose specific challenges for studies on the biological mechanisms of ageing and vitality as well as for the design of diagnostic, preventative and therapeutic strategies.

The disciplines participating in this 13 ECTS course comprise content experts from the field of Biology of Vitality and Ageing (10 ECTS), methodological experts from the line Research and Evidence (1 ECTS) as well as experts from Communication in Science (1 ECTS) and Academic Development (1 ECTS).

The course is split into two major parts. In the first 5 weeks of the course, the basic principles of the biological mechanisms underpinning ageing will be discussed which will be examined in a closed book exam in the 5<sup>th</sup> week of the course. During the last 3 weeks of the course, the students are engaged to go further with deepening their knowledge and skills by preparing a research proposal and business pitch and to finalize a scientific essay and presentation on a biological topic on ageing.

During basic, interactive and keynote lectures, that are scheduled throughout the course, the current state of the art knowledge of the biological mechanisms of ageing and vitality will be presented. Some of the topics will be further explored during working group sessions and journalclubs and topics will be finalized by completing different assignments (e.g., poster presentation, presentation, proposal). The assignments will be introduced by the course coordinators on Mondays during the first 4 weeks in videos that will be published on Brightspace. In addition to the examination, a 2-day study trip to the Max Planck Institute for Biology of Ageing (Cologne, Germany) is scheduled in the 5<sup>th</sup> week of the course.

During workgroups and the assignments, the students will be engaged in interactive discussions. In addition to the diversity of themes addressed in the lectures, the students can deepen their understanding of specific themes by the writing of a scientific essay on a topic of their choice, but that is clearly related to the biology of ageing theme of the course, and by providing their peers with feedback on their products. In addition, further deepening of certain topics is offered by the assignments in which the themes of the first 5 weeks is central.

To stimulate students to translate their knowledge about the biological mechanisms of ageing and vitality to the design of diagnostic, preventative and therapeutic strategies, the students will perform different assignments and will participate in a debate at the end of the course. The products of the assignments (either a poster presentation, mini lecture, presentation, research proposal and business pitch) will be presented during the central sessions scheduled on Fridays in the LUMC or at the Max Planck Institute for Biology of Ageing (Cologne, Germany). Together with your team, you will have sufficient time scheduled in the program to work on the week assignments.

# *Introduction and general information*

## **Short introduction to the course**

Life expectancy has continuously increased in Western countries over the last two centuries. Today, the average lifespan in Western countries is above 80 years for both men and women. However, many of the years that have been gained over the last two centuries are spent in ill health because people are suffering from a plethora of age-related and (neuro-)degenerative diseases, for which currently no cures are available. Understanding the basic processes behind ageing is a pivotal first step towards helping and alleviating ageing and age-related diseases and enhancing vitality. The general aim of this course is to increase the understanding of the (basic) biological mechanisms and theories of ageing that underlie ageing and age-related diseases so as to stimulate scientific thinking towards potential interventions and business opportunities aimed at enhancing vitality.

## **Central concept**

Ageing can be described as “a progressive, generalized impairment of function, resulting in an increasing vulnerability to environmental challenge and a growing risk of disease and death”. Although the pathologies that accompany ageing are diverse and the rate at which it occurs differs widely between species, the universality of the ageing process suggests that common biological mechanisms may be at play. Many of the prevailing proximate theories of ageing center on the hypothesis that the rate of ageing is determined by an intricate balance between damage accumulation and defense and repair mechanisms. From this hypothesis, it follows that analysis of the mechanisms by which this balance is regulated may reveal the regulatory axes of the ageing process and allow the development of anti-ageing therapeutics.

This course will focus on the biological aspects of vitality and healthy ageing. Attention will be paid to repair mechanisms, sleep, nutrition, longevity and maintenance of bodily (metabolic and cardiovascular) and mental functions and independence.

## **Structure and organization of the course**

Based on the central concept described above, this course focuses during the first five weeks on five major themes, namely, (i) Demography and the life course, (ii) Molecular damage control, (iii) Neuro-endocrine systems, (iv) Environmental cues, and (v) Animal studies: methods and tools”. These themes will be part of the written examination in week 5. During these weeks, the program will be a mixture of (interactive) lectures and keynote lectures, work groups, journalclubs and group assignments. During the final 3 weeks of the course, the program will comprise 2 major themes, namely, (i) Interventions to Enhance vitality, and (ii) Entrepreneurship in Ageing. Furthermore, the final weeks of the course will be devoted on finalizing the writing and presenting the scientific essay on a biological topic of your own choice.

## **Part 1: Themes related to the written closed book examination**

### *1. Demography and the life course*

To understand the need of ageing research in societies, ageing from a demographic perspective is pivotal. In addition, a life course perspective offers an interdisciplinary framework for guiding research on human ageing and vitality. The aim is to elucidate how interactions between various biological, behavioural, and psychosocial processes contribute to health and risk of disease across an individual's life course. We will discuss what study designs have been used and developed in human research to observe or predict (sex-specific) changes in health at different phases in life. Along the human life course, we will discuss hallmarks and determinants of the ageing process and the concept of

biomarkers of disease and mortality risk. Furthermore, the concepts of chronological age and biological age will be discussed.

## *2. Molecular damage control*

There are strong evolutionary arguments that ageing is not programmed, but instead occurs in an evolutionary shadow. Due to evolved limitations in the systems for maintenance and repair, stochastic damage to vital macromolecules will accumulate over a lifetime, leading to a gradual functional decline. Persistent damage will interfere with the functionality of different macromolecules and disrupt the integrity of cells, tissues and the organism. To deal with the different types of macromolecular damage, several dedicated systems for maintenance and repair have evolved. We will discuss which role(s) DNA repair mechanisms, epigenetics, immunology, stem cell biology play in the context of vitality and ageing.

## *3. Neuro-endocrine systems*

Evolutionarily conserved neuro-endocrine pathways have been identified in model organisms, whose modulation strongly impacts on longevity. In mammals, these include the somatotrophic/insulin/insulin-like growth factor-1 axis, the thyrotrophic axis, and the hypothalamic-pituitary adrenal (HPA) axis. These pathways play an important role in adapting the organism to its changing environment. Under adverse conditions, such as infection or starvation, growth and development are generally suppressed and available energy is preferentially invested in maintenance and repair to cope with these and anticipated future challenges, while under favorable conditions, available energy is readily invested in growth and development. Subtle changes in the setting of these neuro-endocrine pathways (which will determine how cues from the environment are perceived and integrated to provoke a coordinated response) can have great impact on lifespan.

## *4. Environmental cues*

Depending on the environment and the stage of the life cycle, cues from the environment can have great impact on lifespan by changing the balance between energetic investments in maintenance and repair versus growth and reproduction. Such environmental cues include, amongst others, signals on the presence of potential mate(s), competitors, chemotoxic agents or pathogenic micro-organisms, and cues that convey information on nutrient availability, and circadian time and rhythm. It is thought that the current epidemic of obesity is one of the major health threats and may accelerate ageing and age-related diseases, including different neuro-degenerative diseases. Interestingly, from the perspective of the biology of ageing, experiments involving calorie restriction (CR) in rodents provided the first promise for modulation of life span. Importantly, lifespan extension produced by CR is associated with delayed onset, reduced incidence and reduced severity of age-associated diseases and with preservation of brain health. CR, and other interventions, will be discussed in this part of the course. During this theme special attention is given to sleep, circadian rhythmicity and nutrition in the context of ageing, and how you can study this using different study designs.

## *5. Animal studies: methods and tools*

Research using model organisms has significantly advanced our understanding of the biological mechanisms and pathways that play key roles in vitality and ageing. This theme, which will be integrated in all 4 preceding weeks, is especially devoted to the research on the biological mechanisms of ageing using multiple animal models, including mice, killifish, drosophila melanogaster and C Elegans (among others). This theme will be finalized by a 2-day study trip to the Max Planck Institute for Biology of Ageing (Cologne, Germany) during which animal research will be further explained and

some hallmark examples will be presented on how research findings in animals can be translated to humans. Students are requested to prepare a presentation on an animal model.

## **Part 2: Themes related to group assignments**

### *6. Interventions to enhance vitality*

A lot of aspects of ageing are yet unexplored and we are still marginally able to influence the ageing process by different interventions. A lot of progress is being made by studies and projects that are externally funded by either the government or by different research foundations. During this theme you will learn the basis of research funding, and you will, together with your team, prepare your own research proposal with the intention to influence the biology of ageing and to prolong vitality.

### *7. Entrepreneurship in Ageing*

Multiple findings from biological experiments have clinical and societal relevance and can therefore be the start of setting-up a company. But how do you start a company? Where do you get sufficient amounts of money? To learn you some of the basics to start your own company, tutors from Centre for Innovation and Entrepreneurship (PLNT) are invited to provide you with some of the key ingredients to learn how the findings we explored during the first 5 course themes can eventually end up in products or service to be available to the general public.

### **Expert lectures**

Every year, we try to invite a number of leading experts in the field of ageing to provide experts lectures about their topic of study. This year, we invited a number of leading experts from the Netherlands and abroad to provide you with some inspiring stories. These lectures are also open to other students outside of the Biology of Vitality and Ageing course and to researchers within the LUMC Research Theme Lifecourse Epidemiology and Geroscience. The specific content of the lecture will be announced on Brightspace once available.

### **Overall course objectives**

The student:

- can explain ageing and age-related diseases from a demographic and life course perspective.
- describes the biological mechanisms that underlie ageing and age-related diseases.
- demonstrates how molecular mechanisms, the immune system, and metabolic adaptations play a role in the balance between damage accumulation and repair mechanisms in the ageing process.
- reports how neuro-endocrine mechanisms that evolved to facilitate adaptation of the organism to its changing environment are related to the ageing process.
- argue whether biological mechanisms relate to the potential for preventive and therapeutic interventions to modulate lifespan, health span and enhance vitality in humans and animals.
- can apply available knowledge to understand the challenges and opportunities of doing research with (i) model organisms and (ii) human subjects in the study of vitality and ageing.

Furthermore, the student can (not part of final written examination in week 5)

- is able to (i) provide a literature overview of the current knowledge for a topic related to biological mechanisms of ageing and vitality, to (ii) identify a relevant area that requires further research, and to (iii) formulate a novel research question for further research.
- is able to translate a biological concept into a potential successful business model.



### **Assessment information**

During the course, a broad spectrum of different biological mechanisms of ageing will be discussed. The exam will comprise multiple choice and open (short essay) questions about the material presented and discussed during the lectures and workgroups during the first 5 weeks (themes 1 till 5; will count for 40% of the final grade for BVA). The other summative assignment during this course consists of weekly assignments (to be conducted within your team; graded as pass/fail) and the individual writing of a scientific essay. Furthermore, students are asked to prepare, **as a team**, a research proposal and a business pitch (both will be graded; 15% each of the final grade for BVA). The scientific essay (30% of the final grade for BVA) will also be assessed by the teachers of the line Communication in Science and the line Research and Evidence, and will give separate grades that will count for these courses.

Other assignments during this course include the participation in a debate at the end of the course, and mentor-talk including a written reflection and peer feedback assignments (for Academic Development).

### **Teams**

Students will be grouped in 3 teams per working group throughout the course. Each week throughout the course, you will work in the same team. You will work together on the assignments (or as specified otherwise).

## Assessment matrix

Learning outcomes	Learning objectives The student:	Formative assessment (->feedback)	Summative assessment (->credits)
<p><b>Knowledge and understanding</b></p> <p>K1- has state-of-the-art knowledge and understanding of biological mechanisms of ageing</p>	<p>describes the biological mechanisms that underlie ageing and age-related diseases</p>	<p>Working group assignments</p>	<p>Written exam BVA</p>
	<p>demonstrates how molecular mechanisms, the immune system, and metabolic adaptations play a role in the balance between damage accumulation and defence and repair mechanisms in the ageing process.</p>		<p>Research proposal assignment</p>
	<p>can explain ageing and age-related diseases from a demographic and life course perspective</p>		<p>Entrepreneurship assignment</p>
	<p>reports how neuro-endocrine mechanisms that evolved to facilitate adaptation of the organism to its changing environment are related to the ageing process.</p>		<p>Scientific essay</p>
	<p>argue whether the biological mechanisms relate to the potential for preventive and therapeutic interventions to modulate lifespan and enhance vitality.</p>		

<p><b>Applying knowledge</b></p> <p>A1- is able to critically analyse the challenges, shortcomings and opportunities in the fields of biology of vitality and ageing, older individuals and organisation of an ageing society</p>	<p>can apply available knowledge to understand the challenges and opportunities of doing research with (i) model organisms and (ii) human subjects in the study of vitality and ageing</p>	<p>Study visit to Cologne and contribution in assignment</p>	
	<p>is able to translate a biological concept into a potential successful business model</p>	<p>Feedback during working group</p>	<p>Entrepreneurship assignment</p>
<p>A2 - is able to conduct a scientific analysis of original data or existing literature in the field of vitality and ageing</p>	<p>is able to (i) provide a literature overview of the current knowledge for a topic related to biological mechanisms of ageing and vitality, to (ii) identify a relevant area that requires further research, and to (iii) formulate a novel research question for further research.</p>	<p>Peer review sessions</p>	<p>Scientific essay (BVA, CIS, R&amp;E)</p>
<p>In this table, only the mandatory assessments are mentioned. Feedback will also be provided to the students during working groups.</p>			

## CREDITS

- Credits will only be given if besides passing the exam, also the compulsory formative and summative assessments are completed.
- If a student cannot be present at or carry out a compulsory assignment, the student must inform the course coordinator in advance by e-mail (masterva@lumc.nl). Possible consequences, like an alternative assignment or a retake, are determined by the course coordinator.
- If a summative assessment is done too late without permission of the study-advisor, the maximum grading will be lowered (grading at most 7.0).
- If a student failed for an assessment, the student will get a retake or revision or has to fulfil an alternative assignment. In case of revisions or alternative assignments, the maximum grading will be at most 7.0
- On behalf of the examiner, the written assignment will be assessed by a staff member. If there is doubt about pass/fail or if a student fails, a second staff member will also assess the assignment. These assessments are discussed in a consensus meeting.
- Additionally, as validation, a second staff member will assess a random sample of 10-20% of the written assignments. In case this validation reveals a large discrepancy ( $\geq 2$  points) in one of the assignments, all written assignments will be assessed by a second staff member. The examiner will determine the final grades, in general as the mean of the two grades.
- Every result will be registered in the Grade Center and converted in a grade in Usis if all components are completed.
- Students, who completed the half minor Vitality and Ageing in a previous year, will follow a personalized program determined by the course coordinators to bring their knowledge and skills up to the master level. Instead of writing the scientific essay, these students will write a full research proposal (on a different topic as the scientific essay in the minor!). These students are not required to do the final written examination, and the final mark for BVA will be based for 70% on the full research proposal, together with the successful completion of the Entrepreneurship and Research proposal assignment (15% each). Furthermore, successful completion of the study visit to Cologne is still required, even in the case the student has participated in the trip before. For the educational line Research and Evidence, the full research proposal will be graded instead of the scientific essay. For the educational line Communication in Science, the full research proposal will be graded instead of the scientific essay and the grade of the presentation and defense of the full research proposal will replace the grade of the presentation of the Scientific Essay.
- Students will carry out the main assignments in teams (ca 3-4 students). A replacement assignment will be offered to those that missed an assignment. The assignments in the first 5 weeks of the course will not be part of the final grade of the course (formative: pass/fail). The Research Proposal and Entrepreneurship Assignments (given in the last 3 weeks of the course) will be graded, and will count for 15% each in the final grade of the course.
- The final examination is “closed book”, which means that no documents are allowed during the examination. The final examination will be on campus and otherwise online using proctoring under the conditions as set out in the Rules and Regulations of the Board of Examiners. The use of communication equipment, including mobile phones, smartphones and smart watches is not allowed during the examination. The written examination composes of the material that are discussed during the lectures and working groups within the first 4 weeks of the course.
- Please note, in this assessment plan only compulsory assessments are mentioned. The other (formative) activities are described day-by-day in the module book.

**CREDITS Biology of Vitality and Ageing: 10 ECTS**

<b>Assessment</b>	<b>Weighing (%)</b>	<b>Passing the Assessment is compulsory? (Yes/No)</b>	<b>Result expressed as:</b>	<b>Cut-off score (pass / fail)</b>	<b>Resit / Retake (Yes/No)</b>
Written exam BVA (closed book)	40%	Yes	Grade	5.5	Yes
Scientific Essay (BVA/CIS/R&E)	30%	Yes	Grade	5.5	Yes
Study trip to Cologne	-	Yes	Completed		Replacement assignment
Research Proposal group assignment	15%	Yes	Grade	5.5	Yes
Entrepreneurship group assignment	15%	Yes	Grade	5.5	Yes
Assignments in the first 5 weeks	-	Yes	Completed	-	-

## Overview deadlines during BVA

Date	Activities
October 11, <u>before 12.00</u>	Students will send their first draft of their essay (Brightspace CIS)
October 13	Assessment of feedback skills (hand-in via Brightspace AD)
October 18	Exam BVA
October 27	Deadline for handing in ILP (via brightspace AD)
October 31, before 12.00	Submit 2 <sup>nd</sup> draft of essay for peer review (via Brightspace CIS)
November 2	Students will give a presentation about their essay: oral feedback from students and lecturers (BVA, R&E and CIS)
November 3, before 12.00	Upload peer review feedback on the second draft of the essay
November 10	Hand-in final version of the essay on Brightspace/Assignments ( <b>IMPORTANT</b> : hand-in <u>3 times</u> : via Brightspace BVA, CIS and R&E)
1 week before first mentor meeting	Upload your portfolio on Brightspace Academic Development with a completed assignment 'The Golden Circle' (See course book AD for requirements).
2 weeks after mentor meeting	Upload your updated portfolio in Brightspace Academic Development. See course book AD for requirements.

**NOTE: If not mentioned otherwise, all deadlines are at 23.59**

**Line Education**

During the course there will be lessons, working groups and lectures from the three lines: Academic Development, Research & Evidence and Communication in Science. A description of the lines is provided in the respective course books, as well as the associated rubrics.

## ***(Graded) assignments throughout the BVA course***

### ***Overview of the week assignments:***

- **Assignment 1:** Give a poster presentation on lifespan, health span and disease span with different age-related diseases
- **Assignment 2:** Self-study assignment on the primary hallmarks of ageing and disease development
- **Assignment 3:** Make a knowledge presentation on the involvement of the antagonistic hallmarks of ageing in the development of different age-related diseases
- **Assignment 4:** Make a minilecture on the role of sleep in the onset of age-related diseases, and explain how the hallmarks of ageing could link sleep with age-related diseases
- **Assignment 5:** Make a presentation on how different animal models can be used in the research on ageing
- **Assignment 6:** Design a research project, in the format of a research proposal and presentation, how the knowledge learned during the course can be put into interventions to enhance vitality.
- **Assignment 7:** Design a business pitch, in the format of an oral pitch and business proposal text, how the knowledge learned during the course can be translated into a successful business proposal.

Assignments in week 1-5 will be formative and will be graded either as “passed” or “failed”. Active participation to the working group discussions is mandatory. Assignments in week 6 and 7 will be graded by the course coordinators and will count for 15% each (30% total) to the final grade of the Biology of Vitality and Ageing course.

A more elaborate instruction on each assignment is included in the **Appendix**.



# BVA Part 1:

All themes and activities being part of the written (closed book) examination in week 5

**Lecture: Introduction to the course Biology of Vitality and Ageing and assignment 1**

Location: On campus

**Description of the lecture**

This lecture will introduce the course, introduce the different concepts of biological ageing, and will discuss the different components of the course and will introduce the assessments that need to be completed during the course.

## *Theme 1: Demography and the Life course*

### **Lecture: Introductory lecture Biology of Vitality and Ageing**

#### **Description of the lecture**

In this short lecture, which is available prerecorded (and can therefore be watched at any time) on Brightspace, the assignment of this week will be introduced. Questions can be asked centrally on the discussion board on Brightspace. Questions and answers will be available for everyone.

### **Lecture: Life course perspective of molecular ageing research, human cohorts and study designs**

#### **Description of the lecture**

The field of molecular epidemiology of ageing is the discipline that tries to mark and understand the risk of groups or individuals to a faster or slower functional decline (physical, mental, social capacities) and susceptibility to disease in an early phase of the adverse molecular ageing processes. Ageing as a process can contribute to the risk of functional decline and disease from very early moments in life onwards. We will discuss what study designs have been used and developed in human research to observe or predict changes in health at different phases in life. Along the human life course, we will discuss hallmarks and determinants of the ageing process and the concept of biomarkers of age-related disease, frailty, mortality risk, biological age and biomarkers monitoring improvement in health ageing by lifestyle interventions. We will also discuss how results of molecular studies, increased our understanding of the biology of ageing and broadened our options to generate biomarkers of the process that might be used in the clinic and in public health. The lectures following the first lifecourse perspective lecture are illustrations of how ageing research considering the observation of subjects in different phases in life eventually leads to understanding healthy ageing.

### **Lecture: The Hallmarks of Ageing**

#### **Description of the lecture**

There are many unanswered questions about the causes of the adverse effects associated with ageing, and even about what ageing actually is. The aim of this course is to make it clear that understanding the biology that underlies ageing will give us powerful insights into the mechanisms of ageing and the treatment of its related diseases. In this course, we will discuss how the rate of ageing is determined by damage and maintenance and repair. Next, we will discuss how the balance between investments in early survival and reproduction versus investments in body maintenance is, at least to some extent, controlled by conserved neuro-endocrine signalling pathways that respond to environmental cues, such as available levels of nutrition. Subsequently, we will discuss potential strategies to modulate health and enhance vitality. The lectures presented during the course will help students in identifying promising areas of future research that may lead to interventions that may improve health in old age and enhance vitality.

**Lecture: How to learn BVA (for non-(bio)medical background students only)**

**Description of the lecture**

Studying biology can be overwhelming, especially when you do not have a biology background in your bachelor program. What to read? What to study? What do I need to know for the exam? To get you started, we will discuss within a small group of all non-(bio)medical students how you plan to study the course. Together with the course coordinator, you will learn how you can best start with the course.

**Lecture: Additional information on Academic Development (Team meeting)**

**Description**

Information session in which you will get more information about Academic development, especially regarding the Individual Learning Pathway (ILP) and portfolio. The session will take place per Team and will have a duration of 30 minutes.

**Keynote lecture: Evolution of ageing**

**Keynote lecture: Populations Dynamics**

**Working groups: International demography**

**Description**

In this working group you will gain knowledge regarding international demography aspects by practical exercises. Using easy-to-use webtools we will learn how to calculate life tables and how to create life-expectancy curves. And we will learn more about the international trends in demography over the last 150 years.

**Lecture: Introduction to the essay**

**Description of the lecture**

During the course students will individually work on an essay. To facilitate the choice for a suitable topic for their essay, the course will start with an overview of all topics that will subsequently be discussed during the rest of the course.

### Working group: Journalclub

#### Description of the journalclubs:

Reading scientific papers is the basis of science, and a critical appraisal of the content in papers is necessary to make progress in the respective field of research. To facilitate you in reading scientific papers in a proper way, multiple scientific papers will be discussed throughout the course in which different methodologies will be discussed so that you can gain extra experience in quantitative research methods what you learned during the quantitative week of Research and Evidence.

### Working group: Belbin Team roles (Line AD)

#### Description

In this working group you will learn about the different roles that need to be performed in teams, learning your own and other's preferences for team roles, and practice how to use everyone's preferences and skills in a team assignment.

### Presentations of Assignment 1

#### Description of the working group

The products of the assignment will be presented and discussed during in a working group session with your fellow team mates and others from your working group. The product of the assignment needs to be uploaded on Brightspace **before** the working group. Remember that your contribution to the working group is obligatory and active participation is required to pass this assignment.

NOTE: The presentations will be done in a joint session with both working groups from the master together. All groups will give a presentation. 2 pitches from of the same topic will be presented right after each other. It will be followed by a plenary discussion.

### Questions and exam training – week 1

#### Description of the lecture

Any questions the students have concerning the lectures can be discussed in this session. Also, a quiz with exam-level questions will be provided to the students to test their progress and knowledge needed for the exam.

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## *Theme 2: Molecular damage control*

### **Lecture: Introduction to assignment 2**

#### **Description of the lecture**

In this short lecture, which is available prerecorded (and can therefore be watched at any time) on Brightspace, the assignment of this week will be introduced. Questions can be asked centrally on the discussion board on Brightspace. Questions and answers will be available for everyone.

### **Lecture: Ageing and Immunosenescence**

#### **Description of the lecture**

Biologically, ageing is a multifactorial process, involving changes in metabolism, immunity, hormonal systems, brain function and other biological processes. Especially declines in immune function are associated with increased morbidity and loss of disability-free years (quality of life). There are multiple remarkable age-related changes observed in the body concerning the immune system. One of these changes is the involution of the thymus, the central organ orchestrating production of new T cells. T-cells are sophisticated immune cells that develop in the thymus. As the thymus involutes with age, we will discuss T-cell development in more detail as example of ageing in relation to immune fitness. In addition, we will talk about inflammaging, we will discuss the role of the decline in immune function in the context of vaccination strategies for elderly people and we will study the prevalence of several immune-related diseases, which are increasing with age.

### **Working group: Scientific Writing 1 (Line CIS)**

#### **Description of the working group**

In this class, you will explore the structure and language of scientific writing from a reader's perspective, focusing on abstracts. Students will make an inventory of what they know about good, effective scientific writing, as well as of what makes a good abstract, which will prepare them for the writing assignment in the second class. Specific areas of focus will be scientific register, the use of verb tense, effective linking. The language of scientific writing—how to implement tense, voice and effective transitions—will be a focus of the class.

### **Lecture: Introduction to cellular aging**

#### **Description of the lecture**

Cells perform essential functions in our body and proliferate, differentiate and age. To understand how normal cells function we have to learn about their composition and about the basic concepts of DNA replication, transcription and translation. Furthermore, we require knowledge about cell division which is an essential process for tissue growth and maintenance and also for the formation of gametes. This knowledge is needed to unravel the mechanisms of diseases and to develop cures.

It is important to know that, with increasing age, cellular functions will change as well. During the lecture, we will discuss the main changes of cells and cellular function

**Lecture: Introduction to Science and Career****Description of the lecture**

This lecture informs students of the procedures and timelines for finding, starting, and doing an internship. Also information is given on the procedures and timelines for students who wish to do an international internship.

**Lecture: Epigenetics and the Lifecourse****Description of the lecture**

Health and disease are influenced by genetic and environmental factors. We also know that many diseases and perhaps in particular the ageing process are characterized by a disturbed regulation of gene expression. Enter the epigenome. The epigenome encompassed all epigenetic marks in a cell and is responsible for regulating gene expression. Moreover, the epigenome is influenced by the environment but also genetic differences between individuals. In other words: the epigenome is where nature and nurture meet. Therefore, studies of the epigenome are powerful means to unravel disease mechanisms and may lead to way to the development of new strategies to prevent and treat disease. For example, DNA methylation, a key epigenetic mechanism, is affected by the prenatal environment (as apparent from studies of the Dutch Hunger Winter), smoking, and may effectively mark someone's biological age. Implications of this research for society are multiple and include the potential for new preventative strategies but also the question who is responsible for preventing long-term effects of the environment through epigenetic mechanisms.

**Lecture: Additional information on Academic Development (Team meeting)****Description**

Information session in which you will get more information about Academic development, especially regarding the Individual Learning Pathway (ILP) and portfolio. The session will take place per Team and will have a duration of 30 minutes.

### Keynote lecture: 100plus research Amsterdam

#### Description of the lecturer

An estimated 60-80% of the chance to develop Alzheimer's disease depends on genetic factors, and similar percentages apply to other neurodegenerative diseases. Thousands of genetic risk factors are involved: some occur only very rarely in the population, others are more common. Each individual is uniquely vulnerable for developing diseases, which depends on the unique constellation of disease associated genetic variants they inherited from their parents.

Therefore, it is important to know which genetic factors are involved: (1) they point towards the molecular processes underlying the disease, necessary to design accurate treatment strategies. (2) they can be used to predict the individual vulnerability for diseases, far before the onset of symptoms. In the future, when treatment options become available, predicting who is at risk before the onset of symptoms will allow timely and accurate treatment.

Unfortunately, only a fraction of disease associated genetic elements is currently known. To identify novel genetic elements, dr.'s group compares the genetic constellations of those affected by neurodegenerative diseases with cognitively healthy individuals. Next to identifying risk-increasing genetic variants, her group takes a unique approach: it aims to identify genetic elements that *protect* against neurodegenerative diseases.

The group conceived the **100-plus Study**: an on-going prospective cohort study of centenarians who self-reported to be cognitively healthy, their first-degree family members and their respective partners. By investigating the genetic constellations and biomaterials of those who *escaped* disease until extreme ages, we aim to learn how cognitive decline can be avoided.

### Keynote Lecture: DNA damage and repair

### Keynote lecture: "Cellular Senescence"

### Journalclub: Epigenetics paper discussion

#### Description

Reading scientific papers is the basis of science, and a critical appraisal of the content in papers is necessary to make progress in the respective field of research. To facilitate you in reading scientific papers in a proper way, multiple scientific papers will be discussed throughout the course in which different methodologies will be discussed so that you can gain extra experience in quantitative research methods what you learned during the quantitative week of Research and Evidence.

Following the lecture on Tuesday, the literature will be discussed to obtain further knowledge on the topic.

### **Mentoring session (group A and B)**

#### **Description**

The first mentor meeting is scheduled during BVA. Your mentor group will be the same as your team. An overview of the teams and room allocation will be published on Brightspace.

### **Re-take famelab talk**

### **Speed date sessions scientific essay**

#### **Description of the lecture**

During this speed date session each student will have 5 minutes with one of the course coordinators to explore the subjects for the essay and students can start to formulate their research question.

The time schedule will be announced on Brightspace.

### **Week assignment 2 – Hallmarks of ageing**

#### **Description of the working group**

The answers to the questions from the individual assignment will be discussed during a central discussion with one of the course coordinators. A Word document with your answers needs to be uploaded on Brightspace **before** the session. Remember that your contribution to the working group is obligatory and active participation is required to pass this assignment.

### **Questions and exam training – week 2**

#### **Description**

Any questions the students have concerning the lectures can be discussed in this session. Also, a quiz with exam-level questions will be provided to the students to test their progress and knowledge needed for the exam.



## Theme 3: Neuroendocrine Systems

### Lecture: Introduction to assignment 3

#### Description of the lecture

In this short lecture, which is available prerecorded (and can therefore be watched at any time) on Brightspace, the assignment of this week will be introduced. Questions can be asked centrally on the discussion board on Brightspace. Questions and answers will be available for everyone.

### Lecture: Cortisol and adaptation to stress: homeostasis and allostasis – the HPA Axis

#### Description of the lecture

Cortisol is an essential hormone for survival. Cortisol is best known for its response to stressors. It coordinates the initial response to stressors, prevents overshoot of certain stress reactions, but also helps sustaining more chronic stress responses.

Cortisol secretion from the adrenal cortex is regulated by the hypothalamus – pituitary – adrenal (HPA) axis. Cortisol acts by binding to two types of nuclear receptors, mineralocorticoid and glucocorticoid receptors. These are transcription factors, and establish changes in gene expression that – somehow – support adaptation in many different organs in the body.

In the context of acute stressors, cortisol aims at restoration of homeostasis. However, adaptation may necessitate steering away from initial homeostatic set points towards a new state of the organism. This shift from one homeostatic situation to another is called allostasis. This is relevant in relation to more chronic stressors, and to the accumulated exposure to stressors as occurs during aging.

Cortisol exposure over time may on the one hand be viewed as a marker for ‘allostatic load’ (or chronic stress). It may also be viewed as an actual agent of allostatic change over time.

Many people claim – and for good reasons – those chronic elevations in cortisol may add to neurocognitive decline, compromised metabolic health and osteoporosis. Such effects can also occur as a consequence of chronic exposure to synthetic forms of the hormone, i.e. synthetic glucocorticoids.

### Lecture: Thyroid axis and (healthy) ageing

#### Description of the lecture

In this lecture, it is explained how the hypothalamic-pituitary-thyroid (HPT) axis regulates the concentrations of thyroid hormones in the circulation via physiological feed-forward and feedback mechanisms. Furthermore, the differences between hypothyroidism and hyperthyroidism will be discussed. Next, the main sources of variation in thyroid stimulating hormone (TSH) levels within an individual are discussed. Furthermore, data will be presented on the analysis of parameters of the HPT axis in relation to human ageing and longevity and we will discuss the implications of these findings.

### **Lecture: GH/IGF-1 signaling and human ageing and longevity**

#### **Description of the lecture**

Though ageing is in itself not programmed, genetically determined programs do exist for development, early life survival and reproduction which are intimately linked with ageing. Evolutionarily conserved pathways have been identified in model organisms, whose modulation strongly impacts on longevity, including signaling pathways that work through insulin/insulin-like growth factor-1 and receptors for nuclear hormones. These pathways play an important role in adapting the organism to its changing environment. Lifespan is affected by the genetically determined setting of such pathways and how these interact with the environment (match or mismatch) in both animal models and human. A key question addressed in this lecture is whether the effects of altered IGF-1/insulin signaling on lifespan as observed in model organisms are relevant for human ageing and longevity.

### **Mentoring session (group C)**

#### **Description**

The first mentor meeting is scheduled during BVA. Your mentor group will be the same as your team. An overview of the teams and room allocation will be published on Brightspace.

### **Keynote lecture: Trade-offs between growth and ageing**

### **Q&A Lecture: Neuroendocrine systems**

#### **Description of the lecture**

During this interactive lecture, students are able to ask questions about the recent lectures.

### **Workshop: Teamwork (Line AD)**

#### **Description of the lecture**

Further understanding and practicing of how to collaborate in interdisciplinary teams.

### **Working group: Journalclub Neuroendocrine systems**

#### **Description of the journalclub**

Reading scientific papers is the basis of science, and a critical appraisal of the content in papers is necessary to make progress in the respective field of research. To facilitate you in reading scientific papers in a proper way, multiple scientific papers will be discussed throughout the course in which different methodologies will be discussed so that you can gain extra experience in quantitative research methods what you learned during the quantitative week of Research and Evidence.

### **Working group: Belbin Team roles (Line AD)**

#### **Description**

In this working group you will learn about the different roles that need to be performed in teams, learning your own and other's preferences for team roles, and practice how to use everyone's preferences and skills in a team assignment.

### **Workshop: Writing your essay: Structured Literature Searching (PubMed)**

#### **Description of the lecture**

The claims you make in your essay need to be supported by the work of others. To be sure not to miss relevant publications in the field, you have to perform a thorough literature search that can be controlled or repeated by others. This requires a systematic approach. During the workshop you will work out your research question in PubMed while assistance of the information specialist is available. Tips and tricks will be shared.

### **Assignment 3 - Neuroendocrine systems**

The products of the assignment will be presented and discussed during an "on campus" session together with your fellow team mates. The product of the assignment needs to be uploaded on Brightspace before the working group.

Structure of the session will be included in an update of this module book with further instructions once available.

### **Questions and exam training – week 3**

#### **Description**

Any questions the students have concerning the lectures can be discussed in this session. Also, a quiz with exam-level questions will be provided to the students to test their progress and knowledge needed for the exam.

Note: this session will NOT be recorded.

**Working group: Questions regarding essay (via enrolment on Brightspace)**

**Description of the working group**

During this interactive meeting, the tutors will be present to help the students address their questions and/or issues that were encountered during the writing of their scientific essay. Note that questions can only be related to the content of the review; questions about structure and English writing should be communicated with the tutors of Communication in Science.

You can register for this session via Brightspace. More information and a schedule will be published on Brightspace in due course.

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## Theme 4: Environmental cues

### Lecture: Introduction to assignment 4

#### Description of the lecture

In this short lecture, which is available prerecorded (and can therefore be watched at any time) on Brightspace, the assignment of this week will be introduced. Questions can be asked centrally on the discussion board on Brightspace. Questions and answers will be available for everyone.

### Lecture: Healthy ageing in intervention studies

#### Description of the lecture

Metabolic and physical health generally decline among older adults, be it in a highly heterogeneous fashion. Hence, there is an urge to stimulate healthy ageing among the increasing group of older adults. Metabolic health can successfully be improved by lifestyle changes, such as dietary restriction and/or increased physical activity thereby reducing the risk for cardiovascular disease (CVD). Different research field apply interventions on different at-risk individuals and age groups. How can we understand and structure the many efforts in this field and what knowledge they add to the stimulation of healthy ageing.

Besides clinical markers, metabolic health can also be monitored by novel technologies, such as Nuclear Magnetic Resonance (NMR), which are able to measure large numbers of metabolites in an affordable and standardized way. Distinct profiles of metabolites have been demonstrated to associate with intake of specific food components, (future) type 2 diabetes (T2D) and CVD, showing the potential of metabolomics to monitor metabolic health. In the Growing Old TOgether (GOTO) study we investigated the effect of a lifestyle intervention in older adults. Participants were between 55 and 75 years old and reduced energy balance by 25% for 13 weeks, targeted by 12.5% reduction in caloric intake and 12.5% increase in physical activity.

### Scientific Writing 2 (Line CIS)

#### Description of the working group

This session will be dedicated to the writing of the Abstract in class. In preparation for this session it is vital that you read the assigned scientific article so as to properly prepare for the session. Afterwards we will discuss the different techniques used during the writing and how these could be applicable to a larger style paper.

### **Lecture: The biological clock**

#### **Description of the lecture**

More than half of the elderly in today's society suffer from sleep disorders with detrimental effects on brain function, behavior and social life. A major contribution to the regulation of sleep stems from the circadian system. The circadian clock regulates 24-hour patterns of many aspects of behavior and physiology, including the activity of brain nuclei, hormone levels (cortisol, melatonin), cognitive functions, performance, reaction time, heart rate, blood pressure, sleepiness, temperature, activity of the liver and intestines and sensitivity to medication.

The central circadian clock located in the suprachiasmatic nucleus (SCN) of the hypothalamus is like other brain regions subject to age-associated changes. One of the hallmark features of old clocks is a reduction in the amplitude of the timing signal and subsequently a weakening in the control of peripheral oscillators and a decrease in amplitude and precision of daily rhythms. The distortion in temporal organization is thought to be related to a number of serious health problems and to promote neurodegeneration. The lecture will discuss the effect of ageing on different levels of the circadian system from behavioral and physiological changes to underlying neuronal network alterations and cellular/molecular modification.

### **Chronobiology symposium**

#### **Description of the lecture**

The biological clock lays a role in multiple aspects and is considered as a main target for disease development and treatment effectiveness and safety. For this reason, many researchers are currently performing research on different aspects of the biological clock. During this symposium, junior researchers from the nationwide Bioclock consortium, which was funded in the program of the National Research Agenda, will present their research projects and initial results.

### **Lecture: Appropriate care for older people ("Passende Zorg")**

#### **Description of the lecture**

Modern medicine is increasingly organized according to the principles of Evidence-Based Medicine (EBM). Optimal treatment is considered to result from the integration of the individual components of EBM: the preference and individual situation of the patient, scientific evidence, and the knowledge and expertise of the physician.

Arguably, the ageing process affects all elements of EBM. Older patients are very heterogeneous and may have different treatment goals. Furthermore, scientific evidence is lacking as older patients are systematically excluded from relevant clinical studies. And physicians are not trained enough to deal with these issues.

In this lecture we will discuss in more detail what evidence-based medicine is, how it is affected by ageing and how we should organize medicine for older patients.

**Online Internship walk-in hour (by registration) (S&C)**

**Description of the working group**

This online question hour is organized to answer any question(s) you may have about your internship plan. A schedule with the exact timing will be provided approximately two days prior to the session.

**Online question hour on ILP (by registration) (line AD)**

**Description of the working group**

This online question hour is organized to obtain additional guidance and to answer any question(s) you may have about your ILP. A schedule with the exact timing will be provided approximately two days prior to the session.

**Lecture: Extension of life- and health span by dietary restriction. Mechanisms and clinical implications.**

**Description**

Dietary restriction extends life- and healthspan in a wide variety of species. Why is that? Does it apply to humans as well? And can we use our knowledge of the mechanisms involved in clinical practice? These issues will be covered in this lecture.

**Lecture: In the search of causality of environmental cues in ageing research: Mendelian Randomization**

**Background**

Observational studies are prone to confounding, reverse causation, and other biases, which have previously led to misleading conclusions with sometimes far-reaching consequences. Genetic epidemiology has tried to address these concerns through the use of Mendelian randomisation (MR) studies, which is based on the concept that the inheritance of germ line genetic variants is subject to the random allocation of alleles at conception. MR studies utilize genetic variants known to be associated with modifiable risk factors to provide an unbiased estimation of causality in a research design resembling an RCT. However, there are certain assumptions and limitations which are important to consider in these types of analyses. One example is pleiotropy, which occurs when a genetic marker is associated with multiple phenotypic traits. This lecture will provide an introduction to MR and outline recent developments in MR methodology, especially to investigate how the role of environmental cues can be studied in relation to ageing and age-related disease.

**Keynote speaker 9: Age-associated sleep disorders and disease development**

**Content of the lecture:**

Sleep Disorders with Ageing: A clinical and biological perspective.

**Deadline essay draft version 1 (hand-in via Brightspace CIS)**

**Extra Working group for those in need (by registration on Brightspace)**

**Description of the working group**

This working group will be organized if necessary. Students will be able to ask questions regarding the previous weeks to catch up, ask questions regarding the essay or other problems they have run into.

This working group is especially for the master students with a non-biological background. Participation to this working group is by subscription only on Brightspace. Maximum participants is 10.



**Working group: Journalclub biological clock in health and disease****Description of the journalclub**

Reading scientific papers is the basis of science, and a critical appraisal of the content in papers is necessary to make progress in the respective field of research. To facilitate you in reading scientific papers in a proper way, multiple scientific papers will be discussed throughout the course in which different methodologies will be discussed so that you can gain extra experience in quantitative research methods what you learned during the quantitative week of Research and Evidence.

**Workshop: Teamwork (Line AD)****Description of the lecture**

Further understanding and practicing of how to collaborate in interdisciplinary teams.

**Workshop: Providing feedback (line AD)****Introduction**

In your working life (and outside) you may sometimes need or want to give feedback to people, be it positive or negative. Giving negative feedback can be hard because people receiving the feedback may not like what they hear. Effective feedback is feedback that is given in such a way that it is heard, understood and accepted by the receiver. In this workgroup we will practice giving positive and negative feedback in such a way that enhances the likelihood that your feedback is received well.

This working group is a preparation for the assessment on 13 October.

**Week assignment 4 – Environmental cues****Description**

The products of the week assignment will be presented and discussed during an “on campus” session together with your fellow team mates and others from your working group. The product of the week assignment needs to be uploaded on Brightspace before the working group.

The structure with more information will be announced later.

## Questions and exam training – week 4

### Description

Any questions the students have concerning the lectures can be discussed in this session. Also, a quiz with exam-level questions will be provided to the students to test their progress and knowledge needed for the exam.

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## Theme 5: Animal models and Examination

### Practice exam (Digitaal toetsen)

#### Description

Students will be given the opportunity to perform a practice examination to be able to:

- Get to know the LUMC examination system
- Learn about the level of the examination questions.

The practice examination will be composed of 10 multiple choice questions and 1 short open essay question.

### Final Question hour for the Exam

#### Description

During this session, you will have the opportunity to ask your final questions before the exam. Furthermore, the answers to the practice examination will be discussed.

### Exam BVA

The written examination of the course Biology of Vitality and Ageing composes of 40 multiple choice questions and 5 open essay questions covering the topics of the first 5 themes of the BVA course. Questions of the written examination are based on the lectures and working groups that have been given during the course.

**IMPORTANT:** it is not allowed to have any documents with you during the examination. The written examination is **closed book**. The use of any communication devices, including smart watches etc, is not allowed and will be considered as fraud.

### October

#### Study trip Cologne, Germany

#### Description (draft program)

In the morning, we will gather at Leiden Central station (bus station) to leave for a study field trip to Cologne in Germany. After a lunch at the Max Planck Institute for the Biology of Aging, an introductory talk will be given and a presentation will be given about the Cluster of Excellence for

**October**

**Study trip Cologne, Germany**

Aging Research, which is a research group in Cologne to translate the biological findings in aging research to clinical practice (valorization). During the evening, there is a group dinner after which there is free time.

On Friday morning and early afternoon, we will return to the Max Planck Institute for the Biology of Aging in Cologne. You will learn about the application of different animal models. Furthermore, together with your working group, you will give a presentation about a specific animal model and how that animal model can be used to study biological mechanisms of ageing in humans.

NOTE: definitive times and schedule will be presented on Brightspace.

NOTE2: attendance to the Max Planck visit is part of the assessment of the BVA course; if you are not planning/not able to attend, please contact the study advisor to obtain approval of your absence. You will need to do a replacement assignment.

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# **BVA Part 2:**

All themes and activities being part of the application of the knowledge gained from part 1

## Week 6, 7 and 8

During the final 3 weeks of the BVA course, you will work on three different final assignments (which will all be graded and are part of the final grade of the BVA course), notably:

- Writing, presenting and defending a research project (see appendix 7) aiming to investigate aspects of biological ageing to enhance vitality and ageing.
- Writing, presenting and defending a business pitch (see appendix 8) aiming to set up a business, based on a biological principal, to enhance vitality and ageing
- The finalization and presentation of the scientific essay.

During these final weeks, you will receive multiple lectures and opportunities to discuss your progress with the lecturers. Note that these final assignments are meant to make use of the knowledge from the first part of the BVA course, and to translate knowledge to real-life applications.

### Lecture: Introductory lecture – final assignments

#### Description of the lecture

This lecture will introduce the second part of the course and will discuss the different assignments that need to be completed.

### Lecture: Introductory lecture – grant writing

#### Description

To perform research on ageing, money is needed to hire personnel, buy materials and to compensate study participants. To obtain the money, you will need to write project proposals that will be submitted to funding agencies. During this lecture, you will be provided with a general overview of what kind of work funding agencies are doing and what steps you need to take from proposal submission to final acceptance of funding.

### Lecture: Introductory lecture – entrepreneurship

#### Description:

In this session, students will be introduced to the concept of entrepreneurship within the context of biology and aging. Entrepreneurship plays a vital role in translating scientific knowledge into practical solutions. Students will explore how entrepreneurial thinking can contribute to the design of innovative diagnostic, preventative, and therapeutic strategies for the challenges that they perceive.

During the session, students will engage in interactive discussions and activities aimed at fostering their understanding of entrepreneurship and its relevance to aging. The importance of

**Lecture: Introductory lecture – entrepreneurship**

entrepreneurial skills such as critical thinking, problem-solving, and creative approaches will be highlighted as essential components of entrepreneurial endeavors in this field.

**Lecture: Internship examples hour (S&C)****Description**

In this session, examples and possibilities for internships will be presented. If possible, the projects will be introduced by researchers, professionals, or V&A alumni. Alumni can share their experiences with you. Presenters/organisations will be announced via Brightspace Science & Career.

**Lecture: Entering the Life Sciences and Health Market****Description of the lecture**

To valorise literally means: “to enhance or to try to enhance the value (or price) of something”. In this context: “to let someone pay for your innovation”. In this session you will learn that it is important and often even crucial for the success of your innovation that someone wants to pay for it in some way. Because if there is no monetary transaction, it is literally worthless and therefore no innovation at all! The main problem is that in the Life Sciences and Health Sector, it is difficult and sometimes even impossible to define on beforehand who’s going to be your (paying) client. During this session we will dive into the complexities of the (Dutch) healthcare system and explore both the hurdles innovations have to overcome as well as the tools that are at hand to overcome them.

**Questions regarding essay****Description of the working group**

During this interactive meeEssating, the tutors will be present to help the students address their questions and/or issues that were encountered during the writing of their scientific essay. Note that questions can only be related to the content of the review; questions about structure and English writing should be communicated with the tutors of Communication in Science.

You can register for this session via Brightspace. More information and a schedule will be published on Brightspace in due course.

**Deadline: Hand-in ILP (brightspace AD)**

**Working group: Scientific Writing 3 (Line CIS)****Description**

In this writing workshop we will explore how to give and receive effective feedback. We will also explore global feedback on your Scientific Essay (CIS1). Here you will receive input on different sections of your first essay draft, as well as follow-up information on strong scientific writing style—in particular, we'll focus on effective introductions. During the session you will work together with your peers to review each other's drafts. In addition, we will review a few aspects of giving a clear presentation, both live and as a recording, in preparation for your Essay Topic Presentation (CIS2).

**Lecture: Entrepreneurship****Description:**

In this interactive session, students will engage in the process of ideation and develop their own entrepreneurial ideas related to the field of biology and aging. Building on the concepts learned in the previous sessions about entrepreneurship, valorization etc., students will explore innovative solutions that address challenges in aging, vitality, and the broader life sciences sector.

The session will incorporate the use of the Business Model Canvas, a powerful tool that helps structure and visualize the core components of a business idea. By combining creative ideation with the strategic framework provided by the Business Model Canvas, students will have the opportunity to develop comprehensive entrepreneurial concepts.

**Lecture: Entrepreneurship assignment (schedule announced on Brightspace)****Description**

All teams will discuss their idea with the course coordinator. This will also give the teams the opportunity to ask questions. There is approximately 10 minutes available per team. A schedule will be announced on Brightspace. As time is limited, come prepared.

**Online Internship walk-in hour (by registration) (S&C)****Description of the working group**

This session is organized to answer any question(s) you may have about your internship plan. After registration you will receive a time-slot.

**Deadline: Draft essay vs. 2 (hand in via Brightspace CIS)****Working group: Presentations of essays (line CIS - SSA1)****Description of the working group**



**Working group: Presentations of essays (line CIS - SSA1)**

During this session, you'll each give a 5-minute presentation on your essay topic, using slides. There'll be a 10-minute discussion afterwards with room for questions and input from fellow students and a BVA teacher.

Presentations will be held in a morning and afternoon session, each with half of the VA workgroup. Group divisions will be announced on Brightspace.

**Presentations of the research proposals****Description of working group**

The products of the assignment will be presented and discussed with your fellow team mates and others from your working group. The product of the week assignment needs to be uploaded on Brightspace before the working group.

**Deadline: Digital peer feedback on draft essay vs. 2 (via Brightspace CiS)****Online Internship walk-in hour (by registration) (S&C)****Description of the working group**

This session is organized to answer any question(s) you may have about your internship plan. After registration you will receive a timeslot approximately two days in advance.

**Assessment: Debate BVA (AD)****Description**

Debating is a tool to encourage critical thinking skills. It challenges students to structure and organize their thoughts while also developing their analytical and research skills. Debating also stimulates the student to address a whole range of diverse social issues and viewpoints.

During the session students will practice and improve their debating skills. Today a debate will be organised on topics of Biology of Vitality and Ageing. The students will follow the theory and techniques of the provided online Debate e-learning. The students will participate in the debate and they will get a grade.

The debate will be held in two groups, together with the parttime students and/or the half minor students.

The groups will be announced on Brightspace.

**Working group: Pitches of business proposals**  
**Entrepreneurship: creating an enterprise the startup way**

**Description of the session**

Over the few last days, you had the opportunity to work on fleshing out a business idea. Your final results will need to be pitched live during this session and feedback will be provided to the teams by the jury members. Pitches will also be graded! Groups will need to submit a handout (that will be graded) as well.

**Network event**

**Description**

BVA is now (almost) finished. To celebrate the rounding off of the module, a networking event with drinks is organized to socialize. This is also the time to say goodbye to the half minor students.

**Deadline: Hand-in final version of the BVA essay**  
**(three times: via Brightspace BVA, R&E + CIS)**

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