

COURSE UNIT DESCRIPTION – Molecular mechanisms of aging

Course unit title	Code
Molecular mechanisms of aging and rejuvenation technologies	

Lecturer(s)	Department(s)
Coordinator: Prof. dr. Vytautė Starkuvienė Others: <i>Lectures and seminars:</i> Prof. dr. Vytautė Starkuvienė (paskaitos - 28 val., seminarai - 16 val.) Prof. dr. Daumantas Matulis (paskaitos – 2 val.) Prof dr. Irute Girkontaite (paskaitos – 2 val.)	Faculty of Natural Sciences, Vilnius University, Joint Life Sciences Center, Vilnius.

Mode of delivery	Period of delivered	Language(s) of instruction
Face to face	2 st semester, spring	Lithuanian (English)

Prerequisites and corequisites	
Prerequisites: Biochemistry, genetics, molecular and cell biology, biotechnology	Corequisites (if any):

Number of credits allocated to the course unit	Student's total workload	Contact hours		Self-study and research hours
5	135	Lectures	32	87
		Seminars	16	

Purpose of the course unit: programme competences to be developed
Upon the successful completion of this course, students will acquire: <i>Subject-specific competences:</i> <ul style="list-style-type: none"> • Knowledge of the molecular mechanisms leading to aging • Knowledge about the molecular and evolutionary theories of aging • Knowledge about the major strategies of rejuvenation <i>General competences:</i> <ul style="list-style-type: none"> • Systematic and critical study of the selected topic • Skills to analyse complex interdisciplinary relationships • Productive exchange of the acquired knowledge with the colleagues in a form of the discussion

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
After successful completion of this course a student should be able to know:		
<ul style="list-style-type: none"> • the theories of aging • the major cellular and organismal model systems that are used for aging research • the major mechanisms that are responsible for aging processes • aging markers, to explain their function; and understand the methods for the estimation of biological age • know approaches of rejuvenation, their strengths and limitations, potential risks 	Lectures, seminars, preparation of the seminars via working in groups, self-study	1) 50% of the grade: seminars on the selected course topic 2) 50% of the grade: written exam

Content: breakdown of the topics	Contact hours						Self-study work: time and assignments		
	Lectures	Tutorials	Seminars	Exercises	Laboratory work	Internship/work placement	Contact hours	Self-study hours	Assignments
I. Theory									
1. Introduction to aging research	4.5						4.5	17	
Aging, its socio-economic impact and technological milestones in the increase of the life-span	0.5							3	Analysis of the topic-related scientific papers and material presented by teacher self-directed learning, seminar presentations
Metrics of human population aging	0.5							3	
Evolution theories of aging and longevity	1							4	
Model organisms of aging research	2							4	
Molecular theories of aging – an overview	0.5							3	
2. Molecular mechanisms of aging and corresponding rejuvenation strategies	16.5		16				32.5	44	
Senescence and senolytics	2.5							8	
Aging of nuclear envelope	0.5							2	
Telomeres and aging	1							3	
Aging of DNA	0.5							3	
Genome remodelling	1.5							3	Analysis of the topic-related scientific papers and material presented by teacher self-directed learning, seminar presentations
Protein folding, aggregation, degradation and autophagy in aging	1							3	
Mitochondrial homeostasis and oxidative damage	1							3	
Nutrient sensing and metabolic control	4							8	
Aging of immune system	2							4	
Stem cell aging	1							3	
Aging of cell interaction to the environment	1.5							2	
3. Aging biomarkers	5						5	9	
Aging biomarkers and their detection methods	3							4.5	Analysis of the topic-related scientific papers and material presented by teacher self-directed learning, seminar presentations
Platforms for personalized age detection and diagnostics of aging-related diseases	2							4.5	
4. Drugs for rejuvenation	4.5						4.5	9	
Overview of drug development pipeline	2							3	Analysis of the topic-related scientific papers and material presented by teacher self-directed learning, seminar presentations
Anti-aging drugs	0.5							3	
Gene editing for anti-aging	2							3	
5. Healthy aging	1.5						1.5	8	
Centenarians	1							4	
Anti-aging social trends	0.5							4	
	32		16				48	87	

Assessment strategy	Weight, %	Assessment period	Assessment criteria
Seminar	50	After every seminar	Presentations the selected topic in a form of the seminar. The quality of the presentation, the sources of information and active discussion during the seminars and lectures will be evaluated
Exam	50	Exam session Exam is allowed when the seminars are completed	Open questions in a written or oral exam 2-4 (insufficient) 5 (sufficient) 6 (satisfactory) 7 (highly satisfactory) 8 (good) 9 (very good) 10 (excellent)
Total	100		The final grade is the sum of all evaluated parts, accordingly weighted

Author	Year of publication	Title	Publishing place and house or web link
Compulsory reading			
Reviews and research papers covering the course topics in the following journals: Nature, Science, Cell, Nature Reviews Molecular Cell Biology, Nature Ageing, Nature Medicine, Current Opinions in Cell Biology, Journal of Gerontology, Aging Cell, Aging Research Reviews, Experimental Gerontology			
Several examples are provided below:			
Ahadi et al	2020	Personal aging markers and ageotypes revealed by deep longitudinal profiling	Nature Medicine (research manuscript)
Fane and Weeraratna	2020	How the ageing microenvironment influences tumour progression	Nature Rev Cancer (review)