Course number	U-LAS14 10019 OE69　U-LAS14 10019 OE17		
Course title (and course title in English)	ISS (Natural Sciences b)-E2 :Designing the Future:From the Origin of Life to Future life Integrated Liberal Arts and Science with Small Group Seminars (Natural Sciences b)-E2 :Designing the Future:From the Origin of Life to Future life	Instructor's name, job title, and department of affiliation	Graduate School of Medicine Associate Professor,KIM MINSOO Graduate School of Biostudies Associate Professor,CARLTON, Peter Graduate School of Medicine Senior Lecturer,RAUDZUS，Fabian Graduate School of Medicine Associate Professor,PATAKY，Todd Graduate School of Science Senior Lecturer,BRANDANI，Giovanni・Bruno

Group	Natural Sciences	Field(Classification)	Biology(Introduction)

Language of instruction	English	Old group	Group B	Number of credits	4

Number of weekly time blocks	2	Class style	Lecture + Seminar (Face-to-face course)	Year/semesters	2026・First semester

Days and periods	Thu.3・5	Target year	All students	Eligible students	For all majors

[Overview and purpose of the course]

“What is life?” - This fundamental question serves as the starting point for a journey into the nature of living systems. This course explores the nature and diversity of life, from its origins to its future possibilities. Combining microbiology, genetics, physiology, and biotechnology, students will gain a broad and interdisciplinary understanding of what life is, how life functions, how simple cells evolve into complex organisms, how complex organs function, and how modern science is engineering life through synthetic biology. Finally, we will also discuss the ethical, legal, and social implications of future forms of life.
This course is designed for anyone interested in biology, not just life science majors. Through lectures, discussions, and a final presentation, students will develop critical thinking, ethical reasoning, and scientific literacy.

In addition to 14 lectures, four seminars are offered—
Week 1-7, students choose:“Microbe world - It's a bug's life”or“3D modeling and animation”
Week 8-14, students choose:“Brain function”or“Design a New Protein”.
Students are divided into two groups and will take two different seminars, one in each half of the course.

演習については、4つのセミナー（前半：Microbe world - It's a bug's life，3D modeling and animation、**後半：**Brain function, Design a New Protein）**が行われる。受講者は2グループに分かれ、前半7週と後半7週に異なるテーマで2つの演習を受講できる。**

○ Integrated Course Classification: [Science / Science]
This classification applies to courses in which both the primary and secondary themes have a strong emphasis on the natural sciences.
○統合型複合科目分類【理・理】
主たる課題について理系分野の要素が強く、副たる課題についても理系分野の要素が強いと考えられるもの

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[Course objectives]

1. Understanding of Basic Biology and Biotechnology
2. Gaining Practice in Scientific Expression (Graphic and Oral)
3. Understanding the basics of microbiology, genetics and developmental biology
4. Understanding of How the Brain and Muscles Work Together to Control Movement
5. Understanding the human body as an integrated system within a dynamic biological and metabolic environment
6. Understanding of Ethical Issues Related to Biomechanical Enhancement & Biorobotics
7. Understanding of Basic 3D Biological Modeling and Animation
8. Understanding of Biotechnologies to Create Life: from the Design of New Proteins to Artificial Cells

Students will gain fundamental knowledge through lectures and then deepen their understanding in seminars by applying concepts in discussion and problem-solving activities.

[Course schedule and contents)]

（In this course, students will learn through a combination of lectures and small-group seminars. Attending only the lectures or only the seminars will not be sufficient to achieve the learning objectives. Please be sure to attend the first class, as students will be divided into seminar groups at that time./**この授業では、講義と少人数演習を併せて学びます。講義のみ、少人数演習のみの出席では授業の到達目標に達しません。なお、講義の初回授業において少人数演習のグループ分けを行いますので、必ず出席してください）**

[Lecture] Thu 3rd period. （Classroom :**共東**32）
Class1: Introduction of course“From the Origin of life to Future life
The coordinator and all lecturers introduce themselves and their contributions to the course. The purpose of the course, learning objectives, and evaluation will be explained. The summary of the content covered by each instructor will be introduced. Students will be divided into four small-group seminars and will select two seminars to attend:

Section 1:“What is life?”understanding Simple life (Lecturer: Minsoo KIM)
(Overview)
Exploring the fundamental characteristics of simple life forms such as bacteria, viruses, and archaea, providing insight into how life originated and evolved in diverse environments.
(Schedule and Contents)
Class2: The origin of life and simple organisms: How did life begin? What is the definition of a living organism? What is the RNA world hypothesis? (Minsoo KIM)
Class3: Basic life forms: Understanding the biological differences among microorganisms such as bacteria, viruses, and archaea, and exploring the adaptive strategies of extremophiles. (Minsoo KIM)

Section 2: Building cells and bodies (Lecturer: Peter CARLTON)
(Overview)
Basics of genetics, cell biology and developmental biology through the lens of model organisms.
(Schedule and Contents)
Class 4: Fundamental components of living systems: DNA, RNA, proteins, membranes, and cells
Class 5: Model organisms: How C. elegans, Drosophila, mice and other organisms illustrate fundamental biology
Class 6: Genetics: the journey of genes through inheritance, mutation, recombination, meiosis, and evolution
Class 7: Development: how does a single cell grow into a complex organism?

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Middle term evaluation

Section 3: Life in motion and mind: Action, Energy and Intelligence (Lecturer Fabian RAUDZUS and Yan LUO)
(Overview)
Exploring how organ systems work together to sustain life and maintain internal stability. Investigating the physiological basis of movement (Muscle movement and Sport), energy utilization (nutrition and metabolism), and Brain function.
(Schedule and Contents)
Class8: How the Human Body Works: Organ Systems and Homeostasis (Yan LUO)
Class9: Brain function (Fabian RAUDZUS)
Class10: Muscle movement (Fabian RAUDZUS)

Section 4: Future life and Biotechnology: How we might create or reprogram life
(Lecturer: Giovanni BRANDANI and Todd PATAKY)
(overview)
Engineering biological systems at micro- and macro-levels. Micro-level: Artificial cells and synthetic biology, engineered bacteria, designed proteins and future applications in health and environment. Macro-level: Ethical & social issues associated with biomechanical enhancement and biorobotics
(Schedule and Contents)
Class11: Synthetic Biology (Giovanni BRANDANI)
Class12: Protein Design (Giovanni BRANDANI)
Class13: Biomechanical Enhancement & Biorobotics: technology and ethics (Todd PATAKY)

Class14: Student poster presentations and discussion
Students will give poster presentations and engage in discussions based on the assignments from previous lectures.
Class15: Feedback

［Seminars］
Students choose one seminar from the first half of the course and one from the second half.
Students choose:
Week 1-7: “ Microbe world - It's a bug's life ” or “ 3D modeling and animation ”

Seminar1. Thu 5th period. （Classroom :1共24）
Title: Microbe world - It's a bug's life
By Minsoo KIM, Yan LUO

(Overview and purpose of the course)
This course explores viruses, bacteria, and the interactions between microorganisms and their host cells. Students will learn to explain the roles of microbes in health and disease, understand the social impact of infectious diseases, and creatively express scientific knowledge through art-based presentations. The course also introduces methods for translating scientific concepts into visual communication and provides basic training in graphic design tools.
It complements the " “ What is life? ” understanding Simple life " block of the main course.

(Course schedule and contents)

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Class1: Introduction to Microbes and host interaction: Overview of host-microbe interactions, including Brain-Gut and Gut-Liver-Immune cell axis
Class2: Microbiota and their metabolites: Functions of microbiota and their biochemical products in the host
Class3: Microbiota and Health: From Research Findings to Health Claims
Class4: Pathogenic Bacteria and Horizontal Gene Transfer: Mechanisms of bacterial pathogenicity and gene transfer among microbes
Class5: Virus: Biology of viruses and their interactions with hosts
Class6: Microbial diseases: Biology, Management, and Societal Impact
Class7: The Good and the Bad of Microbes: Group discussion, Graphic design
Details on feedback will be announced separately during class.

Seminar 2. Thu 5th period（Classroom : 1共25(LL)）
Title:　3D modeling and animation
By Todd PATAKY
(Overview, purpose of the course, and Class activity)
Fundamentals of 3D modeling and animation, applied to molecules, virus and cell visualizations.

(Course schedule and contents)
Class1: Fundamentals I: 3D modeling
Class2: Fundamentals II: Animation & rendering
Class3: Modeling I: Molecules
Class4: Fundamentals III: Materials and lighting
Class5: Modeling II: Viruses
Class6: Fundamentals IV: Geometry nodes
Class7: Modeling III: Microvilli
Details on feedback will be announced separately during class.

(Course requirements, Textbooks, References, Study outside of class: If you have, option): Electronic materials including video tutorials will be distributed online.

Students choose:
Week 8-14:“Brain function” or “Design a New Protein”

Seminar 3. Thu 5th period. （Classroom :1共24）
Title: Brain function
By Fabian RAUDZUS
(Overview, purpose of the course, and Class activity)
This course introduces the basic principles of how the brain and muscles work together to control movement. Students will learn about neurons, neurotransmitters, muscle structure, and the effects of hormones and nutrition on muscle function. The purpose is to build a foundational understanding of the biological mechanisms behind human movement and adaptation to training.
Classes include short lectures, visual explanations, and group discussions to help students connect biological concepts with real-life examples such as exercise, recovery, and learning new motor skills. It complements the "Life in Motion and Mind" block of the main course.

(Course schedule and contents)
Class 1: Introduction to the Brain— Muscle System and Movement

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Overview of how the brain and muscles work together to produce movement, basic concept of neural control.
Class 2: Neurons and Neural Communication
Structure and function of neurons; how electrical and chemical signals transmit information in the nervous system.
Class 3: Action Potentials and Synaptic Transmission
Mechanisms of action potential generation; how synapses and neurotransmitters enable communication between neurons.
Class 4: Muscle Cells and Mechanisms of Contraction
Structure of muscle fibers and sarcomeres; how muscle cells shorten to produce force.
Class 5: Neuromuscular Junction and Motor Control
How neurons communicate with muscles through neurotransmitters; coordination of movement by the nervous system.
Class 6: Hormonal and Nutritional Regulation of Muscle Function
Roles of hormones and nutrition in muscle growth, repair, and energy balance.
Class 7: Neural and Muscular Adaptation to Training
How exercise leads to changes in neural control and muscle structure; introduction to plasticity and recovery mechanisms.
Details on feedback will be announced separately during class.

(Course requirements, Textbooks, References, Study outside of class, If you have):
Weekly revision of the class materials is required.

Seminar 4. Thu 5th period（Classroom : 1共25(LL)）
Title: Design a New Protein
By Giovanni BRANDANI
(Overview, purpose of the course, and Class activity)
Proteins are the language of life. In this seminar course, students learn how to speak this language: recognize and predict the structure of proteins, understand their function, and design new proteins. This will be an opportunity to explore the use 3D modelling and 3D printing for scientific communication: 3D modelling will help us to understand how proteins are built and how they work, and each student will have their newly designed protein 3D printed.

(Course schedule and contents)
Class 1. “Letters and Words” - proteins as the language of life, made of amino acid letters and secondary structure words.
Class 2. "Sentences" - how protein folding into specific structures allows them to acquire meaning.
Class 3. "Meaning" - protein structure-function relationships.
Class 4. "Evolution" - how nature designs functional proteins over the course of evolution.
Class 5. "Design" - how evolution can teach us how to design new proteins.
Class 6. Individual projects: design a new protein with a specific function.
Class 7. Individual projects: build a computer model of your protein design for 3D printing
Details on feedback will be announced separately during class.

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[Course requirements]

None

[Evaluation methods and policy]

Lecture(50% of final grade): Class attendance and active participation (40%), Homework (20%), Poster Presentation (40%)

Seminar(50% of final grade):Students take two seminars. Evaluation criteria may vary slightly by group and will be explained by each seminar instructor during the first class.
・Seminar A & B: Class attendance and active participation (20%), Assignments (40%), Final Presentation (40%)
・Seminar C & D: Class attendance and active participation (40%), Assignments (20%), Final Presentation (40%)

Final Grade = Lecture (50%) + Average of Two Seminars (50%)

[Textbooks]

Not used
No textbook will be used, but lecture materials as well as additional reading in English will be provided as handouts or distributed electronically.

[References, etc.]

（References, etc.）
Introduced during class

[Study outside of class (preparation and review)]

To achieve the course goals, students read the recommended lecture materials before the class and review the course handouts.

[Other information (office hours, etc.)]

No formal office hours, the instructors are available by appointment to meet with students. We expect active participation in class.

Due to character limits on official documents such as transcripts, the English course title "Integrated Liberal Arts and Science with Small Group Seminars" is abbreviated as "ISS."
Please note that the same restriction applies to E2 course titles on KULASIS, where the title is also abbreviated as "ISS."
成績証明書等では、表示文字数の制約上、英文科目名「Integrated Liberal Arts and Science with Small Group Seminars」**が**「ISS」**と略記されます。**
なお、E2**科目名については**KULASIS**上も同様の制約がかかり、科目名が**「ISS」**と略記されていますので、ご注意ください。**

[Essential courses]