科目ナンバリング	U-LAS14 20038 LE68						
授業科目名<英訳>	Introduction to Molecular Biotechnology-E2 Introduction to Molecular Biotechnology-E2			担当者所属職名・氏名	医学研究科　講師　Erik　WALINDA		
群	自然科学科目群			分野(分類)	生物学(各論)	使用言語	英語
旧群	B群	単位数	2単位	週コマ数	1コマ	授業形態	講義（対面授業科目）
開講年度・開講期	2025・前期	曜時限	金2	配当学年	主として1・2回生	対象学生	理系向

[授業の概要・目的]

This course provides a comprehensive introduction to molecular biotechnology, an interdisciplinary field at the cutting edge of science. We will explore how molecular biotechnology shapes our world, from recombinant technologies to the production of transgenic organisms.

Through a combination of PandA/YouTube lectures, quick in-class review of those online lectures, in-class discussions, and problem-solving exercises, students will engage deeply with the material.

By the end of the course, you will have a solid understanding of these techniques, their applications, and the ethical considerations surrounding them.

Students will also engage in hands-on learning experiences and case studies that relate to real-world applications of biotechnology.

[到達目標]

By the end of the course, students should be able to:

* Describe the structure and regulation of genomes and genes.
* Explain key molecular biology techniques such as recombinant DNA technology and protein synthesis.
* Apply these techniques in hypothetical scenarios involving microbial, plant, and animal biotechnology.
* Analyze the social, ethical, and bioethical issues in molecular biotechnology.
* Engage in informed debates on the risks and benefits of gene therapy, regenerative medicine, and transgenic organisms.
* Develop critical thinking and problem-solving skills by applying biotechnology concepts to real-world scenarios and case studies.

[授業計画と内容]

Week 1: Introduction to Molecular Biotechnology

* Definitions and the need for biotechnological innovations in today’s world
* History and role of molecular biotechnology, addressing potential issues
* Overview of fields and subfields within molecular biotechnology

Key applications of molecular biotechnology (selected examples)

Week 2: Nucleic Acids and Gene Expression

* Basic structure of DNA and RNA
* Central dogma of molecular biology

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* Principles of gene expression
* Protein translation at the ribosome

Week 3: Genomes and DNA Replication

* Genome organization within chromosomes
* Prokaryotic vs. eukaryotic genomes, genome composition, and complexity
* DNA replication, concluding the central dogma and exploring gene structure

Week 4: Epigenetics and Gene Regulation

* Chromatin conformation and epigenetic modifications
* Transcriptional regulation of gene expression
* mRNA modifications, miRNA/siRNA, gene silencing, and siRNA-based drugs

Week 5: Cloning and Gene Expression Control

* Translational and post-translational regulation of gene expression
* Molecular cloning I: biotech methods for DNA analysis
* Molecular cloning II: plasmid components and restriction enzymes

Week 6: Recombinant DNA and Library Construction

* Sticky-end DNA cloning
* Applications of recombinant DNA technology in transgenic animals and plants
* Genomic and cDNA libraries, hybridization techniques (Southern Blotting, cDNA library screening)
* PCR and its invention by Karry Mullis

Week 7: DNA Sequencing and Hybridization

* DNA microarray and Yeast Two-Hybrid (Y2H) techniques
* Importance of DNA sequencing
* Sanger sequencing (di-deoxy NTPs)
* Southern and Northern blotting, In-situ hybridization

Week 8: Genomics and Recombinant Proteins

* RT-PCR and In-situ hybridization
* Genomics, personalized medicine, bioinformatics, AI
* Recombinant proteins
* Expression of target genes in prokaryotic cells

Week 9: Microbial Biotechnology and Protein Purification

* Overview of microbial biotechnology
* Protein extraction and purification techniques
* Chromatography methods (gel filtration, ion-exchange, affinity chromatography)

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* Industrial applications: composting and other microbial biotechnology examples

Week 10: Microbial Applications and Diagnostics

* Applications of bacteria and yeast in biotechnology
* Microbial genomics and diagnostics, SDS-PAGE, Western blotting, antibodies
* Microbial detection methods (ELISA, PCR, hybridization)
* Production of therapeutic proteins and vaccines

Week 11: Microbial Enzymes and Biopolymers

* Microbial enzymes and their engineering for biotechnological applications
* Strategies for antibiotic development and studies
* Commercial biopolymers

Week 12: Animal Biotechnology

* Introduction to animal biotechnology and transgenic animals
* Creating transgenic animals using retrovirus techniques
* Cloning and applications of transgenic animals

Week 13: Transgenic Plants

* Methods and applications of transgenic plants
* Further exploration of transgenic plant technology

Week 14: CRISPR/Cas9 and the Future of Biotechnology

* Basics of CRISPR/Cas9 technology
* Applications: gene knockouts, base-editing, and current advances in CRISPR
* Review of the semester's key concepts

Week 15: Examination

Week 16: Feedback and Review

* Course wrap-up, feedback session, and open discussion on examination results and final course insights.

[履修要件]

特になし

[成績評価の方法・観点]

Class Attendance and Participation (30%): Active participation in discussions, group work, and quick presentations.

Weekly Quizzes (30%): Quizzes conducted through (online) MS Forms serve as a reflection on the previous

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week’s learning. While these quizzes are not scored directly, student participation and the insights shared during discussions about the quiz will be evaluated.

Final Exam (40%): A comprehensive examination covering all course content.

[教科書]

Full handouts and videos will be distributed in class

[参考書等]

（参考書）
授業中に紹介する

[授業外学修（予習・復習）等]

Students are expected to review handouts and videos uploaded to PandA/YouTube before each class. Each week, students should complete the assigned readings, watch the provided videos, and prepare responses to discussion questions, which will be reviewed during the in-class session. Weekly quizzes and active participation will help assess your understanding of the material.

In addition to scientific concepts, we will explore the broader societal impacts of molecular biotechnology. Ethical issues will be integrated into many class discussions, with dedicated sessions on the moral dilemmas of transgenic organisms, gene editing, and medical biotechnology. Students are encouraged to bring their perspectives and critically engage with these complex topics.

[その他（オフィスアワー等）]

[主要授業科目（学部・学科名）]