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	2026・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]

Welcome to molecular biotechnology! In this class, we’ll start right from the basics. Think high-school chemistry level and slowly build our way up. Step by step, we’ll go from DNA and proteins to the fascinating tools and techniques behind today’s biotech. No need to worry if some classmates already know a lot; we all begin from the same starting line.

Before each class, you’ll watch a short LMS/GoogleDrive lecture at home. That way, when we meet in class, we can zip through a quick English summary and spend our time talking, discussing, and solving problems together.

We’ll also do some hands-on activities and look at real-world examples, so you don’t just learn the science; you see how it’s used to shape the world around us.

[到達目標]

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

Understand and describe how DNA and genes are organized and controlled.

Explain basic molecular biology methods, including recombinant DNA and how proteins are made.

Imagine how these methods could be used in examples from microbes, plants, or animals.

Think about and discuss the social, ethical, and bioethical issues in biotechnology.

Join simple debates on the risks and benefits of things like gene therapy, regenerative medicine, or transgenic organisms.

Practice critical thinking and problem-solving by connecting biotechnology ideas to real-life examples 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)

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Week 2: Nucleic Acids and Gene Expression

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

Introduction to Molecular Biotechnology-E2(3)へ続く↓↓↓

* Overview of microbial biotechnology
* Protein extraction and purification techniques
* Chromatography methods (gel filtration, ion-exchange, affinity chromatography)
* 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: 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%): You will get points for being present, taking part in discussions, working in groups, and giving short presentations in class.

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Introduction to Molecular Biotechnology-E2(4)

Weekly Quizzes (30%): Each week there will be an online quiz (using MS Forms) about what we learned the previous week. The quizzes themselves are not graded by score, but your effort in completing them and how you join the class discussions about them will count toward your grade.

Final Exam (40%): At the end of the course, there will be one exam that covers everything we studied.

[教科書]

All the materials you need for this class (handouts, videos, and other resources) will be provided by the instructor. You do not need to buy any textbooks.

However, some past students have found it helpful to also study with Japanese-language books that they chose themselves, since this class is taught in English. If you feel more comfortable, you are welcome to do the same for your own self-study.

[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]

Before each class, please review the handouts and watch the videos uploaded to LMS/GoogleDrive. This preparation will help you understand the short class summary and take part in discussions more easily.

Each week, you will:

* Watch the videos.
* Do the assigned readings (from the handouts).

Think about the discussion questions to prepare for class.

Weekly quizzes and your participation in class will help check how well you are following the material.

[その他（オフィスアワー等）]

Office Hours: I am happy to talk with you anytime. Please send me an email first before coming to my office or before setting up an online meeting (Zoom, etc.). Don’t worry about the reason - whether it’s about class, the homework, or even if something just feels unclear - I’m here to help, so please don’t be shy to contact me.

[主要授業科目（学部・学科名）]