ANGOL NYELVŰ

COURSE DESCRIPTION

Title:	*Basics of Cell Biology*
Neptun code:	
Lectures/Practices (hours/week):	*2*
Credit:	*6*
Program(s)/type:	*PhD*
Section:	*full-time/correspondence*
Requirements:	*none*
Semester offered:	*spring/autumn*
Language:	*Hungarian/English*
Pre-requirement(s):	*none*
Teaching institute/department(s):	*MATE ÁTI*
Course leader:	*Dr. Szabolcs Tamás Nagy, DSc*

Course description:

This course provides an overview of the structure of prokaryotic and eukaryotic cells, the similarities and differences between animal and plant cells, the physiological roles of cell organelles, and the possibilities and limitations of the main cell-analytical tools used in agricultural research.

Aims of teaching:

To introduce students to the fundamental concepts of cell biology and their connections to agricultural aspects.

Course content:

1. Prokaryotic and eukaryotic cells. Animal and plant cells.
2. The nucleus, the genome, and chromatin.
3. The cell cycle, mitosis, and DNA replication. Transcription and translation.
4. Regulation of gene expression in prokaryotes and eukaryotes.
5. Endoplasmic reticulum, Golgi complex. Vesicular transport.
6. Cytoskeleton, plasma membrane. Membrane transport.
7. Mitochondria: their origin, structure, and function.
8. Cell-biological basis of reproduction. Meiosis.
9. Fundamentals of developmental biology.
10. Cell death: apoptosis and necrosis.
11. Signal transduction and intercellular communication.
12. Cell analytics in practice — laboratory demonstration.

Assessment and grading system:

Personal attendance at the course, and completion of the online examination.

Notes, textbooks, recommended literature:

- Szeberényi J.: Molekuláris sejtbiológia. Dialóg Campus Kiadó, 2004.
- Bálint M.: Molekuláris biológia I-II. Műszaki Könyvkiadó, 2000.
- Bálint M.: Molekuláris biológia III. Nemzeti Tankönyvkiadó, 2002.

- GM Cooper, RE Hausman: The Cell. A Molecular Approach. ASM Press, 2007.

COURSE DESCRIPTION

Title:	*Molecular genetic methods applied in animal breeding*
Neptun code:	
Lectures/Practices:	*40/0*
Credit:	*6*
Program:	*PhD*
Type:	*full time*
Requirements:	*Animal breeding, Genetics*
Semester:	*spring*
Language:	*English*
Pre-requirements:	*MSc*
Institute/Department:	*Institute of Animal Sciences*
Course leader:	*Dr. ZsolnaiAttila, DSc*

Description:
The practical application of molecular genetic methods is an integral part of animal biotechnology. The subject discusses the relevant basic knowledge, methods and practical applications, with particular attention to the presentation of the results achieved so far.

Aims:
Learning about the relevant basic knowledge, methods and practical applications in the topic.

Syllabus:
At present there is considerable interest in the application of molecular technologies for specific DNA markers associated with various QTL (Quantitative Trait Loci) to promote more efficient and relatively easy selection in farm animals. Recent advances in molecular genetics have enabled the application of MAS (Marker Assisted Selection) and GWAS (Genome-Wide Association Study) in achieving different breeding objectives. The course gives a summary of the main molecular markers and methods used in livestock improvement programmes.

Grading: 1-5, colloquium

References: Zsolnai Attila: Genetics

1. Anton I., Húth B., Füller I. et al.: Effect of single nucleotide polymorphisms on intramuscular fat content in Hungarian Simmental cattle. AJAS, 31, 9, 1415-1419. (2018).
2. Zsolnai A., Maróti-Agóts Á., Kovács A., Bâlteanu AV., Kaltenecker E., Anton, I.: Genetic position of Hungarian Grey among European cattle and identification of breed-specific markers. Animal, 14, 9, 1786-1792, (2020).
3. Zsolnai A., Egerszegi I., Rózsa L., Anton I.: Genetic status of lowland-type Racka sheep colour variants. Animal, 15, 2 , Paper: 100080 , 6 p. (2021).
4. Zsolnai A., Egerszegi I., Rózsa L., Mezőszentgyörgyi D., Anton I.: Position of Hungarian Merino among other Merinos, within-breed genetic similarity network and markers associated with daily weight gain. Animal Bioscience 36, 1.,10-18. , 9 p. (2023).
5. Kis J., Rózsa L., Husvéth F., Mezőszentgyörgyi D., Kovács S., Bakos Z., Zsolnai A., Anton I.: Association of myostatin gene polymorphism with echocardiographic and muscular ultrasonogr. measurements in Hungarian thoroughbred horses. Res.Vet.Sci.,160, 45-49. (2023).
6. Márton J., Szabó F., Zsolnai A., Anton I.: Genetic diversity and phylogenetic relationship

of Angus herds in Hungary and analyses of their production traits. Anim. Biosci. (2023). https://doi.org/10.5713/ab.23.0157

COURSE DESCRIPTION

Title:	*Genetic reprogramming methods and their application in mammals*
Neptun code:	SDIÁTD8_004 GOD-EN-N=PHD=EL00
Lectures/Practices/ week:	*2*
Credit:	*6*
Program:	*PhD*
Type:	*Regular/corresponding*
Requirements:	*no*
Semester:	*Spring/Autumn*
Language:	*English*
Pre-requirements:	*no*
Institute/Department:	*Institute of Physiology and Nutrition, Szent István Campus*
Course leader:	*Prof. Dr. András Dinnyés*

Description:
The future of large animal breeding in the 21st century is based on the more effective utilization of the genetic and epigenetic potential of individual animals and the rapid development of livestock populations capable of adapting to both global changes and local environmental conditions. (Epi)genetic reprogramming and micromanipulation techniques provide valuable tools for agricultural professionals in developing high-value livestock for agricultural production, as well as large-animal models for biomedical research and medical applications (e.g., xenogeneic organ production). By acquiring knowledge of modern biotechnological methods, future agricultural professionals will be able to understand and actively shape these processes.

Aims: Students will gain a comprehensive understanding of the new opportunities offered by (epi)genetic reprogramming and micromanipulation techniques, which represent key technologies for the future of agricultural biotechnology. These methods enable the development of high-value livestock for agricultural production, as well as applications in biomedical research (large-animal models) and healthcare interventions (e.g., the production of porcine xeno-organs for transplantation).

Syllabus:

1. Biotechnological methods in reproduction and *in vitro* embryo production.
2. Micromanipulation techniques for improving fertility and animal cloning.
3. Applications of cloned animals in agriculture and biomedicine.
4. Novel approaches to epigenetic reprogramming and induced pluripotent stem cells (iPSCs).
5. *In vitro* methods for gamete production.
6. Emerging industrial challenges in cell culture, including cultured meat and other cell-based industrial products.

Grading: Students are required to attend the course in person and successfully complete either an in-person or an online examination.
References: • Lecture materials and course notes. • *Agricultural Biotechnology* (Agroinform), **Animal Breeding Biotechnology**, by Attila Zsolnai, Zsuzsanna Bősze, Elen Gócza, Péter Péczeli, András Dinnyés, László Varga, and István Komlósi.

COURSE DESCRIPTION

Title:	Transgenic livestock
Neptun code:	DHKAT012N
Lectures/Practices:	
Credit:	6
Program:	PhD
Type:	
Requirements:	Five-grade assessment; examination and associated coursework
Semester:	To be confirmed
Language:	English
Pre-requirements:	Not specified
Institute/Department:	Hungarian University of Agriculture and Life Sciences (MATE), Department of Animal Biotechnology, Precision Breeding Group
Course leader:	Dr Lilla Bodrogi
Description: This course introduces the principles, methods and applications of transgenic and genetically modified animals in animal breeding, biomedical research and basic science. Students learn the embryological and micromanipulation foundations, the design of transgene constructs, classical gene-transfer methods, targeted gene modification and modern genome-editing approaches, as well as the validation and maintenance of modified animal lines. Ethical considerations, the 3Rs and the regulatory framework for animal research are also addressed.	
Aims: Students will understand the theoretical foundations of transgenic technologies, compare major gene-transfer and genome-modification methods, assess factors involved in selecting an appropriate technology, and critically interpret scientific findings related to the generation, validation and use of transgenic animal models.	
Syllabus: 1. Historical development of genetic improvement in animal breeding; conventional selection and the emergence of transgenic technologies 2. Definitions, types and applications of transgenic animals 3. Reproductive biology and embryology: fertilisation, oocytes and sperm, embryo culture and embryo transfer 4. Hormonal synchronisation, micromanipulation and embryo handling 5. Design of transgene constructs: promoters, transgenes, reporter genes and selection cassettes 6. Pronuclear microinjection and generation of classical transgenic animals 7. Embryonic stem cells, chimeras and gene targeting by homologous recombination	

8. Positive-negative selection; knockout and knock-in animal models 9. Conditional genetic modification: Cre–loxP and inducible Cre-ERT systems 10. Somatic cell nuclear transfer and cloning: Dolly and the significance of the technology 11. Modern genome editing: principles of CRISPR/Cas9, base editing and prime editing 12. Transgenic and genome-edited livestock and biomedical models 13. Genotyping, molecular characterisation, validation, off-target effects and quality control 14. Maintenance and breeding strategies for animal lines, genetic background and appropriate controls 15. Ethical considerations, the 3Rs, animal welfare and Hungarian/European regulations on animal research
Grading: Five-grade assessment. Requirements include a written examination (short explanations of key concepts and an essay question), analysis of a scientific publication, completion of a Jackson Laboratory (JAX) online course with a written report. The weighting of individual components is to be confirmed.
References: Lecture materials and scientific publications assigned by the lecturer. Larson, M. A. (Ed.). (2020). Transgenic Mouse: Methods and Protocols. Methods in Molecular Biology. Springer. https://doi.org/10.1007/978-1-4939-9837-1