**Short content of lectures on Basics of Animal Biotechnology**

**Lecture #1**

**Title:** The main directions and tasks of modern animal biotechnology.

**Aim:** to provide students insight into history, current state, prospects, approaches and branches of animal biotechnology, give them information about practical issues and prospective experiments in the field of biotechnology, biomedicine, and agriculture.

**Questions:**

1. Describe the science of biotechnology and identify its product domains.
2. Give examples of careers and job responsibilities associated with biotechnology.
3. Outline the steps in producing and delivering a product made through recombinant DNA technology.
4. Describe how scientific methods are used to conduct experiments and develop the products.
5. Apply the strategy for values clarification to bioethical issues.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.
2. Мак-Ларен Э. Химеры млекопитающих, М. Мир, 1979
3. Мухамедгалиев Ф.М., Тойшибеков М.М., Абильдинов Р.Б., Бердонгарова О.И., Джанабеков К.Д. Трансплантация зигот в племенном овцеводстве.- Алма-Ата: Наука, 1981.- 168с.
4. Серов О.Л. Перенос генов в соматические и половые клетки. Новосибирск. 1985.

**Lecture #2**

**Title:** Objects of Animal Biotechnology

**Aim:** to provide a list of the most popular and useful animal models, accepted for various experiments in animal biotechnology, the history of their discoveries, main properties, features, and achievements.

**Questions:**

1. Make a list of the most important characteristics for animal models to be accepted for the further biotechnological experiments.
2. Make a list of invertebrate and vertebrate animal models.
3. Describe the greatest experiments and discoveries which were made with the help of animals.
4. Create a list of models, which can be included as the most prospective animals for biotechnology and biomedicine.

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**Resources**

1. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.
2. Мак-Ларен Э. Химеры млекопитающих, М. Мир, 1979
3. Мухамедгалиев Ф.М., Тойшибеков М.М., Абильдинов Р.Б., Бердонгарова О.И., Джанабеков К.Д. Трансплантация зигот в племенном овцеводстве.- Алма-Ата: Наука, 1981.- 168с.
4. Серов О.Л. Перенос генов в соматические и половые клетки. Новосибирск. 1985.

**Lecture #3**

**Title:** History of Animal Biotechnology

**Aim:** to give detailed information about the usage of animals as the objects for obtaining biotechnological products from the ancient times until now. Show, how animals serve to solve problems in nutrition, agriculture, medicine, drug and hormones production, bioconservation, biotesting etc. Demonstrate how long is the history of animal biotechnology and how many ways of it exist.

**Questions:**

1. The first attempts to use animals as the objects of biotechnology.
2. The first beneficial products which were obtained via the use of animals and biotechnological methods and tools.
3. Animal biotechnology nowadays: current achievements and prospective variants in the future.
4. Outline the hallmarks of animal biotechnology such as the cloning technology or obtaining of representatives with recombinant DNA.
5. Discuss any possible ways animal biotechnology may evolve in Kazakhstan, list the most prospective animals for agriculture and medicine.

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**Resources**

1. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.
2. Мак-Ларен Э. Химеры млекопитающих, М. Мир, 1979
3. Мухамедгалиев Ф.М., Тойшибеков М.М., Абильдинов Р.Б., Бердонгарова О.И., Джанабеков К.Д. Трансплантация зигот в племенном овцеводстве.- Алма-Ата: Наука, 1981.- 168с.
4. Серов О.Л. Перенос генов в соматические и половые клетки. Новосибирск. 1985.

**Lecture #4**

**Title:** Methodological base of Animal Biotechnology. Types of producing organisms: allophenic animals, cloned animals, transgenic animals.

**Aim:** provide information about the methods, which are used in modern animal biotechnology, and types of animals, created though these methods, such as clones, GMO, and allophenic ones, show the difference between several widespread techniques and products.

**Questions:**

1. Define the terms cloned animals, transgenic animals, allophenic animals and give examples.
2. Describe the process of nuclear transfer from an embryonic donor cell into an enucleated oocyte.
3. Describe the process of DNA transfer from a donor organism into a recipient, give examples.
4. Define the difference between breeding animals and genetically modified animals.
5. Discuss the possible danger of the usage of genetically modified and cloned animals in medicine, agriculture, and other fields of everyday life.

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**Resources**

1. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.
2. Мак-Ларен Э. Химеры млекопитающих, М. Мир, 1979
3. Мухамедгалиев Ф.М., Тойшибеков М.М., Абильдинов Р.Б., Бердонгарова О.И., Джанабеков К.Д. Трансплантация зигот в племенном овцеводстве.- Алма-Ата: Наука, 1981.- 168с.
4. Серов О.Л. Перенос генов в соматические и половые клетки. Новосибирск. 1985.

**Lecture #5**

**Title:** Biosafety and Bioethics issues in Animal biotechnology. The Future of Animal Biotechnology.

**Aim:** to give information about the main bioethical issues, the activities of bioethical committees worldwide, the principles of working with animals, the protocols for householding, treatment, killing, and utilization, the modern tendencies and practices to deny working with animals in several developed countries.

**Questions:**

1. Define the term bioethics.
2. Give an example of an event that might lead to lab employee to be faced with an ethical issue.
3. Describe how the different strategies for values clarification can be used to solve a problem such as the use of primates for basic research.

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1. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.
2. Мак-Ларен Э. Химеры млекопитающих, М. Мир, 1979
3. Мухамедгалиев Ф.М., Тойшибеков М.М., Абильдинов Р.Б., Бердонгарова О.И., Джанабеков К.Д. Трансплантация зигот в племенном овцеводстве.- Алма-Ата: Наука, 1981.- 168с.
4. Серов О.Л. Перенос генов в соматические и половые клетки. Новосибирск. 1985.

**Lecture #6**

**Title:** Good manufacturing practice. Good laboratory practice. Intellectual property rights.

**Aim:** to show the importance of the appropriate householding the laboratory animals, determine the role of the most useful machines and tools, which are used in a typical laboratory, agricultural complex, or manufacture. Demonstrate the process of production vaccines, antibodies, gene-editing, or transgenic animals as model for investigating human diseases and producing recombinant therapeutics, and the bioinformatics methods are the innovative intellectual outcomes. Explain how are intellectual property rights regulated and protected worldwide.

**Questions:**

1. Determine the most appropriate tools for using in animal biotechnology laboratory.
2. Determine the most comfortable conditions for various (selectable) animal models in the laboratory.
3. List the laws and the organizations, protecting intellectual property.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.
2. Мак-Ларен Э. Химеры млекопитающих, М. Мир, 1979
3. Мухамедгалиев Ф.М., Тойшибеков М.М., Абильдинов Р.Б., Бердонгарова О.И., Джанабеков К.Д. Трансплантация зигот в племенном овцеводстве.- Алма-Ата: Наука, 1981.- 168с.
4. Серов О.Л. Перенос генов в соматические и половые клетки. Новосибирск. 1985.

**Lecture #7**

**Title:** Chimeras. Methodological base of embryo engineering.

**Aim:** to define the term chimera, list the main methods and techniques of obtaining different types of chimeras (dispermic chimera, blood chimera, mosaic chimera, female chimera, microchimera, etc.), describe common characteristics of chimera and prospects of their usage for diagnostics and treatment of human diseases.

**Questions:**

1. Provide any examples of chimerism in wild nature and describe this phenomenon.
2. Describe the major steps of animal chimera production.
3. Detect the differences between various kinds of chimera and list the main features of every cohort.
4. White a short review about the problems of embryo engineering.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://www.healthline.com/health/chimerism#diagnosis>
2. <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/chimera>

**Lecture #8**

**Title:** Chimera production. Types of animal chimeras.

**Aim:** (continue) to define the term chimera, list the main methods and techniques of obtaining different types of chimeras (dispermic chimera, blood chimera, mosaic chimera, female chimera, microchimera, etc.), describe common characteristics of chimera and prospects of their usage for diagnostics and treatment of human diseases.

**Questions:**

1. Provide any examples of chimerism in wild nature and describe this phenomenon.
2. Describe the major steps of animal chimera production.
3. Detect the differences between various kinds of chimera and list the main features of every cohort.
4. White a short review about the problems of embryo engineering.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://www.insider.com/what-is-a-human-chimera-and-how-does-it-happen-2017-11>

**Lecture #9**

**Title:** The base of cryobanking. Cryopreservation of gametes and embryos.

**Aim:** to show the main methods and protocols common of cryoconservation of reproductive cells and embryos under extremely low temperatures for use in the laboratories.Discuss the responses of living cells to ice formation without the further degradation and the basic physical and chemical reactions the preserved cell undergoes during this procedure.

**Questions:**

1. Find the protocols for working with sperm cells and oocytes and describe the main differences in working with these types of cells.
2. Make a list of the most popular cryoprotectants and describe the principle of their protection.
3. Make a list of tools and reactants which are essential to equip the laboratory specializing in cryconservation.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. Jang TH, Park SC, Yang JH, et al. Cryopreservation and its clinical applications. Integr Med Res. 2017;6(1):12-18.
2. <https://www.abcam.com/protocols/cryopreservation-of-mammalian-cell-lines-video-protocol>
3. <https://www.pnas.org/content/116/16/7738>

**Lecture #10**

**Title:** Animal cloning. History of cloning animals.

**Aim:** to give a brief review of the history of animal cloning, the procedure of cloning, the genetical and cellular mechanisms of cloning, and the pros and cons of cloning. Discuss the possible fields of the use of cloned organisms including humans, and bioethical issues of cloning.

**Questions:**

1. White a review of the history of cloned animals and *Xenopus laevis* as the first cloned organism.
2. Outline the major disadvantages of the use of cloned animals.
3. Outline the major fields where cloned animals are significantly used.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://www.livescience.com/58079-cloning-facts.html#:~:text=The%20first%20study%20of%20cloning,the%20Genetic%20Science%20Learning%20Center>.
2. <https://dash.harvard.edu/bitstream/handle/1/8852108/Paul.pdf?sequence=1&isAllowed=y>

**Lecture #11**

**Title:** Methods for reprogramming the somatic nuclei potency.

**Aim:** to introduce students the main steps of the process of reprogramming somatic cells and change the potency (the ability to turn into stem cells), to give a brief review of the major discoveries of obtaining iPSC.

**Questions:**

1. Classify stem cells according their potency and list features of all of them.
2. Display the experiment of John Gurdon and Shinya Yamanaka and explain the results of them.
3. Discuss the possible applications of iPSC in modern biomedicine and biotechnology.
4. Discuss the bioethical issues in case of the usage of iPSC.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. Ye L, Swingen C, Zhang J. Induced pluripotent stem cells and their potential for basic and clinical sciences. Curr Cardiol Rev. 2013;9(1):63-72. doi:10.2174/157340313805076278
2. <https://stemcell.ucla.edu/induced-pluripotent-stem-cells>

**Lecture #12**

**Title:** Stem cells. Cell potency and differentiation. Application of stem cells.

**Aim:** to give information about the main characteristics of stem cells, including differentiation, dedifferentiation, proliferation, homing etc. for better understanding their role in living multicellular organisms.Discuss the potency to use stem cells in therapy.

**Questions:**

1. Depict the Waddington Landscape and explain the process of differentiation.
2. Depict the role of methyltransferase as a participant in DNA differentiation.
3. Make a scheme of differentiation of stem cells from the totipotent zygote to differentiated somatic cells.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://www.mayoclinic.org/tests-procedures/bone-marrow-transplant/in-depth/stem-cells/art-20048117>
2. <https://www.yourgenome.org/facts/what-is-a-stem-cell>
3. Biehl JK, Russell B. Introduction to stem cell therapy. J Cardiovasc Nurs. 2009;24(2):98-105. doi:10.1097/JCN.0b013e318197a6a5

**Lecture #13**

**Title:** Genetic transformation of animal somatic cells.

**Aim:** to give information about the main protocols and methods of DNA transformation, including gene gun, liposome package, DAEA-dextran method, microinjection, electroporation, etc, the prospects of these methods and human diseases, which can be treated by the use of any of the current techniques, the future of transgenic animals and people and bioethical and social consequences of any types of DNA transformation.

**Questions:**

1. Classify current methods of DNA-transformation.
2. Make a list of genetically modified animals and list all possible properties of these organisms for biomedicine and biotechnology.
3. List all advantages and disadvantages of the usage of GM-techniques, including the impact of GMO on population, ecosystem, and biosphere as a whole.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://www.genscript.com/what-is-dna-transformation.html>
2. <https://dnalc.cshl.edu/resources/animations/transformation1.html>

**Lecture #14**

**Title:** Genetic transformation of animals.

**Aim:** to give information about the methods of insertion foreign DNA from a host organism into a recipient animal for production new types of proteins, hormones, drugs etc. for various aims in biomedicine, including treatment of human diseases (transgenic mice, cattle, fishes).

**Questions:**

1. Make a list of current applications accepted in animal breeding.
2. Find protocols describing the processes of DNA transformation in multicellular animals.
3. Find information about how can these animals are used in agriculture and biomedicine.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://scielo.conicyt.cl/scielo.php?script=sci_arttext&pid=S0717-34582006000200010>
2. Шевелуха В.С., Калашникова Е.А., Воронин Е.С. и др. Сельскохозяйственная биотехнология. 2-е изд. М. Высшая школа, 2003.
3. Щелкунов С.Н. Генная инженерия. Новосибирск. Изд-во Новосибирского государственного университета. 2004.
4. Жимулев И.Ф. Общая и молекулярная генетика. Новосибирск. Изд-во Новосибирского университета. Сибирское университетское издательство. 2002. 459 с.

**Lecture #15**

**Title:** Genetic engineering and gene therapy.

**Aim:** to introduce new approaches in gene therapy of human genetic diseases such as Duchene myodystrophy and others, provide protocols of gene therapy in animals and humans.

**Questions:**

1. Discuss the ethical statements as limiting factors for gene engineering and gene therapy.
2. Explain why humans can not be used as models for gene engineering.
3. Imagine the planet, where every individual would get a chance to edit their genome and discuss the possible consequences of these solutions.

**Type of class** Online lecture on Miscrosoft Teams.

**Resources**

1. <https://www.nature.com/subjects/genetic-engineering>