**Laboratory work #1**

**Title:** Scientific methodology in a research facility.

**Aim:** to give information about the main principles of scientific methodology in a research facility, laboratory equipment, reagents, tools, software, machines, glass etc. used in modern laboratories specialized in animal biotechnology, show the protocols of solutions preparation, evaluation, purification and conservation.

**Questions:**

1. What is animal biotechnology?
2. Depict a standard animal laboratory and point at the main tools which are used for common manipulations.
3. Classify the fields of animal biotechnology and illustrate the products it is possible to obtain though the use of animals which are beneficial for human needs.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #2**

**Title:** Organisms and their components used in animal biotechnology: DNA, cells, tissues, and individuals.

**Aim:** to give a list of the most important animal models accepted for biotechnological and biomedical researches, explain their contribution to the modern science, classify the components of animals such as DNA, RNA, proteins, cells, tissues and organs which are also the resource for manipulations in animal laboratories.

**Questions:**

1. Identify the levels of biological organization and explain their relationship.
2. Describe cell structure and its significance in biotechnology research and product development.
3. Discuss the types of organisms researched and the types of cells grown and studied in biotechnology facilities plus the products with which they are associated.
4. Distinguish between various types of cells.
5. List the four main classes of macromolecules and describe their structure and function.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #3**

**Title:** The basic skills of the biotechnology laboratory. Materials, tools, and solutions.

**Aim:** to discuss the basic skills which are essential for working with animals, including bioethical issues and limitations. Show in details materials, tools, and solutions which can be used during the experiments with animal model organisms.

**Questions:**

1. Determine the most appropriate tool for measuring specific volumes or masses.
2. Describe how to select, set, and use a variety of miscopipets within their designated ranges to accurately measure small volumes of solutions.
3. Convert between units of measurement using B//C rule and appropriate conversion factors.
4. Recognize the different expressions for units of concentration measurements and use their corresponding equitation to calculate the amount of solute needed to make a specified solution or make a dilution.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #4**

**Title:** Animal models as producers of proteins, antibodies, and drugs.

**Aim:** to discuss the animal models which are used for production essential products for humans including amino acids, proteins, antibodies, hormones and specific drugs, give a brief history of the introduction of animals as prospective players in the field of biotechnology and biomedicine.

**Questions:**

1. List the animals, which are used as producers of antibodies and hormones.
2. List the main characteristics for animals to be selected as a model for biomedical and biotechnological supply.
3. Select one animal form the list and present a brief history of its discovery and its contribution to the modern science.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #5**

**Title:** Bioethics as the fundamental issues in animal biotechnology.

**Aim:** to discuss the problem of ethical attitude to animals, the laws and principles of international committees and organization, regulating the usage of animals, limiting their participation in biomedical experiments, producing protocols and methods for non-violent householding and manipulations with animal.

**Questions:**

1. Compose a statement explaining how and why you have decided these certain animals should be approved for certain applications.
2. Describe any condition that could cause you to change your position on the use of these animals and the new position you might take.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #6**

**Title:** Introduction to DNA: mutations, gene expression, and protein production.

**Aim:** to give a brief insight into molecular genetics, refresh information about the structure of DNA, gene expression, mutations and mutagenesis, the processes of transcription and translation, and protein synthesis. Show the importance of this information for further biotechnologists.

**Questions:**

1. Classify mutations according their properties and give examples.
2. Depict the processes of transcription and translation and point at the major enzymes involved in these reactions.
3. Show the scheme of gene expression (both activation and suppression) and describe how does it impact on the total amount of final product-protein?
4. Find information about the Human Genome Project and its consequences and influence on modern science.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #7**

**Title:** Introduction to animal reproduction and in vitro fertilization.

**Aim:** to give information about natural and artificial processes of fertilization, the structure of gametes (on all stages of meiosis and maturation), describe the role of various hormones, including FSH, LH, progesterone, and estrogen, and brain regions such as pituitary glands and hypothalamus as the main regulators of sex cells production and sex cycle initiation.

**Questions:**

1. Depict the structure of a mature ovum and a sperm cells, list their differences.
2. Make a scheme of the main hormones taking participation in reproduction.
3. Distinguish Sertoli and Leydig cells and describe the main functions in male reproductive system.
4. Make a list of the main characteristics of gametes appropriate for *in vitro* insemination.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #8**

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

**Aim:** to discuss the phenomenon of chimeras in wild nature and the methods of chimera production under laboratory conditions.

**Questions:**

1. Case study. Find information about various types of chimera and analyze the impact of chimerism on the functions of the organisms.
2. Case study. Find the protocol, describing step by step the process of chimera production. Make a list of equipment, reagents and tools making this operation possible.
3. Find information about chimera projects and explain what is the main goal of this type of experimental work.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #9**

**Title:** Microsurgery of embryonic cells (morula, blastocyst) to create allofennic animals. Methods for assessment of the of the somatic cells, gametes and embryos viability.

**Aim:** to show the main criteria for evaluation of sex cells and embryos preparing for *in vitro* insemination and transplantation, including of assessment of sperm cells mobility and type of movement, the state of *zona pellucida* and *corona radiata* in oocytes, number, form, shape, and the texture of embryo.

**Questions:**

1. Make a list of requirements for sex cells, which will be selected for artificial insemination.
2. Show, what problems a researcher might face with during the process of sex cells selection (various non typical forms of head, neck and tail in sperm cells, for example).
3. Make a scheme of the process of blastocyst assessment, point the crucial marks.

**Form of class:** online in Miscosoft Teams/Zoom.

**Literature:** Internet resources

**Laboratory work #10**

**Title:** Introduction to cloning. The main principle of DNA dedifferentiation.

**Aim:** to discuss the process of animal cloning from the beginning until now, to show the experiments carried out by John Gurdon with clawfrog *Xenopus leavis*, and the consequences of them for modern medicine, show the scheme of the process of dedifferentiation (reverse differentiation) which is based on DNA methylation and activity of specific enzymes.

**Questions:**

1. Depict the scheme of the experiment provided by John Gurdon and landmark the crucial steps.
2. Write an essay about the role of clawfrog in modern science.
3. Discuss advantages and disadvantages of cloning as one of the prospective methods for human diseases treatment.
4. What is the difference between differentiated and non-differentiated DNA?
5. Make a list of cloned animals and describe the impact of these experiments on current state of bioethical limitations.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #11**

**Title:** Method of embryonic cloning. Cloning method using the somatic cell nuclear transplantation. Cloning amphibians. Cloning mammals.

**Aim:** to discuss the differences between the protocols for cloning non mammalian and mammalian animals, the methods and techniques which are used for reprogramming of somatic cell DNA and nuclear deactivation, to see the principles the bioethical committees appellate to ban any experiments on cloning.

**Questions:**

1. Why did John Gurdon select clawfrog for his experiments?
2. Why did Campbell and Wilmut select sheep for cloning?

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #12**

**Title:** Introduction to stem cells. Types of stem cells. The main properties and future prospects of stem cells.

**Aim:** to discuss the types, properties, prospects and disadvantages of stem cells, to show the scheme of differentiation and migration of stem cells to the target place in organisms, the way of cell division, and the activity of telomerase.

**Questions:**

1. Find an illustration of stem cells and Waddington landscape.
2. Define the term Hayflick limit and answer why do stem cells ignore this limitation in cell division.
3. Outline the most prospective way to use stem cells in research and medicine.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #13**

**Title:** The principles of genetic engineering in Animal biotechnology: constructing of genes for expressing in mammalian cells, selectable markers.

**Aim:** to discuss the principles of genetic and chromosome engineering and fields of application of these methods, show the short scheme of creating recombinant DNA with programmed properties and the use selectable markers to ensure that gene expression is activated.

**Questions:**

1. Make a scheme of recombinant DNA creation.
2. Find protocols describing gradually all steps and stages of recombinant DNA creation.
3. Classify all markers which are used to detect gene expression.
4. Describe the role of promoter in constructing recombinant DNA.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources

**Laboratory work #14**

**Title:** Methods of introducing the foreign DNAs into animal cells, identification of the foreign DNA in transformed cells and organisms

**Aim:** (continue) to discuss the principles of genetic and chromosome engineering and fields of application of these methods, show the short scheme of creating recombinant DNA with programmed properties and the use selectable markers to ensure that gene expression is activated.

**Questions:**

1. Make a scheme of recombinant DNA creation.
2. Find protocols describing gradually all steps and stages of recombinant DNA creation.
3. Classify all markers which are used to detect gene expression.
4. Describe the role of promoter in constructing recombinant DNA.
5. Describe the principles of gene banks establishment.

**Form of class:** online in Miscosoft Teams

**Literature:** Internet resources

**Laboratory work #15**

**Title:** Determination of the expression pattern of the foreign DNA.

**Aim:** to show examples of genetically modified animals and techniques allowing to assess the quantity of transgenic cells in an organism. Methods of detecting gene expression, such as real-time PCR, classic PCR, protein collection and purification.

**Questions:**

1. Describe step by step PCR method and answer the question how can it be used for needs of researchers to assess the activity of gene.

**Form of class:** online in Miscosoft Teams/Zoom

**Literature:** Internet resources