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| **Al-Farabi Kazakh National University****Syllabus** **(«**6D070100-Biotecnology**»)** **Spring semester 2017**  |
| **The Code of Discipline** | **The Name of Discipline** | **Type** | **Hours per week** | **Credits** | **ECTS** |
| **Lecture** | **Work****shop** | **Lab. work** |
|  | **Genomic and gene diagnostics** | ОК | 2 | 0 | 1 |  | 5 |
|  |   |
| **Lecturer/****Assistant**  | Aitkhozha Bigaliyev, Full Professor, | **Hours of Classes** | According to schedule |
| **e-mail** | e-mail: aitkhazha@gmail.com |
| **Mobile:** | 377-33-29, 12-10 | **Room** | 425 |
| **Academic review**  | This major course is provided as a part of educational program PhD students. The main aim of course isto provide methodological and practical materials in accordance to modern trends in the field of gene diagnostics and medicine |
| **Prerequisites** | «General Biology», «Ecology», «Molecular Biology», «Genetic», «Physiology» |
| **Expected Results of Education** | 1. Understand the basic scientific principles and laws accepted in Gene Diagnostics;2. Describe the process of sequencing of different genomes (i.e. eukaryotic and prokaryotic) and process of gene expression under various conditions;3. Classify all protocols accepted in diagnostics of animal, plant and human diseases, evaluate its negative effect on living organisms and genomic sustainability;4. Make graphs and/or illustrations of scientific protocols; explain them;5. Compare different protocols and methods accepted in gene diagnostics in accordance to their properties;5. Assess obtained experiential data in accordance to its quality.  |
| **List of Literature Sources** | **Main sources**:1. Molecular Diagnostics (Second Edition)Edited by: George P. Patrinos and Wilhelm J. Ansorge*,* 2010 ISBN: 978-0-12-374537-8 2. Francis RC (2011). Epigenetics : the ultimate mystery of inheritance. New York: W.W. Norton. [ISBN](https://en.wikipedia.org/wiki/International_Standard_Book_Number) [9780393070057](https://en.wikipedia.org/wiki/Special%3ABookSources/9780393070057).3.Laird PW (Mar 2010). "Principles and challenges of genome wide DNA methylation analysis". Nature Reviews Genetics. **11** (3): 191203. [doi](https://en.wikipedia.org/wiki/Digital_object_identifier):[10.1038/nrg2732](https://dx.doi.org/10.1038/nrg2732). [PMID](https://en.wikipedia.org/wiki/PubMed_Identifier) [20125086](https://www.ncbi.nlm.nih.gov/pubmed/20125086).4. National Human Genome Research Institute (2010-11-08). ["FAQ About Genetic and Genomic Science"](http://www.genome.gov/19016904). Genome.gov. Retrieved 2011-12-03.5. Labow MA (2002-11-08). "Genomics". In Robinson R. Genetics. Macmillan Science Library. Macmillan Reference USA. [ISBN](https://en.wikipedia.org/wiki/International_Standard_Book_Number) [0028656067](https://en.wikipedia.org/wiki/Special%3ABookSources/0028656067). 6. Min Jou W, Haegeman G, Ysebaert M, Fiers W (May 1972). "Nucleotide sequence of the gene coding for the bacteriophage MS2 coat protein". Nature. **237** (5350): 82–7. Sanger F (1980). ["Nobel lecture: Determination of nucleotide sequences in DNA"](http://nobelprize.org/nobel_prizes/chemistry/laureates/1980/sanger-lecture.pdf) (PDF). Nobelprize.org. Retrieved 2010-10-18.8. Fleischmann RD, Adams MD, White O, Clayton RA, Kirkness EF, Kerlavage AR, et al. (Jul 1995). "Whole-genome random sequencing and assembly of Haemophilus influenzae Rd". Science. **269** (5223): 496-512. [Bibcode](https://en.wikipedia.org/wiki/Bibcode):[1995Sci...269..496F](http://adsabs.harvard.edu/abs/1995Sci...269..496F). [doi](https://en.wikipedia.org/wiki/Digital_object_identifier):[10.1126/science.7542800](https://dx.doi.org/10.1126/science.7542800). [PMID](https://en.wikipedia.org/wiki/PubMed_Identifier) [7542800](https://www.ncbi.nlm.nih.gov/pubmed/7542800).9. Mardis ER (2008). ["Next-generation DNA sequencing methods"](http://www.lcg.unam.mx/frontiers/files/frontiers/annurev.genom.9.081307.164359.pdf) (PDF). Annual Review of Genomics and Human Genetics. **9**: 387–402. [doi](https://en.wikipedia.org/wiki/Digital_object_identifier):[10.1146/annurev.genom.9.081307.164359](https://dx.doi.org/10.1146/annurev.genom.9.081307.164359). [PMID](https://en.wikipedia.org/wiki/PubMed_Identifier) [18576944](https://www.ncbi.nlm.nih.gov/pubmed/18576944).**Online sources**:1. Electronic handbook: <http://books4study.biz/c16>2. Electronic handbook: [http://www.edu.ru](http://www.edu.ru/)3. Electronic handbook: <http://www.maps/edu.ru>4. Electronic Journal of genetics: [http://www.maik.ru](http://www.maik.ru/) |
| **Academic Policy**  | 1. Students must be prepared as for lectures in accordance to current schedule. All preparations must be finished **before** the beginning of class.
2. Home works and individual tasks will be spread during the whole period of the course as shown in this syllabus.
3. The majority of home works includes in several tasks as to make scientific reports, do exercises or prepare presentations. Cheating and using another's materials, articles or answers **are not permitted**.
4. For laboratory works labcoats are mandatory.
5. Using mobile phones or other electronic devices or surfing the Internet during the all types of classes is not allowed.
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| **Assessment** | **Individual Student Work Requirements** | **Percentage** | **Results** |
| Individual tasks Laboratory worksExam and midtermTotal | 36%24%40%100% | 1, 4, 5, 62, 3Paper work or test  |
| The final grade will be calculated by the formula:$$Итоговая оценка по дисциплине=\frac{РК1+РК2}{2}∙0,6+0,1МТ+0,3ИК$$95% - 100%: А 90% - 94%: А-85% - 89%: В+ 80% - 84%: В 75% - 79%: В-70% - 74%: С+ 65% - 69%: С 60% - 64%: С-55% - 59%: D+ 50% - 54%: D- 0% -49%: F |
| **Timetable** |
| **weeks** | **Title of lecture** | **hours** | **bands** |
| 1 | **Lecture 1.** History, etymology and study methods of genomic and the gene diagnostic.**Seminar 1.** To view of the knowledge of full genomes, [functional genomics](https://en.wikipedia.org/wiki/Functional_genomics). **SIW 1.** Patterns of [gene expression](https://en.wikipedia.org/wiki/Gene_expression) under different conditions. | 12 | 0515 |
| 2 | **Lecture 2.** Theoretical issue of fundamental aspects of Genomic and the gene diagnostic. **Seminar 2.** To view of creation about main problems and advances of modern gene engineering and biotechnology; genomic and the gene diagnostic new methods  | 12 | 5 |
| 3 | **Lecture 3.** Modern methods of study of discipline include information about basic objectives of functional genomics.**Seminar 3.** View of cell engineering experimental issue basic to plants and animals genomics.**SIW 2.** New methods accepted in cell engineering and human diagnostics. | 12 | 520 |
| **Module 2 the study of the complete set of**[**epigenetic**](https://en.wikipedia.org/wiki/Epigenetic)**modifications on the genetic material of a cell, known as the [epigenome](https://en.wikipedia.org/wiki/Epigenome%22%20%5Co%20%22Epigenome)** |
| 4 | **Lecture 4.** Epigenetic modifications on a cell’s DNA or histones that affect gene expression without altering the DNA sequence; **Seminar 4.** View the methods of two of the most characterized epigenetic modifications are [DNA methylation](https://en.wikipedia.org/wiki/DNA_methylation) and [histones acetylation](https://en.wikipedia.org/wiki/Epigenetics%22%20%5Cl%20%22DNA_methylation_and_chromatin_remodeling%22%20%5Co%20%22Epigenetics). The estimation of risk of anthropogenic influence on genome sustainability and species life. | 12 | 5 |
| 5 | **Lecture 5**. The study of metagenomes, [genetic](https://en.wikipedia.org/wiki/Genetics) material recovered directly from [environmental](https://en.wikipedia.org/wiki/Natural_environment) samples; Principles and methodology. **Seminar 5.** The main postulates of environmental genomics, ecogenomics or community genomics.  | 12 | 10 |
| 6 | **Lecture 6.** Traditional microbiolog[ical](https://en.wikipedia.org/wiki/Microbiology) techniques. Microbial [DNA sequencing](https://en.wikipedia.org/wiki/Genome_sequencing)  and [clonal](https://en.wikipedia.org/wiki/Clone_%28genetics%29) [cultures](https://en.wikipedia.org/wiki/Microbiological_culture), **Seminar 6.** The role of early environmental gene sequencing cloned specific genes (often the [16S rRNA](https://en.wikipedia.org/wiki/16S_ribosomal_RNA) gene) to produce a [profile of diversity](https://en.wikipedia.org/wiki/Microbial_ecology) in a natural sample. **SIW 3.** DNA clones: methods and protocols | 12 | 1020 |
| 7 | **Lecture 7.** [Functional genomics](https://en.wikipedia.org/wiki/Functional_genomics) as a field of [molecular biology](https://en.wikipedia.org/wiki/Molecular_biology) to describe [gene](https://en.wikipedia.org/wiki/Gene) and [protein](https://en.wikipedia.org/wiki/Protein)s functions and interactions. **Seminar 7.** Functional genomics and function of DNA at the levels of genes, RNA transcripts, and protein products. | 12 | 5 |
| **Per 7 weeks** | **100** |
| **Midterm**  | **100** |
| 8 | **Lecture №8**. The principal difference between structural genomics and [traditional structural prediction](https://en.wikipedia.org/wiki/Protein_structure_prediction) **Seminar №8.** Determination of a [protein structure](https://en.wikipedia.org/wiki/Protein_structure) through a genomics structural basis.  | 12 | 05 |
| 9 | **Lecture №9.** The study of the complete set of [epigenetic](https://en.wikipedia.org/wiki/Epigenetic) modifications on the genetic material of a cell **Seminar №9.** Epigenetic modifications in gene expression and regulation. **SIW 4.** The pole of methylation in gene expression. Modern issues and investigations | 12 | 0520 |
| 10 | **Lecture №10.** The study of metagenome, [genetic](https://en.wikipedia.org/wiki/Genetics) material recovered directly from [environmental](https://en.wikipedia.org/wiki/Natural_environment) samples. **Seminar №10.** Usage of "shotgun" [sequencing](https://en.wikipedia.org/wiki/Chain_termination_method) or massively parallel [pyrosequencing](https://en.wikipedia.org/wiki/Pyrosequencing%22%20%5Co%20%22Pyrosequencing) to get largely unbiased samples of all genes. | 12 | 05 |
| 11 | **Lecture №11.** Metagenomics as a revolutionary mechanism for understanding the entire living world. **Seminar №11.** Bacteriophage genome sequences and analysis of bacterial genomes. P[rophage](https://en.wikipedia.org/wiki/Prophage) sequences and prophage-like elements. | 12 | 05 |
| 12 | **Lecture №12.** Principles of separation from bacteria, animals or plants genes for change or artificial synthesis of necessary genes. **Seminar №12.** New methods of creation the special genetic constructions (vectors).**SIW 5.** Other artificial methods of DNA recombination | 12 | 0520 |
| 13 | **Lecture №13.** Transgenic plants and animals which changed in genetic operations. **Seminar №13.** Promoters, terminators, and gene reporters, changing the genes. | 12 | 05 |
| 14 | **Lecture №14.** Ti – plasmids of Acrobacterium tumefasiens ground bacteria, wich carry the gene of protein – toxic and introduction in plant cells (ONA of plants). **Seminar №14.** Creation new forms of useful agricultural plants, sustainable for harmful insects | 12 | 05 |
| 15 | **Lecture №15.** Bacteriophage genome sequences can be obtained through direct sequencing of isolated bacteriophages, but can also be derived as part of microbial genomes. **Seminar №15.** Analysis of bacterial genomes for different medical and scientific purposes.**SIW 6.**The role of prophages in changing the bacterial genome | 12 | 0520 |
| **Per 7 weeks** | **100** |
| **Totally**  | **300** |
| **Recommendations**In case of illness, traumas, disabilities, accidents or scientific/business trips students are allowed to get extra bands overtime. Also in these cases students can select the most comfortable way to do it. All bands will be added to the final grade at the end of the semester. Discussions, disputes and active participation in classes are highly encouraged. Lecturer or assistant can give additional tasks if they is not sure in student's knowledge. |
| **Recommendations for SIWs.****SIW 1.** Make a presentation or scientific report about the classification of gene expression and the pain players in this process. **Sources:** scientific articles and reports on the Internet. **SIW 2.** Make a list of modern methods accepted in modern science for gene engineering. Bioethics and its main postulates.**Sources:** recommended literature**SIW 3.** Write a short report about the main approaches of DNA clones described in scientific sources. **Sources:** Internet sites**SIW 4.** Find any scientific evidences of influence of DNA methylation on human organisms. **Sources:** DNA methylation and Memory Formation [Jeremy J. Day](https://www.ncbi.nlm.nih.gov/pubmed/?term=Day%20JJ%5BAuthor%5D&cauthor=true&cauthor_uid=20975755) and [J. David Sweatt](https://www.ncbi.nlm.nih.gov/pubmed/?term=Sweatt%20JD%5BAuthor%5D&cauthor=true&cauthor_uid=20975755)**SIW 5.** Make a presentation about the main methods of getting recombinated genome. List advantages of all of them. **Sources:** recommended literature**SIW 6.** Make a speech about the role of prophages and methods of their integration in bacterial genome**Sources:** recommended literature |

Head of Department Z.G. Aitasheva

Lecturer A.B. Bigaliyev