

**Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
(RUDN UNIVERSITY)
Institute of Medicine**

Recommended by MCSD

ACADEMIC COURSE WORKING PROGRAM

Discipline: General Genetics

**Recommended for postgraduates
Direction 06.06.01 «Biological sciences»,
profile «Genetics: molecular basis of human hereditary diseases»
Qualification (degree) of a degree carrier:
Researcher. Lecturer-researcher**

1. Goal and tasks of the discipline:

- to train highly qualified academic personnel;
- to form and develop their competencies in the field of classical, molecular and medical genetics in accordance with professional standards;
- to form skills required to use the modern biological techniques and procedures

2. Position of the discipline in the structure of the Educational program:

Block 1 – Educational disciplines (modules). Variative part.

Preceding and following disciplines forming competencies of the discipline are shown in table 1.

Table 1. Preceding and following disciplines forming the given competencies

№	Code of competence	Preceding disciplines	Following disciplines
Universal competencies			
1	UC-1		Methodology of scientific research Methods in Human Genetics Human hereditary diseases Molecular basis of heredity
General professional competencies			
1	GPC-1		Methods in Human Genetics Human hereditary diseases Molecular basis of heredity
Professional competencies			
1	PC-1		Methods in Human Genetics Human hereditary diseases Molecular basis of heredity
2	PC-2		Methods in Human Genetics Human hereditary diseases Molecular basis of heredity
3	PC-4		

3. Requirements for the results of the discipline study

Discipline studying is designed to form the following competencies:

Universal competencies (UC)

- **UC-1.** the ability to analyze and evaluate current scientific achievements, generate new ideas and solve the research and practical problems.

GPC – general professional competencies.

- **GPC-1.** the ability to carry out research in the professional field with the use of modern methods of research and information technologies.

PC – professional competencies:

- **PC-1.** the ability to understand modern problems of biology and use fundamental biological ideas in professional activities for the goal setting and solution of new problems;
- **PC-2.** the ability to use the basic theories, concepts and principles in the chosen field of activity, the ability to systems thinking;
- **PC-4.** knowledge of the history and methodology of Genetics.

In consequence of studying the discipline a postgraduate is due to:

Know:

1. Methods used in modern genetics.
2. The concept of genetic, biochemical and structural unity of all life. The achievements of modern genetics which is one of the basic disciplines of modern biology.
3. The population as an elementary unit of evolution. The gene pool, the genetic unity, and genetic heterogeneity of natural populations. Genetic equilibrium in populations.
4. Chromosomes, the concept of karyotype. Morphological types of human chromosomes. Autosomes and sex chromosomes.
5. Concepts of the gene, the genotype, the genome, the phenotype. The allelic and non-allelic, linked and non-linked genes. Pleiotropic and lethal genes. The concepts of penetrance and expressivity. Forms of gene interaction.
6. The life cycle, mitotic and meiotic cell division. The control of the cell cycle.
7. The history of genetics. The laws of heredity. Patterns of inheritance.
8. Nucleic acids as the genetic material. Evidence of a genetic role of DNA. The chemical structure of the monomers of nucleic acids. The primary, secondary and tertiary structure of DNA and RNA molecules. Denaturation and annealing of DNA.
9. DNA replication in prokaryotic and eukaryotic cells.
10. Transcription and translation. The processing of RNA molecules. Control of gene expression in prokaryotic and eukaryotic cells.
11. Organization of the genetic material of viruses, prokaryotes, eukaryotes. The chromosomal and extrachromosomal DNA. Mobile genetic elements in eukaryotes and prokaryotes. Plasmids.
12. Genetic engineering and cloning.
13. Forms of variability. Classification of mutations. Molecular mechanisms of gene mutations. The causes of mutations. Mutagens. The basic mechanisms of DNA repair.
14. Methods of human genetics. Hereditary diseases and their causes. Principles of diagnosis, treatment and prevention of hereditary diseases. Genetic counseling.

Be able to:

1. use the methods of modern genetics, taking into account their capabilities and limitations;
2. determine the morphological types of chromosomes;
3. analyze the results of crosses and solve genetic problems;
4. carry out the polymerase chain reaction, and analyzing the results of the experiment in different ways;
5. classify mutations; analyze the causes of point mutations;
6. analyze the human karyotype;
7. classify hereditary diseases;
8. evaluate the risk of pathological trait in the offspring;
9. carry out the statistical processing of the data obtained in the research;
10. write scientific work at the level required to be published in peer-reviewed journals;
11. analyze study books and scientific articles.

Have the skills in:

1. modern molecular genetic techniques and procedures;
2. analysis, summarizing and public presentation of the results of the performed research work.

4. Discipline hours and types of training activity

General labor intensity is 4 points of credit

№	Type of academic load	Totally hours	Semesters	
			1	2
1.	Class exercises (academic hours)	80	40	40
	Including:			
1.1.	Lectures	40	20	20
1.2.	Practical classes	40	20	20
2.	Self-study work of postgraduates (academic hours)	64	32	32
3.	Total labor intensity (academic hours)	144	72	72
	<i>Total labor intensity (points of credit)</i>	4	2	2

5. Content of the discipline**5.1. Content of the discipline units**

№	Discipline unit	Content of the unit
1.	Introduction to Genetics	Subject and tasks of Genetics. Fields of Genetics. Genetics in Biology and Medicine. The history of Genetics.
2.	Genetic material.	Functions of nucleic acids, their location in the cell; the primary,

	Structure and functions of nucleic acids.	secondary, and tertiary structure of nucleic acids. The genetic code. DNA replication in prokaryotic and eukaryotic cells. DNA polymerases and their characteristics. The principles of the polymerase chain reaction (PCR). Forms of variability. Classification of mutations. Gene mutations and their causes. DNA repair mechanisms. Solving of genetic problems.
3.	Gene expression	Structure of eukaryotic and prokaryotic genes. Synthesis of RNA molecules (transcription) in prokaryotic and eukaryotic cells. Processing of RNA molecules. RNA polymerases. Control of gene expression in prokaryotes and eukaryotes. Operons. Translation in prokaryotic and eukaryotic cells. The Central Dogma of Molecular Biology. Solving of genetic problems.
4.	Genomes of viruses, prokaryotes and eukaryotes	Genetic material of viruses, prokaryotes and eukaryotes. Chromosomal and extrachromosomal DNA. Plasmids. Mobile genetic elements.
5.	Cell division	The life cycle, mitotic and meiotic cell division. The control of the cell cycle. Gametogenesis.
6.	The laws of heredity	Concepts of the gene, the genotype, the genome, the gene pool, the phenotype. The allelic and non-allelic, linked and non-linked genes. Pleiotropic and lethal genes. The concepts of penetrance and expressivity. Forms of gene interaction. The laws of heredity. Patterns of inheritance. Solving of genetic problems.
7.	Genetics of Populations	The population as an elementary unit of evolution. The gene pool, the genetic unity, and genetic heterogeneity of natural populations. Genetic equilibrium in populations. The Hardy–Weinberg Law. Solving of genetic problems.
8.	Human Genetics and Medical Genetics	Introduction to Human genetics and Medical genetics. Man as an object of genetic research. Methods of Human Genetics (pedigree analysis, twin study, karyotyping, DNA analysis). Classification of hereditary diseases. The principles of diagnosis, prevention and treatment of human hereditary diseases. Introduction to the molecular basis of the gene therapy. Genetic counseling. Solving of genetic problems.

5.2. Units of the discipline and types of classes

№	Unit	Lectures	Practical classes		Self-study work	Totally
			S	PC		
1.	Introduction to Genetics	4			2	6
2.	Genetic material. Structure and functions of nucleic acids	6		4	6	16
3.	Gene expression	6		8	20	34
4.	Genomes of viruses, prokaryotes and eukaryotes	4		6	4	14
5.	Cell division	4		4	2	10
6.	The laws of heredity	4		6	4	14

7.	Genetics of Populations	2		2	4	8
8.	Human Genetics and Medical Genetics	10		10	22	42
	TOTALLY:	40		40	64	144

6. Laboratory classes are not provided.

7. Practical classes

№	Units	Practical classes	Labor intensity (hours)
1.	Introduction to Genetics	-	-
2.	Genetic material. Structure and functions of nucleic acids	Structure and functions of nucleic acids. DNA replication in prokaryotic and eukaryotic cells.	4
3.	Gene expression	Synthesis of RNA molecules (transcription) in prokaryotic and eukaryotic cells. Translation in prokaryotic and eukaryotic cells. Control of gene expression	8
4.	Genomes of viruses, prokaryotes and eukaryotes	Genetic material of viruses. Genetic material of prokaryotes. Genetic material of eukaryotes.	6
5.	Cell division	Control of the cell cycle. Mitosis. Meiotic cell division.	4
6.	The laws of heredity	Mendel's laws. Sex-linked inheritance Inheritance of linked genes. Genetic mapping.	6
7.	Genetics of Populations	Genetic processes in populations	2
8.	Human Genetics and Medical Genetics	Human heredity. Hereditary diseases. The principles of diagnosis and prevention of human hereditary diseases.	10

8. Academic support:

a) main literature

1. Concepts of genetics / W.S. Klug; Pearson new international edition. - 3th ed. - England : Pearson, 2014. - 885 p.

b) additional literature

1. Gardner A., Davies T. Human Genetics. – Scion Publishing Ltd. – 2009.

2. Fletcher H., Hickey I. Genetics. – Garland Science. – 2013.
3. Lewin B. Genes. – Oxford University Press. – 2012.
4. Color Atlas of Genetics / Passarge Eberhard. - 4th edition, revised and update. - Stuttgart ; New York : Thieme, 2013.
5. Vogel and Motulsky's Human Genetics: Problems and Approaches / M. Speicher, Antonarakis S.E., Motulsky A.G. – Springer. – 2010.

9. Data bases, information, reference and search systems:

1. <http://esystem.rudn.ru/>
2. National Center for Biotechnology Information (NCBI) - www.ncbi.nlm.nih.gov
3. Royal Society of Chemistry <http://pubs.rsc.org/>
4. ScienceDirect - <http://www.sciencedirect.com>
5. Scientific electronic library: - <http://elibrary.ru>
6. Google Academy - <http://scholar.google.ru/>

10. Equipment and material support of the discipline:

- Computers
- Multimedia projectors
- The PCR laboratory

11. Methodological recommendations on discipline study organization:

During practical classes and lectures, corresponding topics are studied with the use of computers and multimedia projectors.

Before each class PhD students must read the corresponding topic in the recommended main and additional text-books and try to answer questions for self-study control.

Self-study work is organized in class rooms of the department and in the computer class.

Electronic study guides on some topics are also posted in the Internet on the site of the department:

<http://esystem.pfur.ru/>

Out-of-class self-study work includes:

- Learning topics with the use of text-books, study guides;
- Preparation of reports on the selected topic
- Preparation for tests

12. Evaluation instrument fund

Evaluation instrument fund for the discipline «General Genetics» is available for students at TUIS RUDN.

The program is designed in accordance with the RUDN educational standard of higher education.

Developers of the training and methodology complex


_____ M.M. Azova


_____ O.B. Gigani

Director of the program


_____ M.M. Azova

