

**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: Molecular basis of heredity**

**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 molecular 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	History and philosophy of science Methodology of scientific research General Genetics	
General professional competencies			
1	GPC-1	General Genetics	
Professional competencies			
1	PC-1	General Genetics	
2	PC-2	General Genetics	
3	PC-3		

### 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-3.** the readiness for the independent analysis of available information, the goal setting, and problem solving.

**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 history of molecular genetics.
4. 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.
5. DNA replication in prokaryotic and eukaryotic cells.
6. Transcription and translation in prokaryotic and eukaryotic cells. The processing of RNA molecules. Control of gene expression in prokaryotic and eukaryotic cells.
7. Organization of the genetic material of viruses, prokaryotes, eukaryotes. The chromosomal and extrachromosomal DNA. Mobile genetic elements in eukaryotes and prokaryotes. Plasmids.
8. Genetic engineering and gene therapy.
9. Forms of variability. Classification of mutations. Molecular mechanisms of gene mutations. The causes of mutations. Mutagens. The basic mechanisms of DNA repair.

***Be able to:***

1. use the methods of modern genetics, taking into account their capabilities and limitations;
2. carry out the polymerase chain reaction, and analyzing the results of the experiment in different ways;
3. classify mutations; analyze the causes of point mutations;
4. carry out the statistical processing of the data obtained in the research;
5. write scientific work at the level required to be published in peer-reviewed journals;
6. 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	
			3	4
<b>1.</b>	<b>Class exercises (academic hours)</b>	<b>80</b>	<b>40</b>	<b>40</b>
	Including:			
1.1.	Lectures	40	20	20
1.2.	Practical classes	40	20	20
<b>2.</b>	<b>Self-study work of postgraduates (academic hours)</b>	<b>64</b>	<b>32</b>	<b>32</b>
<b>3.</b>	<b>Total labor intensity (academic hours )</b>	<b>144</b>	<b>72</b>	<b>72</b>
	<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 Molecular Genetics	The subject and tasks of Molecular Genetics. Molecular Genetics in Biology and Medicine. The history of Molecular Genetics.
2.	Genetic material	Functions of nucleic acids, their location in the cell; the primary, secondary, and tertiary structure of nucleic acids. The genetic code. DNA replication in prokaryotic and eukaryotic cells. DNA polymerases and their characteristics. Telomeres and telomerase. Gene mutations and their causes. DNA repair mechanisms. Solving of genetic problems.
3.	Gene expression. Transcription	Structure of eukaryotic and prokaryotic genes. Synthesis of RNA molecules (transcription) in prokaryotic and eukaryotic cells. RNA polymerases. Processing of RNA molecules in prokaryotic and eukaryotic cells. Solving of genetic problems.
4.	Gene expression. Translation	Translation in prokaryotic and eukaryotic cells. The genetic code. Protein processing. The Central Dogma of Molecular Biology. Solving of genetic problems.
5.	Control of gene expression	Control of gene expression in prokaryotes and eukaryotes. Control of transcription, translation, and processing.
6.	Genomes of viruses, prokaryotes and eukaryotes	Genetic material of viruses, prokaryotes and eukaryotes. Chromosomal and extrachromosomal DNA. Plasmids. Mobile genetic elements in

		prokaryotic and eukaryotic cells.
7.	DNA analysis	Modern techniques of DNA analysis (PCR, gel electrophoresis, DNA restriction analysis, DNA sequencing, Southern blotting)
8.	The gene therapy	The molecular basis of the gene therapy and genetic engineering.

## 5.2. Units of the discipline and types of classes

№	Unit	Lectures	Practical classes		Self-study work	Totally
			S	PC		
1.	Introduction to Molecular Genetics	4			2	6
2.	Genetic material	6		6	10	22
3.	Gene expression. Transcription	6		6	10	22
4.	Gene expression. Translation	4		6	10	20
5.	Control of gene expression	6		6	10	22
6.	Genomes of viruses, prokaryotes and eukaryotes	4		4	6	14
7.	DNA analysis	6		10	10	26
	The gene therapy	4		2	6	12
	<b>TOTALLY:</b>	<b>40</b>		<b>40</b>	<b>64</b>	<b>144</b>

**6. Laboratory classes** are not provided.

## 7. Practical classes

№	Units	Practical classes	Labor intensity (hours)
1.	Introduction to Molecular Genetics	-	-
2.	Genetic material	Structure of nucleic acids DNA replication in prokaryotic cells. DNA replication in eukaryotic cells.	6
3.	Gene expression. Transcription	Synthesis of RNA molecules (transcription) in prokaryotic cells. Transcription in eukaryotic cells. Processing of RNA molecules in prokaryotic and eukaryotic cells.	6
4.	Gene expression. Translation	Translation in prokaryotic and eukaryotic cells.	6

5.	Control of gene expression	Control of transcription in prokaryotes and eukaryotes. Post-transcriptional regulation of gene expression	6
6.	Genomes of viruses, prokaryotes and eukaryotes	Chromosomal and extrachromosomal DNA. Mobile genetic elements in prokaryotic and eukaryotic cells.	4
7.	DNA analysis	PCR DNA sequencing, Southern blotting	10
8.	The gene therapy	Molecular basis of the gene therapy	2

## **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. 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](http://www.ncbi.nlm.nih.gov)
3. ScienceDirect - <http://www.sciencedirect.com>
4. Scientific electronic library: - <http://elibrary.ru>
5. 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 of 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 «Molecular basis of heredity» 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

