

*Federal State Autonomous Educational Institution of Higher Education "Peoples'
Friendship University of Russia"*

Agrarian and Technological Institute

Recommended by ISSC / ME

THE WORKING PROGRAM OF THE DISCIPLINE

The name of the discipline PLANT GENETICS

Recommended for direction of training/specialties

06.06.01 "Biological Sciences"

(Code and name of the direction of training / specialty are indicated)

Focus of the program (profile)

03.02.07 Genetics

(Educational program in accordance with the direction (profile))

1. Goals and objectives of the discipline:

Purpose: the formation of a theoretical base necessary for the implementation of research and teaching activities in the field of genetics.

Tasks: in-depth study of the theoretical and methodological foundations of genetics; improvement of biological education, including focused on professional activities in the field of genetics.

2. Place of discipline in the structure of EP VO:

Discipline "Plant Genetics" is included in the Variable part of General education disciplines *curriculum*.

The interrelation of the discipline with other disciplines of OOP, such as "History and Philosophy of Science", "Foreign Language", "Methodology of Scientific Research" contributes to the in-depth preparation of graduate students to solve professional problems in the field of genetics.

Table 1 shows the subsequent disciplines aimed at the formation of competencies in accordance with the competence matrix of EP HE.

Table No. 1

Prior and subsequent disciplines aimed at the formation of competencies

P / p No.	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
Universal competences			
1	UC-1: the ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary fields		The genetic basis of plant immunity Molecular and biochemical markers Plant breeding and biotechnology
General professional competencies			
1	GPC-1: the ability to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies		The genetic basis of plant immunity Molecular and biochemical markers Plant breeding and biotechnology
Professional competence			
1	PC-1: the ability to understand modern problems of biology and use fundamental biological concepts in the field of professional activity to formulate and solve new problems;		Russian language in sphere professional communications The genetic basis of plant immunity
2	PC-2: Ability to use basic theories, concepts and principles in the chosen field of activity, ability to think systems		Molecular and biochemical markers Plant breeding and biotechnology
3	PC-4: Knowledge of the history and methodology of genetics, expanding general professional, fundamental training		

3. Requirements for the results of mastering the discipline:

The process of studying the discipline is aimed at the formation of the following competencies:
Universal Competencies (UC):

UC-1: the ability to critically analyze and evaluate modern scientific achievements, generate new ideas when solving research and practical problems, including in interdisciplinary fields

General professional competences (GPC):

GPC-1 - the ability to independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies

Professional competencies (PC):

PC-1: Ability to understand modern problems of biology and use fundamental biological concepts in the field of professional activity to formulate and solve new problems

PC-2: Ability to use basic theories, concepts and principles in the chosen field of activity, ability to think systems

PC-4: knowledge of the history and methodology of genetics, expanding general professional, fundamental training

As a result of mastering the discipline, a graduate student must:

Know: fundamental foundations, directions and achievements of modern genetics; modern research methods in the field of genetics; the main directions and prospects of using the achievements of modern genetics in biomedicine, agriculture, in the field of nature protection.

Be able to: explain the fundamental foundations of genetics, modern achievements, problems and trends in the development of genetics, its relationship with other sciences; explain the essence of genetic processes and their mechanisms; critically analyze information about modern achievements of genetics and its applied use; to determine promising directions of scientific research.

Possess: genetic terminology and genetic concepts; methods for solving genetic problems; information on the prospects for the development of molecular genetic methods.

The types of professional activities for which graduates are trained who have mastered the postgraduate program 06.06.01 "Biological Sciences":

research activities in the field of biological sciences; teaching activities in the field of biological sciences.

4. Scope of discipline and types of educational work

The total workload of the discipline is _____ 4 _____ credit units.

Type of educational work	Total hours	Semesters			
		3	4		
Classroom lessons (total)	80	40	40		
Including:	-	-	-	-	-
Lectures	40	20	20		
Practice workshop	40	20	20		
Independent work (total)	34	11	23		
knowledge control	30	21	9		
Total labor intensity hour	144	72	72		
credits units	4				

5. Content of the discipline

5.1. Contents of discipline sections

Name of the discipline	Plant genetics
Credit / Hours	4 / 144 hours
Discipline summary	
The name of the sections (topics) of the discipline	Summary of sections (topics) of the discipline
Introduction to plant genetics	Genetics and its place in the life sciences. The concept of heritability and genetic variation. History of Genetics. The role of genetics in agriculture, medicine, biotechnology and ecology. Genes as determinants of species diversity. Genetic diversity.
Patterns of inheritance	Methodology in plant genetics. Genes and gene products. Alleles frequency of the same gene. The chi-square test for genetic interactions. Autosomal inheritance. Genes interactions – Complementary, Suppression, Epistasis (dominant and recessive epistasis), Polymerism, Transgression. Pleiotropy, Genes Modifier. Expressivity and penetrance of genes. Influence of external conditions on the gene expression. Genotypes. Sex chromosomes and linked inheritance.
The chromosomal theory of inheritance	Chromosomal theory of T. H. Morgan. The history of chromosomal theory. Chromosomes. Mitosis and meiosis. Crossing-over and its mechanism. The quantity chiasm and the linear arrangement of genes on the chromosome. Single and multiple crossing-over. Interference. Localisation of genes. Linked inheritance of genes and crossing-over. The linear arrangement of genes on the chromosome. The genetic map of the chromosomes. Cytological evidence of crossing-over. Factors affecting the chiasm of chromosomes. Somatic crossing-over. Molecular basis of crossing-over.
The molecular basis of heredity	Nucleic acids - the hereditary material of organisms. The structure of nucleic acids. The chemical composition and species specificity of the DNA. General features of DNA replication. DNA synthesis in Eukaryotes. RNA as the genetic material and its replication. RNA types in the polypeptide synthesis. Messenger RNA. Ribosomal RNA. Transfer RNA. Transcription of DNA into RNA template (reverse transcription). Genetic code and its properties. Evidence of the triplet code. The degeneracy of the code. Universality of the genetic code. Protein biosynthesis. Structure of the eukaryotic gene: exons, introns. Post-transcriptional processing of mRNA in eukaryotes (processing, splicing). Organization of the promoter region in eukaryotes. Genetic engineering and its problems
Modification and mutational variability. Polyploidy.	Induced and spontaneous mutagenesis. Mutation. Mutagenic factors. Ionizing radiation and mutation. Chemical mutagenic factors. Polyploidy and aneuploidy.
The genetics of ontogenesis	Ontogenesis - genetically determined program of development of species. Genome stability and the differential activity of genes in the process of individual development. Gene expression and its effects on embryonic stage. Amplification of genes. Tissue-specific gene activity. Genes pleiotropic and its effects in ontogeny. Genes interaction determining the formation of traits in ontogeny. Cell relationships in morphogenesis.

Distant/ remote hybridization	The concept of distant hybridization. Types of hybrids obtained by distant hybridization in plants and animals. Barriers of the non-combining ability during hybridization. Methods for overcoming the non-combining ability during hybridization.
Population genetics. Inbreeding and heterosis.	Elementary processes of evolution. Changes in the genetic structure of a population as a result of natural selection. Changes in gene frequencies under complete dominance. Changes in gene frequency in the absence of dominance. Changes in gene frequencies at superdominance. Genetic and automatic processes in the population (random genetic drift). Migration and its impact on the population structure. Factors of population isolation. The concept of genetic load. Genetic homeostasis in populations. Inbreeding in cross-pollinating crops. Inbred minimum. Plant inbred lines. Hypothesis of overdominance and its genetic basis. Applications of inbreeding and heterosis effects in agricultural practices.
Plant genomics	Review on plant genomics. Organization of plant genome. Comparative genome mapping and modeling system.

5.2. Sections of disciplines and types of classes

N o.	Discipline section	Lecture.	Practice.	knowledge control	Ind. work	Total hour.
1.	Introduction to plant genetics	2	2	3	3	
2.	Patterns of inheritance	4	4	3	4	
3.	Chromosomal theory of inheritance	4	4	3	4	
4.	Molecular basis of heredity	6	6	4	4	
5.	Modification and mutational variability. Polyploidy.	4	4	3	4	
6.	The genetics of ontogenesis	4	4	3	3	
7	Distant/ remote hybridization	4	4	3	4	
8	Population genetics. Inbreeding and heterosis.	4	4	3	3	
9	Plant genomics	6	6	5	5	
Total		40	40	30	34	144

6. Laboratory workshop (in the presence of)

7. Practical exercises (seminars)

P / p No.	Practical training topics	Labor capacity (hour.)
-----------	---------------------------	------------------------

1.	Introduction to plant genetics	2
2.	Patterns of inheritance	4
3.	Chromosomal theory of inheritance	4
4.	Molecular basis of heredity	6
5.	Modification and mutational variability. Polyploidy.	4
6.	Ontogenetic genetics	4
7.	Remote hybridization	4
8.	Population genetics. Inbreeding and heterosis.	4
9.	Plant genomics	6
Total		40

8. Material and technical support of the discipline:

- Specialized equipment for general use:
 - Water bath
 - Laboratory balance
 - pH meter
 - Heating table
 - Magnetic stirrer
 - Distiller
 - Autoclave
 - Centrifuge
 - PCR Amplificator
 - Cameras, power supply, UV transilluminator for DNA gel electrophoresis and analysis
 - Laminar box

9. Information support of the discipline

a) software

Volume Licensing Program (Microsoft Subscription) Enrollment for Education Solutions (EES) No. 56278518 dated 04/23/2019 (renewed annually, the program is assigned a new number).

b) databases, reference and search systems

1. EBS of RUDN University and third-party EBS to which students have access on the basis of concluded agreements:

- Electronic library system RUDN - EBS RUDN <http://lib.rudn.ru/MegaPro/Web>
- EBS "University Library Online" <http://www.biblioclub.ru>
- EBS Yurayt <http://www.biblio-online.ru>
- EBS "Student Consultant" www.studentlibrary.ru
- EBS "Doe" <http://e.lanbook.com/>
- TUIS: <http://esystem.pfur.ru/course/view.php?id=46>

2. Database of biological publications:

- **Bulletin of RUDN University**: access mode from the territory of RUDN University and remotely <http://journals.rudn.ru/>
- **Scientific library Elibrary.ru**: access by IP-addresses of RUDN University at the address: <http://www.elibrary.ru/defaultx.asp>
- **ScienceDirect (ESD), "FreedomCollection", "Cell Press" ID "Elsevier"**. There is remote access to the database, access by IP-addresses of RUDN University (or remotely by individual login and password).
- **Google Academy (eng. Google Scholar)** - free search engine for full texts of scientific publications of all formats and disciplines. Indexes full texts of scientific publications. Access mode: <https://scholar.google.ru/>
- **Scopus** - scientometric database of publishing house "Elsevier". There is remote access to the database.

Access by IP-addresses of RUDN University and remotely by login and password (Grant of the Ministry of Education and Science). Access mode: <http://www.scopus.com/>

- **Web of Science**. There is remote access to the database. Access to the platform is carried out by IP-addresses of the RUDN University or remotely. Remote access to WOS is activated without administrator intervention after registering on the platform from RUDN University <http://login.webofknowledge.com/>
- Protein Data Bank, PDB Database - <http://www.rcsb.org> (open access)
- SWISS-PROT, UniProt the protein sequence data bank, UniProt database - <http://beta.uniprot.org> (open access)
- UniProt database on the server of the European Bioinformatics Institute (EBI) - <http://www.ebi.ac.uk/uniprot> (open access)
- Databases Swiss-Prot, TrEmbl, UniProt on the server ExPASy (Expert Protein Analysis System) of the Swiss Institute of Genomics and Proteomics SIB - <http://www.expasy.org> (open access)
- Classical and molecular biology - <http://molbiol.ru> (open access)
- Joint Center for Computational Biology and Genomics, and Proteomics, a Russian-language information site with web addresses and a brief description of molecular biological databases - <http://www.jcibi.ru> (open access)
- Practical Molecular Biology - <http://molbiol.edu.ru> (open access)
- Server of the US National Center for Biotechnology Information (NCBI): databases GenBank, NCBI Protein Database, UniGene, HomoloGene, etc. - <https://www.ncbi.nlm.nih.gov/> (open access)
- Server of the Molecule Modeling Center of the National Institutes of Health NIH, USA - <https://cmm.cit.nih.gov/>

3. Internet resources:

- Genetic Analysis / Eds. Griffiths AJF, Gelbart WM, Miller JH, Lewontin RC - <http://www.ncbi.nih.gov/book/genomic>
- Genomics / Brown E. 2nd ed. - <http://www.ncbi.nih.gov/book/genomic>
- Modern Genetic Analysis - <http://www.ncbi.nih.gov/book>
- Modern Genetic Analysis / Eds. Griffiths AJF, Gelbart WM, Miller JH, Lewontin RC - <http://www.ncbi.nih.gov/book/genomic>
- Molecular Cell Biology. / Eds. Lodish H., Berk A., Zipursky S. L., Matsudaria P., Baltimore D., Darnell D - <http://www.ncbi.nih.gov/book/genomic>

10. Educational and methodological support of the discipline:

a) main literature

1. Nakhaeva, V.I. Practical course in general genetics: textbook / V.I. Nahaeva. - 3rd ed., Stereotype. - Moscow: Flint Publishing House, 2016. - 210 p. - ISBN 978-5-9765-1204-7; The same [Electronic resource]. <http://biblioclub.ru/index.php?page=book&id=83544>
2. Romanova E.V. General Genetics [Text / electronic resource] = General Genetics. Manual for Graduate Students: Textbook / E.V. Romanov, P. Keziman. - The book is in English; Electronic text data. - M.: Publishing house of RUDN, 2018. -- 104 p. : ill. - ISBN 978-5-209-08470-9: 71.84

b) additional literature

- one . Kuznetsov, V.V. Molecular genetic and biochemical methods in modern plant biology [Electronic resource]: textbook / V.V. Kuznetsov, V.V. Kuznetsov, G.A. Romanov. - Electron. Dan. - Moscow: Publishing House "Laboratory of Knowledge", 2015. - 498 p. <https://e.lanbook.com/book/66252>.
2. Genetic Variation and Evolution. Cambridge, MA: NPG Education, 2010. <https://www.nature.com/scitable/ebooks/cntNm-16553748>

11. Methodical instructions for students on mastering the discipline (module)

Starting to study the discipline " Plant genetics", the graduate student should familiarize himself with the content of her work program.

The educational process for mastering the discipline includes: lectures, practical classes and independent work. All forms of teaching are compulsory. Throughout the course, it is recommended to pass test tasks on the TUIS platform:<http://esystem.pfur.ru>

For practical training, before being admitted to work in a molecular biological laboratory, it is necessary to undergo safety instructions from a responsible person. At the beginning of each session, laboratory equipment should be checked for visible damage. If damage is found, inform the teacher. At the end of each lesson, the teacher summarizes the implementation of the practical lesson and gives a topic for study for the next lesson. After each PZ, the postgraduate student performs cleaning of his workplace.

Independent work is an important element of postgraduate student training. The tasks of independent work are to acquire the skills of independent research work based on the analysis of the texts of literary sources and the use of various research methods; developing the ability to independently and critically approach the material being studied.

Working with educational and scientific literature is the main form of independent work and is necessary in preparation for the current control of knowledge or intermediate certification. It includes the study of lecture material, as well as the study of recommended sources and literature on the subject of lectures. When self-studying a theoretical topic, a graduate student, using the literary sources and electronic resources recommended in the RPD, must answer control questions or complete tasks suggested by the teacher.

Detailed information, including theoretical material, a glossary and a list of recommended literature for graduate students can be found on the TUIS platform: <http://esystem.pfur.ru>...

During the semester, current control of knowledge and intermediate certification of graduate students are carried out. Ongoing control is carried out at each practical lesson in the form of a selective, group or individual survey in oral or written form in order to check the formation of the competencies set forth in the FOS.

The study of the discipline "Plant genetics" passing the exam (intermediate control). The exam is accepted on tickets in the form of an oral interview. Each exam ticket includes 3 questions. Questions for preparing for the exam are posted on the TUIS platform.

Features of the implementation of discipline for people with disabilities and people with disabilities.

Training in the discipline of disabled people and persons with disabilities (hereinafter HIA) is carried out by the teacher, taking into account the characteristics of psychophysical development, individual capabilities and health status of such students.

For students with musculoskeletal disorders and hearing disabilities, lectures will be accompanied by multimedia tools and handouts.

For students with visual disabilities, the use of technical means for enhancing residual vision is provided, and the possibility of developing audio materials is also provided.

In this discipline, training of disabled people and persons with disabilities can be carried out both in the classroom and remotely using the capabilities of the electronic educational environment (TUIS) and e-mail.

In the course of classroom training, various means of interactive learning are used, including group discussions, brainstorming, business games, project work in small groups, which makes it possible to include all participants in the educational process in active work on mastering the discipline. Such teaching methods are aimed at joint work, discussion, group decision-making, contribute to group cohesion and provide opportunities for communication not only with the teacher, but also with other students, cooperation in the process of cognitive activity.

Training of disabled people and persons with disabilities can be carried out according to an approved individual schedule, taking into account the characteristics of their psychophysical development and health status, which implies the individualization of the content, methods, pace of the student's learning activity, the ability to follow the specific actions of the student when solving specific problems, making the need, the required adjustments in the training process.

It provides for individual consultations (including counseling via e-mail), the provision of additional educational and methodological materials (depending on the diagnosis).

12. Fund of assessment tools for intermediate certification of students in the discipline (module)

Materials for assessing the level of mastering the educational material of the discipline (evaluation materials), including a list of competencies indicating the stages of their formation, a description of indicators and criteria for assessing competencies at various stages of their formation, a description of the assessment scales, typical control tasks or other materials necessary for the assessment of knowledge, abilities, skills and (or) experience of activity, characterizing the stages of the formation of competencies in the process of mastering the educational program, methodological materials that determine the procedures for assessing knowledge, skills, skills and (or) experience of activities that characterize the stages of formation of competencies, developed in full and available for students on the discipline page at TUIS RUDN.

.Developers:

Associate Professor of the Department of
Agrobiotechnology
position, department name


signature

E.V. Romanova
initials, surname

Director of the Department of
Agrobiotechnology
position, department name


signature

E. N. Pakina
initials, surname

Program manager
Associate Professor of the Department of
Agrobiotechnology
department name


signature

E.V. Romanova
initials, surname