

**HIGHER EDUCATION OF THE REPUBLIC OF UZBEKISTAN,  
MINISTRY OF SCIENCE AND INNOVATION**

**KOKAND STATE UNIVERSITY**

**FUNDAMENTALS OF GENETICS AND GENOMICS**

**SCIENCE CURRICULUM**

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| Field of Knowledge: | 500000 – Natural sciences, mathematics and statistics |
| Field of Study:     | 510000 – Biology and related sciences                 |
| Type of Study:      | 60510100 – Biology                                    |

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| <b>Subject/module code</b><br>GGA14510   | <b>Academic year</b><br>2025-2027               | <b>Semester</b><br>4-5           | <b>ECTS - Credits</b><br>5/5     |                          |
| <b>Subject/module type</b><br>Compulsory | <b>Language of instruction</b><br>Uzbek/Russian |                                  | <b>Weekly class hours</b><br>44/ |                          |
| <b>1.</b>                                | <b>Name of science</b>                          | <b>Auditory training (hours)</b> | <b>Independent study (hours)</b> | <b>Total load (hour)</b> |
|  | Fundamentals of Genetics and Genomics           | 60/60                            | 90/90                            | 150/150                  |

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| <b>2</b> | <p><b>I. The content of science</b></p> <p>The purpose of science. science from teaching goal to student genetics and selection the basics to oneself typical characteristics, development history, heredity, variation, selection goal and tasks about knowledge to give. that with together heredity laws of genetics, interaction of genes and many compensation influence, heredity chromosome theory, gender genetics, cytoplasmic heredity, heredity molecular basics, modification and mutation to variability related knowledge possession analysis to do to teach analytical, critical, creative and independent idea driving skills development</p> <p>The task of the science. The science of genetics solves a number of theoretical and practical problems of biology. The theoretical problems that it must solve are:</p> <ul style="list-style-type: none"> <li>examination of the structure and function of the material basis of heredity - chromosomes, genes, DNA and RNA molecules;</li> <li>determine the laws of transmission and development of the characteristics and properties of organisms to future generations;</li> <li>to reveal the laws of the emergence of hereditary variability in organisms under the influence of various physical and chemical factors;</li> </ul> <p>Research into the importance of genetic variation in the evolution of organisms.</p> <p>Based on theoretical laws, the science of genetics also solves the following important practical problems:</p> <ul style="list-style-type: none"> <li>development of effective methods for creating new varieties of cultivated plants, new breeds of domesticated animals, and new strains of beneficial microorganisms;</li> <li>studying the occurrence of various hereditary diseases in humans, creating effective methods for their prevention and treatment;</li> </ul> <p>Creating genetic methods to improve the ecological environment and preserve the gene pool of organisms from factors that negatively affect heredity</p> <p><b>II. Main theoretical part (lectures)</b></p> <p><b>II.I. The subject includes the following topics:</b></p> |
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**Topic 1. The subject, tasks and methodological foundations of genetics.**

The content of genetics. Branches of genetics. The main stages of the development of genetics. The main methods of genetics. The role of genetics in the system of natural sciences. Theoretical and practical significance of genetics.

**Topic 2. Cytological and biochemical basis of asexual reproduction**

Cell division. External, internal structure and chemical composition of chromosomes. DNA replication. Concept of karyotype. Genetic significance of mitosis. Informal types of mitotic division (amitosis, endomitosis, polyteny phenomenon).

**Topic 3. Cytological and biochemical foundations of sexual reproduction**

Meiosis division. Gametogenesis in animals. Sporogenesis and gametogenesis in plants. Fertilization in plants and animals. Informal types of sexual reproduction. Plant and in animals generations Galling . Biological significance of meiosis.

**Topic 4. Mendel's laws and monohybrid inheritance.**

Mendel's first and second laws of inheritance. Hypothesis of gamete purity. Inheritance of traits in the intermediate state. Statistical examination of segregation in  $F_2 - x^2$ .

**Topic 5. Di and polyhybrid inheritance.**

Crossbreeding. Cytological basis of crossbreeding. Statistical study of the results obtained in crossbreeding. Necessary conditions for the implementation of Mendel's laws. Expression and determination of gene alleles. Polyhybrid crossbreeding.

**Topic 6. Sex genetics.**

Sex genetics. The role of chromosomes and genes in sex determination. Development of sex in humans. Sex differentiation. Sex determination through hormones.

**Topic 7. Sex-linked inheritance of traits.**

Inheritance of traits (genes) linked to sex. Inheritance of traits when sex chromosomes are not distributed. Inheritance when linked to the X chromosome. Sex-limited and sex-linked traits.

**Topic 8. Crossover, the combined inheritance of traits.**

Gene clustering. Crossingover. Cytological proof of crossover. Double crossover and interference. Genetic maps. Factors affecting crossover. Chromosomal theory of heredity.

**Topic 9. Types of gene interaction in the inheritance of traits. Complementary effect.**

Interaction of allelic genes. The effect of the dominant allele of a gene on the recessive allele. Multiple allelism. Codominance. Interaction of nonallelic genes. Complementary. The ratio of characters in  $F_2$  is in the 9:3:3:1 scheme. The ratio of characters in  $F_{22}$  is in the 9:3:4 scheme. The ratio of

characters in  $F_2$  is in the 9:7 scheme. The ratio of characters in  $F_2$  is in the 9:6:1 scheme.

**Topic 10. Epistatic effects in the inheritance of genes.**

Epistasis. Its dominant and recessive forms.

**Topic 11. Polymeric and pleiotropic effects in gene inheritance**

Polymerization. Its cumulative and non-cumulative forms. The phenomenon of transgression. The effect of modifier genes. Expressivity and penetrance.

**Topic 12. Cytoplasmic inheritance**

General concept of cytoplasmic inheritance. Plastid-linked inheritance. Mitochondrial inheritance. Cytoplasmic predetermination. Cytoplasmic male infertility. Inheritance of small particles and symbionts in the cell. Molecular basis of cytoplasmic inheritance. Specific features of the genome of chloroplast and mitochondrial genes.

**Topic 13. Volatility**

Variation and its types. Mutational variation. Gene mutations. Chromosome mutations. Genome mutations. Natural and artificial mutations.

**Topic 14. Molecular Basis of Heredity**

Bacterial transformation. Transduction. Gene structure. Protein biosynthesis in the cell. Special types of genetic information transfer.

**Topic 15. Genetics of ontogenesis**

General concept of ontogenesis. Genetic program of ontogenesis. Genetic methods used in the study of ontogenesis. Regulation of protein biosynthesis in the cell. Operon system.

**Topic 16. Population genetic structure and genetic basis of evolution**

General concept of population. Heredity in populations. Factors influencing population genetic dynamics. Genetic basis of evolution.

**Topic 17. Behavioral genetics**

Behavioral manifestations. Tasks of behavioral genetics. Study of Animal Behavior. Genetic Basis of Human Behavior.

**Topic 18. Genetic engineering and biotechnology**

The concept of genetic engineering. Transposable genetic elements. Plasmids. Restriction endonucleases. Obtaining recombinant DNA and cloning genes. Modifying plant heredity through genetic engineering.

**Topic 19. Introduction to Human Genetics**

Difficulties in studying human heredity and variability. The main goal of anthropogenetics. Methods of studying human heredity.

**Topic 20. Material basis of human heredity**

Cell cycle. History of the study of chromosomes. Chemical composition of chromosomes. Biosynthesis of oocysts in the cell.

**Topic 21. G. Mendel's laws on the inheritance of certain traits in humans**

**Hybridization** method . Inheritance in monohybrids . Oral inbreeding . Analytical crossbreeding .

**Topic 22. Coherence of traits in humans and the genetic map**

Morgan's law. Inheritance in complete linkage disequilibrium. Crossing over. Genetic maps. Chromosomal theory of heredity.

**Topic 23. Medical genetics**

Gene diseases. Chromosomal diseases. Genome diseases. Hereditary predisposition or multifactorial (multifactorial) diseases.

**Topic 24. Subject, content and objectives of selection**

new varieties, breeds and strains

**Topic 25. N.I. Vavilov's doctrine of the centers of origin of cultivated plants**

The law of homologous sequences in hereditary variation. Origin and centers of diversity of cultivated plants.

**Topic 26. Classification of crossbreeding types and propagation methods**

inbreeding - crossbreeding of related species, outbreeding - crossbreeding of unrelated species. The infertility of hybrids of genetically distant forms.

**Topic 27. Heterosis**

The dominant hypothesis of hyperdominance. The concept of genetic balance. the concept of compensatory complexes.

**Topic 28. Selection methods**

Mass and individual selection.

**Topic 29. Seed production**

Change name, update name elite seeds

**Topic 30. Scientific work in the field of genetics and breeding sciences in Uzbekistan**

AAA bdullaev, JAMusaev, MAKhmedov, MFAabzalov, ASAlmatov, Sh.Turabekov, ATG'ofurov, S.Fayzullaev

**III. Instructions and recommendations for practical training**

*Practical Recommended topics for work:*

1. Chromosome morphology.
2. Meiosis. Phases of meiosis.
3. Mitosis. Phases of meiosis.
4. Symbols used in genetics
5. Gamete retrieval procedure
6.  $\chi^2$  method
7. Issues related to the inheritance of traits in combination with sex solution.
8. Complete and incomplete merging of characters. Calculation of the amount of crossover.
9. Identifying attachment groups
10. solve problems involving the ratios 9:3:3:1, 9:6:1, 9:7, and 9:3:4. Complementary inheritance

11. In the second section, solve problems involving the ratios 13:3, 12:3:1, 9:7, 9:3:4. Epistasis
12. Commulative and non-commulative inheritance of quantitative traits  
Solving problems about the interaction of genes.
13. Heredity molecular Solve puzzles about the basics.
14. Problems related to finding the number and percentage of DNA nucleotides
15. Hydrogen in a DNA molecule gardens number find
16. DNA in the molecule phosphodiester gardens number find
17. DNA in the molecule total water gardens number find
18. Depends on the process of mRNA synthesis problem solving
19. Protein weight to find circle problem solving
20. Amino acids number solving problems about finding
21. Viewing chromosomes in a human somatic cell on a microscope slide, constructing a chromosome idiogram.
22. The issue of G. Mendel's laws in the inheritance of traits in humans and solving exercises.
23. Issues related to the inheritance of traits in humans solution
24. Genes of human traits mutual on the influence of heredity problem solving.
25. Genes of human traits mutual Solving issues related to heredity under the influence of.
26. Selection materials to the quality looking at grouping
27. Cotton varieties diversity main to the signs looking at grouping
28. Fruity plants variety uniforms comparison
29. In Uzbekistan sowable corn navigator to oneself typical signs
30. Seed potatoes, wheat, oilseed varieties

#### **IV. Independent education and independent affairs**

*Recommended independent work topics:*

1. The role of genetics in the system of natural sciences
2. Theoretical and practical importance of genetics
3. DNA replication
4. Informal types of cell division
5. Biological significance of mitosis
6. Informal types of sexual reproduction
7. Breeding of species in plants and animals
8. Biological significance of meiosis
9. Inheritance of traits through an intermediate process
10. Multiple allelism
11. Statistical analysis of the inheritance of traits in  $F_2 - x^2$
12. Statistical analysis of the results obtained from hybrids -  $x^2$
13. Necessary conditions for the implementation of Mendel's laws
14. Inheritance of traits linked to sex
15. Inheritance of traits in the absence of chromosome distribution

16. Inherited by X-linked inheritance
17. Gender-restricted and gender-bound characters
18. Genetic method of early sex determination
19. Double crossover
20. Interference
21. Comparison of genetic and cytological maps of chromosomes
22. Factors affecting crossover
23. Chromosomal theory of heredity
24. Epistasis effect.
25. Effect of modifier genes
26. Expressivity and penetrance
27. Cytoplasmic male infertility
28. Inheritance of small particles and symbionts in the cell
29. Molecular basis of cytoplasmic inheritance
30. Natural and artificial mutations
31. Methods for detecting recessive mutations
32. The concept of modification and variability
33. Studying modification variability using mathematical statistical methods
34. Genetics of ontogenesis
35. Protein biosynthesis in the cell
36. Population inheritance
37. Factors affecting population genetic dynamics
38. Genetic basis of evolution
39. Eugenics
40. Studying the inheritance of traits using genetic engineering
41. Studying animal heredity using cell engineering
42. Animal cloning
43. Studying the human genome
44. The inheritance of human traits through the interaction of genes
45. Mutagenesis
46. Animals selection
47. In Croatian hybridization
48. At that moment fertilization
49. Oh my god personal development
50. Oh, my. development genetic program
51. Oh, my. family tree
52. In man pleiotropic genes mutual impact
53. Oh, my. genetic map
54. Oh, my. gender harmonies impact
55. Selection materials to the quality looking at grouping
56. Cotton varieties diversity main to the signs looking at grouping
57. Fruity plants variety uniforms comparison
58. In Uzbekistan sowable corn varieties to oneself typical signs
59. In Uzbekistan sowable potato varieties to oneself typical signs
60. Seed potatoes, wheat, oilseed varieties

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| 3. | <p><b>V. Learning outcomes/Professional competencies</b></p> <p>As a result of learning a subject, the student:</p> <ul style="list-style-type: none"> <li>- basic concepts of genetics and selection, heredity, variability and the history of the development of selection; heredity and variability, its types, Mendel's laws, genetics of sex, heredity in the combined state, the interaction of genes, genetic engineering, biotechnology and selection, the goals and objectives of selection, the history of the development of selection, the centers of origin of cultivated plants, <b>knowledge about the diversity of breeds, varieties and strains</b></li> <li>- basic concepts of genetics and selection, heredity, variability and the history of the development of selection; heredity and variability, its types, Mendel's laws, genetics of sex, heredity in the combined state, the interaction of genes, genetic engineering, biotechnology and selection, the goals and objectives of selection, the history of the development of selection, centers of origin of cultivated plants, <b>the skills to identify differences in breeds, varieties and strains and to determine the causes of the process;</b></li> <li>- basic concepts of genetics and selection, heredity, variability and the history of the development of selection; heredity and variability, its types, Mendel's laws, genetics of sex, heredity in the combined state, the interaction of genes, genetic engineering, biotechnology and the goals and objectives of selection, the history of the development of selection, centers of origin of cultivated plants. Must have <b>the skills to evaluate breeds, varieties and strains</b></li> </ul> |
| 4. | <p><b>VI. Educational technologies and methods:</b></p> <ul style="list-style-type: none"> <li>• lectures;</li> <li>• interactive case studies;</li> <li>• seminar (logical thinking, quick questions and answers);</li> <li>• work in groups;</li> <li>• making presentations;</li> <li>• individual projects;</li> <li>• Projects for teamwork and advocacy.</li> </ul>   |
| 5. | <p><b>VII. Requirements for obtaining loans:</b></p> <p>Fully master the theoretical and methodological concepts of the subject, be able to correctly reflect the results of the analysis, conduct independent observations of the processes and concepts being studied, and complete the tasks and assignments given in the current and intermediate control forms, and pass the final control test.</p>   |
| 6. | <p><b>Main literature</b></p> <ol style="list-style-type: none"> <li>1. Gafurov AT “Evolutionary education” Tashkent “Alokachi” 2009. Textbook</li> <li>2. Gafurov AT, Fayzullaev SS, “Genetics” Tafakkur 2010. Textbook</li> <li>3. Haydarov S. “Methods of solving problems and exercises in genetics” methodological manual “Navruz” Tashkent- T 2014</li> </ol> <p><b>Q additional literature</b></p>   |



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|  | <ol style="list-style-type: none"> <li>1. Fayzullayev SS, Gafurov AT, Matchonov BE “Human Genetics” Tashkent “Barkamol Fayz Media”, 2018 textbook</li> <li>2. Sobirov P “Genetics and Biotechnology” Tashkent. “O'FMJ” T – 2019 textbook</li> <li>3. Asanov A "Basic Genetics and Hereditary Disorders" "Academy M - 2003" study guide</li> <li>4. Musayev J. “Fundamentals of Genetics and Selection” textbook “Teacher” Tashkent – 2000</li> </ol> <p><b>Information sources</b></p> <ol style="list-style-type: none"> <li>1. <a href="http://www.Ziyonet.uz">www.Ziyonet.uz</a></li> </ol> |
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