



Department of Biology

College of Science

Salahaddin University - Erbil

Subject: Genetics

Course Book – (Year 4)

Lecturer's name Mustafa Sabir Mustafa, PhD

& Mohamed Ali Saleem, M.Sc.

Academic Year: 2020/2021

Course Book

1. Course name	Genetics
2. Lecturer in charge	Prof.Dr. Mustafa Sabir Mustafa & Lecturer Mohamed Ali Saleem
3. Department/College	Biology / Science
4. Contact	e-mail: mustafa.mustafa@su.edu.krd, mohammed.saleem@su.edu.krd Tel: (0750 461 65 38) (0750 413 21 45)
5. Time (in hours) per week	For example Theory: 2 Practical: 2
6. Office hours	To be Return to the schedule on the office door
7. Course code	SBG 406
8. Teacher's academic profile	<p>I graduate from Salahaddin University in 1992(Ranked 2th in collage) accepted directly in post graduate Msc . In 1995 I finished my MSc degree and start as Assistant Lecturer Teaching Practical Genetics, Practical Cell Biology, Practical Endocrinology, and Practical Medical Entomology. For 8 years (Between 1995-1999) and (2004-2006) I worked as a Member of the Examination Committee for College of Science. I worked as a head of Central Examination Committee for College of Science in 2013-2014.</p> <p><u>My experience:</u></p> <ul style="list-style-type: none"> • Assist. Lecturer in College of Science 1995. • Lecturer in College of Science 2004- 2008. • Assist. Prof. from 13/8/2008 till now. • Director of central chemical warehouse from 1996 till 2005. • Director of Science affairs section in presidency of Salahaddin University from 2005 till November 2008. • Editorial secretary of Zanko Journal of Pure and Applied Sciences/ Salahaddin University-Erbil from 2005 till May 2009. • Member of editorial board of Zanko Journal of Pure and Applied Sciences/ Salahaddin University- Erbil from 2009 till now. • Head of Ecology Department/ College of Science, from June 2007 till September 2008. • Head of Biology Department/ College of Science from September 2008 till 2013. • Head of Environmental Science Department/ College of Science from January 2013 till 2017. • Vice president of scientific affairs and postgraduate studies of Salahaddin university-Erbil from Feruary 2017 till now. <p>In 2004 I get my PhD degree in Human and Animal Genetics from 2004-2008, as a Lecturer, and from 2008 till now I am in charge in teaching Genetics theory for 4th class students, , Supervising Genetics Practical Laboratory, Teaching Advanced Genetics, Cytogenetics, Human Genetics, and Cell Biology for Graduate students</p> <p>Number of M.Sc thesis under my supervision: (6 thesis) Number of Ph.D thesis under my supervision: (1 thesis) Now two M.Sc students work under my supervision</p>
9. Keywords	Genetics, Principles of Genetics, Animal Genetics, Plant Genetics, Microbial Genetics, Population Genetics, Sex and Environment, Chromosomal aberrations, Repair system, Molecular biology.

10. Course overview:

Course description, objectives, and format

Genetics is one of the basic science courses that comprise the Biology curriculum of the four years of Science College. The overall goal of these courses is to provide with the knowledge and understanding of the scientific principles that are the basis of current approaches to know the genetic basis of organisms. The application of these scientific principles and knowledge to the practice of science and diseases, including the development of life-long learning and problem-solving skills, is emphasized. The genetic course consists of 30 lectures (annually) and covers topics are integrated with the concurrent agriculture, medicine, statistics, microbiology, pathology, and integrated problems.

Lectures from basic sciences, clinical disciplines and microbiology teach the fundamental principles of genetic and how these principles apply to the diagnosis and treatment of these problems in above fields.

Course learning objectives

By the end of this course, students will be able to apply their basis background in genetics to the practice of agriculture, scientific research, including the effective diagnosis, treatment and prevention of genetic disease. Detailed learning objectives are provided for each lecture.

11. Course objective:

Each lecture is accompanied by a power point presentation. Information from the presentation and assigned reading is important for mastering the learning objectives which are the primary focus of exam questions.

Example:

- History of Genetics,1-Blending theory, 2-Acquired character inheritance, 3-Pangenesis theory, 4- Performation and Epigenesis, 5-Cell theory (Classical and modern interpretation)
- The subject matter of genetics includes: Heredity; The molecular nature of the genetic material; The ways in which genes, which determine the characteristics of organisms, control life functions; The distribution and behavior of genes in populations.
- Genetics four major subdisplines: Transmission Genetics; Molecular Genetics; Population Genetics; Quantitative Genetics
- Gene Expression, Genome, chromatin, chromosome, Gene (Mendelian factor), Allele, Homozygous, Heterozygous, Genotype, Phenotype.
- Characteristics of Organisms Used For Genetic Studies, General Features
- Viruses, *Eschirichia.coli*, Human, *Drosophila melanogaster*, Maize, *Arabidopsis thaliana*.
- Methods of genetic study, 1- Planned breeding, 2- Pedigree analysis
- Why do Pedigrees?, Goals of Pedigree Analysis, Symbols used in pedigree analysis
- Autosomal recessive trait, Autosomal dominant trait
- Complete dominance, -incomplete dominance, Codominance, Overdominance, Heterosis.
- Lethal genes, a-Dominant genes with recessive lethal effect, b- Recessive gene with recessive lethal effect.
- Multiple alleles
- Multiple genes (Polygeny)
- Qualitative genetics
- Quantitative traits
- Epistasis, epistatic gene, hypostatic gene, Types of epistasis, Classical ratio, Dominant epistasis, Recessive epistasis, Duplicate genes with cumulative effect, Duplicate dominant genes, Duplicate recessive genes, Dominant and recessive interaction.

12. Assessment scheme

Examinations

There will be at least two obligate exams through the year (one exam in each semester), each exam will contain multiple-choice, true-or-false, short answer questions, long answer questions, give the reasons, solving the problems, make the diagram, etc. .

Quizzes and weekly assignments:

The exam has (10) marks, the practical exam have (35) marks, so the final grade will be based upon the following criteria:

Mean of two examinations: 15%

Practical examination: 35%

Final examination: 50%

13. Student learning outcome:

At the end of your undergraduate teaching you will be expected to be able to:

- Recognize pattern of inheritance.
- Have knowledge of several Mendelian and chromosomal conditions.
- Recognize the genetic and environmental contribution to multifactorial conditions.
- To know the genetic and environmental basis of sex determination.
- Learned approaches which can be used for the diagnosis of genetic disease and carrier detection.
- Learned different forms of DNA testing (prenatal diagnosis, predictive testing, and diagnostic testing).
- Be familiar with the practice of the genetic counseling.
- Know when and where to get genetic advice and information.
- Be familiar with the major ethical issues.
- To know the effects of cytoplasmic inheritance.
- To know the population genetics and the factors affects the gene frequency in the population.
- Types of mutations, mutagens and repair systems.
- To know some approaches of biotechnology and their applications.

14. Course Reading List and References:

- 1- Tamarin, R.H. (1995). Principles of genetics (5th edi.). Wm. C. Brown publisher. U.S.A
- 2- Tamarin, R.H. (1996). Principles of genetics (6th edi.). Wm. C. Brown publisher. U.S.A
- 3- Nester, E.W.; Anderson, D.G.; Roberts, Jr. C.E.; Pearsall, N.N.; Nester, M.T. (2001). Microbiology a human perspective (3rd ed.). Mc Graw Hill, U.S.A .
- 4- Tortora, G.J. ; Funke, B. R. and Case, Christine, L. (2004). Microbiology: an introduction (6th edi.). Pearson, Benjamin Cummings. U.S.A .
- 5- Brooker, Robert J. (2005). Genetics (analysis and principles). Mc Graw Hill. U.S.A .
- 6- Pierce B.A. (2006). Genetics, A conceptual approach (2nd edi.). W.H. Freeman and Company. New York, U.S.A .

15. The Topics:

Topics	Lectures
Introduction	Course outline, how to study Genetics, the role of genetics in life, distribution of marks, exams, and final exams
History of genetics	History of genetics, the genetic theories, the subject matter of genetics includes, genotype and phenotype
Mendelian inheritance	Gregor Mendel (1822-1884), Genetic terminology, Punnett square, Mendel's experimental methods, Mendel's 1st and 2nd laws, test cross and back cross

Characteristics of Organisms Used For Genetic Studies	Viruses, <i>E.coli</i> , Human, <i>Drosophila</i> , maize, <i>Arabidopsis thaliana</i> , methods of genetic study, pedigree analysis
Type of dominance	Dominant/ recessive, incomplete dominance, Codominance, Overdominance, Lethal genes, Multiple alleles (Polygenic inheritance)
Epistasis	Dominant epistasis (12:3:1), Recessive epistasis (9:3:4), Duplicate genes with cumulative effect (9:6:1), Duplicate dominant genes (15:1), Duplicate recessive genes (9:7), Dominant and recessive interaction (13:3), Gene interactions (non-epistatic interaction)
Sex-determination system	Genetic mechanisms of sex determination, chromosomal basis of sex determination, Genic balance
Exam.	
Sex Determination and Environment	Haplodiploidy, Single gene effect, Sex determination and environment
Inheritance related to sex (X-linked recessive and dominant traits)	Variation of sex-linkage, Pseudoautosomal Inheritance, Sex linked in <i>Drosophila</i> , Criteria for an X-linked recessive trait and examples, Criteria for an X-linked dominant trait and examples.
Y-linked traits, Sex influenced traits, sex limited traits	Y-linked inheritance and their examples, Sex influenced traits, sex limited traits and their examples
Linkage and recombination	Work of Bateson and Punnett, Coupling and repulsion, Linkage, Crossing over, Factors affecting crossing over, Methods of calculation of crossing over, Complete linkage, Mapping Genes
Cytoplasmic inheritance	Organelle heredity, Infectious heredity, Maternal effect
Chromosome aberrations, variation in chromosome number	History of cytogenetics, classification of chromosomes, aneuploidies of the sex chromosomes, aneuploidies of the somatic chromosomes, aneuploidy vs polyploidy
Variation in chromosome structure	Deficiencies/Deletions; Duplications The genetic material remains the same, but is rearranged; Inversions; Translocations and their examples
Population genetics	Defenition, Hardy-Weinberg principle and population equilibrium, Applying the Hardy-Weinberg Principle
Exam.	
Changes in Gene Pools	Genetic drift, mutations, natural selection, non-random mating
Microbial genetics, Types of mutation	Definition, What Are Mutations?, causes and types, Are mutations helpful or harmful?, single base-pair mutations, point mutation, substitutions, inversion, additions, Deletions, tautormeric shifts
Mutagenic agents and the mechanisms of mutation	Physical agents, ionizing and non-ionizing radiation, chemical agents, nitrous acid, hydroxylamine, base analogue mutagen, alkylating agents, acridines
Detection	(a) Plating the bacteria on antibiotic media, Visible Mutations, Auxotrophic

and isolation of mutants	Mutations, Conditional Mutations, Resistance Mutations, Using minimal media with sugars. (b) Using minimal media with sugars. Replica plating technique, Ames test
Repair of DNA	Photoreactivation repair, Base excision Repair, Nucleotide Excision Repair, Recombination repair, MisMatch Repair, SOS response, Double strand break repair
Regulation of gene expression, inducible operon	Definition, the operon system, genetic map of lactose operon, negative and positive control, Catabolite repression
Repressible operon	Definition, genetic map of tryptophan operon, Organization of the trp operon and regulation via the trp repressor protein, attenuation, Comparative properties of inducible and repressible operons
Exam.	
Genetic transfer & recombination in bacteria	Genetic recombination, homologous recombination, transformation, transduction, conjugation, conjugation in gram-positive bacteria
Introduction to cloning and recombinant DNA technology	DNA cloning, DNA sequencing, detection of disease genes, Polymerase chain reaction (PCR)
Application of recombinant DNA technology and gene therapy	(PCR basics, PCR in medicine, PCR in forensics), agricultural applications, transgenic mammals,
Continue to lecture (26)	Medical applications, recombinant DNA vaccines, methods of gene therapy
Genetics of cancer	Cancer is a genetic disease, cell cycle regulation and cancer, predisposition to cancer, causes of cancer, cancer and environment
Exam.	

16. Examinations:

1. Compositional: In this type of exam the questions usually starts with Explain how, What are the reasons for...?, Why...?, How....?

With their typical answers

Examples should be provided

Question/ Why do Pedigrees? Punnett squares and chi-square tests work well for organisms that have large numbers of offspring and controlled mating, but humans are quite different:

1. Small families. Even large human families have 20 or fewer children.
2. Uncontrolled matings, often with heterozygotes.
3. Failure to truthfully identify parentage.

2. True or false type of exams:

In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided

Q1/Write True and False in front of the following sentences, then correct the false. (15 Marks)

1-Although incorrect, the concept of pangensis was highly influential and persisted until the late 1900s.

2- The genetic and molecular organization of the mouse and human genes are quite similar.

Answers/1-F/1900 ---T/1800, 2-T.

3. Multiple choices:

In this type of exam there will be a number of phrases next or below a statement, students will match the correct phrase. Examples should be provided.

Question/ For each term in the left column, choose the best matching phrase in the right column.

				Answer
A	Karyotype	1	Crosses in which the male and female traits are reversed, thereby controlling whether a particular trait is transmitted by the egg or the pollen	A-4
B	Reciprocal crosses	2	The cross of an individual of ambiguous genotype with a homozygous recessive individual	B-1
C	Population genetics	3	Which deals with heredity in groups of individuals for traits that are determined by one or only a few genes	C-3
D	Test cross	4	The array of chromosomes in a given cell	D-2

Course Book

1. Course name	Practical Genetics
2. Lecturer in charge	Govand Musa Qadir
3. Department/ College	Biology/ Science
4. Contact	e-mail: govand.gadir@su.edu.krd Tel: (optional)
5. Time (in hours) per week	2 hrs./week
6. Office hours	3 hrs./week
7. Course code	
8. Teacher's academic profile	
9. Keywords	Bacterial Chromosome, Genes regulation in Bacteria, Operon, Bacterial Mutation, Isolation of Mutant bacteria, Conjugation, Transformation, and Ames test.
10. Course overview: <ul style="list-style-type: none"> • The importance of studying the Bacterial Genetics. • Understanding of how bacteria regulate its Genes expression. • Understanding of the principles bacterial conjugation and transformation. • Induction of Mutation in Bacteria and Isolation of Mutant Bacteria. • What are the differences between Gene Induction and Repression mechanisms? • What are the components of bacterial Operon? • Understanding of the mutagens and mutation. • Understanding of how resistant gene could transfer among bacteria. • What are plasmids and its importance for bacteria? • Testing the gene regulation of bacteria in the lab. • Testing Bacterial transformation and conjugation in the lab. • Testing induction of mutation and isolation of mutant in the lab. • Understanding of mutagenicity and carcinogenicity of chemicals by using Ames test (Bacterial model). 	
11. Course objectives: <ul style="list-style-type: none"> ▪ Cell cycle, mitosis & meiosis division in eukaryotes. ▪ Mutation induction in <i>Drosophila melanogaster</i> & the purpose of using this organism in genetic research. ▪ Polytene chromosome preparation. ▪ Using Chromatography to Identify the Eye Mutation of <i>Drosophila melanogaster</i> ▪ Fingerprints & palmar dermatoglyphics. ▪ Simple human non-metric traits. ▪ Preparation of metaphase chromosome in mice (<i>Mus musculus</i>) & karyotype analysis. ▪ Structural & numerical chromosomal aberrations in mice. ▪ Sperm abnormalities in mice. ▪ Introduction to Bacterial Genetics and Safety rules of the lab. ▪ Providing information about study microbial genetics. ▪ Understanding the concepts of induction. 	

- Understanding the mechanism of repression.
- Counting the number of antibiotic-resistant mutant (spontaneous mutation) bacteria
- Differentiate between direct and indirect mutant selection.
- Auxotrophic mutant production and differentiate between it and prototrophs.
- Isolation of mutant bacteria by replica plating.
- Detection of possible mutagens and carcinogens by Ames test.
- Understanding the mechanism of bacterial conjugation
- Understanding the process of transformation.

12. Student's obligation

***Exam policy:** Student Should take at least 1 exam during the course.

*lab polices:

1- Attendance: You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. You are responsible for obtaining any information you miss due to absence.

2- Lateness: Lateness to class is disruptive.

3- Electronic devices: All cell phones are to be turned off at the beginning of class and put away during the entire class.

4-Talking: During class please refrain from side conversations. These can be disruptive to your fellow students and your professor

5- No Disrespectful to both the teacher and to your colleagues.

6- Weekly Quizzes: every lab you should take quiz

7- Lab coat: you have to wear your lab coat to your protection.

8- Eating and drinking is prohibited inside the lab.

9- You should monitor and records your practical works and results.

13. Forms of teaching

- Course book
- Data show and power point.
- Scientific videos.
- Seminars.
- Papers for practical work and notes.
- Whiteboard.

14. Assessment scheme:

Exam 1 **80% marks**

Quizzes and Weekly lab activates **20% marks**

15. Student learning outcome:

- Cell cycle, mitosis & meiosis division in eukaryotes.
- Mutation induction in *Drosophila melanogaster* & the purpose of using this organism in genetic research.
- Polytene chromosome preparation.
- Using Chromatography to Identify the Eye Mutation of *Drosophila melanogaster*
- Fingerprints & palmar dermatoglyphics.
- Simple human non-metric traits.
- Preparation of metaphase chromosome in mice (*Mus musculus*) & karyotype analysis.
- Structural & numerical chromosomal aberrations in mice.
- Sperm abnormalities in mice.

- The importance of studying the Bacterial Genetics.
- Understanding of how bacteria regulate its Genes expression.
- Understanding of the principles bacterial conjugation and transformation.
- Induction of Mutation in Bacteria and Isolation of Mutant Bacteria.
- What are the differences between Gene Induction and Repression mechanisms?
- Understanding of how resistant gene could transfer among bacteria.
- How to test the gene regulation of bacteria in the lab.
- How to test Bacterial transformation and conjugation in the lab.
- How to Perform Ames test in the lab.

16. Course Reading List and References:

- Key references:
 - 1) Mertens, T.R. & Hammersmith, R.L. (2001). **Genetics: Laboratory Investigations.** Twelfth Edition. Prentice Hall, Englewood Cliffs, NJ.
 - 2) Macgregor, H.C. & Narley, J.M. (1983). **Working with animal chromosome.** NewYork: John Wiley & Sons
 - 3) Johnson, T.R and Case, C.L.(2007). **Laboratory experiments in microbiology.**
 - 4) Alexander, S. K., Strete, D. and Niles, M.J. (2004). **Laboratory exercises in organismal and molecular microbiology.**
 - 5) Harley, J. P., and Prescott, L. M. (1996). **Laboratory exercises in microbiology. Third edition.**
- Useful references:
 - 6) Brown, A. E. (2005). **Bensons microbiological applications.**
 - 7) Atlas, R. M., Park, L. C. and Brown, A. E. (1995). **Laboratory manual of experimental microbiology.**
- Magazines and review (internet): Any new related trusted magazine, researches and websites

17. Practical Topics

1. Introduction, course outline, concept for Genetic terms.
2. The cell cycle and mitosis.
3. The Study of Meiosis Division in eukaryotes.
4. Using of ***Drosophila melanogaster*** in genetic research.
5. Polytene chromosome preparation.
6. Mutation induction in ***Drosophila melanogaster***
7. First Exam.
8. Using Chromatography to Identify the Eye Mutation of ***Drosophila melanogaster***
9. Fingerprints & Palmar Dermatoglyphics
10. Simple Human Non - Metric Traits
11. Micronucleus test

<p>12. Metaphase chromosome preparation</p> <p>13. Sperm preparation</p> <p>14. General lab safety rules and course book</p> <p>15. Gene regulation: Induction.</p> <p>16. Gene regulation: Repression.</p> <p>17. Gene regulation: Catabolite Repression.</p> <p>18. Selection of Bacterial Mutants Resistant to Antibiotics.</p> <p>19. Isolation of Auxotrophic Mutants and Replica Plating Technique.</p> <p>20. Ames Test for Detecting Possible Chemical Carcinogens.</p> <p>21. Bacterial Conjugation: The Transfer of Antibiotic-resistant Plasmids.</p> <p>22. Transformation: A Form of Genetic Recombination.</p> <p>23. Second Exam</p>	
<p>18. Examinations:</p> <p>1. Compositional: In this type of exam the questions usually starts with Explain how, What are the reasons for...?, Why...?, How...?</p> <p>Example: write the mechanism of induction.</p> <p>2. test identifying:</p> <p>Example: identify this test (in the picture or direct)</p> <p>3. fill the blanks:</p> <p>Example: <u>The operator gene</u> is binding site of repressor protein.</p>	
<p>20. Extra notes: No notes</p>	
<p>21. Peer review</p> <p>Peer name: Dr. Mustafa S. Mustafa Al-Attar.</p>	