MINISTRY OF EDUCATION AND SCIENCE OF THE KYRGYZ REPUBLIC
"SALYMBEKOV UNIVERSITY" INSTITUTION
INTERNATIONAL FACULTY OF MEDICINE

Natural Sciences Department

AGREED
Head of Department
Kasymalieva K.K._____
«____»_____20____г.

APPROVED
Rector «Salymbekov University» Institution
Zhumadilov E.Zh._____
«_____» _____20____г.

Educational-methodical complex of discipline

Medical biology, genetics, parasitology

Educational program (specialty) "General Medicine"

Compiled by: Senior Teacher Mambet kyzy Gulina

Bishkek

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INTERNATIONAL FACULTY OF MEDICINE

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«Medical biology, genetics, parasitology» Discipline

Educational-methodical complex of discipline «Medical biology, genetics, parasitology»

"General Medicine" Educational program (specialty)

Graduate Qualification "Doctor"

Full-time education form

Compiled by (s): Senior Teacher Mambet kyzy Gulina

The working program was reviewed and approved at a EMC meeting of the Salymbekov University Institution

№_____ от_____20____

The work program was reviewed and approved at a department meeting « Salymbekov University»

№_____ от_____20____

Head EMD

Akmatova A.T. _____

Head of Department

Kasymalieva K.K.(PhD) _____

Compiled by

Senior Teacher Mambet kyzy Gulina _____

CONTENTS

MINISTRY OF EDUCATION AND SCIENCE OF THE KYRGYZ REPUBLIC
"SALYMBEKOV UNIVERSITY" INSTITUTION

INTERNATIONAL FACULTY OF MEDICINE

Department of Natural Humanitarian

WORKING PROGRAM

«Medical biology, genetics, parasitology»

Discipline type Professional

Direction of preparation General Medicine

Course___1_____ Semester __1,2_____Number of study weeks __20_____

Number of credits___5____

Total hours on the curriculum:

- Lectures_____42ч._____
- Practical (seminar)_____64ч._____
- Laboratory _____
- Self work_____44_____

The working program is developed in accordance with the requirements of the State educational standard for the "General Medicine" specialty.

The working program was developed by: Senior Teacher Mambet kyzy Gulina

The working program was reviewed and approved at the meeting of the Department

_____

Protocol no. _____ from "_____"_____20_____.

Agreed with the Educational and Methodological Committee (EMC) of the "Salymbekov University» Institution.

Protocol no. _____ from "_____"_____20_____

Head of Department _____ _____

(signature)

Бишкек

ANNOTATION

The Biology program represents a current state and development of Biological science. The Modern Biology is fundamental science in whole system of knowledge about nature and Human. The life on the planet can be studied on various levels: molecular, cellular, tissue, organism, population, community, ecosystem and Biosphere.

The living things study begins from discussion of the Cell Biology: structural components, a metabolism of the cell, a structure of the genetic apparatus, and regulation of cell existence. Important property of living things is reproduction which leads to the storage and transmission of hereditary traits and continuity of generations. The knowledge of hereditary mechanisms helps for understanding the reasons of pathological processes that may occur in a cell. It leads to violation of functions of a cell, then tissues and organs till whole organism in general.

The Medical Parasitology chapter includes studying of parasite's morphology, life cycles and epidemiology of diseases caused by them. Also their pathogenic action, diagnostics and all measures directed to protection of human health.

Introduction about distribution of parasites in some regions of Kyrgyzstan, India is very important for medicine. Because the rates of human population infections with some parasites are very significant. According to Kyrgyz Republic Health Ministry`s order on strengthening measures against parasitic diseases, the section of Medical Parasitology gets importance in system of doctor training.

The last unit is focused on the relations of nonorganic and living matter in life. The unity and particularity of all ecosystems and Biosphere as the largest system of organization are explained. The main principles of existence ecosystems and the role of human in sustainability and changes are important questions of discipline.

1. GENERAL PROVISIONS

1.1. Purpose of training: Study fundamental properties of Life at the molecular, cellular and individual levels.

Tasks of teaching:

1. Study flux of information, matters and energy in the cell
2. Study reproduction types and individual development of organism
3. Heredity and variation fundamentals
4. Study evolution and Human origin
5. Study environmental factors and their influence to Human organism
6. Study Medical Parasitology fundamentals

7. Formulate basic knowledge and main aspects of modern Biology

1.2. Place of discipline in the structure of the GEP

Prerequisites: Biology (Zoology, anatomy, Human Physiology) Chemistry, Physics (school program)

Post requisites: Histology, Microbiology, Physiology, Biochemistry, Pharmacology, General Hygiene, Epidemiology, Infection diseases

1.3. Competences:

GSC (General scientific competences)	*Living Systems:* Applies knowledge and skill in the natural sciences to solve problems related to molecular and macro systems including biomolecules, molecules, cells, and organs. *Human Behavior:* Applies knowledge of the self, others, and social systems to solve problems related to the psychological, socio-cultural, and biological factors that influence health and wellbeing.
IC (Instrumental competences) Computer skills	Computers are used for a wide range of functions in medical education: • Improve performance at Multiple Choice Questions (MCQ), Objective Structured Clinical Examination (OSCE) • Develop problem solving skills and knowledge, and increase student satisfaction. • In addition computers are also now being regularly used in student assessments. • Improve performance of practice applications and computer based lectures to more advanced simulations and intelligent tutoring systems • Microscopic skills
SPC (Social-personal and general cultural competences)	Social: Demonstrates an awareness of others' needs, goals, feelings, and the ways that social and behavioral cues affect peoples' interactions and behaviors; adjusts behaviors appropriately in response to these cues; treats others with respect.
PC (Professional competences)	Ability to perform preventative measures to avoid infectious, parasitic, non-infectious diseases. Sanitary educational work

The study of this educational discipline is directed to the formation of the following general cultural (GC), general professional (GP) and professional competencies (PC) in students:

GENERAL CULTURAL COMPETENCIES

№	Code	Content of competence	Result of studying the discipline:		
			Knowledge	Skills	Expertise
1	GC-1	Demonstrates knowledge of socio-cultural factors that affect interactions and behaviors; shows an appreciation and respect for multiple dimensions of diversity; recognizes and acts on the obligation to inform one's own judgment; engages diverse and competing perspectives as a resource for learning, citizenship, and work; recognizes and appropriately addresses bias in themselves and others; interacts effectively with people from	1. Subject, tasks and methods of Biology; 2. The properties of life; 3. The prokaryotic and eukaryotic cells structures; 4. The Cell Theory. 5. Cell cycle and its stages; 6. Reproduction and its forms. 7. Gametogenesis: oogenesis and spermatogenesis. 8. The structure of gametes (spermatozoon, ovum) 9. Biology of Development 10. Stages of ontogenesis 11. Critical periods of embryo development 12. Subject and tasks of medical Genetics. 13. Basic concepts	1. Define components of the cell; 2. Differentiate mitosis stages; 3. Distinguish stages of gametogenesis 4. Define types of chromosomes; 5. Differentiate the types and forms of ontogenesis 6. Create human pedigree 7. Identify the inheritance of blood groups 8. Schematically construct genetic maps of chromosomes 9. Identify the human sex chromatin 10. Solve Genetic problems on mono hybrid cross and dihybrid cross 11. Solve Genetic	1. Use a light microscope 2. Preparing micro-slides for inspection 3. Microscopic images documentation 4. Basic instrument maintenance 5. Create Human pedigree, using suitable symbols

		diverse backgrounds	of Genetics 14. The Mendel`s laws. The main Genetics symbols and signs 15. Gene interaction types 16. Forms of non-allelic gene interactions 17. Inheritance of human blood groups 18. Features of human karyotype 19. Chromosomes behavior during meiosis 20. The main provisions of the Chromosomal theory of heredity 21. Law of Linkage 22. Crossover and its significance 23. Mapping of chromosomes	problems on polyhybrid cross 12. Solve problems with linkage of genes 13. Be able to translate regulatory mechanisms of ecology, rational using of natural resources 14. Accept decisions on the base of sustainable development of Biosphere	
2	**GC-2**	Ability to analyze social and personal philosophical values. Also to analyze main philosophical categories for	1. Origin of life 2. Theory of unicellular origin 3. Theory of multicellular origin 4. Main	1. Define main evolution processes 2. Define main biological processes, occur in living thins 3. Recognize the	4. Medico -biological concepts 5. Make conclusions

		self-improvement	characteristics of living things 5. Levels of Biological organizations 6. Factors of evolution 7. Anthropogenesis 8. Mechanisms of Anthropogenesis	biological Human heritage	
3	**GC-5**	Ability to logical and argumentative analysis, make a speech, discussion, text editing with specific content, solution of conflicts, tolerance	Main Biological concepts, processes , phenomena	Analyzing Biological processes, phenomena and make conclusions	Competent making of Medical and Biological essays

GENERAL PROFESSIONAL COMPETENCIES
(Preventive measures)

№	Code	Content of com	Result of studying the discipline:		
			Knowledge	Skills	Expertise
1	GPC-11	Ability to perform	Subject, tasks and methods of Medical	1. Define the parasitic flagellates	Use a light Microscope

		preventative measures to avoid infectious, parasitic, non-infectious diseases. Sanitary educational Work	Parasitology Role of transmissive Diseases Parasitism as Biological phenomenon Influence of parasite to host Life cycles of parasites	2. Differentiate the parasitic flagellates. 3. Recognize the parasitic sporozoans. 4. Differentiate species of Malaria agents 5. Designate a parasitic Sarcodinas. Cillates. 6. Designate the structured features of flukes 7. Define the features of the tape-worms 8. Differentiate the larval stages of tape worms 9. Distinguish of Parasitic roundworms	Preparing micro-slides for Inspection Microscopic images Documentation Basic Instrument Maintenance Sanitary educational work

1.4. The list of knowledge and practical skills which students have to take

The student should to know:

24. The subject, tasks and methods of Biology;
25. The properties of life;

26. The prokaryotic and eukaryotic cell structure;
27. The Cell Theory.
28. The cell cycle and its stages;
29. The reproduction and its forms.
30. The gametogenesis: oogenesis and spermatogenesis.
31. The structure of gametes (spermatozoon, ovum)
32. Subject and tasks of medical Genetics.
33. Basic concepts of Genetics
34. The main Genetics symbols and signs
35. The Mendel`s laws
36. Gene interaction types
37. Forms of non-allelic gene interactions
38. Inheritance of human blood groups
39. Features of human karyotype
40. The method of ideogram preparation
41. 11.Chromosome behavior during meiosis
42. The main provisions of Chromosomal Theory of heredity
43. Law of Linkage
44. Crossover and its significance
45. Mapping of chromosomes
46. Parasitism as biological phenomenon.
47. Classification of parasites.
48. Principle of interaction of a parasite and host.
49. Life cycles of parasites.
50. Morphological adaptation of parasites.

The student should be able to:

15. Define components of the cell;
16. Differentiate mitosis stages;
17. Distinguish stages of gametogenesis;
18. Define types of chromosomes;
19. Differentiate the types and forms of ontogenesis
20. Examine sperms under microscope
21. Differentiate the types of eggs
22. Determine the gonads (testis, ovary)
23. Determine the zones in the testis

24. Determine immature and mature follicles in ovary
25. Create human pedigree
26. Identify the inheritance of blood groups
27. Create the human ideograms
28. Schematically construct genetic maps of chromosomes
29. Identify the human sex chromatin
30. Solve Genetic problems on mono hybrid cross
31. Solve Genetic problems on dihybrid cross
32. Solve Genetic problems on polyhybrid cross
33. Solve problems with linkage of genes
34. Use a light microscope.
35. Define the parasitic flagellates
36. Differentiate the parasitic flagellates.
37. Recognize the parasitic sporozoas.
38. Differentiate species of Malaria Plasmodium
39. Designate a parasitic Sarcodinas and Infusorians
40. Designate a structure features of flukes
41. Define the features of the tape-worms
42. Differentiate the larval stage of tape worms
43. Distinguish of parasitic roundworms
44. Distinguish of ticks
45. Differentiate the stages of ticks.
46. Differentiate the parasitic representative of insects
47. Preventative measures against infection and invasion vectors
48. Sanitary educational Work

2. CONTENT AND COMPLEXITY

In accordance with the curriculum of the institution "Salymbekov University" of the medical faculty, the subject of Biology is taught in the following volume: Scope of discipline, types of educational work and control forms.

Semester	Credits	Total	Hours		IW	Control forms
			lectures	practice		
1,2	5	150	42	64	44	Exam

2.1. STRUCTURE OF THE DISCIPLINE

	Theme of module	Amount of academic hours		Amount og Independent work (IW)	
		Lecture	**Practice**	**IW Student**	**IW teacher**
	1,2 semester				
1.	**Module 1** • Cell Biology • Cell cycle • Sexual reproduction Ontogenesis	8	12	9	
2.	**Module 2** • Genetics fundamentals • Gene interactions • Inheritance on cellular level • Inheritance on molecular level Human Genetics	10	12	9	
3.	**Модуль 3** ✓ Medical Parasitology ✓ Medical Protozoology ✓ Medical Helmintology ✓ Medical Arachnoentomology	8	12	9	
	Total Hours:	26	36	27	

2.2. SCHEDULE FOR MODULES

The schedule of lectures

№	Themes	hours
1	Biology – the science of living things. Living systems.	2
2	The methods of research in Biology. Cytology fundamentals	2
3	The forms of reproduction and their cytological basis	2
4	Sexual reproduction. The classification. Importance of Meiosis	2
5	Biology of development. Types. Stages	2
6	The Genetic fundamentals. Inheritance on the organism level	2
7	Gene interactions. Types.	2
8	Inheritance on the cellular level. X-linked inheritance. The properties of the chromosomes. An experiment of T. Morgan	2
9	Inheritance on the molecular level. Properties of genes. Types	2
10	Variation and its types. Human Genetics	2
11	Medical Parasitology fundamentals. Medical Protozoology	2
12	Medical importance of Class Flagelata and Sporozoa	2
13	Medical importance of classes Sarcodina and Cilliata	2
	Total	**26**

The schedule of the practical classes

№	Theme	hours
1	The main characteristics of living things. Levels of Biological organization. The types of the Cell organization.	2
2	Cell Biology. Main components of the Eukaryotic Cell.	2
3	The flux of information in a cell. Cell cycle.	2
4	The types of sexual reproduction. Meiosis	2
5	Ontogenesis. Stages. Critical periods of Embryonic development.	2
6	Module No 1	2
7	Inheritance on the organism level. Monohybrid and dihybrid crosses. Solution of genetic problems	2

8	Types of gene interactions. Solution of genetic problems	2
9	Inheritance on the cellular level. X-linkage. Solution of genetic problems related with x-linkage	2
10	Realization of genetic information. Gene properties. Solution of genetic problems related with genetic code	2
11	Human Genetics. Modifications and mutations	2
12	Module No 2	2
13	Medical Protozoology fundamentals. The glossary used in Parasitology	2
14	General characteristics of Phylum Metamonada, subphylum Eopharingia and Parabasalia. *G.lamblia, T.vaginalis*	2
15	General characteristics of Phylum Sarcomastigophora, subphylum Mastigophora	2
16	Life cycle and characteristics of phylum Apicomplexa, Class Sporozoa. Parasitic representatives	2
17	Life cycle and characteristics of subphylum Sarcodina representatives. *Entamoeba spp*	2
18	Parasitic representatives of phylum Ciliata, Class Litostomatea	2
19	Module No 3	2
	Total	38

2.3. THE CONTENT OF PRACTICAL CLASSES THEMES

Theme №1.

The main characteristics of living things.Levels of Biological organization.The types of the Cell organization.

Tasks, goals, methods of study of Biology. Define Biology. It`s role in preparation of the Doctors. A living systems. Difference between prokaryotic and eukaryotic cells.

Theme №2.

The types of the Cell organization.Cell Biology.Main components of the Eukaryotic Cell.

Cell Biology.Cell as complete system.Structural and functional organization of the cell.Biological properties of cell components.Cell evolution.Differences between animal and plant cell.

Practical part: The preparation and study of plant and animal micro-slides.

No. 3.

The flux of information in a cell.Cell cycle.

The flux of information in a cell.The laws of cell existence in time.Cell cycle and its stages.Karyokinesis and cytokinesis.Biological properties of cell cycle.Regulation of cell cycle.

Practical part: Study schemes cell cycle, micro-slide a karyokinesis in anion root, micro-slide a karyokinesis in animal cell

Theme No.4.

The types of sexual reproduction.

Forms of sexual reproduction in unicellular (conjugation, copulation).Forms of sexual reproduction at multicellular (with fertilization, without fertilization).Gametogenesis as process of maturing of gametes.Forms of a gametogenesis (spermatogenesis, oogenesis).Structure of gametes (spermatozoa, ova).Various types of ova.Parthenogenesis and its forms.

Practical part: Study of micro-slides of spermatozoids and ovaries of mammals. Rabbit testis.

Theme No.5.

Ontogenesis.Stages. Critical periods of Embryonic development.

Types, forms and stages of ontogenesis.Pro-embryonic period.Types of the eggs.Insemination.Its forms.Fertilization.Types.The stages of fertilization.

General concepts of embryonic development.The stages of embryigenesis.Zygote.Clevage. Types of cleavage. Gastrulation and organogenesis. Extraembryonic membranes (amnion, allontois, yolk sac, chorion, placenta).

Practical part: Study of development stages with tables and schemes

Theme No.6.

The gene interactions in the determination of traits

Interaction of alleles (complete, incomplete dominance, over-dominance, co-dominance). Interaction of non-allelic genes (complementarity, epistasis, polygenic, pleiotropy). Inheritance of blood groups.

Practical part: Solving problems

Theme No.7.

Inheritance on the cellular and molecular levels.

The karyotype and its properties.Human karyotype.Ideograms.Inheritance of sex.The sex chromatin.Sex linkage.Linkage of genes.The mechanism of linkage (Morgan).Chromosome mapping.Genetic and cytological maps of chromosomes.

Practical part: Solving problems

Theme No.8.

Variation and its types.Modifications and mutations.The Human Genetics.

Variation and its type.Modification variability. Genotypic variationand its forms. Combinative variation.Mutational variability and its forms (genomic, chromosomal, gene).Mutagenic environmental factors.The karyotype and its properties.Human karyotype.Ideograms.Inheritance of sex.The sex chromatin.Sex linkage.Linkage of genes.The mechanism of linkage (Morgan).Crossover as a cause of violations of gene linkage.Chromosome mapping.Genetic and cytological maps of chromosomes.

Theme No.9.

Phylum Protozoa. Class Flagellates. Class Ciliates

Introduction to Medical Parasitology.Branches of Parasitology.Medical Protozoologyfundamentals.Classification of parasites. Biological basis of parasitism.Transmissive diseases.General characteristic of Phylum Protozoa.

Class Flagellates. *Trichomonas spp*.,*G. Lamblia.*Protozoan diseases.

Practical Work:

Work No. 1:

Consider a constant micro-slide under big magnification. Note a dark-violet colored oval body of trichomonas. At the forward part of body a vesicle-like nucleus, at the end of axostyle. Sketch two-three trichomonads and designate: nucleus, axostyle, undulating membrane, flagella, kinetoplast.

Work No. 2:

To consider Opalin's micro-slide under small magnification, pay attention to a shape of a bodyand compare to balantidium. Draw a balantidium structure from the table. Designate: pellicle, cilia, macronucleus, micronucleus, to cytosome, cytopharincs, digestive vacuoles.

Work No. 3:

Designate micro slide of Balantidium under the small increase. Pay attention on the body shape and compare with Paramecia. Sketch and label basic organelles, nucleus, cytostome, cytopharinx.

Theme No.10.

Phylum Protozoa.Class Sarcodina. Class Sporozoa

General characteristic of dysentery, oral and intestinal amebae.Vegetative and cyst forms of amebae.

Practical Work:

Sketch a cycle of Dysenteric Amoeba development by comparing to the table, and to designate amoeba forms.

General characteristic.*Plasmodium Malaria. Plasmodium vivax., P.ovale.,P. falciparum., P.malaria., Toxoplasmagondii*

Practical Work:

Work No. 1:

A malarial plasmodium - schizont in a ring stage, or truesschizont. Consider on a micro-slide of blood smear of the patient with malaria under immersion preparation. Erythrocytes and leukocytes are under review visible. Find the erythrocytes struck with a plasmodium. They are a little increased, inside there are schizont. At an early stage of development the parasite has a roundish form, cytoplasm in the form of a narrow rim of blue coloring, a nucleus lies on the periphery and is painted in red color, vacuoles in the center is a ring stage. Sketch and designate: schizont, a nucleus, cytoplasm, vacuoles, not affected erythrocytes.

Work No. 2:

*Plasmodium vivax*life cycle. Study of life cycle in tables and sketch it in album

Work No. 3:

Toxoplasma gondii. Consider a micro-slide under big magnification. Find toxoplasma, pay attention to a semi-lunar shape of a body. Cytoplasm is painted in violet color, and a large nucleus in the red. Sketch and designate: cytoplasm, nucleus.

Theme No.11.

Medical Helminthology.Phylum Platyhelminthes.Class Trematoda.

General characteristic.Liver fluke.Cat fluke.Lanceatum fluke.Concepts of Bio- Geo- and contagious helminthes. Diseases caused by flukes

Practical Work:

Work 1.

Life cycle of a liver fluke. Discuss the life cycle according to the table, pay attention to egg structure, comparing to the table. Sketch and designate definitive and intermediate hosts. Note the developmental stages.

Work 2.

Gastrointestinal tract of a liver fluke. Consider the gastrointestinal tract injected by ink on a total preparation. Find an oral sucker in which there is an oral opening in the forward end of a body. From it the narrow and short throat which passes into branched intestine. The last forms two main branches of intestines - right and left with numerous branches. Track the direction of two main branches of a gastrointestinal tract. Having reached the last, both branches go almost in parallel each other in the direction by the back end of a body and come to end blindly. The side branches of intestines terminating also blindly depart from each branch of the main channel towards the periphery of a body.

Work 3.

Micro-slide of liver fluke eggs. Consider under small, and then under big magnification of microscope a specimen with liver fluke eggs. Liver fluke egg in comparison with eggs of others flukes has the largest sizes (130-150*70*90), an oval form with yellow-brown color. On the top pole the operculumthrough which leaves miracidia is visible. To sketch and designate an egg operculum.

Work 4.

The life cycle of a cat fluke. Draw and label: Life cycle of cat fluke from the table.

Designate definitive and intermediate hosts in development stages.

Work 5.

lanceolate fluke. Consider the colored preparation of a lanceolate fluke. Find an oral sucker on the forward end of a body. Consider reproductive system: on a forward half of a body two wrong and oval forms of a seed plant painted in crimson color. The uterus is placed a back half of a body, on each side a uterus is located.

Consider a uterus under small magnification in a microscope, to see its huge number of eggs. Pay attention to the different color of eggs caused by their maturity. Mature eggs have almost black color. In a middle part of a body, on each side a uterus is located ovaries. Comparing to the table to sort and sketch a development cycle, to designate: definitive and intermediate hosts to note development stages.

Theme No.12.

Medical Helminthology.Phylum Platyhelminthes.Class Cestoda.

General characteristic of tape worms.*TaeniaSolium.T.Saginata, Echinococcusgranulosus*

Diseases caused by tape worms.

Practical Work:

Work 1.

Find a specimen with the turned-out head of the armed tapeworm. Consider a micro-slide under small magnification ofmicroscope. Sketch a life cycle and designate: definitive and intermediate hosts. Note a development stages.

Find a preparation with the turned-out head of an unarmed tapeworm. Consider a preparation under small magnification of microscope. Sketch and designate: 1)astrobila, 2) suckers, 3) scolex

Work 2.

Mature segmentof unarmed tapeworm. Consider a preparation under small magnification of microscope. Sketch and designate number of side branches of a uterus.

A mature segment of the armed tapeworm. Consider a micro-slide under small magnification of microscope. Sketch and designate number of uterus branches.Micro-slide of tape worm eggs. Consider a preparation under small magnification of microscope.

Work 3.

Preparation ofechinococcus.Under the microscope sketch and designate: head 2) neck 3) hermaphroditic and mature proglottids. Consider a macro-preparation of a larval stage ofechinococcus and echinococcalhydatid cyst.Sketch by schemes a life cycle of echinococcus.

Theme No.13.

Medical Helminthology.Phylum Nemathelminthes.Class Nematoda.

General characteristic of round worms.*A. lumbricoides.E. vermicularis. T. trichinus*

Diseases caused by round worms.

Practical Work:

Work 1.

Cross section of ascaridfemale.To consider a preparation under small magnification of microscope. Draw and designate:1) a cuticle 2) a hypoderm 3) the muscular layer 4) primary cavity of a body 5) tubules of secretory system, 6) nervous system 7) ovaries 8) tubes 9) a uterus, 10) intestines.

Work 2.

Scheme of ascaris life cycle.Draw and label: The scheme of a life cycle and migration of ascaris larva

Work 3.

Male, female and egg of the pinworm. Consider a micro-slide under small magnification of microscope. Sketch and note sexual dimorphism.

Theme No.14.

Medical Arachnoentomology.Phylum Arthropods.Class Arachnida.Ticks.Mites

Practical Work:

Work 1.

Ixodidae ticks. (Permanent slide). Consider appearance of ticks and pay attention to a structure of ticks. The body is not segmented. Size 2,5mm, "head", i.e. set of mouth parts arewell visible from the back part. The male on a back has a protection closing dorsal surface. The protection occupies only forward part of a female body; it is of great importance, because the mass of a female increases by 10 times more. Compare the sizes of full and hungry ticks, larvae, nymphs, an imago to the table. Remember a structure and life cycle of ixodae ticks and designate:

1) imago 2) eggs 3) nymph etc.

Work 2.

Sarcoptidaescabiei.

From the table sketch and designate a structure and a life cycle of a tick.

1) eggs*S. scabiei*

2) larva

3) nymph.

Work 3.

Oral part of a tick (helitser and pedipalpa).To consider a micro-slide under small magnification of microscope. Sketch and designate: 1) helitser 2) pedipalpa 3) lower limbs

Theme No.15. Phylum Arthropoda.Class Insecta.Lice.Fleas.Blood sucking insects.Mosquito.Flies.Final class. Test

General characteristics of Subphylum Tracheata.Class Insecta. Lice spp., Fleas

Practical Work.

Work 1.

Louse of head (*Pediculuscapitus*) and clothes *(P. humanushumanus*). Consider a micro-slide under small magnification of microscope and find 3 part of a body: head, thorax, abdomen. Pay attention on the last segment of body. Sketch and designate: 1) a head 2) thorax 3) mouth part4) eyes 5) thorax 6) limbs 7) stigma.

Work 2.

Flea (Pulex sp.). Consider a micro-slide under small magnification of microscope. Pay attention to the body of a flea laterally flattened. On a head there are short mouth parts and eyes. On three thorax segments limbs are located, the last couple longer and serves for jumping. Sketch and designate: 1) head 2) thorax 3) abdomen, 4) limbs 5) short moustaches 6) eyes.

Class insects (Insecta). Group dipterous (Diptera)

Work 1.

Head of a female and male of Anopheles and Culex. Consider micro-slide under small magnification of microscope. Note specific and sexual distinctions.

Work 2.

Egg, a larva, a pupa – Anopheles. Consider a micro-slide under small magnification of microscope. Sketch and designate: 1) air cameras of eggs 2) respiratory openings on a penultimate segment of a larva, 3) a funneled form of a respiratory siphon of a pupa.

Work 3.Egg, a larva, a pupa – Culex. Consider a preparation under small magnificationof microscope. Sketch and designate:1) the eggs which stuck together as the boat, a respiratory tubule of a larva 3) a cylindrical form of a respiratory tube of a pupa.

Work 4.

Mosquito (Phlebotomus). Consider a preparation under small magnification of microscope. Pay attention to a structure of the oral device and extremities.

3. LIST OF EDUCATIONAL AND METHODOLOGICAL SUPPORT FOR INDEPENDENT WORK OF STUDENTS

3.1. Subject and scope of independent work of students

№	Theme	hours
1	The structural organization of prokaryotes. The properties of prokaryotic cell	2
2	Food vacuoles are temporary (not essential) components of the cell. Vacuoles. Cytosol	2
3	The Polytheny phenomena. The polythenic chromosomes.	2
4	The conjugation as one form of sexual reproduction	2
5	The Parthenogenesis and its forms. The Hermaphroditism.	2
6	The regulation of cell cycle	2
7	The regulation of gene expression	2
8	Cytoplasmic inheritance. Mitochondrial genome.	2
9	Hybridization of somatic cells. Genetic engineering	2
10	Genetic analysis. Prenatal diagnosis. Amniosentesis. Choriocentesis	2

11	Genetic engineering and its achievements.	2
12	Genetics and Ecology	2
13	Cenogenesis (embryo adaptation). Similar embryonic organs.	2
14	Teratogenic factors	2
15	Parasitism and parasites.	2
16	Adaptation to a parasitic lifestyle. The cycle of the parasite.	2
17	Phylum Protozoa. Class Flagellates. Trypanosome	2
18	Phylum Plathelminthes. Class Cestoda. *H. nana*	2
19	Class Trematoda. Blood fluke	2
20	Phylum Nemathelmintes. Ancilostoma. Necatorus	2
21	Phylum Arthropoda. Tick – born Encephalitises: West Nile Encephalitis, Japanese enc.,	2
22	Circulation of chemical elements in Biospher, Problems of protection the Biosphere	2
	Total	44

4. FUND OF ASSESSMENT TOOLS FOR THE CURRENT, MODULE AND FINAL CONTROL UPON COMPLETION OF DISCIPLINE

4.1. The list of competencies indicating the stages of their formation in the process of mastering the discipline

№	**Name of the chapter**	**Formed competences (specify the competence code)**	**Information and educational technology**
1	Subject, tasks and methods of Biology	*GC-1, GC-3, GC-5*	Survey. Reports of students. Discussion.
2	Main characteristics of living things	*GC-1, GC-3, GC-5,* GPC-11	Survey. Reports of students. Discussion
3	Cytology fundamentals	*GC-1, GC-3, GC-5,* GPC-11	Survey. Reports of students. Discussion.

4	Ontogenesis fundamentals	*GC-1, GC-3, GC-5,* GPC-11	Survey. Reports of students. Discussion. Clinical case questions
5	Genetics fundamentals	*GC-1, GC-3, GC-5,* GPC-11	Survey. Reports of students. Discussion.Solution of problems.
6	Medical Parasitology	*GC-1, GC-3, GC-5,* GPC-11	Survey. Reports of students. Discussion.Clinical case questions
7	Ecology fundamentals	*GC-1, GC-3, GC-5,* GPC-11	Survey. Reports of students. Discussion.

4.2. Methodological materials that define procedures for evaluating knowledge, skills, and (or) experience

The basis of modular training is the structuring of the content of the academic discipline into modules. The studied discipline consists of a set of modules. The volume of the educational material of the module reveals a separate topic of the studied discipline or several topics (discipline section). The discipline is divided into several modules per semester.

For each module, a list of required types of student work is established, including: attending lectures, practical (laboratory) classes; answers to theoretical questions, solving practical problems and completing tasks in a practical lesson; laboratory work; performance of control work; testing on a topic (group of topics); other types of work determined by the teacher.

Each disciplinary module should end with a certain form of control in order to assess the degree of mastering of educational material and obtain a rating assessment of the quality of mastering of educational material.

Academic achievements-students ' learning outcomes are evaluated on a 100-point scale, correlated with a five-point system, and can be correlated with the ECTS system (table.1).

The final module-rating rating for the discipline is based on the results of two modules and the final control of knowledge.

The distribution of rating points between types of control is established in the following ratio:

Form of intermediate certification	**Number of scores**			
	Current control	Boundary control	Outcome control	Amount of scores
Exam	40	40	20	100
Differentiated credit	40	40	20	100

Table No 1.

Rating marks (%)	**5-point rating**	**Rating ECTS**	**Definition ECTS**
85-100	5 –exellent	A	Excellent result with minimal mistakes
81-84	4 – good	B	Above average result with some mistakes
70-80		C	Average result with notable mistakes
60-69	3 – satisfactory	D	Weak result with significant disadvantage
55-59		E	Mediocre result
0-54	2 – negative	F	Necessary to retake whole material

Independent work of the student (IWS) consists of two parts:

- the first part includes independent work with the participation of the teacher (IWST).
- the second part is based on performing individual independent work (IIW). Hence, IWS = IWST + IIW.

Students should get the task for the IWS at the beginning of the semester.

The final assessment of students ' knowledge consists of three components:

* current control (CC);
* boundary control (BC), i.e. results of modular work;
* independent work of the student or IWS).

Hence, FC=CC+BC+IWS

The choice of the type and forms of control should be determined by the objectives of the discipline and the content of the formed competencies.

The section specifies traditional and innovative educational technologies used in the implementation of various types of educational work.

In accordance with the requirements of THE state HPE in the field of training, the implementation of the competence approach should provide for the wide use in the educational process of active and interactive forms of classes (business and role-playing games, analysis of specific situations, psychological and other training) in combination with extracurricular work to form and develop professional skills and competencies of students.

It is important to justify the connection of educational technologies used with the formed competencies. In this section, it is recommended to provide criteria for assessing the level of competence(s), which are developed by the teacher for individual forms of control, taking into account the specifics of the subject.

5. CONTROL TASKS OR OTHER MATERIALS REQUIRED TO EVALUATE KNOWLEDGE, ABILITIES, SKILLS AND (OR) EXPERIENCE.

Here are the control questions for each module and the structure of the examination ticket (written work) with the indication of the evaluation criteria for each task.

List of questions for self - control:

1. Name the types of microscopes.
2. The Subject and tasks of Cytology.
3. Differences of prokaryotic cell from eukaryotic cell?
4. Name the not cellular forms of life.
5. Structure of cytoplasm.
6. Name the general organelles
7. What kind of cells includes more amounts of mitochondria?
8. Where is genetic information of the cell located?
9. Types of chromosomes.
10. Monomers of nucleic acids.
11. Differences of DNA and RNA.
12. Types of RNA.
13. What is mitotic cycle of the cell?
14. The periods of cell cycle. Dividing phase.
15. Biological value of mitosis?

16. Forms of sexual reproduction.
17. What is the parthenogenesis?
18. Features of the ovum structure.
19. Features of the sperm structure.
20. Stages of the spermatogenesis.
21. Feature of oogenesis
22. A biological role of meiosis
23. Phylum Protozoa. Characteristic and classification. Their role in Medicine.
24. Morphophysiological characteristic of class Sporozoa. The causative agents.
25. Morphophysiologicalcharacteristic of *Toxsoplasmagondii.*
26. Morphophysiological characteristic of class Sarcodina.
27. The concept of helminthes. Geo-and bio-helminthes, contagious helminthes.
28. Characteristic features of the organization, classification and medical value of them.
29. Concept of invasion.
30. Characteristic of class Trematoda.
31. The characteristic of class Cestoda. An armed tapeworm - / Taeniasolium/.
32. Echinococcus – / Echinococcusgranulosus/.
33. The characteristics of Nematodabody systems.
34. Round worm - / Ascarislumbricoides/.
35. Characteristic and classification of phylum Arthropods
36. Class Crustacea and their medical value.

The Biology exam questions for 1 year foreign students of General Medicine faculty

1. This is modifications that make an organism suited to its way of life. This is…

A.+ Adaptation

B. Reproduction

C. Organization

D. Growth and development

2. Which function is associated with the rough endoplasmic reticulum?

A. ATP synthesis

B. + protein synthesis

C. DNA synthesis

D. active transport

3. Crossing over occurs in which phase of meiosis?

A. + Prophase I

B. Metaphase II

C. Anaphase I

D. Telophase II

4. Active transport required:

A. concentration gradient

B. + energy

C. osmosis

D. hypertonic solution

5. The scientist who has given a name to "Bilogy"

A. + J.B.Lamark

B. C.Linnaeus

C. Ch. Darwin

D. T.Shwann

6. Isotonic solution:

A. Solute concentration is greater than that inside the cell

B. + Solute concentration is the same as that inside the cell

C. Solute concentration is less than that inside the cell

D. None of the above is correct

7. A structure that connects the two chromatids together at the middle

A. + centromere

B. cancer

C. tumor

D. surgery

8. The fluid-mosaic model of the plasma membrane suggests that

A. cholesterols are always bad in nature

B. some proteins are free to move laterally through the membrane

C. phospholipids form a single lipid layer in the center of the membrane

D.+ the membrane has rigidity and flexibility

9. The idea of epigenesis.

A. + The specialized tissue forms from unspecialized tissue

B. A newborn requires to mother

C. The development of high mammals occur with placenta

D. Direct development is incorrect.

10. ... is the process by which the internal environment of the body is regulated in order to maintain a stable state.

A. adaptation

B. + homeostasis

C. reproduction

D. evolution

11. N*ot larval* and *prenatal* type of ontogenesis refers to…

A. direct or incomplete

B. indirect or complete

C. + direct or complete

D. indirect or incomplete

12. It controls what enters and leaves the cell

A. mitochondrion

B. + nucleus

C. Golgi Apparatus

B. cell membrane

13. The type of cell division that produces gametes.

A. heredity

B. gametes

C. + meiosis

D. mitosis

14. Some cells take in large molecules through the process of:

A. aprotein synthesis

B. + endocytosis

C. cytoplasmic streaming

D. ATP

15. The final stage of the cell cycle, during which the cytoplasm divides, is called

A. Prophase

B. metaphase

C. Anaphase

D. + Telophase

16. Molecules that are transported into the cell up their concentration gradients do so by:

A. + facilitated diffusion

B. osmosis

C. coupled transport

D. none of the above.

17. The longest phase of the cell cycle is . . .

A. metaphase

B. Anaphase

C. Telophase

D. + Interphase

18. Which of the following represents the Kingdom Monera?

A. ant

B. euglena

C. + bacteria

D. yeast

19. It made up of tubulin protein and used for locomotion

A. cytosol

B. ribosome

C. + flagella

D. cell membrane

20. Smooth ER plays an important role in carbohydrate metabolism, drug detoxification and .._.

A. lysosome synthesis

B. + lipid biosynthesis

C. vacuole synthesis

D. oxygen fixation

21. The differences between primary oocyte, secondary oocyte and ovum in…

A. cell structure

B. nucleus structure

C. chromosome structure

D. + chromosome number

22. A cell placed in hypotonic solution water will:

A. shrivel up

B. lose water

C. + swell

D. result in absence of water molecules

23. The first step of development is initial contact between the male`s sperm and…

A. primary oocyte

B. + secondary oocyte

C. ovum

D. polar body

24. Which of the following is a function of the Golgi complex?

A protein synthesis

B. ribosome synthesis

C. Ca 2+ storage in muscle cells

D.+ modifying and packaging of proteins and lipids into vesicles

25. During cleavage the morula form, which is located…

A. in uterus

B. in corpus luteum

C. + fallopian tube

D. perimetrium

26. In DNA guanine always pairs with:

A. Adenine

B. + cytosine

C. guanine

D. thymine

27. Two identical daughter cells result from the division of a single cell. What is this process called?

A. heredity

B. gametes

C. meiosis

D. + mitosis

28. DNA replication results in two DNA molecules

A. each with two new strands

B. Each with two original strands

C. one with two new strands and the other with two original strands

D. + each with one new strand and one original strand

29. Haploid numbers of chromosomes are usually found in the _____ of an organism

A. heredity

B. + gametes

C. meiosis

D. mitosis

30. During DNA replication, a DNA strand that has the bases CTAGGT produces a strand with the bases:

A. TCGAAC

B. + GATCCA

C. AGCTTG

D. GAUCCA

31. During cell division the spindle fiber attached with which part of chromosome?

A. centromere

B. + kinetochore

C. telomere

D. none

32. A cell in which the DNA is localized in a region, but not bound by a membrane is said to be:

A. endosymbiotic

B. organoid

C. eukaryotic

D. + prokaryotic

33. The smallest level of organization, where the characteristic of life emerge, is the ____ level.

A. atomic

B. + cellular

C. molecular

D. population

34. Pinocytosis is an example of:

A. facilitated transport

B. passive transport

C. co-transport

D. + endocytosis

35. Cell theory was given by:

A. + Shleiden and Shwann

B. R.Virchov

C. Both

D. None

36. Which feature is not characteristic of the_____animals?

A. multicellular heterotrophs

B. sexual reproduction

C. embryonic development

D. + cell walls

37. The formation of polar body refers to…

A. postembryonic stage

B. + pre-embryonic stage

C. embryonic stage

D. direction stage

38. Exocytosis involves:

A. ingestion of large organic molecules or organisms

B. the use of ATP C.

the uptake of fluids from the environment

D. + the discharge of materials from cellular vesicles

39. The product of male meiosis is …

A. immotile, lightweight egg

B.+ motile, lightweight sperm

C. motile, lightweight egg

D. immotile, lightweight sperm

40. Which of the following organelles is common to plant & animal cells?

A. chloroplasts

B. wall made from of cellulose

C. + mitochondria

D. centrioles

41. A chromatid is attached to a spindle fiber by the…

A. + centromeres

B. chromosomes

C. centrioles

D. fibers

42. The cell theory is not applicable to

A. bacteria

B. algae

C. + virus

D. fungi

43. The process of linking of the replicated homologous chromosomes is termed a …

A.+ tetrad

B. crossing over

C. thin thread

D. thick thread

44. What structure dissolves so that the sister chromatids can move to opposite ends of the cell during cell division?

A. + centromere

B. allele

C. sister chromatids

D. chromosome

45. The tetrads move toward the center and line up on plate. This phase is…

A. Prophase II

B. + Metaphase I

C. Anaphase I

D. Telophase II

46. Lysosomes are produced by the:

A. vacuoles

B. nucleus

C. mitochondria

D. + Golgi Apparatus

47. An organism differed in one character only

A. phenotype

B. + monohybrid

C. dihybrid

D. trihybrid

48. Which of the following is NOT associated with mitosis?

A. growth in height

B. repair of a cut

C. growth of the fetus in the womb

D. + production of gametes

49. An asexual reproduction of unicellular organism

A. conjugation

B. fragmentation

C. + budding

D. multiple fission

50. To study the smallest organelles and cellular components of cells ____ are used:

A. x-rays

B. + the transmission electron microscope (TEM)

C. the compound light microscope

D. flashlights

51. This type of asexual reproduction occurs in worms.

A. conjugation

B. copulation

C. budding

D. + multiple fission

52. Facilitated diffusion:

A. is a type of passive transport

B. moves molecules down the concentration gradient

C. is made possible by specific molecules within the membrane

D. = all of the above apply.

52. The identical twins are produced …

A. sexually

B. +asexually

C. conjugation

D. without fertilization

53. The binomial system of classification was developed by:

A. Lamark

B. +Linnaeus

C. Bovery

D. Malthus

54. What type of cell division reduces the number of chromosomes in sex cells to one half?

A. mitosis

B. +meiosis

C. amitosis

D. multiple fusion

55. What type of reproduction is meiosis?

A simple fission

B reproduction by budding,

C +sexual reproduction

D asexual reproduction

56. A sexual reproduction of multicellular organism without fertilization

A. conjugation

B. copulation

C. budding

D. + parthenogenesis

57. Which one of the following describes the function of the cell membrane or plasma membrane?

A. cell membrane separates the cell from its external environment.

B. plasma membrane gives the cell a definite size and shape.

C. plasma membrane controls the movement of molecules from the cell to the outside

D. + all of the above are the functions of cell membrane.

58. A sexual reproduction of unicellular organisms

A. + conjugation

B. multiple fission

C. budding

D. parthenogenesis

59. Which of the following is true regarding interphase?

A. + it is the longest phase of cell cycle

B. chromatids separate during this phase

C. male and female gametes combine to form a zygote

D. the cell cytoplasm divides

60. In a species of plant, a cross between a homozygous purple-flowered and a homozygous white-flowered plant yields all lavender-flowered plants. The purple allele is…

A. dominant

B. recessive

C. pleiotropic

D. + incomplete dominant

61. Mitochondria:

A. + are involved in cellular respiration

B. turn on and off metabolic pathways

C. are present in animal but not in plant cells

D. all of these are correct

62. Chromosomes diffuse or uncoil to form a new nucleus during…

A. Prophase

B. metaphase

C. Anaphase

D. + Telophase

63. Pinocytosis:

A. the ingestion of large organic molecules or organisms

B. the use of ATP

C. + the uptake of fluids from the environment

D. moves molecules down the concentration gradient

64. Chromosomes line up in a single row along the equator of a cell in what phase?

A. Prophase

B. + metaphase

C. Anaphase

D. Telophase

65. Which of the following cell parts is described as a "fluid mosaic"

A. chloroplast

B. vacuole

C. + cell membrane

D. endoplasmic reticulum

66. A structure that connects the two chromatids together at the middle

A. + centromere

B. cancer

C. tumor

D. surgery

67. When a cell is observed under compound light microscope, which of the following structures will be seen?

A. carbohydrates, lipids, and proteins

B. DNA and RNA

C. + cell membrane, cytoplasm, and nucleus

D. all cytoplasmic organelle

68. When studying an inherited phenomenon, a geneticist discovers a phenotypic ratio of 9:3:3:1 among offspring of a given mating. A possible explanation for this is …

A. epistasis

B. linkage

C. pleiotropy

D. +independent assortment

69. Diffusion of water across a selectively permeable membrane is called:

A. active transport

B. + osmosis

C. exocytosis

D. passive transport

70. A monohybrid cross tests which of the following rules?

A. Rule of Independent Assortment

B. Chromosome Theory of Inheritance

C. + Rule of Segregation

D. Cell theory of Gametes

71. Genetic diversity is greatest trough:

A. parthenogenesis

B. + sexual reproduction

C. asexual reproduction

D. binary fission

72. The founder of genetics is

A. Correns Mendel

B. De Varies

C. Gregor Tschermach

D. + Gregor Mendel

73. Organisms in the Kingdom Animalia are:

A. + mutlicellular and heterotrophic

B. multicellularand autotrophic

C. only prokaryotes

D. unicellular and autotrophic

74. Which best describes the structure of a plasma membrane?

A. + proteins embedded within two layers of phospholipids

B. phospholipids sandwiched between two layers of proteins

C. proteins sandwiched between two layers of phospholipids

D. a layer of proteins on top of a layer of phospholipids

75. The ability to mask the expression of the other allele refers to…

A. recessive allele

B. incomplete allele

C. complete allele

D. + dominant allele

76. If two organisms are in the same phylum, they must also be in the same:

A. + class

B. species

C. family

D. kingdom

77. The genetic constitution of an individual is…

A. pleiotropic

B. dominant

C. phenotype

D. + genotype

78. Organisms that are eukaryotic, and consist of single cells or colonial would be classified into kingdom:

A. Plantae

B. Fungi

C. Animalia

D. + Protista

79. In this case the heterozygote exceeds in quantity the phenotypic expression of both the homozygotes. It is…

A. epistasis

B. codominance

C. + over dominance

D. pleiotropy

80. Which of the following is NOT a type of passive transport?

A. diffusion

B. osmosis

C. + endocytosis

D. facilitated diffusion

81. If one gene masks the effect of another, a phenomenon called…

A. + epistasis

B. complete dominance

C. over dominance

D. pleiotropy

82. Active transport?

A. requires a carrier protein

B. moves a molecule against its concentration gradient

C. requires a supply of energy

D. + all of these are correct

83. All the altered alternate forms of a gene, whose number is more than two, are called…

A. pleiotropic alleles

B. poligenic alleles

C. phenotype

D. + multiply alleles

84. Cell theory was proposed by:

A. Beadle and Tatum

B. Robert Hooke

C. + Schwann and Schleiden

D. Levenhook

85. One of three MAIN stages of ontogenesis:

A. isolecithal stage

B. gamete formation stage

C. + embryonic stage

D. zygotic stage

86. Which cell process occurs within the mitochondria?

A. exocytosis

B. respiration

C. cytokinesis

D. photosynthesis

87. The eggs can be divided into three types, which depend on…

A. structure of nucleus

B. chromosome number

C. structure of organelles

D. + amount of nutrients

88. Members of kingdom Animalia are with respect to their mode of nutrition:

A. + ingestive heterotrophs

B. ingestive autotrophs

C. absorptive heterotrophs

D. absorptive autotrophs

89. The outer layer, the trophoblast, eventually forms…

A. an ectoderm

B. + the placenta,

C. the endoderm

D. the embryo

90. What organelle is responsible for package and export proteins?

A. mitochondria

B. endoplasmic reticulum

C. nucleolus

D. + Golgi Apparatus

91. Select the syndrome in which the person has 45 autosomes

A. + Down

B. Klinefelter

C. Turner

D. Jacob

92. The difference between vacuoles and vesicles is based on:

A. + size

B. composition

C. number

D. contents

93. Select the syndrome that is a monosomy

A. Down

B. Klinefelter

C. + Turner

D. Jacob

94. Membrane-bound intracellular structures are called:

A. + organelles

B. tissues

C. organs

D. cytoplasm

95. Which syndrome affects the sex chromosomes?

A. Down

B. Edward

C. Patau

D. + Turner

96. Which of the following sequences of organization is likely to be seen in multicellular organisms, going from smallest to largest?

A. cell, organ, tissue, organism

B. cell, organ, system, tissue

C. + cell, tissue, organ, organism

D. organism, system, organ, tissue

97. Select the disease caused by an autosomal recessive pattern

A. + PKU

B. hemophilia

C. neurofibromatosis

D. color blindness

98. Simple diffusion is defined as:

A. movement of molecules across a membrane from low to high concentration

B. + movement of molecules down a concentration gradient

C. movement of water across a membrane from low solute concentration to high solute concentration

D. movement of solute up a concentration gradient

99. Height, weight, skin colour, intelligence, hair colour, many forms of behavior are inherited by…

A. pleiotropy

B. multiply alleles

C. + polygenic

D. epistasis

100. When red blood cells are placed in distilled water they swell and burst. What prevents plant cells from bursting under the same circumstances?

A. plant cells are unaffected by distilled water

B. animal cell membranes are structurally weaker than plant cells

C. plant cells have cell walls which prevent them from bursting

D. + plant cells have contractile vacuoles

101. ____ Painful, swollen lymph glands (buboes) arise, usually in the groin, axilla, or neck. This symptoms of

A. + Bubonic plague

B. Pneumonic plague

C. Septisemic plague

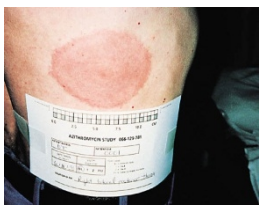
D. Meningeal plague

102. In this picture you see the rat flea, which is the most important vector for transmission of plague

A. True

B. + False

C. Do not know



D. contaminated food

103. True statement regarding *Entamoeba histolytica* is…

A. The trophzoites are infective to man

B. Mature cyst has eccenteric nucleolus

C. It can cause primary amoebic encephalitis

D. + Cyst are resistant to chlorine concentration used in drinking water

104. Normal habitat of Giardia is…

A. + Duodenum and jejunum

B. Stomach

C. Caecum

D. Ileum

105. All of the following protozoans are found in small intestine except

A. + Giardia lamblia

B. Balantidium coli

C. Cyclospora caytanensis

D. Isospora belli

341. The following is true of giardiasis except

A. + Fever and presence of blood and mucus in stool

B. Acute or chronic diarrhea

C. Duodenum and jejunum are the prime sites of involvement

D. Giardia cysts are resistant to dessication

106. Giardia lamblia was discovered by…

A. + Giard

B. Robert hook

C. Leuwenhoek

D. Losch

107. True about Giardia is…

A. May cause traveller's diarrhea

B. Giardia inhabits ileum

C. Trophozoites are infective to man

D. + Encystment of trophozoites occur in jejunum

108. Motility of *Trichomonas vaginalis* is described as

A. Amoeboid

B. + Jerky

C. Falling leaf

D. Lashing

109. Vaginal discharge in *Trichomonas vaginalis* vaginitis is

A. Colorless

B. + Yellow

C. Curd-white

D. Blood stained

110. All of the following protozoan cannot be transmitted by sexual contact except:

A. + Trichomonas vaginalis

B. Entamoeba histolytica

C. Enteromonas hominis

D. Giardia lamblia

1. EDUCATIONAL-METHODICAL AND INFORMATION SUPPORT OF THE DISCIPLINE

LITERATURE:

1. Neit A. Campbell, "Biology Concepts and Connections", University of California, Riversside, 2012, 4-th edition
2. Campbell *Mitchell* Reece, "Biology Concepts and Connections", University of California, Riversside, 2011, 5-th edition
3. William K. Purves (Un. California), David Sadava (The Claremont Colleges Caremont, California), Gordon H. Orians (Emeritus. The University of Washington), H. Graig Heller (Stanford University), "Life The Science of Biology", 2011, Sixth Edition
4. K.D. Chatterjee M.D. (Cal)6, Amrita Banerjee Road, Kolkata-700 026 Parasitology
5. SougataGhosh M.D. DCH Paniker`s textbook of Medical Parasitology
6. Dr. Shahid Anwar. Medical illustrated Parasitology for MBBS students
7. GirmaMekete, Mohamed AwoleAdem. "Parasitology lecture notes" For Medical Laboratory Technology Students 2013.
8. Internet sources www.learner.org
9. Harold W. Brown, (Columbia University college), Franklin A.Neva "Basic Clinical Parasitology", fifth edition, 2010.

10. World Health Organization, Geneva, “Basic Laboratory methods in Medical Parasitology”,2011.

2. LIST OF METHODICAL GUIDELINES FOR STUDENTS IN THE DEVELOPMENT OF THE DISCIPLINE.

Independent work in the study of disciplines includes:

- reading by students of the recommended literature and assimilation of the theoretical material of the discipline;
- preparation with Internet sources;
- preparation for various forms of control (tests);
- preparation and writing of essays;
- performance of control works;

Material outlined in lectures should be regularly developed and supplemented with information from other sources of literature presented not only in the discipline program, but also in periodicals.

When studying the discipline, you must first read the recommended literature on each topic and make a short summary of the main provisions, terms, and information that require memorization and are fundamental in this topic for the development of subsequent topics of the course. To expand the knowledge of the discipline, it is recommended to use Internet resources; conduct searches in various systems and use materials from sites recommended by the teacher.

7.1. Guidelines for practical and lecture classes

Laboratory work is the conduct of experiments by students on the instructions of the teacher or on the instructions of the experiments using devices, tools and other technical devices, i.e., the study of any objects or phenomena using special equipment.

Practical work is carried out after lectures, and are clarifying, generalizing and reinforcing. They can be held not only in the classroom, but also outside the school.

In the course of laboratory and practical work, students perceive and comprehend new educational material. Practical classes are systematic, regularly following each lecture or two or three lectures.

Laboratory and practical work is performed according to the schedule of the educational process and independent work of students in the disciplines. The student is allowed to do laboratory and

practical work only after a safety briefing. Safety regulations are set out in the instructions, which must be clearly visible in the laboratory.

During preparation for laboratory studies, it is necessary to study methodological recommendations for its implementation in advance. Pay attention to the purpose of the lesson, to the basic questions for preparing for the lesson, to the content of the topic of the lesson.

Each student leads a workbook, the design of which must meet the requirements, the main of which are as follows:

- on the title page indicate the subject, course, group, last name, first name, middle name of the student;

- each work is numbered in accordance with the sequence, specify the date of completion of the work;

- fully record the name of the work, the purpose and principle of the method, briefly describe the course of the experiment and the object of research;

- if necessary, give a picture of the installation; the results of experiments are recorded in the form of drawings with mandatory captions to them, as well as tables or describe verbally (the nature of the design of the work is usually specified in the guidelines for independent work);

- at the end of each work, a conclusion or conclusion is made, which is discussed when

summing up the lesson.

All primary records must be made in a notebook during the experiment

Laboratory and practical work includes the following steps:

- setting the topic of classes and defining the tasks of laboratory and practical work;
- determination of the order of laboratory and practical work or its individual stages;
- Direct implementation of laboratory / practical work by students and
- monitoring the progress of classes and observance of safety measures;
- Summing up the results of laboratory and practical work and formulating the main conclusions.

To check the academic activity and quality of the student's work, the teacher periodically checks the workbook.

7.2. Guidelines for preparing copy notes

Abstract – a written summary of the content of the scientific work on the given topic. This is an independent research work, where the student reveals the essence of the problem under study with elements of analysis on the topic of the abstract.

Provides various points of view, as well as their own views on the problems of the topic of the abstract. The content of the abstract should be logical, the presentation of the material should be simple problem-thematic nature.

Requirements for abstract design:

The volume of the abstract can range from 5-7 printed pages.

Main sections: table of contents (plan), introduction, main content, conclusion, list of references. The abstract text should contain the following sections:

- title page indicating: the name of the University, Department, topic of the abstract, full name of the author and full name of the teacher;

- Introduction, relevance of the topic.

- main section.

- conclusion (analysis of the results of literary search); conclusions.

- The list of literary sources must have at least 10 bibliographic names, including network resources.

The text part of the abstract is drawn up on a sheet of the following format:

- top spacing - 2 cm; left margin - 3 cm; indent on the right - 1.5 cm; indent from the bottom - 2.5 cm;

- text font: Times New Roman, font height - 14, space - 1.5;

- pagination - at the bottom of the sheet. On the first page, the number is not put.

The abstract should be carried out competently in compliance with the culture of presentation. There must be references to the literature used, including periodical literature over the past 5 years.

Criteria for assessing the abstract:

- relevance of the research topic;

- correspondence of the content to the topic;

- depth of material development;

- The correctness and completeness of the development of the questions posed;

- significance of conclusions for further practical activities;

- correctness and completeness of the use of literature;

- Compliance of the abstract to the standard;

- the quality of the message and answers to questions while protecting the essay.

7.3. Guidelines for the preparation of independent work

Independent work of students is aimed at solving the following problems:

- development of skills of perception and analysis of professional information;

- development and improvement of decision-making abilities and their implementation;

- development and improvement of creative abilities in the independent study of professional problems.

To solve the first problem, students are offered for reading and meaningful analysis monographs and scientific articles on human biochemistry. The results of working with texts are discussed at seminars and colloquiums.

To develop the skills of independent work, students perform tasks, independently turning to educational, reference and scientific and methodological literature.

Verification of assignments is carried out both at seminars with the help of oral presentations of students and their collective discussion, and with the help of written independent works.

For the development and improvement of students' communicative abilities, special training sessions are organized in the form of "disputes" or "conferences", in preparation for which students are pre-assigned to groups defending a particular point of view on the issue under discussion.

3. INFORMATION AND EDUCATIONAL TECHNOLOGIES

Educational technology - an ordered system of actions, the implementation of which leads to the achievement of goals and educational technology - the construction of the educational process with guaranteed achievement of goals. Educational teaching technologies as a generalized universal system that organically and optimally integrates many of the technologies necessary to achieve specific educational and development goals and which, as a holistic unity of the content and technology of its study, is implemented through a set of technologies:

Used interactive forms and methods of teaching the discipline

A lecture is a form of organization of the educational process in which the teacher transmits a large amount of systematized information as an indicative basis for independent work of students.

The general structural framework of any lecture is the wording of the topic, communication of the plan and recommended literature for independent work, and then strict adherence to the plan of the proposed work.

Types of lectures

1. The introductory lecture gives the first holistic view of the subject and guides the student in the system of work for this course. The lecturer acquaints students with the purpose and objectives of the course, its role and place in the system of academic disciplines and in the system of specialist training. At this lecture, methodological and organizational features of the work within the framework of the course are expressed, as well as an analysis of the educational and methodical literature recommended by students, the terms and forms of reporting are specified.

2. Lecture information. It is focused on the presentation and explanation to students of scientific information to be comprehended and memorized. This is the most traditional type of lecture in high school practice.

3. A review lecture is a systematization of scientific knowledge at a high level, which allows a large number of associative connections in the process of comprehending the information presented during disclosure within the subject and between subject matter, excluding detailing and concretization. As a rule, the core of the stated theoretical provisions is the scientific, conceptual and conceptual basis of the entire course or its major sections.

4. Lecture-visualization is a visual form of presentation of lecture material by means of TCO or audio-video equipment. Reading such a lecture comes down to a detailed or short commentary on the visual materials being viewed.

5. A binary lecture is a type of lecture in the form of two teachers (either as representatives of two scientific schools, or as a scientist and practitioner, teacher and student).

6. The lecture-conference is held as a scientific and practical lesson, with a pre-set problem and a system of reports, lasting 5-10 minutes. Each presentation is a logically finished text, prepared in advance as part of the program proposed by the teacher.

Methods and techniques of interactive teaching practical exercises

• Critical thinking questions - a stream of questions and answers, or suggestions and ideas on a given topic, in which the analysis of correctness / incorrectness is performed after the storming. Read more about brainstorming in class.

- Clusters, comparative charts, puzzles - search for keywords and problems on a specific mini-topic.

- An interactive lesson with the use of audio and video materials, ICT. For example, tests online, working with electronic textbooks, training programs, training sites.

- A round table (discussion, debate) is a group view of the method, which involves a collective discussion by students of a problem, proposal, idea, opinion and a joint search for a solution.

- The project method - independent development by students of a project on a topic and its protection.

4. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Discipline Study Methods

1. Lecture material

2. Independent work

3. The theoretical basis

4. Group discussion

Information and technical support

1. Maps (territories, events, archaeological sites)

2. Photographs and drawings (prominent historical figures, events)

3. Examples of text sources (historical, modern, archival)

4. Archaeological data (photographs, drawings, tools)

5. Samples of the material culture of the peoples of Kyrgyzstan.

Technical Training Tools

1. Projection computer installation

2. Laptop

3. Visual aids (cards)

10. NOTES FOR CLASSES

SEMESTER 1.

Lecture No1.

LIVING SYSTEM.

T: MAIN CHARACTERISTICS OF LIVING THINGS

Our environment made of both living and non-living things. What is it that makes an organism living? The answer to this is the presence of cell in all living organisms. All organisms are composed of cells. Some are composed of a single cell and are called unicellular organisms while others, composed of many cells, are called multicellular organisms[1].

There are main properties of living things, which distinguish living organisms from non-living:

1. *The chemical nature of the living things*
2. *Living things are organized*
3. *Living things acquire materials and energy*
4. *Living things reproduce*
5. *Living things growth and develop*
6. *Living things inherit*
7. *Living things have homeostasis*
8. *Living things have adaptations*

Lecture No2

THE CELL

What is a cell? Unicellular organisms are capable of independent existence and performing the essential functions of life. Anything less than a complete structure of a cell does not ensure

independent living. Hence, cell is the fundamental structural and functional unit of all living organisms [1].

Every eukaryotic cell consists of three main components:

- Cell membrane
- Cytoplasm
- Nucleus

CELL MEMBRANE

The cell membrane is an outer layer of the cell. It performs several essential functions in a cell:

1. Protection
2. Transport
3. Barrier
4. Connection between cells in multicellular
5. Selective permeable

The detailed structure of the membrane was studied only after the advent of the electron microscope in the 1950s. These studies showed that the cell membrane is composed of lipids that are arranged in a bilayer. The lipid component of the membrane mainly consists of phospholipids. Later was discovered that the cell membranes also possess protein and carbohydrate [1].

An improved model of the structure of cell membrane was proposed by Singer and Nicolson (1972) widely accepted as fluid mosaic model (Fig.1). According to the fluid mosaic model, the plasma membrane is a mosaic of components—primarily, phospholipids, cholesterol, and proteins—that move freely and fluidly in the plane of the membrane. In other words, a diagram of the membrane is just a snapshot of a dynamic process in which phospholipids and proteins are continually sliding past one another [2].

Lecture No3.

CELL CYCLE. The series of changes which involve period of growths (during which proteins are synthesized) replication of DNA, followed by cell division (when cell divides into two or more cells) known as *cell cycle* (Fig.4).

Phases of cell cycle:

G1 – phase (pre-DNA synthesis phase)

S –phase (synthesis phase)

G2 – phase (pre – mitosis phase)

M – phase (mitosis)

1. **G_1 -phase**is the period of extensive metabolic activity, in which cell normally grows in size, specific enzymes are synthesized and DNA base units are accumulated for the DNA synthesis. It is the time between the end of mitosis and initiation of DNA synthesis, also called as ***pre-DNA synthesis phases***.

2. S-phase.

Following the G_1 is the S –phase (synthesis phase) during which the DNA is synthesized.

3. G_2 – phase (pre-mitotic phase).

Now initiates G_2 phase , thus preparing the cell for division i.e. energy storage for chromosome movements, mitosis specific proteins, RNA and microtubule subunits (for spindle fibers) synthesis are accomplished M

4. M-phases (mitosis)

It is the type of cell division, which ensures the same number of chromosomes in the daughter cells as that in the parent cells.

Mitosis is a continuous process, but conventionally it may be divided into two phases:

- **Karyokinesis,** which involves the division of nucleus
- **Cytokinesis** that refers to the division of the cytoplasm or whole cell.

Lecture No4.

THE REPRODUCTION. Life comes only from life. Every species of living things can reproduce or make another new organism like itself. Reproduction divides into two types:

1. Asexual 2. Sexual. In the table №1 (below) is given a classification of reproduction

Table №1

REPRODUCTION			
SEXUALL		**ASEXUALL**	
In unicellulars	**In multicellulars**	**In unicellulars**	**In multicellulars**
1. conjugation 2. copulation	1. With fertilization 2. Without fertilization	1. Budding 2. Schizogony 3. Binary fusion 4. Sporulation	1. Vegetative propagation 2. Budding 3. Sporulation 4. Multiply fusion or fragmentation 5. Identical twins

SEXUAL REPRODUCTION

During sexual reproduction a new organism forms due to fusion of the genetic materials from two different cells. The cells that combine together are called sex cells or gametes. They have two types:

1. Male sex cells or gametes are *sperms.*
2. Female sex cells or gametes are – *eggs or ovum.* These cells are produced by special glands or gonads. The male gonads called ***testis***, and female gonads called ***ovaries.*** The process of sex cell or gamete formation called ***gametogenesis.***

The gametogenesis which occurs in testis called ***spermatogenesis***. It is formation of sperm cells in male body. The gametogenesis which occurs in ovaries called ***oogenesis***. It is formation of egg cells or ovum in female body. In general, gametogenesis process for successful understanding, divided into four stages:

1. Proliferation or division
2. Growth
3. Maturation
4. Differentiation

Lecture No5.

ONTOGENESIS. STAGES. CRITICAL PERIODS OF EMBRYONIC DEVELOPMENT.

Ontogenesis is individual development of each organism. It begins from fertilization and finishes by the death of living organism. Ontogenesis has three stages:

1. Pro-embryonic stage
2. Embryonic stage
3. Postembryonic stage

PROEMBRYONIC STAGE refers to formation of gametes or gametogenesis. In other words, all processes concerned to formation and development of ovum and sperm cell occurs in this stage. It is important to pay attention to formation and further development of ovum. As we know, during oogenesis only one fully developed egg forms, other three cells due to unequal division of cytoplasm convert into polar bodies.

Formation of polar bodies is important, because, ovum takes from polar bodies almost all amount of cytoplasm. The further development of zygote depend on nutrients in cytoplasm, therefore all three polar bodies give their cytoplasm with nutrients to ovum. The polar bodies have no capabilities to further development.

The eggs divided into three types on the basis of:

1. an Amount of yolk
2. a distribution of yolk
3. a Shell

Amount of yolk

1. Alecithal Egg: When the egg contains no yolk Ex. High mammals
2. Microlecithal Egg: When the egg contain Small or negligible yolk Ex. Tunicates
3. Mesolecithal egg: Amount of yolk present is moderate and is not high Ex. Amphibian
4. Macrolecithal or Megalecithal Egg contains large amount of yolk Ex. Reptiles, Birds

Lecture No6.

GENETICS FUNDAMENTALS

Genetics deals with the inheritance, as well as the variation of characters from parents to offspring. Inheritance is the process by which characters are passed on from parent to progeny; it is the basis of heredity. Variation is the degree by which progeny differ from their parents[1].

Gregor Mendel, conducted hybridization experiments on garden peas for seven years (1856-1863) and proposed the laws of inheritance in living organisms.

Law of Dominance

The law of dominance is used to explain the expression of only one of the parental characters in a monohybrid cross in the F_1

"In a cross of parents that are pure for contrasting traits, only one form of the trait will appear in the next generation. Offspring that are hybrid for a trait will have only the dominant trait in the phenotype." (Fig.10).

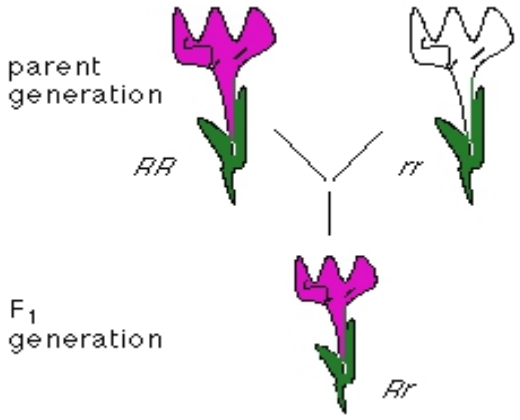


Figure № 10. Law of Dominance. Image modified from OpenStax Biology.

Law of Segregation

"In a cross of F1 generation parents, they (parents) contain two alleles during gamete formation, the factors or alleles of a pair segregate from each other such that a gamete receives only one of the two factors" (Fig.11).

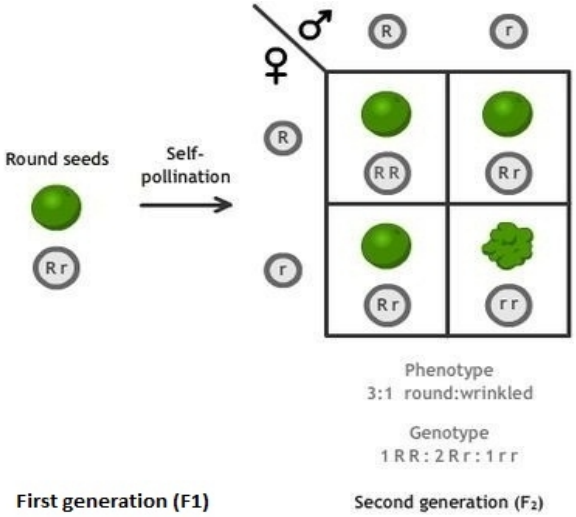


Figure № 11.Segregation of alleles.Image modified from OpenStax Biology.

Low of independent assortment.

The law states that *'when two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other pair of characters'*. Members of one pair of factors separate independently of members of another pair of factors. Therefore, all possible combinations of factors can occur in the gametes (Fig.12).

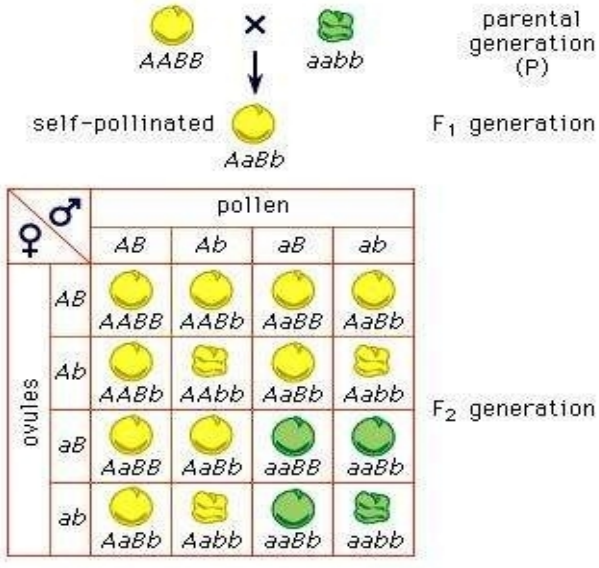


Figure № 12. Independent assortment shows all possible combinations of gametes. Image modified from OpenStax Biology.

Lecture No7.

THE CHROMOSOMAL BASIS OF INHERITANCE

Gregor Mendel's "hereditary factors" were purely an abstract concept when he proposed their existence in 1860. At that time, no cellular structures were known that could house these imaginary units. Even after chromosomes were first observed, many biologists remained skeptical about Mendel's laws of segregation and independent assortment until there was sufficient evidence that these principles of heredity had a physical basis in chromosomal behavior. Today, we know that genes (Mendel's "factors") are located along chromosomes.

We can see the location of a particular gene by tagging chromosomes with a fluorescent dye that highlights that gene.

Around 1902, Walter S. Sutton, Theodor Boveri, and others independently noted the chromosome theory of inheritance. According to this theory, Mendelian factors, genes have specific loci (positions) along chromosomes, and it is the chromosomes that undergo segregation and independent assortment.

Thomas Hunt Morgan, an experimental embryologist at Columbia University, could give the first solid evidence associating a specific gene with a specific chromosome in early 20th century.

His experiments provided convincing evidence that chromosomes are indeed the location of Mendel's heritable factors. For his work, Morgan selected a species of fruit fly, *Drosophila melanogaster.* Morgan's discovery that transmission of the X chromosome in Drosophila correlates with inheritance of an eye-color trait was the first solid evidence indicating that a specific gene is associated with a specific chromosome.

Sex is an inherited phenotypic character usually determined by which sex chromosomes are present. Humans and other mammals have an X-Y system in which sex is determined by whether a Y chromosome is present. Other systems are found in birds, fishes, and insects.

The sex chromosomes carry sex-linked genes for some traits that are unrelated to sex characteristics. For instance, recessive alleles causing color blindness are X-linked (carried on the X chromosome). Fathers transmit this and other X-linked alleles to all daughters but not to sons. Any male who inherits such an allele from his mother will express the trait.

In mammalian females, one of the two X chromosomes in each cell is randomly inactivated during early embryonic development, becoming highly condensed into a Barr body.

X – Linked gene

In addition to genes that determine sex, the X-chromosomes carry genes for traits that have nothing to do with the sex of the individual. By tradition, the term sex-linked or X-linked is used

for genes carried on the X chromosome. The Y-chromosome does not carry these genes and indeed carries very few genes.

Characteristic of X-linked trait:

1. Phenotypic expression is more common in male

2. Sons (male) can't inherit the trait from their father, but daughters can

3. Sons inherits their Y chromosome from their father

4. Only a few genes have been identified on the Y chromosome, among them the testis determiners factor (TDF) that promote development of the male phenotype.

Lecture No8.

THE HUMAN GENETICS. VARIATION AND ITS TYPES.

HUMAN GENETICS

The morphology, physiology and pathology of human were studied in detail. But, unfortunately, during study of Human Genetics, the researchers have faced with following difficulties:

1. Low fertility
2. Slow alternation of generation
3. Impossibility of statement of special experiments
4. The big number of chromosomes

By over mentioned reasons the human is not favorable object for genetic researches. The studying of human inheritance is carry out by following methods:

1. Pedigree analysis method
2. Cytogenetic methods or karyotype
3. Biochemical method
4. Twin method
5. Statistical method

PEDIGREE ANALYSIS METHOD. Unable to manipulate the mating patterns of people, geneticists must analyze the results of matings that have already occurred. They do so by collecting information about a family's history for a particular trait and assembling this information into a family tree describing the traits of parents and children across the generations—the family pedigree. Genetic counselors often construct pedigree charts to determine followings:

1. dominant or recessive
2. heterozygous or homozygous

3. autosomal or X-linked

CYTOGENETIC METHODS OR KARYOTYPING. Abnormalities in the number of chromosomes and some abnormalities within the chromosomes can be detected by analysis of the karyotype. Abnormalities in the number and structure of chromosomes called *chromosomal errors*. Special stains are used to reveal certain changes in fine structure within the chromosomes.

2 SEMESTER

Lecture No1

GENERAL REVIEW OF PROTOZOA

Introduction

Protozoa are unicellular organisms found worldwide. Most species are free living, but almost all higher animals are infected with one or more parasitic species of Protozoa. Infections range from asymptomatic to life threatening, depending on the species and strain of the parasite and the resistance of the host.

More than 50,000 species of the kingdom Protista have been described, most of which are free-living organisms; protozoa are found in almost every possible habitat. Virtually all humans have protozoa living in or on their body, and many people are infected with one or more species throughout their life. Some species are considered commensals, i.e., normally not harmful, whereas others are pathogens and usually cause disease. Protozoan diseases range from very mild to life-threatening. Individuals whose defenses are able to control but not eliminate a parasitic infection become carriers and constitute a source of infection for others.

Morphology. Most parasitic protozoa in humans are less than 50 μm in size. The smallest (mainly intracellular forms) are 1 to 10 μm long, but *Balantidium coli* may measure 150 μm. Protozoa are unicellular Eukaryotes.

The organelles of protozoa have functions similar to the organs of higher animals. The plasma membrane enclosing the cytoplasm also covers the projecting locomotory structures such as pseudopodia, cilia, and flagella. The outer surface layer of some protozoa, termed a pellicle, is sufficiently rigid to maintain a distinctive shape, as in the trypanosomes and *Giardia*. In most protozoa the cytoplasm is differentiated into ectoplasm (the outer, transparent layer) and endoplasm (the inner layer containing organelles); the structure of the cytoplasm is most easily seen in species with projecting pseudopodia, such as the amoebas.

Some protozoa have a cytosome or cell “mouth” for ingesting fluids or solid particles. Contractile vacuoles for osmoregulation occur in some, such as *Balantidium*. Many protozoa have subpellicular microtubules; in the Apicomplexa, which have no external organelles for locomotion, these provide a means for slow movement. The trichomonads and trypanosomes have a distinctive undulating membrane between the body wall and a flagellum. Many other structures occur in parasitic protozoa, including the Golgi apparatus, mitochondria, lysosomes, food vacuoles, conoids in the Apicomplexa, and other specialized structures. Electron microscopy is essential to visualize the details of protozoal structure.

Lecture No2

CLASS SPOROZOEA

Order Eucocciida, Suborder Haemosporina, Genus Plasmodium

Malaria is the most important of all protozoan disease; it annually infects over 250 million individuals. It is a leading cause of illness and death in the developing world. In many endemic areas it is becoming increasingly difficult to control because of Anopheles mosquito vector and the parasite to developed resistance to various eradication and treatment options.

General Characteristics

1. Intracellular obligate parasites.
2. Man is intermediate host.
3. Female Anopheles mosquitoes are the definitive hosts.
4. Those species which infect human being are *P.vivax, P.falciparum, P.malariae* and *P.ovale*
5. No animal reservoir host except *P.malariae* in which monkeys are the reservoir hosts
6. Infective stage to man from the insect vector is sporozoites and to the insect vector from man are gametocytes.

Geographical Distribution. Malaria is endemic in 91 countries with about 40% of the world population is at risk. *Plasmodium falciparum* is the most prevalent species in the humid regions of the world. *P.vivax* is the most widely distributed in the temperate, subtropics and some parts of the tropics. Unlike the other species, it is more common and well adapted to the temperate region than in the tropics. *P.malariae* has much lower prevalence than *P.vivax, P.falciparum* and *P.ovale*. It is confined mainly to tropical Africa. Also it is found in South America and South west Asia.

Habitat. The parasite enters the blood and carried to the parenchyma cells of liver, where they multiply enormously. Then they enter the RBCs and reach all the organs, producing parasitaemia.

Morphology: There are sequential developmental stages with distinct morphological features that help for species identification in Romanowsky stains of Peripheral blood films. This presented on example of *P.falciparum:*

1.Young Trophozoite (Ring forms) Stage frequently found in blood film

2.Mature Trophozoite Stage rarely seen in peripheral blood RBC unaltered in size.

3.Schizont RBC unaltered in size , sometimes stippled, pale.

4.Gametocytes RBC is distorted. Fairly frequently found

5.Stippling Maurer's cleft

Life cycle. Malaria parasites require two hosts to complete their life cycle.

Definitive host: female Anopheles mosquitoes, where sexual reproduction (sporogony) takes place.

Intermediate host: Man, where the asexual reproduction (schizogony) occurs.

Lecture No3

Medical Helminthology

Helminths (Worms)

The word, helminths from Greek means "Worm" and originally referred to intestinal worms but it is more usually interpreted to include both parasitic & free-living species of round worms (phylum Nemathoda)"hair snakes" or gordiid worms (Phylum – Nematomorpha), tubellarians, flukes & tape worms (phylum-plathyhelminthes) & thorny - headed worms (phylum Acanthecephala). The helminths are generally macroscopic, and the adult worms vary tremendously in size from barely visible to 10 meters in length. The life cycles of helminths may be quite complex and include both direct and indirect cycles.

The clinical sign and symptoms of helminthic infections depend on the location of the organisms and may be caused by adults, larva, or eggs. The host response to the presence of parasite may be prominent and often includes eosinophilia, especially in the early stages of infections when the parasites are in tissue. The final diagnosis is usually dependant on detection and identification of a mature or developmental (larva, embryo, egg) stage of the parasite.

Occasionally the diagnosis may be made clinically or serologically. The majority of helminths produce characteristics eggs that are passed in feces and serve as the chief means of diagnosing infections. The identification of eggs should be approached in a systematic manner taking into account the size, and shape of the egg, the thickness of the shell, the presence or

absence of specialized structures such as spines, Parasitology 113 knobs or opercula. The presence and characteristics of larva present within the eggs may be useful.

3.1 Platyhelminths

3.1.1 Class Cestoda (Tape worms)

Tape worm infection in man is less limited in their distribution than are human fluke infections. They are frequently not restricted to any specialized group of intermediate hosts, as species- of Mollusks that may be local in their distribution or confined by certain meteorological

conditions. Some of them are dependent primarily on exclusively on man as a definitive host for the continuation of their life cycles (*T.segina, T.solium, H. nana D.latum*); on the other cases man is incidental to continued propagation of the parasite (*E.granulosus, H. duminuta and Diplidium caninum).* In all known tapeworm infection, except in certain varieties of sparganosis, in which exposure in topical, the portal of entry is mouth hence, strict care not to swallow raw or inadequately, cooked beef, pork or fish or food or water contaminated with faeces or vermin,

will ensure protection of the individuals.

General characteristics:

1. Dorso-venterally flattened (leaf or tape-like)

2. Bilaterially symmetrical.

3. They are provided with a nervous system and an elaborate excretory apparatus.

4. Digestive system may be absent, or when present it is rudimentary and without anus. It obtains its nutrient by absorption through cuticle.

5. Respiratory, circulatory system and body cavity are absent.

6. Tape worms are hermaphrodites and have well developed reproductive system. Parasitology 114

7. Each unit of chain (segements) is known proglottides. The entire chain of proglottids is called strobila

8. The body is divided into three main body regions; this are

Head (scolex): attachment organ and may have grooves, suckers, and rostellum armed with hooklets; this varies with species.

Neck: growth region, proglottids proliferate from this region.

Strobila: varies in number, shape, size, and maturity. It is divided into

three regions:

a/ immature : sex organs are immature.

b/ mature: sex organs are fully mature.

c/ gravid : reduced or atrophied primary genital organs,

uterus is filled with eggs

N.B: Infection persists as long as the scolex and the neck region remain attached to the intestinal wall. Parasitology

9. The entire body is covered with active homogenous, elastic, resistant and continuous cuticle/integument from one proglottid to the next through out the entire body.

10. Elaborate and well developed reproductive system with complete set of male and female genital organs which are found in a single worm.

11. Man is;

a. The only or main definitive host for *T.saginata, T.solium, H. nana and D.latum*

b. Intermediate host for *E.granulosus* and *E.multilcularis*

c. Both as definitive and intermediate host for *H.nana* and

T.solium

Based on the following differences criteria, cestodes are classified into two orders:

Order- Pseudophillidea Order-Cyclophillidea

Differences

1. Scolex - Spoonshaped, grooves - globular with 4 suckers

2. Genital pore - venteral - marginal

3. Utrine pore - Present(ventral) - absent

4. Uterus - coiled - sacular tubular or branched

5. Ova - operculated - non-operculated

6. Onchosphere - ciliated - non-ciliated

7. Rostellum - absent - present

8. Progilottids - broader than long - longer than broader

9. Larval forms - solid - cysticParasitology 116

Lecture No 3

Intestinal Round Worms (Nematodes)

General Characteristics

1. Adult worms live in the intestinal tract

2. Female worms are oviparous (lay eggs)

3. Humans are the only or the most significant hosts

4. Most species are soil transmitted

5. Before becoming adults in their human host, the larvae of *A. lumbricoides, S. stercoralis* , and hookworms have heart lung migration.

Ascaris Iumbricoides

(Round worm)

Geographical Distribution: Cosmopolitans. *A. lumbricoides* is one of the commonest and most wide spread of all human parasites.

Habitat: Adult: In the small intestine Egg: In the faeces

Morphology:-*Adult:* colour: pinkish

***Male*:** size: about 15cm curved tail and two copulatory spicules of unequal size

Female: size 2--25cm , with a straight tail.

Eggs:-There are five types of *Ascaris* eggs.

A. Fertilized Egg With Double Shell

Size: about 70µmShape: oval, or some times round

Shell: The two layer are distinct, rough , brown, covered with

little lumps external shell and smooth, thick, colourless Parasitology internal shell.

Colour: brown external shell, and the contents are colorless or pale yellow.

Content: a Single rounded granular central mass.

B. Unfertilized Egg With Double Shell

size: 80-90µm shape; more elongated (elliptical)

shell: brown, puffy external shell and thin internal shell.

content: full of large round very refractile granules

C. **Semi-decorticated Fertilized Egg Similar to Type A but With out the External Shell**

shell: single , smooth, thick and colourless or very pale yellow.

Content: a single rounded colourless granular central mass.

D. Semi-Decorticated Unfertilized Egg

Shell: a single smooth thin colourless shell (double line)

Content: large rounded colourless refractile granules. Parasitology173

E. Embryonated egg

Figure 3.14. *Ascaris lumbricoides ova*. (From Jeffrey HC and Leach RM. Atlas of Medical Helminthology and Protozoology, 1975.)

Life cycle:

Egg→Larve→Adult

The infective stage is the egg containing second stage rhabditiform larva. Infection occurs by ingestion of the infective egg in contaminated food or drink, from contaminated hand. Following ingestion the larvae hatch in the small intestine and penetrate blood vessels in the small intestinal

wall. The larvae follow a heart lung migrate from and develop. After migrating up the trachea, the larvae are swallowed. In the small intestine, they grow into mature worms.

After mating the female produces large number of eggs (200,000 eggs/day/ female) which are passed in the feces. In shaded soil. the egg develop and contain infective larva. The larva does not hatch until the egg is swallowed. Parasitology

Figure 3.15. Lifecycle of *Ascaris lumbricoides*. (From Hegazi M. Applied Human Parasitology. 1sted. 1994; Cairo, the Scientific Book Centers)

***Pathology*:** During their migration, Ascaris larva can cause inflammatory and hypersensitive reactions including pneumonia like symptoms, attacks of coughing, and bronchial asthma.

-Developing and mature worms in the intestine frequently cause pain, nausea, diarrhea and vomiting. Parasitology -Its infection in children is known to affect gastrointestinal function.

Infected children are often Vitamin A deficient and have low serum albumin levels .Frequent exposure to infection may result in impairment of physical and intellectual development.

Prevention and Control:

1. Prevent soil contamination by sanitary disposal of faeces in latrines and avoid the use of night soil as a fertilizer and washing hands before eating

2. Around eating uncooked foods such as vegetables, green salads and fruits

3. Treatment and health education.

Laboratory Diagnosis

1. Finding the eggs in faeces

2. Identifying adult worms expelled through the anus or mouth.

Relevance to Ethiopia:

Ascaris lumbricoides is one of the commonest and most widespread human parasites in the world. This parasite, most common in the least developed countries, is estimated to infect a quarter of the world's

population.

A. lumbricoides is the commonest nematode parasite of man in

Ethiopia. Out of a total of 28,696 stool specimens obtained from all districts, 57.1% were found to be positive for this species. Highest rates of infection are recorded from children in the age group 5 to 9 years old. The distribution appears to be affected by altitude. being more common in higher than in lower altitudes. Parasitology Ascariasis is found in practically every Ethiopian community and is probably the most common communicable disease in the country, particularly in the malaria -free highlands.

The most extensive survey of ascariasis in Ethiopia reported 44% of 32,276 persons , two thirds of them school children, infected. The highest rates were found in the highlands above 2,500 m elevation (59.2%) and the lowest rates in the lowlands below 1000 m (7.8%) apparently due to greater moisture availability in the former and thus greater survival rate of the ova and larvae in the soil.

The overriding role of climate is also indicated by the distinct geographical distribution of the infection. Thus, between 50% and 75% of the children examined in Kefa, Gojam, Welega, and Gonder were infected; between 10% and 40% in Ilubabor, Sidamo, Wello, Tigray, Gamo Gofa, Shewa, Bale, and Arsi; and below 10% in the semiarid regions of Eritrea and Harerge. The highest prevalence rates were in children aged 15 to 18 (46.2%) but no significant sex differences in infection were observed (Kloos M, et al. 1993). Prevalence rate of Ascaris lumbricoides in recent studies conducted in Ethiopia ranges from 17% to 77.7% (Yared M, 2001).

Lecture No4

MEDICAL ARACHNOENTOMOLOGY

The discipline of medical entomology or public health entomology is devoted to the study of insects and closely related to arthropods that impact human health. They include the study of information gained from scientific research on the behavior, ecology and epidemiology of arthropod, disease vectors which may be utilized by public, local and state officials and other stake holders in the interest of public safety.

Parasitic arthropods: The phylum arthropods is very large. Many species are parasitic. Arthropods cause injury or discomfort through blood, dermatitis and allergy. They are also important vectors of parasitic disease. Insect are the intermediate host for some of the most important tropical disease infectious man and the domestic livestock (malaria, trypanosomes, leishmania and filariasis). Disease transmission can occur via the arthropod mouthparts or through food or skin contamination.

PHYLUM ARTHROPODS CONSIST OF SEVERAL CLASSES

Class – Chelicerata (57 000 species). The chelicerates include terrestrial spiders, scorpions, ticks, mites, horseshoe crabs e.t.c.

Class – Hexapoda.(900 000 species). The body divided into 3 functional unit, group includes insects, ex. butterfly, bees, moths, ants e.t.c.

Class – crustacea (40 000 species). Crustacea are named for their hard shells, the exoskeleton is calcified. Ex. Crabs, crayfishes, barnacles e.c.t.

Class Myriapoda (12 500 species). Group include centipedes and millipedes.

Parasitic Ticks differ from the mite in its larger size, hairless or short-haired leathery body, exposed armed hypostome, and the presence of a pair of spiracles near the coxae of the ourth pair of legs. About 300 species are blood sucking ecto-parasites of mammals, birds, repti1es, and amphibians, and nearly all are capable of biting human beings .

Classification. Ticks are divided into the ARGASIDAE, or soft ticks, and the IXODIDAE, or hard ticks.

The argasid ticks are more primitive and less constantly parasitic, produce few progeny, and infest the habitat of the host.

Itch mite - *Sarcoptes scabiei*. This mite causes scabies or itch in human. Also it is parasitic on dogs, pigs, horses and sheep. Favored sites are in the skin between the fingers, the folds at the wrists, at the bend of the elbow or knee, and under the breasts. Crowded conditions encourage the spread of scabies infestations. The female mite cuts into the skin, makes a burrow under the skin and lays eggs. The larvae return to the surface of the skin to molt, and the nymphal and adult stages then live on the surface. Unnoticed at first in newly infested people, sensitivity and itching build up at the end of the first month of infestation.

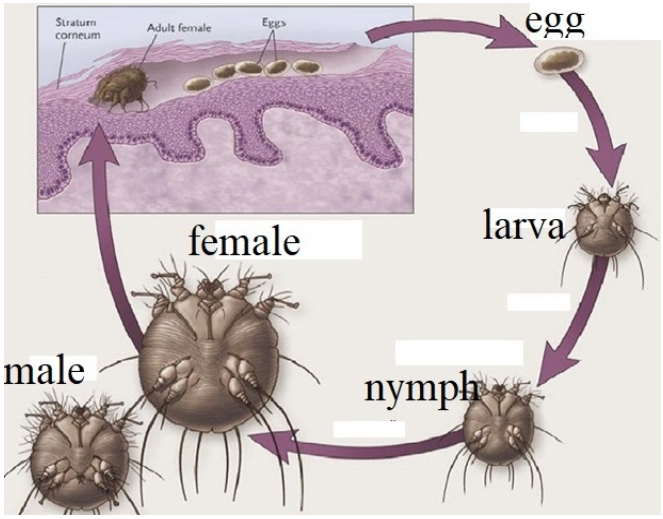


Fig. 38 life cycle of *Sarcoptes scabiei* from slideplayer.com

They are more specialized, more highly parasitic, produce more progeny, and infest the host itself.

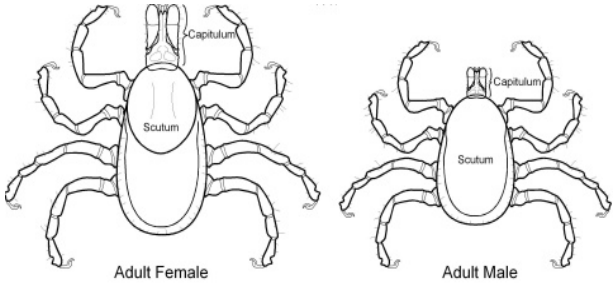


Fig. 39 Morphology of Ixodae tick from adirondackalmanack.com

Developmental Stages

Larvae. Normally, thousands of tiny larvae, commonly called "seed ticks," hatch from an egg batch and crawl randomly in search of a host. Fortunate ones attach to a small mammal or lizard. Feeding time is generally short. As usual, a few hours or a day. During feeding, the host wanders and the tick is transported to a new location. When engorged, it drops off.

Nymphs. After molting, hard tick nymphs climb grass leaves or plant stems and await a host. Because they are higher than ground level, they tend to attach to larger hosts than before. Soft tick nymphs burrow in and await the arrival of a host. After several days of feeding they drop off and again molt.

Adults. Ticks sometimes wait for months or more than a year for a suitable host. When finally engorged, they drop off to oviposit. Ticks that tend to feed on the same host species at each stage are referred to as 1-host ticks, whereas those that feed on different hosts each time are called 3-host ticks.

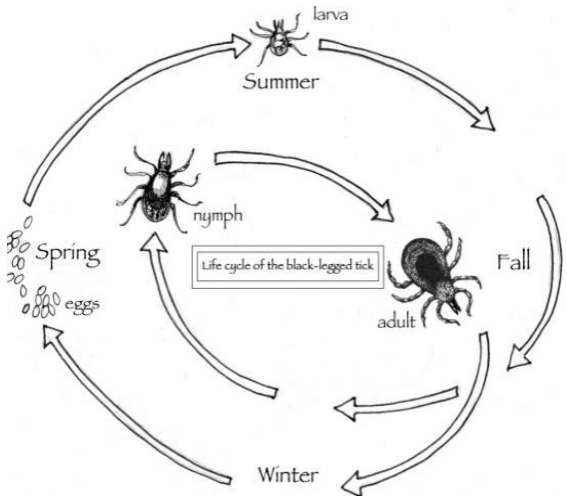


Fig. 40 Life cycle of Ixodae tick from adirondackalmanack.com

Lecture No 5

THEME: INTRODUCTION TO MEDICAL ARACHNOENTOMOLOGY.
PHYLUM: ARTHROPODA.
CLASS: INSECTA.
ORDER: DIPTERA.

Introduction

Insects are extremely successful animals and they affect many aspects of our lives, despite their small size. Ecologies of insects are highly diverse and often they dominate food chains and food webs in biomass and species richness.

The Orders of Insecta

The insecta constitute the largest class in numbers of species in the phylum Arthropoda. The following table includes those insects that are of some known public health importance.

Table 1. The number of described species of important orders of insects

Order	Common names	Estimated No in the world
1. Diptera	Flies, gnats, mosquitoes…	85,000 species
2. Anoplura	sucking lice	250 species
3. Hemiptera	True bugs	55,000 species
4. Siphonaptera	Fleas	1,100species
5. Hymenoptera	Ants, bees, wasps	103,000species
6. Dictyoptera	Cockroaches	4000 species

Brief descriptions of some orders of insects which are of public health importance are presented below.

Order Diptera

Members of the order *Diptera* are a diverse group in both structure and development. These include all the flies and mosquitoes. The insects grouped into the order Diptera are the two winged (di = two; ptera = wings). The wing could be used as a classifying factor. As insects, they are with three body division (head, thorax, and abdomen).

All these insects are characterized by having only one pair of wings; the hind pair has degenerated, therefore, all that remains is a pair of drumstick-like organs, the halters, used for balance in flight.

Dipterans are important to humans for a variety of reasons, many flies are pests. In addition, many serve as either mechanical or biological vectors of infectious agents. Tse tse fly transmits

the agent causing African sleeping sickness; mosquito transmits malaria, lymphatic filariasis, and hundreds of viruses; biting midges transmit filarioid nematodes and viruses. Since these flies are blood-suckers, they can be serious pests regardless of whether they are vectors of infectious agents. Many flies are parasitic as larvae; they can be serious medical and economic problems.

Fig. 41morphology mosquito from stud flies. Net

fig. 42 morphology of fly from pestium.dk

All Diptera go through a complete metamorphosis in their life cycle, developing from the egg through a number of larval stages to the pupa from which the adult emerges. The larva, which is the feeding and growing stage, is typically found in a completely different environment from the adult, although the adult will be associated with the larval environment when mating and laying eggs.

Mouth parts of diptera vary into two aspects:

• A non-biting spongy mouth parts and not able to penetrate into the skin. Example Male mosquitoes. Some feed on plant flower nectars, hence not risk to health. But some others can feed on solid substances (by dissolving) or fluids by sucking. So they are dangerous for transmission and contamination of food and utensils with disease agents; example the common housefly

• Groups with biting mouth part/piercing and sucking type. These are with sharp mouth parts (proboscis) for piercing the skin and blood sucking; so important biological vectors; example.

Tse tse fly, female mosquitoes, etc. The mode of development (life cycle) of all the Diptera group is complete metamorphosis.

In the laboratory, Diptera are the most used as experimental subjects for various research works: example the drosophila groups are used as modeling animals in Genetics.

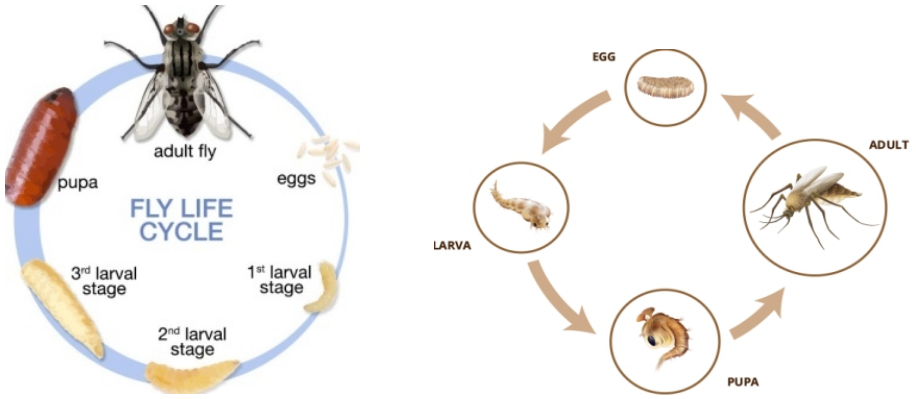


Fig. 43 life cycle of fly and mosquito from studflies. net

11. THE BIOLOGY GLOSSARY

Albino - a person with congenital absence of pigmentation in the skin, eyes, and hair

Adult Stage - the stage that is sexually mature and in which procreation occurs

Accidental parasites - infect an unusual host. *Echinococcus granulosus* infects man accidentally.

Aberrant parasites - infect a host were they cannot develop further. Ex. *Toxocara canis* (dog roundworm) infecting human

In **Accidental host** the parasite is not usually found.

Autoinfection - reinfection by a parasite derived from within the host and which is not exposed to the outside environment.

Allele - any of two or more variants of a gene that have the same relative position on homologous chromosomes and are responsible for alternative characteristics, such as smooth or wrinkled seeds in peas

Asexual - not involving the fusion of male and female gametes, as in vegetative reproduction, fission, or budding

Assimilation - the change of digested food into the protoplasm of an animal; also, the absorption and incorporation of nutritive elements by plants, as in photosynthesis

Bacteria - a very large group of microorganisms comprising one of the three domains of living organisms. They are prokaryotic, unicellular, and either free-living in soil or water or parasites of plants or animals

Binary fission - asexual reproduction in unicellular organisms by division into two daughter cells

Biomass - the total number of living organisms in a given area, expressed in terms of living or dry weight per unit area

Blood - a reddish fluid in vertebrates that is pumped by the heart through the arteries and veins, supplies tissues with nutrients, oxygen, etc, and removes waste products. It consists of a fluid (see blood plasma) containing cells (erythrocytes, leucocytes, and platelets)

Cell - the basic structural and functional unit of living organisms. It consists of a nucleus, containing the genetic material, surrounded by the cytoplasm in which are mitochondria, lysosomes, ribosomes, and other organelles. All cells are bounded by a cell membrane; plant cells have an outer cell wall in addition

Chromosome - any of the microscopic rod-shaped structures that appear in a cell nucleus during cell division, consisting of nucleoprotein arranged into units (genes) that are responsible for the transmission of hereditary characteristics

Circulation - the transport of oxygenated blood through the arteries to the capillaries, where it nourishes the tissues, and the return of oxygen-depleted blood through the veins to the heart, where the cycle is renewed

Circulatory system - the system concerned with the transport of blood and lymph, consisting of the heart, blood vessels, lymph vessels, etc

Class - any of the taxonomic groups into which a phylum is divided and which contains one or more orders.

Clone - a group of organisms or cells of the same genetic constitution that are descended from a common ancestor by asexual reproduction, as by cuttings, grafting, etc, in plants

Codominant - (of genes) having both alleles expressed equally in the phenotype of the organism

Conception - the fertilization of an ovum by a sperm in the Fallopian tube followed by implantation in the womb

Cytoplasm - the protoplasm of a cell contained within the cell membrane but excluding the nucleus: contains organelles, vesicles, and other inclusions

Digestion - the act or process in living organisms of breaking down ingested food material into easily absorbed and assimilated substances by the action of enzymes and other agents

Diploid- having pairs of homologous chromosomes so that twice the haploid number is present

Inside of **Definitive host** develops adult stage of parasite and undergoes sexual reproduction.

Ectoparasites - inhabit only the body surface of the host without penetrating the tissue.

Endoparasite - lives within the body of the host and it tends to cause an infection. Most protozoans and helminthes are endoparasites

Ecosystem - a system involving the interactions between a community of living organisms in a particular area and its nonliving environment

Egg - the oval or round reproductive body laid by the females of birds, reptiles, fishes, insects, and some other animals, consisting of a developing embryo, its food store, and sometimes jelly or albumen, all surrounded by an outer shell or membrane

Epidemiology -The study of disease in populations and factors that determine its occurrence

Etiology -This is the study of causation or origination.

Embryo - an animal in the early stages of development following cleavage of the zygote and ending at birth or hatching

Enzyme - any of a group of complex proteins or conjugated proteins that are produced by living cells and act as catalysts in specific biochemical reactions

Epidermis - the thin protective outer layer of the skin, composed of stratified epithelial tissue

Evolution - a gradual change in the characteristics of a population of animals or plants over successive generations: accounts for the origin of existing species from ancestors unlike them

Fermentation - a chemical reaction in which a ferment causes an organic molecule to split into simpler substances, esp the anaerobic conversion of sugar to ethyl alcohol by yeast

Fertilization - the union of male and female gametes, during sexual reproduction, to form a zygote

Food chain - a sequence of organisms in an ecosystem in which each species is the food of the next member of the chain

Vector - an agent and very often a biting insect that is responsible for the transmission of the disease.

Gamete - a haploid germ cell, such as a spermatozoon or ovum, that fuses with another germ cell during fertilization

Gene - a unit of heredity composed of DNA occupying a fixed position on a chromosome (some viral genes are composed of RNA). A gene may determine a characteristic of an individual by specifying a polypeptide chain that forms a protein or part of a protein (structural gene); or encode an RNA molecule; or regulate the operation of other genes or repress such operation

Gonad - an animal organ in which gametes are produced, such as a testis or an ovary

Growth - the process or act of growing in organisms following assimilation of food

Haploid - a haploid cell or organism

Hermaphrodite - an individual animal or flower that has both male and female reproductive organs

Hormone - a chemical substance produced in an endocrine gland and transported in the blood to a certain tissue, on which it exerts a specific effect

Hybrid - an animal or plant resulting from a cross between genetically unlike individuals. Hybrids between different species are usually sterile

Host - is organism, which harbors the parasite and provides nourishment. As usual, host is larger then parasite.

Infestation - is often employed for parasitization with ectoparasites.

Infection - contamination with parasites present inside of the host organism, such as by malaria parasites or by schistosomes.

Inside of **Intermediate host** develops larval stage of parasite and asexual multiplication takes place there.

Inheritance - the derivation of characteristics of one generation from an earlier one by heredity

Infective Stage - That stage in the life cycle of a parasite during which it is capable of producing infection.

Meiosis - a type of cell division in which a nucleus divides into four daughter nuclei, each containing half the chromosome number of the parent nucleus: occurs in all sexually reproducing organisms in which haploid gametes or spores are produced

Metabolism - the sum total of the chemical processes that occur in living organisms, resulting in growth, production of energy, elimination of waste material, etc

Mitosis - a method of cell division, in which the nucleus divides into daughter nuclei, each containing the same number of chromosomes as the parent nucleus

Mutation - a change in the chromosomes or genes of a cell. When this change occurs in the gametes the structure and development of the resultant offspring may be affected

Nucleus - a large compartment, bounded by a double membrane, that contains the chromosomes and associated molecules and controls the characteristics and growth of the cell

Organ - a fully differentiated structural and functional unit, such as a kidney or a root, in an animal or plant

Ovulation - the process by which a mature ovum escapes from an ovary

Ovum - an unfertilized female gamete; egg cell

Parasites - are living organisms, which depend on a living host for their nourishment and survival.

Phylum - a major taxonomic division of living organisms that contain one or more classes. An example is the phylum Arthropoda (insects, crustaceans, arachnids, etc, and myriapods)

Pathogen - A parasite that injures or deprives its host, i.e. is capable of producing disease.

Pathology - is the precise study and diagnosis of disease. Pathologies is synonymous with diseases.

Physiology - The branch of science that deals with normal functions of living things or their organs.

Puberty - the period at the beginning of adolescence when the sex glands become functional and the secondary sexual characteristics emerge

Recessive - capable of producing its characteristic phenotype in the organism only when its allele is identical

Reproduction – formation of new organism like parent organism

Ribosome - any of numerous minute particles in the cytoplasm of cells, either free or attached to the endoplasmic reticulum, that contain RNA and protein and are the site of protein synthesis

Sexual reproduction - reproduction involving the fusion of a male and female haploid gamete

Skin - the tissue forming the outer covering of the vertebrate body: it consists of two layers (the dermis and epidermis), the outermost of which may be covered with hair, scales, feathers, etc. It is mainly protective and sensory in function

Soil - the top layer of the land surface of the earth that is composed of disintegrated rock particles, humus, water, and air

Spermatozoon or sperm - any of the male reproductive cells released in the semen during ejaculation, consisting of a flattened egg-shaped head, a long neck, and a whiplike tail by which it moves to fertilize the female ovum

Translocation - the transfer of one part of a chromosome to another part of the same or a different chromosome, resulting in rearrangement of the genes

X-chromosome - the sex chromosome that occurs in pairs in the diploid cells of the females of many animals, including humans, and as one of a pair with the Y-chromosome in those of males

Y-chromosome - the sex chromosome that occurs as one of a pair with the X-chromosome in the diploid cells of the males of many animals, including humans

Zygote - the cell resulting from the union of an ovum and a spermatozoon

Zoonosis is diseases and infections, which are naturally transmitted between vertebrates and man.

Obligate - parasite cannot exist without a host. Ex. Toxoplasma gondii and Plasmodium.

Facultative - parasite may either live as parasitic form or as free living form

Reservoir host - harbors the parasite and acts as an important source of infection to other susceptible hosts.

Super-infection - A new infection of a host superimposed on an existing one by the same species of parasite

12. **Appendix**