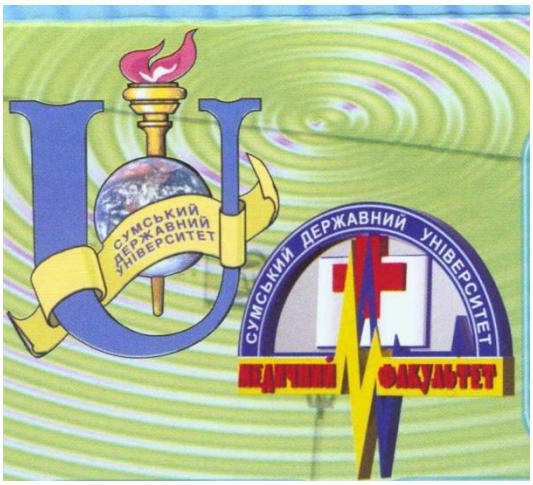
Ministry of Education and Science of Ukraine
Sumy State University
Physiology and Pathophysiology Department



PRACTICAL LESSONS ON MEDICAL BIOLOGY

SPECIALTY: 222 – Medicine

GENERAL INFORMATION ABOUT THE DISCIPLINE "MEDICAL BIOLOGY"

Information about this discipline is presented in the site of physiology and pathophysiology department (see ***here***).

Methodical Instructions for Lessons

For practical lessons, students must have a copybook for solving genetic problems and drawing preparations, a pen, a pencil, and eraser. During a lesson, students receive marks (computers check their knowledge), view and draw preparations, fill in tables, solve problems. At the end of the lesson, a teacher gives mark for student's work.

Each student must prepare a topic of the lesson, read a book and lecture notes. For each lesson, student can find terms, questions, problems, and additional information. Synonyms for terms and names of organisms are written in square brackets.

At the end of the information for some lessons, students can find genetic problems for solving at home.

Additional material is marked with asterisk.

Reworking of missed lessons. Attendance of lessons is obligatory. All missed lessons must be reworked. Reworking of the missed lesson is performed as the additional lesson, according to the special schedule.

Rules of Drawing

The necessary element of studying of the object is the drawing of it in an album. It allows understand and fix better in memory its form and a structure. Figure is the document and the report on the work that is made. At the end of class, the teacher signs student's work.

Each figure should have the name and signatures of details (parts). It is necessary to specify common English name and the Latin name (in brackets) of an organism.

Figure should be large enough that details were well appreciable. It is necessary to have no more than 3–4 figures on one page. If the object is complex and big, only one figure should be drawn. It is necessary to maintain strictly a parity of the sizes (length, width), displaying specific features of object. For this purpose, it is necessary at first to draw the general contour of object, slightly to plan contour of separate details inside it and only after that to draw all parts precisely. It is not necessary to draw a circle (a field of vision of a microscope) around the object. All parts of the object should be signed directly (without figures and footnotes), by drawing a line from object without an arrow. Designations should be done by pencil. The scheme can be carried out by colored pencils.

Lesson 1. Introduction to Medical Biology

Course of Events.

1. Information about safety rules.
2. Methodical instructions.
3. General information about the discipline “Medical biology”.
4. Computer testing of basic knowledge on biology.

Literature.

School books on biology.

Lesson 2. Biology as a Science. Light Microscopy

Reading for a lesson.

1) *Terms:* acid dye, anabolism, anatomy, angular aperture, artefact, basic dye, biology, biosphere, botany, catabolism, cell, cell biology, centrifuge, community, conclusion, condenser, contrast, control group, controlled experiment, coverslip, data, development, diaphragm, ecology, experiment, experimental group, eyepiece, fixation, fixative, focus knob, genetics, glass slide, growth, homeostasis, hypothesis, illumination, immersion oil, irritability, magnification, metabolism, microbiology, microscope, mirror, numerical aperture, objective, observation, ocular, organ, organism, physiology, population, primary image, repair, reproduction, revolving nosepiece, resolving power (resolution), science, secondary image, sensitivity, stage, stand, organ system, systematics, taxis, technology, theory, tissue, tropism, tube, turret, variable factor, virus, working distance, zoology.
2) Biology as a science. Controlled experiment. Fact, data, hypothesis, theory.
3) Living things. Growth, development. Cell, tissue, organ, system, organism, population.
4) Methods of biological investigations. Microscopes. Optical and illuminating parts of the light microscope. Objective lenses. Magnification of a compound microscope.
5) Setting up illumination in a light microscope.
6) Specimens for microscopy. Fixation, staining.

Literature.

1. Smirnov O. "Medical Biology. Vol. 1", Chapter 1.
2. Lazarev K. "Medical Biology" (2003) pp. 3–19.

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PRACTICAL ASPECTS OF MICROSCOPY

The first stage of image formation in the microscope is illumination of the specimen.

a) Rotate the objective lens turret to bring the low magnification objective (8×) into vertical position above the stage. Check the working distance (1 cm) by rotating the coarse focus knob.

b) To move the condenser up, rotate condenser lens adjustment knob counterclockwise. Check the position of a mobile lens (swing this lens inside).

c) Remove an ocular from the microscope and look down the tube. You should catch a bulb or a white cloud by means of the mirror (sunlight is *not* used as a source of light). The lamp must be in the center of the field of view. Replace the ocular. Now don't move the microscope.

d) Place the specimen on the microscope stage and center specimen under the objective lens. Metal clips on the microscope stage are used to hold the slide in place. Using the coarse focus knob, bring the low power objective into focus.

e) Low power objectives cover a wide field of view, and they are useful for examining large specimens or surveying many smaller specimens. If you want to change objective lens ans see preparation under high magnification, rotate turret to bring the high magnification objective (40×) into vertical position (do *not* move tube holder before this, do *not* rotate coarse focus knob!). Then see through ocular (image is not sharp) and rotate the course adjustment knob counterclockwise very slowly (1–2 mm) to get the image sharp, and then use fine adjustment knob to see well. Remember to be careful as you do this, since the working distance is small, and always watch lens surfaces as they approach the specimen. If focus movements are too extreme, there is a risk that the objective might break the microscope slide.

f) To see the preparation better, move condenser by rotating condenser adjustment knob clockwise and counterclockwise. Do not use a mobile lens of the condenser with high-power and immersion objectives (swing this lens aside).

General Information. An important part of good microcopy is to understand that it is a dynamic, interactive process. Virtually all specimens are three-dimensional on a microscopic scale, and it is necessary to continually scan up and down, as well as laterally through a specimen to develop a good understanding of its architecture. Light interacts with the specimen, "transparent" specimens absorb some

light, and small differences in absorbance over the specimen contribute to image formation. Light that is not reflected or absorbed is transmitted through the specimen. Wavelength-dependent absorbance gives specimens color, as in a red blood cell.

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Practical Class Work.

1) **Draw** an optical microscope, mark its main parts.
2) **Analyse** the scheme of the pathway of light in the optical microscope when dry and immersion objectives are used.
3) **Set up** illumination in a light microscope.
4) **Prepare** a specimen of fibers of cotton wool. Separate some fibers from a piece of cotton wool, place them on a mount, place carefully a cover glass. Check that the cover glass fit tightly to the mount, without a backlash. Place slide securely on the stage, making certain it cannot slip or move. Position it so that light coming up through the condenser passes through the area with fibers. Check the distance between low-power objective and your preparation. Look through the ocular and rotate the coarse focus knob to get the image as sharp as possible. **Draw** fibers under small magnification. Change objective lens form 8× to 40×; bring the image into sharp focus using the fine focus control. Study how conditions of light exposure (move the condenser up and down, with or without the mobile lens) influence contrast and quality of the image. Draw a part of fiber under high magnification.
5) **Clean** a workplace. Leave the microscope in non-working position.

Lesson 3. Cell Structure

Reading for a lesson.

1) *Terms:* active transport, ADP, ATP, autolysis, cell, cell theory, cell wall, centriole, centrosome, chloroplast, chromatin, chromoplast, chromosome, compartment, cristae, cytoplasm, cytoskeleton, cytosol, diffusion, endocytosis, endoplasmic reticulum, endosymbiotic theory, eukaryote, exocytosis, glycoprotein, Golgi apparatus, hyaloplasm, hydrophilic, hydrophobic, leucoplast, lysosome, matrix, membrane, microfilament, microtubule, mitochondrion, nucleoid, nucleolus, nucleus, organ, organ system, organelle, organism, osmosis, passive transport, perinuclear space, peroxisome, phagocytosis, pili, pinocytosis, pore, prokaryote, ribosome, semipermeable membrane, tubulin, vacuole.
2) Cell theory.
3) Prokaryotes and eukaryotes, plant and animal cells, unicellular and multicellular organisms. Viruses.
4) Water. Salts. Macroelements, microelements. Organic compounds.
5) Cell membranes. Diffusion and osmosis. Active and passive transport.
6) Cytoplasm ans cytoskeleton.
7) Cytoplasmic organelles.
8) Nucleus and nucleoles.
9) Cell as an open system. Assimilation and dissimilation. ATP.
10) Microscopy.

Literature.

1. Smirnov O. "Medical Biology. Vol. 1", Chapter 2, Sections 2.1–2.2.
2. Lazarev K. "Medical Biology" (2003) pp. 20–44, 52–53.

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Practical Class Work.

1) **Prepare** a specimen of human hair. Examine it in a microscope under high magnification and **draw**. **Clean** a workplace, leave the microscope in non-working position.
2) **Examine** fixed specimen of animal cell – blood of a frog. In a blood smear, red blood cells are oval with nucleus, thrombocytes are very small, with nucleus too. **Draw** one erythrocyte and one thrombocyte. Pay attention to the size and shape of each cell, presence of the nucleus, size and shape of it.
3) **Examine** fixed specimen of animal cell – blood of a man. In a blood smear, red blood cells (erythrocytes), leukocytes (larger rounded cells with the rounded or lobar (segmented) nuclei), and thrombocytes (fine fusiform cells) are present. Pink cytoplasm of erythrocytes is stained by eosin and a dark-violet nucleus is stained by hematoxylin. **Draw** erythrocytes and a leukocyte.
4) Compare erythrocytes of a frog and a man taking into account their shape, size and structure (presence of a nucleus).

Lesson 4. Cell Division. Gametogenesis

Reading for a lesson.

1) *Terms:* amitosis, anaphase, apoptosis, bivalent, cell cycle, cell furrow, cell plate, centromere, checkpoint, chiasma, chromatid, chromosome, cohesin, crossing over [crossover], cytokinesis, development, differentiation, diploid, diplontic organism, egg, equation division, fertilization, fission, gamete, gametogenesis, germ cell, growth factor, haploid, haplontic organism, homologous chromosomes, independent assortment, interkinesis, interphase, karyokinesis, kinetochore, M phase, meiosis, metaphase, mitosis, mitotic index, monoploid, necrosis, nondisjunction, nonhomologous chromosomes, oocyte, oogenesis, oogonium, ovum, polar body, prophase, recombinant chromatids, reduction division, schizogony, segregation, specialization, sperm, spermatid, spermatocyte, spermatogenesis, spermatogonium, spermatozoid, spindle, spindle fibers, spore, synapsis, synaptonemal complex, telophase, tetrad, tubulin, zygote.
2) Prokaryotic cell division.
3) Cell cycle in eukaryotes: interphase and M phase. Mitotic activity of tissues.
4) Control of the cell cycle. Growth factors. Cell specialization and differentiation.
5) Amitosis and schizogony.
6) Meiosis: stages, chromosomes and chromatids, bivalents. Differences between meiosis and mitosis.
7) Gametogenesis: stages. Differences between oogenesis and spermatogenesis.
8) Structure of gametes. Fertilization.
9)* (*additional reading*) Cloning of cells. Apoptosis and necrosis. Malignant growth.

Literature.

1. Smirnov O. "Medical Biology. Vol. 1", Section 2.3.
2. Lazarev K. "Medical Biology" (2003) pp. 44–52, 54, 57–69, 108.

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Practical Class Work.

1) **Examine** a specimen and a photo of mitotic cell fission of a rootlet of an onion. **Draw** such stages: interphase, prophase, metaphase, anaphase, and telophase. Pay attention to the size and shape of each cell, presence of the nucleus and nucleolus, size, shape and location of chromosomes.
2) **Examine** a specimen of spermatozoids of a guinea pig. Choose cells having dark acrosome and light head. Find that some sperm cells have one flagellum, other cells have 2–3 or more flagella. **Draw** 2–3 spermatozoids that have various morphology (one or several flagella). Designate a head with an acrosome, a neck, and a tail.
3) **Examine** and **draw** a specimen of spermatozoids of a cock (long threadlike cells).
4) **View** a specimen of a section of rat testis. Find cells that are on different meiotic stages.
5) **Draw** the genetic scheme of mitosis (n – haploid chromosome number, c – chromatid number or number of DNA molecules).