

AL-FARABI KAZAKH NATIONAL UNIVERSITY
Medicine and Health Care Faculty
Higher School of Medicine
Department of Fundamental Medicine

METHODOLOGICAL INSTRUCTIONS FOR PRACTICAL LESSONS
by discipline « Molecular, Cellular and Genetic Basis of Medicine»
(7 credits)

Practical lesson 1.

Topic: Introduction to molecular biology.

Maximal point: 3

Learning outcomes:

1. Briefly discuss the role of molecular biology in medicine.
2. Explain the central dogma of molecular biology.
3. Describe, identify and draw the components of nucleosides and nucleotides.
4. Characterize and describe the chains of nucleic acids in DNA and RNA.
5. Describe the three hypotheses of DNA replication.
6. Describe the Meselson-Stahl experiment and explain its significance.
7. Explain the molecular mechanism of semiconservative DNA replication.
8. Explain proofreading mechanisms and error correction during DNA replication.

Practical lesson 2.

Topic: Introduction: Fundamentals of the structure and reactivity of organic compounds

Maximal point: 3

Learning outcomes:

1. Identify the general structural characteristics of organic molecules, in particular, the tetravalent nature of carbon and the different ways in which it can be expressed;
2. Define functional group - identify the functional groups in organic molecules;
3. Recognize structural (constitutional) isomers and functional group isomers;
4. Write structures of organic molecules in various ways;
5. Classify the organic compounds; name the compounds according to iupac system of nomenclature and also derive their structures from the given names;
6. Draw structural, condensed, and line formulas for simple chemical compounds;
7. Convert any given structural, condensed, or line formula into its corresponding alternative.
8. Describe types of reactions in organic chemistry

Practical lesson 3.

Topic: The human genome structure and its organization

Maximal point: 3

Learning outcomes:

1. Explain the purpose and goals of the Human Genome Project (HGP) and its significance in the field of genetics and medicine.
2. Discuss the hierarchical organization of the human genome, including nucleosomes, chromatin fibers, loops, and topologically associating domains (TADs).
3. Define genes and non-coding regions of the genome, and discuss their respective functions.

4. Identify the different types of repetitive DNA sequences present in the human genome and their potential implications.
5. Describe DNA transposons, retrotransposons, retroviral integration.
6. Provide examples of human diseases triggered by transposable elements.
7. Discuss the prospects for applying knowledge about the human genome in medicine and pharmaceuticals.

Practical lesson 4.

Topic: Saturated and unsaturated organic compounds: alkanes, cycloalkanes, alkenes, alkadienes, alkynes:

Maximal point: 3

Learning outcomes:

1. Name hydrocarbons according to IUPAC system of nomenclature;
2. Recognise and write structures of isomers of compounds;
3. Identify the physical properties of compounds
4. Determine the basic reactions of compounds
5. Identify a cycloalkane from its structure
6. Name a compounds given its structure and draw given its name
7. Name a compounds given its condensed or line structure
8. Identify cis–trans isomers of alkenes
9. Write chemical reactions of addition, substitution and elimination saturated and unsaturated compounds

Practical lesson 5.

Topic: Gene expression: Transcription of genetic information and mRNA processing

Maximal point: 3

Learning outcomes:

1. Define the terms: transcription, promoter, enhancer, terminator.
2. Describe prokaryotic and eukaryotic RNA-polymerases' structure and functions.
3. Describe phases of transcription, explain the processes happening at each phase and their importance.
4. Explain the process, importance and difference of Rho-independent and Rho-dependent termination of transcription.
5. Explain the mechanism of polyadenylation, its importance.
6. Describe the structure of the cap fragment, its synthesis and functions.
7. Describe the splicing mechanism and its meaning.
8. Explain the effect of splicing on gene expression.

Practical lesson 6.

Topic: Aromatic compounds

Maximal point: 3

Learning outcomes:

1. Identify the structures of aromatic compounds;
2. Explain the importance and function of resonance in aromatic compounds;
3. Name simple monosubstituted or disubstituted aromatic compounds;
4. Predict the products obtained when aromatic compounds react with concentrated HNO₃, Cl₂, Br₂ or concentrated H₂SO₄;
5. Define and recognize aromatic compounds and the importance of resonance and aromaticity;
6. Understand and apply Huckel's rule.

Practical lesson 7.

Topic: Gene expression: Translation of genetic information and post-translational.
Colloquium 1

Maximal point: 3 + 13

Learning outcomes:

1. Describe the structure of tRNA and the mechanism of its charging.
2. Explain the mechanism of translation and its phases.
3. Explain the ribosome cycle and fidelity of translation.
4. Describe the main mechanisms of post-translational processing, including disposition of proteins (degradation)
5. Describe the synthesis of proteins and glycoproteins in the rough endoplasmic reticulum (ER)
6. Detail the functions of the Golgi complex in post-translational modification, processing, and sorting of proteins
7. Explain the auxiliary role of chaperones in protein folding.
8. Give detailed examples of human disorders linked with protein misfolding.

Practical lesson 8.

Topic: Mono- and polyhydric alcohols, phenols, ethers. Colloquium 1

Maximal point: 3 + 12

Learning outcomes:

1. Describe the structural differences between alcohols, phenols, and ethers;
2. Write systematic names for simple alcohols;
3. Draw the structure of an alcohol given its name, in both condensed and line structure format;
4. Classify an alcohol as primary, secondary, or tertiary;
5. Describe the properties of alcohols;
6. Predict the products obtained upon dehydration of an alcohol;
7. Explain why alcohols and phenols are weak acids;
8. Identify an ether
9. Distinguish between an ether and an alcohol

Practical lesson 9.

Topic: Regulation of gene expression

Maximal point: 3

Learning outcomes:

1. Describe the different levels of gene regulation, including transcriptional, post-transcriptional, translational, and post-translational regulation.
2. Explain the functioning and regulation of the following operons: lac, trp.
3. Explain positive and negative controls of operons.
4. Explain the mechanism of transcription regulation in eukaryotes, including the role of promoters, enhancers, and transcription factors in controlling gene expression.
5. Describe the importance of gene regulation in controlling cellular processes, development, and response to environmental changes.

Practical lesson 10.

Topic: Aldehydes, ketones, carboxylic acids

Maximal point: 3

Learning outcomes:

1. Identify a carbonyl group, its polarity and shape
2. Name simple aldehydes and ketones
3. Explain properties of aldehydes and ketones

- Identify the differences between hemiacetals, hemiketals, acetals, and ketals;
- Name simple carboxylic acids, esters, and amides given a structure and write a structure given a name;
- Describe the acidity of different carboxylic acids and predict the products obtained when they react with strong bases;
- Describe how esters and amides are formed from carboxylic acids

Practical lesson 11.

Topic: Epigenetics

Content: Gene structure in prokaryotes. Bacterial operons: lac, ara, trp, gal. Gene structure in eukaryotes. Regulation of transcription: transcription factors.

Maximal point: 3

Learning outcomes:

- Explain the importance of epigenetic regulation and its role in heritability of cellular traits.
- Compare and contrast different epigenetic mechanisms, including DNA methylation, histone modifications, imprinting, X- activation
- Explain the mechanism of RNAi.
- Describe the significance of epigenetic changes in development, disease, and evolution, using specific examples to illustrate their effects.

Practical lesson 12.

Topic: Heterofunctional compounds

Maximal point: 3

Learning outcomes:

- Describe: hydroxy acids, amino acids, oxo acids, amino alcohols, aminophenols (dopamine, noradrenaline, adrenaline);
- Write down characteristic reactions;
- Name heterofunctional compounds,
- Determine their functions in the body and their use in medicine
- Compose complex formation reactions of poly- and heterofunctional compounds;
- Describe the application in medicine

Practical lesson 13.

Topic: Cell signalling. Colloquium 2

Maximal point: 3 + 13

Learning outcomes:

- Give the definition of intracellular signalling (signal transduction).
- Classify and characterize membrane cell receptors, give specific examples.
- Describe and provide examples of secondary intermediaries.
- Characterize the cytoplasmic and nuclear receptors.
- Describe the mechanisms by which cells communicate with each other and their environment, such as autocrine, paracrine, endocrine, and synaptic signaling.
- Explain the basic principles of TGF β signaling
- Describe the concept of JAK-STAT signaling and its importance
- Characterize examples of diseases associated with receptor serine/threonine kinase signaling

Practical lesson 14.

Topic: Heterocyclic compounds. Colloquium 2

Maximal point: 3 + 12

Learning outcomes:

1. Describe the general characteristics of heterocyclic compounds;
2. Write the chemical formula and describe the chemical properties of main biological nitrogen-containing compounds (pyrrole, proline, indole, serotonin, quinoline, pyridine, piperidine, pyridine derivatives (nicotine salts, nad⁺, nadh), purine derivatives, uric acid);
3. Determine the chemical properties of nitrogen-containing heterocyclic compounds (acidic property of pyrrole, alkaline properties of pyridine, reduction reaction, electrophilic substitution);
4. Explain functions in the body and medicinal uses.

Practical lesson 15.

Topic: Cell differentiation and development of a multicellular organism.

Maximal point: 3

Learning outcomes:

1. Give the definitions to the following terms: cell differentiation, morphogenesis, embryogenesis, ontogenesis, stem cells, totipotency, pluripotency.
2. Explain how the level of expression of various genes changes during cell differentiation and at different stages of development of a multicellular organism.
3. Describe the mechanisms of key signaling pathways involved in cell differentiation, such as the Wnt, Notch, Hedgehog, and BMP pathways.
4. Describe the use of stem cells in medicine and cosmetology, analyze the advantages and disadvantages of these methods.

Practical lesson 16.

Topic: Carbohydrates: monosaccharides

Maximal point: 3

Learning outcomes:

1. Describe the functions of carbohydrates in the body;
2. Classify: mono-, di-, oligo- and polysaccharides;
3. Explain cyclo-oxo-tautomerism of monosaccharides (Fischer, Haworth formula);
4. Classify monosaccharides according to the nature of the functional groups and the number of carbon atoms;
5. Explain properties of monosaccharides
6. Explain dehydration monomerization;

Practical lesson 17.

Topic: Mutation

Maximal point: 3

Learning outcomes:

1. Define mutations and explain their role in genetic diversity and evolution.
2. Differentiate between various types of mutations, including point mutations (substitutions, insertions, deletions), frameshift mutations, and chromosomal mutations (deletions, duplications, inversions, translocations) and give specific examples of hereditary diseases.
3. Describe the factors that can induce mutations, such as chemical mutagens, radiation, and errors during DNA replication.
4. Explain how genetic mutations in coding and non-coding regions of the genome affect gene expression and can lead to disease.
5. Describe how allelic variation contributes to the normal and pathogenic phenotypic spectrum.

6. Describe how mitotic errors lead to mosaicism and explain how this affects the phenotypic expression of genomic disorders.

Practical lesson 18.

Topic: Carbohydrates: di-, oligo- and polysaccharides

Maximal point: 3

Learning outcomes:

1. Describe : disaccharides; oligosaccharides; homopolysaccharides (starch, amylose, glycogen, chitin, cellulose); heteropolysaccharides (pectin, alginic acids, agar, hyaluronic acid);
2. Explain the main functions of carbohydrates
3. Explain properties of di-, oligo and polysaccharides
4. Explain the role in the body and use in medicine

Practical lesson 19.

Topic: DNA repair. Colloquium 3

Maximal point: 3 + 10

Learning outcomes:

1. Explain the importance of DNA repair.
2. Explain the mechanisms of base excision, nucleotide excision, homologous recombination, and non-homologous end joining.
3. Give examples of diseases associated with defects in DNA repair mechanisms and explain how these defects can affect the body.
4. Describe modern research methods used to study DNA repair processes.

Practical lesson 20.

Topic: Amino acids. Biologically important properties of α -amino acids. Peptides.

Colloquium 3

Maximal point: 3 + 10

Learning outcomes:

1. Explain the general characteristics and functions of proteins in the body;
2. Describe the structural organization of proteins (primary, secondary, tertiary);
3. Explain the influence of various conditions (ph, temperature) on the structure of proteins and optimal conditions of the body;
4. Name the methods of protein fractionation and purification;
5. Determine the amino acid composition of proteins (20 α -amino acids);
6. Describe aromatic and heterocyclic α -amino acids;
7. Describe the denaturation of proteins and identify the reagents and conditions that will cause denaturation of the protein molecule
8. Identify a peptide bond, and explain how it is formed

Practical lesson 21.

Topic: Methods and Techniques in Molecular Biology

Maximal point: 3

Learning outcomes:

1. Define the key concepts and terminologies related to molecular biology methods and techniques.
2. Explain the central principles of DNA extraction, purification, and quantification, emphasizing the importance of high-quality starting material.
3. Describe the process of polymerase chain reaction (PCR), including its applications in DNA amplification, cloning, and mutation analysis.

4. Discuss the principles of gel electrophoresis and its various applications, such as DNA fragment separation and protein analysis.
5. Interpret electrophoresis results to determine fragment size, purity, and concentration.

Practical lesson 22.

Topic: Nucleic acids (nucleotides, polynucleotides) and enzymes (enzymes).

Maximal point: 3

Learning outcomes:

1. Explain the general characteristics and biological functions of nucleic acids;
2. Determine the composition (uracil, thymine, cytosine, adenine, guanine) and write the formula of polynucleotide chains;
3. Explain levels of structural organization of nucleic acids (fragment of an rna molecule);
4. Define enzyme;
5. Classify enzymes (activators, inhibitors).

Practical lesson 23.

Topic: Methods and Techniques in Molecular Biology.

Maximal point: 3

Learning outcomes:

1. Explain the basics of DNA sequencing methods, including Sanger sequencing and next-generation sequencing technologies.
2. Interpret sequencing results to identify genetic variations, mutations, and gene sequences.
3. Access and retrieve genomic and genetic data from databases such as GenBank, UniProt, and OMIM for comparative genomics and variant analysis.
4. Discuss ethical considerations in molecular biology research, including issues related to data sharing and authorship.

Practical lesson 24.

Topic: Lipids

Maximal point: 3

Learning outcomes:

1. Describe the general characteristics of lipids;
2. Classify lipids;
3. Explain the biological role in the body
4. Name the main fatty acids of the natural lipids, describe their structure, cis-, trans-isomerism of unsaturated fatty acids.
5. Mono- and polyunsaturated fatty acids (waxes. Phospholipids, glycolipids, terpenes, steroids);
6. Name and explain the methods of lipid synthesis;
7. Explain the general physical and chemical properties;

Practical lesson 25.

Topic: Gene engineering and recombinant DNA technology

Maximal point: 3

Learning outcomes:

1. Define gene engineering and recombinant DNA technology, and explain their significance in fields such as biotechnology, medicine, and agriculture.
2. Describe the basic components of a gene and the fundamental techniques used in gene cloning and manipulation.

3. Explain the principles of restriction enzymes, DNA ligases, and vectors in the context of recombinant DNA technology.
4. Discuss the applications of recombinant DNA technology, including the production of genetically modified organisms (GMOs), recombinant proteins, and gene therapy vectors.
5. Examine the principles of gene therapy and its applications in treating genetic disorders, as well as challenges related to vector design and delivery.

Practical lesson 26.

Topic: Lipids: fatty acids

Maximal point: 3

Learning outcomes:

1. define lipids: Triacylglycerols, their structure, biological role and nomenclature. Chemical properties of triacylglycerols: acidic hydrolysis, saponification, hydrogenation, iodine number
2. determine simple and mixed fats, soft and liquid fats. The effect of degree of unsaturation of fatty acids on the properties of fats.
3. explain the concept of lipid peroxidation; β -oxidation of saturated fatty acids.
4. describe phospholipids. Classify and biological role.
5. describe amino alcohols of phosphoglycerides.
6. define steroids. Explain the general structure of steroids, order of numbering of carbon atoms.
7. describe sterols: cholesterol. Cholesterol functions. Ester of cholesterol. Sterols in nature.
8. describe vitamins D2 and D3. Describe structure, biological importance.
9. describe: Bile acids; Explain structure of cholic acid. Describe glycocholic, taurocholic acids. Sphinglipids. Glycolipid.

Practical lesson 27.

Topic: Molecular biomedicine

Maximal point: 3

Learning outcomes:

1. Define molecular biomedicine and explain its significance in understanding the molecular basis of diseases and developing targeted therapies.
2. Describe the principles of genomics, transcriptomics, proteomics, and metabolomics in the context of studying disease mechanisms and biomarkers.
3. Explain the role of molecular genetics in identifying and characterizing genetic mutations associated with inherited and acquired diseases.
4. Discuss the concept of personalized medicine and how it utilizes molecular data to tailor treatments to individual patients.

Practical lesson 28.

Topic: Solutions of macromolecular compounds

Maximal point: 3

Learning outcomes:

1. describe the features of dissolution of high-molecular compounds;
2. explain the swelling of high-molecular compounds;
3. explain the role of the swelling process in living organisms and drug production;
5. describe the influence of various factors on the degree of swelling of polymers;
6. explain the violation of the stability of solutions of high-molecular compounds

Practical lesson 29.

Topic: Nanotechnology in medicine. Colloquium 4

Maximal point: 3+14

Learning outcomes:

1. Give definitions of nanotechnology and bionanotechnology.
2. Describe and provide examples of various bionanotechnologies for targeted delivery of drugs and gene therapy vectors into the cells of the human body.
3. Analyze bionanotechnological methods for the diagnosis and treatment of cancer: quantum dots, magnetic and radioactive nanoparticles, etc.
4. Analyze the prospects for the use of nanorobots in biomedicine.
5. Give definitions and explain the difference between the term's "pharmacogenomics", "pharmacogenetics", "personalized medicine".
6. Explain how a hereditary predisposition can affect the individual reactions of the human body to drugs and dietary supplements, give specific examples.

Practical lesson 30.

Topic: Recap lesson by bioorganic chemistry. Colloquium 4

Maximal point: 3+ 12

Learning outcomes:

1. Explain the principles of classification and nomenclature of organic compounds.
2. Describe the safety rules in the organic chemistry laboratory.
3. Name, classify and write the structure of the main hydrocarbons and their physical and chemical properties and reactions.
4. Describe the main types of reactions of organic substances.
5. Name, classify and write the structure of alcohols, phenols, esters and other hydroxy compounds and their physical and chemical properties and reactions.
6. Name, classify and write the structure of the main aldehydes and ketones and their physical and chemical properties and reactions.
7. Name, classify and write the structure of the main carboxylic acids and their derivatives, as well as their physical and chemical properties and reactions.
8. Name, classify and write the structure of the main aromatic and heterocyclic compounds and their physical and chemical properties and reactions.
9. Explain the stereochemistry and chirality, give examples.
10. Describe, explain, and illustrate the spectral methods of organic chemistry.
11. Name, classify and write the structure of the main amines and 20 α -amino acids and their physical and chemical properties and reactions.
12. Describe and explain the chemical structure and functions of peptides and proteins.
13. Name, classify and write the structure of the main carbohydrates and their physical and chemical properties and reactions.
14. Name, classify and write the structure of the main lipids and their physical and chemical properties and reactions.

METHODICAL INSTRUCTIONS FOR THE PRACTICAL LESSONS

The goal: to form an understanding of the molecular basis of the functioning of the cell and the organism, regulation of gene expression, the chemical structure, properties, and functions of biologically active compounds in living organisms, which are necessary for further understanding of both normal processes of life activity and their disruption, diseases, including hereditary.

Learning outcomes:

1. Explain the structure, isomerism, and nomenclature of biologically active compounds.
2. Describe the physico-chemical properties, the biological role of compounds involved in the processes of vital activity.
3. Demonstrate knowledge of gene biology and mechanisms for implementing genetic information, protein biosynthesis.
4. Apply knowledge of the causes and mechanisms of development of certain changes in the structure and functioning of nucleic acids, especially the expression of genes.
5. Understand the mechanisms of hereditary variability and their role in the formation of human hereditary pathology and congenital malformations.
6. Understand the molecular-genetic and cellular mechanisms of the body's response to drugs and biologically active compounds.
7. Demonstrate the ability to apply the language and knowledge of each discipline to discuss and solve fundamental scientific and clinical problems.
8. Integrate knowledge of the structural and functional characteristics of the genome to solve clinical problems.
9. Demonstrate the ability to identify learning gaps and create strategies to enhance one's own knowledge and skills.
10. Effectively communicate with other students and teachers regarding medical and scientific information, articulate their opinions clearly when discussing and work effectively as a member of the team.

Plan of preparation work for each Practical lesson

1. Familiarize yourself with the basic and additional literature, use textbooks, the syllabus and present directions, Internet resources to prepare for Practical lessons.
2. Be prepared for class and participate actively on case-discussion and problem-solving group activities.
3. Use the examples (in this number cases and your own experience studied before) for illustration of theoretic material.
4. Use different tools for studying, discussion and visualisation of thoughts - drawing,
5. Use the group work with cases for the development of teamwork skills, communication, and problem solving and self-studying.

Response quality scale (written / oral response)

Mark	Criteria	Scale, points
Excellent	<ol style="list-style-type: none">1. all key aspects are included and presented logically;2. high accuracy (relevance, without redundancy) and constant attention to the issue;3. excellent integration of theoretical questions;4. providing relevant examples;5. in-depth analysis and theoretical justification of the problem (if applicable), all key aspects identified and interpreted;6. fluency in professional terminology	90 - 100

Good	<ol style="list-style-type: none"> 1. all key aspects are included and presented logically; 2. constant focus on the issue with satisfactory accuracy, relevance, and / or some redundancy; 3. satisfactory integration of theoretical questions; 4. the lack of examples; 5. satisfactory analysis and theoretical justification of the problem (if applicable), most of the key aspects identified and interpreted; 6. correct use of professional terminology 	70 - 89
Satisfactory	<ol style="list-style-type: none"> 1. most of the key aspects are included; 2. satisfactory focus on the question - some errors and / or noticeable redundancy; 3. theoretical problems presented without noticeable integration; 4. Providing failed examples or no examples; 5. some analysis and theoretical justification of this problem (if applicable), most of the key aspects are defined and interpreted; 6. correct use of professional terminology 	50 - 69
Unsatisfactory (FX)	<ol style="list-style-type: none"> 1. most of the key aspects are omitted; 2. lack of attention to the issue-irrelevant and significant redundancy; 3. some theoretical problems presented without integration and understanding; 4. missing or outdated examples; 5. some analysis and theoretical justification of this problem (if applicable), most of the key aspects are omitted; 6. problems in using professional terminology 	25 - 49
Unsatisfactory (F)	<ol style="list-style-type: none"> 1. most or all of the key aspects are omitted; 2. no focus on the question, not much related to the issue of information; 3. significant gaps in theoretical questions, or their superficial consideration; 4. the lack of examples or irrelevant examples; 5. there is no analysis and no theoretical justification for the given problem (if applicable), most of the key aspects are omitted; 6. problems in using professional terminology 	0-24

METHODICAL INSTRUCTIONS FOR THE TEAMWORK

The medical profession involves working in multidisciplinary teams, so these skills are identified as key in the competence of the doctor and other health professionals in all countries.

Therefore, group work is included as an essential component in the practical exercises of our course. In addition, it aims to provide a safe environment in which you can try out new ideas and practices and acquire relevant group skills. These can be tasks for performance in pairs, triples, or small groups of 4-6 people (work with cases, tasks of the ISW, etc.).

When you are working on a project or task in a team, you could use the various strengths of the group members to create a wider and better project or task than if you were working independently.

Group training means you need to share your knowledge and ideas with other students. There are two benefits to this: you need to think carefully about your own ideas to explain them to others, and you expand your own understanding, taking into account the knowledge and ideas of others.

Interpersonal Communication and Discussion

Take some time to chat and get to know each of your group mates. The better you know each other and the more convenient you communicate, the more effective you can work together.

Create a culture of mutual respect in your group. You probably had little choice or no choice at all when forming training groups and small teams in the classroom. Therefore, you will have to learn to overcome the differences between people. In addition, you will not have the opportunity to choose employees in the workplace, and at work, you will experience much greater pressure to be a productive member of the team.

For effective communication and discussion in a team: you should not be shy to express your opinion and it is important to feel that these opinions will be heard; it is necessary to feel that all members of the group make a feasible contribution to solving problems, observing agreed rules and plans, performing work efficiently and on time; it is important to know that everyone's feelings are taken into account by team members, but the goals and objectives of the group are not compromised, in favor of the whims or desires of individual members;

Try to express your opinion and listen to others. There is nothing wrong with disagreeing with your classmates, no matter how confident they are. When you disagree, be constructive and focus on the problem, not the person. Similarly, when someone disagrees with you, respect what he says and the risk that he takes upon himself to express his opinion. Try to find a way that everyone can agree with, and this is not necessarily the opinion of the loudest or smartest member of the team.

Below we provide some examples of constructive and destructive group behavior¹

Constructive group behavior - a person who:

Unites - interest in the views and opinions of others and willingness to adapt to interest

Clarifies - clearly defines the problems for the group by listening, summarizing, focusing the discussion

Inspires - encourages the group, stimulates participation and progress

Harmonizes - stimulates group unity and teamwork. For example, uses humor as a relaxation after difficult situations.

Take the risk - willingness to take risks at the expense of oneself for the success of the group or project

Manages the process - organizes a group on the issues of the process: for example, plan, schedule, timeline, topic, solution methods, and use of information

¹ adapted from Brunt (1993):

<https://tle.wisc.edu/solutions/engagement/constructive-and-destructive-groupbehaviors>

Destructive group behavior:

Domination - takes a lot of time expressing your opinion and views. Trying to take control by capturing energy, time, etc.

Fussiness - hastens the group to move quickly before the task is completed. Impatient in listening to other opinions and working together.

Suspension - removes itself from a discussion or decision. Opt out

Ignoring - does not respect or belittle the ideas and suggestions of the team or individuals. An extreme manifestation of ignoring is an insult in the form of ridicule.

Distraction - excessive talkativeness, tells stories and leads groups away from the goal

Blocking - prevents group progress by denying all ideas and suggestions. "It will not work because ..."

Effective group work does not arise by itself. A conscious and planned effort is needed, and since many people participate in it, one cannot rely on memory; need to make notes. The following steps will help you and your team work together effectively.

1. *Define clear objectives.* At each stage, you should try to coordinate the tasks. They include a timeline for the project, as well as more specific tasks (such as "agree on an approach to the task before Friday"). Each meeting or discussion should also begin with a specific goal (for example, make a list of tasks that need to be completed). Tasks should be broken down into smaller parts and planned. Sometimes one part cannot be started until the other part is finished, so you may need to draw a simple temporary map.

- Discuss the resources that you have and those that you will need to find.
- Formulate the desired result.
- Consider how you know when you did it well enough?
- Split tasks between the team and
- Set deadlines for subtasks and time for future meetings.

2. *Set the basic rules.* Discussions can become erratic and can prevent more modest group members from participating if you do not have rules to stimulate discussion, resolve disagreements, and make decisions without repetition. Set the rules from the start and change them as needed. For example: an interesting rule that was developed by one group - anyone who missed a meeting would buy the rest of the group coffee in a coffee shop. No one ever missed a meeting after that.

3. *Communicate effectively.* Make sure you regularly communicate with group members. Try to be clear and positive in what you say without repeating.

4. *Find consensus.* People work together most effectively when they work towards a goal with which they have agreed. Make sure everyone has their own opinion, even if you need time to get more participants to say something. Make sure you listen to everyone's ideas and then try to come to an agreement that everyone shares, and everyone has contributed.

5. *Define the roles.* Divide the work that needs to be done into separate tasks, for which you can use the strengths of individual team members. Define roles for both fulfilling your tasks and for meetings / discussions (for example, Arani is responsible for summarizing the discussions, Joseph is for everyone to express their opinions and make decisions, etc.).

Examples of roles and functions:

Facilitator or leader (depending on context) - to clarify the goals of the meeting and to summarize the discussions and decisions; ensures that the meeting takes place, continues and the basic rules are respected.

Secretary - keep a record of the ideas discussed and decisions made and who does what.

Time Manager - to make sure that you discuss everything that you need in the time allotted for the meeting.

Controller - to ensure that work is completed by an agreed time, and to solve problems if they are not being performed.

A process observer is someone who monitors the process, not the content, and can bring problems to the attention of the team. In this role, it is important to be positive, not condemning.

Editor - bring all materials together, identify gaps or matches and ensure consistency in the final presentation.

6. *Make it clear.* When a decision is made, it should be explained in such a way that it is clear to everyone that it was decided, including the time frame.

7. *Keep good notes.* Always summarize the discussions and document the decisions and publish them (for example in WhatsApp or Kaizala chat) so you can always get back to them. This includes lists of those who agreed what to do.

8. *Stick to the plan.* If you agreed to do something as part of the plan, do it. Your group relies on you to do what you agreed to do, and exactly in this way, not in the way you would like. If you think the plan should be reviewed, discuss it.

9. *Keep track of progress and keep up to date.* Discuss progress together regarding your schedule and deadlines. Make sure you meet deadlines personally, so you do not let your group down.

Co-writing a document / report

Joint writing is one of the most difficult parts of group work. There are many ways to do this, and your group must decide how to separate the work of writing, comparing, editing, and finalizing your work. Writing in a group (six people crowd around the keyboard) is a recipe for conflict and lack of progress. The other extreme - when one person assumes all responsibility and ultimately does most of the work - is also unproductive and contributes to conflict.

Three approaches are possible when working on a common document:

1 - One person writes the most part - this means that a narrow circle of ideas is used, and the rest of the team does not learn (and will not learn) to write reports and documents.

2 - Each person writes one section - then it is difficult to make a single consistent report, and you will not know about the rest, except for your own section.

3- Co-writing. This is the most productive way to solve group problems and provides the greatest benefit from collaboration. For example: in each section, there is a writer and at least one reviewer, and each team member is the author of a section and a reviewer of another one.

All team members before finalization by **the editor** must review the final product. Alternatively, you can have one author with others, editors, add and review, and someone tidies the finished report.

Try to divide the writing of source documents into tasks and solve them individually or in pairs. After the first draft of the sections are written, send out all the components and read them. You will probably need to come together to discuss how to combine them so that they fit together. Any participants who were not involved in preparing the drafts can do part of this work. Then edit, improve and polish the draft. It's convenient to collaborate on documents in Google documents.

When preparing a report / final document, regularly check the following:

- Is the purpose of the project clear from the report?
- Are the conclusions or recommendations clear?
- Do conclusions follow from the main part of the report?
- Do sections fit well?
- Does the report achieve goals (and evaluation criteria)?
- Are the necessary components sufficiently covered?

Whatever method you use, all group members must agree on the process and how they are going to maximize the collaborative approach to writing the final document.

Monitoring team performance and coping

Below is a checklist that includes a list of common problems that arise in a group work. Use it regularly to identify problems before they get out of hand. If serious problems and tensions arise, use it to determine where something might go wrong. First answer each question about yourself, and then give answer to this **question** about the group. Then gather a group and

discuss where, in your opinion, problems may arise, and think about how you can overcome these problems.

Each participant must complete this checklist. You should do this exercise regularly to track and improve your team's performance.

1. Answer each question regarding your teamwork.
2. Answer each question regarding the rest of the team.
3. Get together with your entire team and discuss where, in your opinion, any problems arise.
4. Discuss what you are going to do to overcome these problems.

Checklist for self-assessment of team effectiveness.

You	I personally	Group as a whole	Comments
Effectively clarify your tasks and tasks at each stage?			
Evaluate the progress of work?			
We clarify and document everything that the group decided?			
We clarify who will do what and how?			
We clarify by what date each task should be done?			
Setting meeting management rules?			
Adhere to agreed rules?			
Listening to each other?			
Allow some team members to dominate?			
Allow some team members to refuse / withdraw?			
We sacrifice personal desires for the success of the team?			
Recognize the feelings of other team members?			
Making equal contributions to team progress?			
Adhere to agreed rules for writing and naming files?			

Points and Grade

Group tasks and assignments mean that grades are given to the whole group based on the results of the work of the whole group. Everyone should be interested in ensuring the effective contribution of all members of the group and ensuring the high quality of the assignment. Sometimes, to assess the relative contribution of each to the group process, a form of peer-to-peer or peer review and a team assessment form will be used. This can be used to moderate assignment grades, or simply as a way to give feedback on your work in a group. The following are examples of student assessment criteria for team training.

№	Student assessment criteria in practical classes
1	<i>Preparation for classes:</i> He studies information focused on the case and problematic issues, uses various sources, and supports the statements with relevant links.
2	<i>Group skills and professional attitude:</i> Demonstrates excellent attendance, reliability, responsibility Takes the initiative, takes an active part in the discussion, helps the teammates, willingly takes on tasks
3	<i>Communication skills:</i> Actively listens, shows emotions according to the situation, is susceptible to non-verbal and emotional signals, shows respect and correctness in relation to others, helps to resolve misunderstandings and conflicts
4	<i>Feedback Skills:</i> Demonstrates a high level of introspection, critically evaluates oneself and colleagues, provides constructive and objective feedback in a friendly manner, accepts feedback without opposition
5	<i>Skills of critical thinking and effective learning:</i> Effectively participates in generating hypotheses and formulating problematic questions, gives relevant examples from life, skillfully applies knowledge to the problem / case under consideration, critically evaluates information, draws conclusions, explains and substantiates statements, draws diagrams and drawings, demonstrates a constant interest in the material being studied
6	<i>Theoretical knowledge and skills on the topic of the lesson:</i> All key aspects are presented logically; accuracy, relevance of answers to the questions posed without redundancy; integration of theoretical issues; Use of relevant examples proper use of professional terminology

Basic literature:

1. Alberts B. et al. Molecular biology of the cell. 6th ed. 2015. Garland Science.
2. Lodish H. et al. Molecular cell biology. 8th ed. 2016. WH Freeman.
3. John McMurry, et al. Fundamentals of General, Organic, and Biological Chemistry, 8th Edition. 2018. Pearson Education Limited.
4. Soderberg T. Organic Chemistry with a Biological Emphasis. 2016. Chemistry Publications.
5. Azimbayeva, Gulnur Toleugazyiyevna. Organic Chemistry [Text]: textbook / Gulnur Toleugazyiyevna Azimbayeva; Ministry of Education and Science of the Republic of Kazakhstan. - Almaty: Association of Higher Educational Institutions of Kazakhstan, 2016. - 313 p.: tab. - Bibliogr.: p. 313. - ISBN 978-601-7529-86-4

Additional literature:

1. Jenis, J. Study Guide and Practice Tests for Organic Chemistry (Organic Compounds of Aliphatic Series) / Al-Farabi KazNU. Almaty: Qazaq university, 2017.
2. Russell P.J. iGenetics. A molecular approach. 3rd ed. 2009. Pearson.
3. Karp G. Cell and molecular biology. Concepts and experiments. 7th ed. 2013. Wiley.
4. Hartwell L. et al. Genetics. From genes to genomes. 4th ed. 2011. McGraw Hill.
5. Zhussupova A.I. Molecular Biology (Interdisciplinary Approaches in Teaching and Research) / Al-Farabi KazNU. Almaty: Qazaq university, 2016.
6. Kroschwitz J.I. Chemistry: general, organic, biological. New York, 1990.
7. Rastogi V.B. Zubay's principles of biochemistry. New Dehli, 2017.
8. Alagarsamy, V. Textbook of Medicinal Chemistry. New Dehli, 2016.
9. Zhussupova A.I. Modern issues in molecular diagnostics / Al-Farabi. Kazakh National University - Almaty: Qazaq university, 2015.
10. Nazarbekova S.P. Chemistry. - Almaty: Association of Higher Educational Institutions of Kazakhstan, 2016.
11. Jenis J. Chemistry of Natural Compounds / Al-Farabi Kazakh National University. - Almaty: Qazaq university, 2016.

Internet resources:

1. Lecturio.com
<https://www.lecturio.com>
2. "Human Genome" Project
https://web.ornl.gov/sci/techresources/Human_Genome/project/info.shtml
3. NCBI - The National Center for Biotechnology Information, USA
<https://www.ncbi.nlm.nih.gov/>
4. NDB - a portal for three-dimensional structural information about nucleic acids
<http://ndbserver.rutgers.edu/>
5. OMIM - compendium of human genes and genetic phenotypes
<https://www.ncbi.nlm.nih.gov/omim?db=OMIM>
6. Ensembl - Genome browser for vertebrate genomes <http://asia.ensembl.org/index.html>
7. EMBL-EBI - European Bioinformatics Institute
<https://www.ebi.ac.uk/>
8. Video lectures by Molecular Biology:
<https://www.khanacademy.org/>