

MINISTRY OF EDUCATION AND SCIENCE IN UKRAINE

IVAN FRANKO NATIONAL UNIVERSITY OF LVIV

METHODOLOGY OF RESEARCH IN MICROBIOLOGY

(in English)

guide for the students of the second (master) level of higher education
by the speciality 091 "Biology and Biochemistry"
and educational profession program "Microbiology"

Lviv-2023

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CONTENT

INTRODUCTION	2
1. PROGRAM OF THE ACADEMIC DISCIPLINE	5
2. PRACTICAL WORKS	6
1. Emergence and evolution of science.....	6
2. Academic integrity.....	10
3. Drawing up an application for a grant.....	12
4. Drawing up a report on the performed research work.....	13
5. Preparation of scientific article.....	16
6. Preparation of conference abstracts.....	20
7. Preparation of a poster report.....	22
8. Preparation and design of qualification (master) thesis.....	24
3. CONTROL TASKS.....	28
4. STUDY RESULTS ASSESSMENT SYSTEM.....	29
5. INFORMATION RESOURCES.....	30
REFERENCES.....	31

INTRODUCTION

The discipline "Methodology of Research in Microbiology" is taught to students of the second (master's) level of higher education, who are studying in the specialty 091 "Biology", the educational profession program "Microbiology". The subject of the study of the academic discipline is the methods of organizing the process of preparation, conducting, design and presentation of the results of research.

Purpose: To acquaint students with the general principles and methods of conducting scientific research in biology and biochemistry, with an emphasis on microbiological research.

Task: to acquaint students with the technology of scientific research; to form in students a system of knowledge, abilities and skills in conducting and presenting the results of scientific research.

The course is designed to form students' general competencies:

GC01. Ability to work in an international context.

GC02. Ability to use information and communication technologies.

GC04. The ability to act on the basis of ethical considerations (motives).

GC07. Ability to search and analyze information using various sources, including the results of own research.

special (professional) competences:

SC01. Ability to use the latest advances in biology and biochemistry necessary for professional, research and/or innovation activities.

SC02. Ability to formulate modeling tasks, create models of objects and processes on the example of different levels of living organization using mathematical methods and information technologies.

SC03. The ability to use modern information technologies and analyze information in the field of biology and on the border of subject areas.

SC08. Ability to present and discuss the results of scientific and applied research, prepare scientific publications, participate in scientific conferences and other events.

SC09. Ability to apply author's rights legislation for practical purposes.

SC11. Ability to perform work in compliance with the rules of biological ethics, biosafety, biosecurity.

As a result of study, the following program learning outcomes will be achieved:

PO01. Possess state and foreign languages at a level sufficient for communicating on professional issues and presenting the results of own research.

PO02. Use libraries, information databases, Internet resources to find the necessary information.

PO06. Analyze biological phenomena and processes at the molecular, cellular, organismal, population-species and biosphere levels from the point of view of fundamental general scientific knowledge, as well as using special modern research methods.

PO09. Plan scientific research, choose effective research methods and their financial support.

PO10. To present the results of scientific work in writing (in the form of a report, scientific publications, etc.) and orally (in the form of reports and defense of the report) using modern technologies, to argue one's position in a scientific discussion.

PO13. To observe the basic rules of biological ethics, biosafety, biosecurity, to assess the risks of applying the latest biological, biotechnological and medical-biological methods and technologies, to identify potentially dangerous organisms or production processes that may create a threat of emergency situations.

PO14. To adhere to the norms of academic integrity during study and conducting scientific activities, know the basic legal norms regarding the protection of intellectual property.

PO16. To interpret critically theories, principles, methods from various branches of biology to solve practical tasks and problems.

PO23. To adhere to the main methodological principles of scientific research in modern microbiology, to use methodological and methodical tools for their implementation.

As a result of studying the academic discipline, the student will know:

- stages of conducting scientific microbiological research;
- rules of labor safety, biosafety and biosecurity during work in a microbiological laboratory;
- rules for writing scientific publications and reports;
- method of performing master's coursework and qualification work;

- requirements for writing master's course and qualification theses;
- requirements for the presentation of master's course and qualification theses;
- methods of implementation of research results;
- sources of funding for scientific research;
- methods of evaluating the effectiveness of scientific research;
- main scientometric databases;
- basics of scientific ethics.

be able to:

- use libraries, information databases, Internet resources to find the necessary information;
- find ways to quickly and effectively solve the task, generate ideas, using the acquired knowledge and skills;
- present the results of scientific work in writing (in the form of a report, scientific publications, etc.) and orally (in the form of reports and defense of the report) using modern technologies, conduct a discussion correctly;
- comply with the basic rules of biological ethics, biosafety, biosecurity, basic approaches to risk assessment under the conditions of using the latest biological, biotechnological and medical-biological methods and technologies;
- adhere to the main methodological principles of scientific research in modern microbiology, to use the methodological and methodical tools of their conduct;
- perform coursework and qualification (master's) work;
- distinguish discovery, invention;
- to patent inventions and utility models;
- carry out measures to implement the results of scientific research;
- draw up an application for receiving a grant;
- evaluate the effectiveness of scientific research;
- determine the citation index of authors in scientometric databases and the impact factor of journals that publish scientific articles;
- observe the norms of academic integrity.

1. PROGRAM OF THE ACADEMIC DISCIPLINE

Subject module 1. Organization of research.

Topic 1. Science and research in the modern world. Definition of science, its significance for humanity. The emergence and evolution of science. Classification of sciences. Theoretical and methodological principles of science. Types and signs of scientific research. Methodology and methods of scientific research. Organization of scientific activity in Ukraine.

Topic 2. Academic integrity. Concept of academic integrity. Promotion of academic integrity during teaching, scientific guidance. Academic writing and integrity. Academic integrity in assessment.

Topic 3. Technology of research. General characteristics of research processes. Formulation of the topic of research and definition of the working hypothesis. Determination of the goal, tasks, object and subject of research. Carrying out theoretical and applied research.

Topic 4. Experimental study of objects. Information search. Peculiarities of experimental research of objects. Labor safety during microbiological research. Biosafety and biosecurity in the process of conducting the microbiological research. Information search in the process of scientific work. Electronic search of scientific information.

Topic 5. Invention. Implementation of the results of research. Common features and differences of scientific discovery and invention. Patenting of inventions and utility models. Measures to implement the results of research.

Topic 6. Funding and evaluation of the effectiveness of research. Technical and financial support of scientific teams. Evaluation of the effectiveness of research.

Topic 7. Basics of scientific ethics. Basic principles and norms of ethics of the scientific society. Violation of scientific ethics. Scientific ethics in the process of publishing. Documentation of research and storage of source materials. Scientific etiquette. Ethics of the relationship between science and society.

Subject module 2. Presentation of the results of research.

Topic 8. Designing the results of research work. Report on the completed research work. Bibliographic apparatus of research. Rules for compiling a bibliographic description for lists of literature and sources. Location of bibliographic descriptions in lists of literature. Rules for citations and bibliographic references in the texts of scientific works.

Topic 9. Work on writing scientific articles, monographs, scientific reports. Types of scientific publications. Scientific monograph. Scientific Article. Conference abstracts. Scientific report. Rules for design of publications. The main scientometric bases, the citation index of the authors of scientific articles in them and the impact factor of journals that publish scientific articles.

Subject module 3. Qualification studies.

Topic 10. Master's course work and qualifying (master's) work. The sequence of coursework and master's work. Preparatory stage of course and master's work. Work on the text of the course and master's thesis. Preparation of course and master's work. Preparation for defense and defense of course and master's thesis. Management and review of course and qualification papers of the master's educational qualification level.

2. PRACTICAL WORKS

1. Emergence and evolution of science

The history of the emergence and development of science goes back thousands of years.

The first elements of science appeared in the ancient world in connection with the needs of social practice and were of a purely practical nature.

The most distant cognitive prerequisites of science are associated with an intellectual leap that took place approximately between the 8th and 6th centuries BC as a result of the completion of the transition process "from myth to logos", when the rational structures that we operate with today were formed in Ancient Greece. It was in Ancient Greece that such forms of cognitive activity as systematic proof, rational justification, logical deduction, and idealization arose, from which science could further develop.

Even at the dawn of its development, humanity improved living conditions due to knowledge and a certain transformation of the surrounding world. For centuries, millennia, experience was accumulated, appropriately generalized and passed on to the next generations. The mechanism of imitation of the accumulated information was gradually improved due to the establishment of certain rites, traditions, and then writing.

The specified changes contributed to the formation of a new social status of knowledge: knowledge becomes a necessary element, a determinant of social actions, people's behavior. There was a need in

society for spiritual mediators who would transfer knowledge from one social stratum to another "horizontally" (from teacher to student), as opposed to ways of transmitting knowledge "vertically" (from father to son who inherits the craft). The stratification of traditional society was intensified by the activities of the first philosophers. At the same time, their activity made rational practice – skills of logical reasoning, definition of concepts, methods of proof and refutation, construction of arguments, inferences, intellectual competitions, etc. socially significant. The new status of knowledge found its expression in the attitude of ancient Greek philosophers to knowledge, its formation and use.

The change in the social status of knowledge was one of the prerequisites for the emergence of a new type of knowledge — protoscientific. This premise was strengthened and acquired a real character on the way to the formation of special social forms of education, which provided for the teaching of various knowledge, inherited or discovered anew.

This is how the historically first form of science arose — the science of the ancient world, or protoscience, the subject of which was the study of nature as a whole. During this period, the fundamentals of chemistry, astronomy, and mathematics appeared.

Primitive (ancient) science was not yet divided into separate branches and had features of protoscience, which was very close to philosophy.

A new upheaval in the cultural system took place during the Renaissance, which spans the 14th to the beginning of the 17th centuries. During the Renaissance, the main intellectual work was carried out, which prepared the emergence of classical natural science.

One of the essential features of the culture of the Renaissance can be considered the cult of dialogue, the revival of conversation that was characteristic of antiquity. This feature also influenced the formation of scientific knowledge – the search for truth in direct, live communication. The Renaissance did not simply borrow this type of scientific communication, but significantly modified it in accordance with new cultural values and ideals of scientific work.

Official science, which was taught in universities, exhausted itself and began to slow down progress. Therefore, the scientist of the Renaissance went beyond the boundaries of university corporations, as a result of which he did not occupy a certain official position in the hierarchy of social roles. Knowledge was valued as the personal property of the thinker, which was achieved by his own search.

Intellectuals of a new type clustered around new cultural centers. They were academies formed in the 15th century and printing houses. Two outstanding achievements of this era were the clear presentation of the "system of the heavens", the center of which was the Sun (the system of M. Copernicus), and the first detailed anatomy of the human body, given in the works of A. Vesalius. Both works were published in 1543.

From the second half of the 15th century, during the Renaissance, the first period of significant development of natural science began, the beginning of which (mid-15th - mid-16th centuries) was characterized by the accumulation of a large amount of factual material about nature, which was obtained by experimental methods. At this time, further differentiation of science took place, the basics of fundamental scientific disciplines — mathematics, physics, chemistry — began to be taught in universities.

Science in its modern forms began to develop in the 17th–18th centuries. and due to the main regularity of its development, in our era it has turned into a direct productive force that significantly and comprehensively affects the life of society.

The second period in the development of natural science, which can be characterized as revolutionary in science, covers the time from the middle of the 16th century until the end of the XIX century. It was during this period that outstanding discoveries were made in physics, chemistry, mechanics, mathematics, biology, astronomy, and geology. The geocentric system of world construction, created by Ptolemy in the II century, was replaced by the heliocentric one (M. Copernicus, G. Galileo — XVI–XVII centuries); the laws of universal gravitation were discovered (I. Newton — the end of the 17th century), the conservation of mass in chemical transformations (M. Lomonosov, A. Lavoisier — the second half of the 18th century), the basic laws of heredity (H. Mendel — the end of the 18th century). In the second half of the XIX century D.. Mendeleev formulated the periodic law in chemistry. A real revolution in natural science was made by the theory of evolution (Ch. Darwin) and the law of conservation and transformation of energy.

Such a significant leap in the development of science contributed to the further process of its differentiation. For example, analytical geometry, differential and integral calculus, the theory of differential equations, and differential geometry aroused and developed independently in mathematics. Similar phenomena occurred in other fields of science, which led to the appearance of groups of separate disciplines at the end of the 19th century – natural sciences, social

sciences, technical sciences, sciences about human and his spiritual culture. But these groups and individual disciplines were closely related.

The second stage of the revolution (the end of the 19th century) led to the collapse of views according to which nature with its objects and connections was considered unchanging and moving forever in the same circle. A decisive role in this was played by I. Kant and P. Laplace, who created the cosmogonic theory.

At the end of the 19th and the beginning of the 20th centuries the revolution in natural science entered a new, third, specific stage. Physics crossed the threshold of the microcosm: the electron was discovered (J. Thomson, 1897), the foundations of quantum mechanics were laid (M. Planck, 1890), and the discrete nature of radioactive radiation was discovered.

In the 20th century the development of science throughout the world was characterized by exceptionally high rates. Based on the achievements of mathematics, physics, chemistry, biology and other sciences, molecular biology, genetics, chemical physics, physical chemistry, cybernetics, biocybernetics, etc. have developed.

The rapid pace of development of science in the 20th century. stimulated the creation of scientology, which studies the regularities of the functioning and development of science, the structure and dynamics of scientific activity, the economy and organization of scientific research, forms of interaction with other spheres of the material and spiritual life of society.

Questions for the independent work:

1. Emergence of science. Science in the ancient world.
2. Development of science during the Renaissance.
3. The first period of significant development of natural science.
4. The second period in the development of natural science. First stage of revolution.
5. The second stage of revolution in natural science.
6. The third stage of revolution in natural science.
7. Development of science in the 20th century.

Lesson progress. Lesson is performed in the form of seminar, at which the questions for independent work are discussed.

Recommended literature:

1. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]

2. Birta H. O., Burhu Y. H. Methodology and organization of research. Kyiv: Centre for the Educational Literature, 2014. 142 p. [in Ukrainian]

2. Academic integrity

Academic integrity is a set of ethical principles and rules defined by law that must be followed by participants in the educational process during learning, teaching and carrying out scientific (creative) activities in order to ensure trust in the results of studies and/or scientific (creative) achievements. It is a commitment to six fundamental values: honesty, trust, fairness, respect, responsibility, and courage. By embracing these fundamental values, instructors, students, staff, and administrators create effective scholarly communities where integrity is a touchstone. Without them, the work of teachers, learners, and researchers loses value and credibility.

Observance of academic integrity by academic and scientific workers involves:

- references to sources of information in case of use of ideas, developments, statements, information;
- compliance with the legislation on copyright and related rights;
- provision of reliable information about research methods and results, sources of used information and own teaching (scientific, creative) activity;
- control over compliance with academic integrity by education seekers;
- objective assessment of learning outcomes.

Observance of academic integrity by students involves:

- independent performance of educational tasks, tasks of current and final control of learning results (for persons with special educational needs, this requirement is applied taking into account their individual needs and capabilities);
- references to sources of information in case of use of ideas, developments, statements, information;
- compliance with the legislation on copyright and related rights;
- provision of reliable information about the results of own educational (scientific, creative) activities, used research methods and sources of information.

Violation of academic integrity is considered:

- academic plagiarism - publicizing (partially or completely) scientific (creative) results obtained by other persons as the

results of own research (creativity) and/or reproduction of published texts (publicized works of art) of other authors without indicating authorship;

- self-plagiarism - publishing (partially or completely) one's own previously published scientific results as new scientific results;
- fabrication - fabrication of data or facts used in the educational process or scientific research;
- falsification - a deliberate change or modification of already available data related to the educational process or scientific research;
- write-off - performance of written works involving external sources of information other than those permitted for use, in particular during the evaluation of learning outcomes;
- cheating - provision of knowingly false information about one's own educational (scientific, creative) activity or organization of the educational process; forms of cheating are, in particular, academic plagiarism, self-plagiarism, fabrication, falsification and plagiarism;
- bribery - providing (receiving) by a participant in the educational process or offering to provide (receiving) funds, property, services, benefits or any other benefits of a material or non-material nature in order to obtain an undue advantage in the educational process;
- biased evaluation - deliberate overestimation or underestimation of the learning outcomes of education seekers;
- providing assistance to students during their assessment of learning outcomes or creating obstacles not provided for by the conditions and/or procedures of such an assessment;
- influence in any form (request, persuasion, instruction, threat, coercion, etc.) on an academic (scientific) worker in order to make him biasedly evaluate the results of education.

Questions for the independent work:

1. The fundamental values of academic integrity.
2. Observance of academic integrity by students and academic workers.
3. Methods of supporting the principles of academic integrity in higher education institutions.
4. Academic integrity during the estimation of study results.
5. Academic integrity during the distance learning.
6. Violations of academic integrity.

7. Plagiarism prevention.
8. Responsibility for the violation of academic integrity.

Lesson progress. Lesson is performed in the form of seminar, at which the questions for independent work are discussed.

Recommended literature:

1. Academic integrity [Electronic resource] // National Agency for Quality Assurance of Higher Education. URL: <https://naqa.gov.ua/академічна-добросесність>. [in Ukrainian]
2. The Fundamental Values of Academic Integrity [Electronic resource] / International Center for Academic Integrity. 2021. URL: https://academicintegrity.org/images/pdfs/20019_ICAI-Fundamental-Values_R12.pdf.
3. Ukrainian law "About the Education" // Vidomosti of Verkhovna Rada of Ukraine. 2017. N 38–39. Art. 380. [in Ukrainian]
4. Series of information bulletins "Academic integrity Infobulletin" [Electronic resource] // Academiq. 2020. URL: <https://academiq.org.ua/novyny/informatsiini-bulleteni>. [in Ukrainian]
5. Recommendations for institutions of higher education regarding the development and implementation of a university system for ensuring academic integrity [Electronic resource] / National Agency for Higher Education Quality Assurance. 2019. URL: <https://naqa.gov.ua/wp-content/uploads/2019/10/Рекомендації-ЗВО-система-забезпечення-академічної-добросесності.pdf>. [in Ukrainian]
6. Guidelines for institutions of higher education on supporting the principles of academic integrity [Electronic resource] / V. Bakhrushyn, E. Nikolaev. URL: https://drive.google.com/file/d/1IJtjefmfqO1uNCn4p9cT5g6_58h0Cxq9/view. [in Ukrainian]
7. Brennecke P. Academic integrity at MIT. 2020. 36 p.
8. Handbook of academic integrity / ed. by Bretag T. Springer, 2016. 1097 p.

3. Drawing up an application for a grant

To win a competition for a grant, the author first needs to have good ideas for solving certain scientific problems. The assessment of the

project will be more objective and the chances of a positive decision will increase if the authors will not neglect some rules for writing the application.

The project should start with the basics. If it does not contradict the terms of the proposal, the document should be divided into different sections. Short paragraphs and sentences with a simple structure should be used. Application should be visually attractive.

Title of work should reflect its essence and contain 8–15 words. The summary should allow to imagine the scientific problem, author's plan for its solution, the main directions of experimental work and possible conclusions. The purpose should be clearly defined. Then the applicant should describe the current state of problem development, scientific achievements by the applicants, suggested methods and approaches. Authors' own publications concerning project title and available resources should be clearly elucidated.

Tasks for the independent work. Learn how to draw up an application for a grant and get ready to do it at the lesson.

Lesson progress. Students obtain a task and necessary materials to draw up an application for a grant for conducting a research, defined by teacher. Then they are divided into groups. Each of them draw up some part of the application. Then each group represent their part of application. The teacher sums up.

Recommended literature:

1. Research methods handbook. GO-GN, 2020. 79 p.
2. Mishra S. B., Alok S. Handbook of research methodology: a compendium for scholars & researchers. Dwarka: Educreation Publishing, 2017. 160 p.
3. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]

4. Drawing up a report on the performed research work

The completed research work is submitted in the form of a report. This is a document containing comprehensive systematized information about the work performed. During its compilation, the requirements are regulated by the State Standard of Ukraine DSTU 3008:2015 "Information and documentation. Reports in the field of science and technology. Structure and rules of design".

The report on the completed research work should consist of three parts: the introductory part, the main part, and appendices.

The introductory part contains the following structural elements: cover (pages 1 and 2 of the cover); title page; list of authors; abstract; content; a list of conventional designations, symbols, units, abbreviations and terms; preface.

The main part consists of an introduction; the essence of the report; conclusions; recommendations; list of references.

Appendices are placed after the main part of the report.

The text is printed, observing the margins: left - at least 25 mm, right - at least 10, top and bottom - at least 20 mm. Use the Times New Roman font of the Word text editor with a 14-point pin with a line spacing of 1.5–2. The paper format is A4 (210 x 297 mm), if necessary, you can use A3.

The title page is the first page of the work and contains the following information: distribution restrictions or confidentiality stamp (if necessary); report identifiers; international standard book number (ISBN) or international serial number (ISSN) - given for reports issued; information about the performer of the work - a legal entity (organization) or an individual; approval and approval vultures; full name of the document; signatures of responsible persons, including the supervisor; year of drawing up (approval) of the report; author's priority date (if necessary); if necessary – any special records (information about the connection of a certain report with other works, for example, the report is part of a dissertation submitted for defense; performance of work on the topic of a target state program; the work is proactive, etc.)

The list of performers includes the names of all responsible performers, performers and co-performers (authors of the work) who took a creative part in the work, indicating their positions, scientific degrees, academic titles. If there is only one executor of the work, his name and signature are placed on the title page.

The abstract is intended for familiarization with the report. It should be concise, informative and contain information that allows you to decide whether to read the entire report. The abstract should be placed directly after the list of authors, starting on a new page. In the case of publishing a report, the text abstract is preceded by a full bibliographic description of the report, which is performed in accordance with the requirements of current standards for library and publishing.

The abstract should contain the following elements:

- information about the volume of the report, the number of parts of the report, the number of illustrations, tables, appendices, the number

of sources according to the list of references (all information is given, including the data of the appendices);

- the text of the abstract, in which data about the object of research or development are indicated; the purpose of the work; research methods and equipment; results and their novelty; main structural, technological and operational characteristics and indicators; degree of implementation; relationship with other works; recommendations on the use of work results; field of application; economic efficiency; significance of work and conclusions; predictive assumptions about the development of the object of research;

- a list of keywords (must include from 5 to 15 words in the nominative case).

The abstract should be no more than 500 words; it is desirable that the abstract is contained on one page of A4 format.

The content includes a list of conventions, symbols, units, abbreviations and terms; preface; introduction; sequentially listed names of all sections, subdivisions, points and subsections (if they have headings) of the report; conclusions; recommendations; references; names of appendices and page numbers that contain the beginning of the material. The table of contents may list the numbers and titles of figures and tables, indicating the pages on which they are placed.

The list of conventional designations contains all uncommon conventional designations, symbols, units, abbreviations and terms adopted in the report and their explanations. This list is placed directly after the table of contents, starting on a new page.

The introduction to the report on the completed scientific work should contain an assessment of the state of the studied research problem, the names of leading companies and the names of leading scientists and specialists in this field; global trends in solving the tasks; the relevance of the work and the reasons for its implementation; purpose of work and field of application.

The main part should highlight the choice of research direction; the essence of theoretical and/or experimental research; generalization and assessment of research results.

Conclusions should contain a concise summary of the results of the performed scientific research work or its separate stages, proposals for their use, including implementation. It should be noted the scientific and social significance of the work results.

Recommendations may be made in the report based on the findings. The recommendations identify further work that is considered

necessary, focusing on proposals for effective use of the results of research or development. They must have a specific nature and be fully confirmed by the reporting work. They are placed after the conclusions, starting from a new page.

The list of used sources includes a complete bibliographic description of monographs, articles, archival and other documents that were used during the performance of research work.

The appendices, if necessary, include auxiliary materials of the report: samples of questionnaires, questionnaires, texts; auxiliary data tables; acts of implementation; intermediate mathematical proofs, formulas and calculations; illustrations of an auxiliary nature, etc. In terms of form, it can be text, table, diagram, graph, map, etc.

Tasks for the independent work. Prepare a report on the completed research work based on the results of own research.

Lesson progress. Students discuss the reports prepared before the class. The teacher sums up.

Recommended literature:

1. Research methods handbook. GO-GN, 2020. 79 p.
2. DSTU 8302:2015 Bibliographic reference. General statements and composition rules [Valid from 2016-07-01]. Kyiv: UkrNDNC, 2016. 26 p. [in Ukrainian]
3. DSTU HOST 7.1-2006. Bibliographic note. Bibliographic description. General requirements and composition rules [Valid from 2007-07-01]. Kyiv: Derzhspozhyvstandart Ukrainy, 2007. 47 p. [in Ukrainian]
4. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]
5. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]
6. DSTU 3008:2015 Information and documentation. Reports in the field of science and technology. Structure and rules of design [Valid from 2015-06-22]. Kyiv: UkrNDNC, 2016. 26 p. [in Ukrainian]

5. Preparation of scientific article

A scientific article is one of the main types of publications. It contains a statement of intermediate or final results of scientific research, highlights a separate issue, fixes the scientific priority of the author, makes the material the property of specialists. The scientific article is

submitted to the editors in a completed form in accordance with the requirements, which are published in separate issues of journals in the form of a rules for the authors.

An experimental article usually has the following structure: source information, abstract (summary), key words, introduction, research materials and methods, results, discussion and conclusions, list of cited sources.

The source information is the name, data about the authors and the place of performance of the work. The title of the article should briefly inform about its content and be no more than 12 words. The name should be interesting for an international audience.

Next, we cite as an example the rules for the authors of the Journal "Biosystems Diversity", which has been indexed since 2015 in the Web of Science database with volume 23, number 1.

Abstract should have 1500–2800 characters. The abstract should be informative and full of substance. Please do not use any undefined abbreviations or unspecified references. The abstract should be understandable without reading the paper.

Keywords: 4-6 items.

Research papers should not exceed 40 printed pages. Please use MS Word (*.doc).

Use internationally accepted signs and symbols (SI units).

Title should inform about the content of the paper in a condensed form. The title should not exceed 12 words. A full research paper should have following components:

- Title
- Name(s) of the author(s)
- The address(es) and affiliations of the author(s)
- The e-mail address, full telephone and fax no. of the corresponding author
- Abstract
- Key words (indexing terms), normally 4–6 items
- Introduction
- Material and Methods
- Results
- Discussion
- Conclusion
- Acknowledgements
- References.

Review paper may have any number of sections of any names. Only Conclusion is obligatory.

Cite references in the text by name and year in parentheses. Please use the following reference style in the text: one author – (Vinson, 2015), 2 authors – (Vargo & Laurel, 2004; Vargo & Hulse, 2014), 3 and more authors – (Davis et al., 2006; Jones et al., 2016).

Tables

Please use the table function, not spreadsheets, to design tables. Tables should be self-explanatory. Tables are placed in the text just after its first reference. They should be mentioned and numbered consecutively (e.g. Table 1). Please provide an informative title at the top of the table.

Each column should carry a brief heading. Tables will be reproduced in the journal as presented in the final submission. Please do not insert huge tables, which cannot be fit within the page margins. Details of statistics and description should be disposed beneath the table body as a footnote. Use asterisks for significance values and other statistical data.

Figures

All figures should be referred in the text and numbered consecutively. Use Times New Roman font in the figures.

Caption must appear beneath the figure and should make the figure sufficiently understandable apart from the text. Lettering and symbols should be explained in the caption and only exceptionally in the figure. Figures should be of good quality. Colour figures will appear in the downloadable files. Figures should be fit to the text area and embedded.

References

The list of references should only include published or accepted works that are cited in the text. Personal communications and unpublished works should only be mentioned in the text.

Reference list entries should be alphabetized by the last names of the first author of each publication.

The names of all authors should be provided. Please use the standard of APA – American Psychological Association (www.crossref.org)

Journal article

Author, A. A., Author, B. B., & Author, C. C. (2005). Title of article. Title of Journal, vv(n), pp–pp. doi.

Putchkov, A. (2011). Ground beetles of the Ukraine (Coleoptera, Carabidae). *ZooKeys*, 100, 503–515. doi:10.3897/zookeys.100.1545

Putchkov, A. V. (2013). Survey of carabid beetles of the tribe Nebriini (Coleoptera, Carabidae) of the fauna of Ukraine. *Entomological Review*, 93(5), 620–629. doi:10.1134/s0013873813050102

Husband, R. W., & Khaustov, A. A. (2004). A new species of *Eutarsopolipus* (Acari: Podapolipidae) from *Calathus fuscipes* (Coleoptera: Carabidae) from Ukraine. *International Journal of Acarology*, 30(4), 329–333. doi:10.1080/01647950408684401

Sidorenko, A. I., & Siokhin, V. D. (2016). Gnezdovanie bol'shogo baklana (*Phalacrocorax carbo*) na tehnogennyh sooruzhenijah v Ukraine [Nesting of Great Cormorants (*Phalacrocorax carbo*) on man-made structures in Ukraine]. *Visnyk of Dnipropetrovsk University. Biology, Ecology*, 24(2), 308–316 (in Russian). doi:10.15421/011640

Book

Freeland, J. R., Kirk, H., & Petersen, S. (2011). *Molecular Ecology*. WileyBlackwell, Oxford. doi:10.1002/9780470979365

Tasks for the independent work. Write a scientific article based on your own research. Upload it to Moodle platform before the defined time. Then prepare the review for the article of your colleague.

Lesson progress. Students present the written articles, reviewers present their reviews, all students take part in the discussion. The teacher sums up.

Recommended literature:

1. Research methods handbook. GO-GN, 2020. 79 p.
2. Mishra S. B., Alok S. Handbook of research methodology: a compendium for scholars & researchers. Dwarka: Educreation Publishing, 2017. 160 p.
3. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]
4. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]
5. Biosystems diversity [Electronic resource]. URL: <https://ecology.dp.ua/index.php/ECO>.
6. Tarabas O. V., Hnatush S. O., Tashyrev O. B., Hovorukha V. M., Havryliuk O. A., Moroz O. M., Halushka A. A. Production of hydrogen by purple non-sulfur bacteria *Rhodospseudomonas yavorovii* IMV B-7620 // *Microbiol. Journ.* 2021. Vol. 83. N 5. P. 19–29. doi: <https://doi.org/10.15407/microbiolj83.05.019>.

7. Verkholiak N., Peretyatko T., Halushka A. Effects of phenolic compounds on the sulfidogenic activity of *Desulfotomaculum* sp. and *Desulfovibrio desulfuricans* bacteria // Ecological questions. 2021. Vol. 32. N 4. – P. 135–142. DOI: <http://dx.doi.org/10.12775/EQ.2021.39>.

6. Preparation of the conference abstracts

Abstracts of the report are materials of a preliminary nature published before the start of the scientific conference (congress, symposium), where the main aspects of the scientific report are outlined. They fix the scientific priority of the author and contain materials that are not in other publications.

The title of the abstract should concisely reflect the main idea, opinion, position (five to seven words).

The usual format of abstract is close to the format of an abstract of a scientific article.

It is advisable to present the essence of the report in the following sequence: relevance of the problem; the state of development of the problem (list the scientists who addressed the development of this problem); the presence of a problematic situation and the need for its study, improvement, and the current state of its development and implementation; the main idea, provisions, conclusions of the study, by what methods it was achieved; the main results of the research, their significance for the development of theory and/or practice.

References to sources, citations in abstracts of reports are rarely used. It is allowed to include digital, factual material.

The formulation of each thesis begins with a new line. Each thesis contains an independent opinion expressed in one or more sentences. The essence of the idea or position is presented without giving specific examples.

Requirements for the conference abstract for the practical work.

Abstract size is up to 1 page A4 format, orientation Portrait, all margins – 2 cm, font Times New Roman, type size 12, space 1,0, paragraph – 1.25 cm. In abstracts in Ukrainian, the annotation in English (5– 6 lines) should be added. No figures, no diagrams are allowed. Literature citation in text should be presented as author name and year of publication in brackets (Orlenko, 2019). Do not use change of register, fonts, text formatting and marking.

Demanded abstract form:

Names of all authors (name of the presenting author should be underlined)

TITLE OF ABSTRACT

Official name of scientific institution, where study was carried out

Post address of the institution

e-mail

Abstract text (short content of presentation).

For example:

I. Vanaga, J. Gurkina, O. Treikale, I. Priekule, J. Pugacova

INFLUENCE OF HERACLEUM SOSNOWSKYI CONTROL
MEASURES ON WEED DIVERSITY IN AGRICULTURAL FIELDS
IN LATVIA

*Latvian Plant Protection Research Centre
Lielvardes iela 36/38, Riga, LV1006, Latvia
e-mail: ineta.vanaga@laapc.lv*

Abstract text...

Tasks for the independent work. Prepare abstracts of the report based on the results of own research.

Lesson progress. Students discuss written abstracts, the teacher summarizes.

Recommended literature:

1. Research methods handbook. GO-GN, 2020. 79 p.
2. Mishra S. B., Alok S. Handbook of research methodology: a compendium for scholars & researchers. Dwarka: Educreation Publishing, 2017. 160 p.
3. DSTU 8302:2015 Bibliographic reference. General statements and composition rules [Valid from 2016-07-01]. Kyiv: UkrNDNC, 2016. 26 p. [in Ukrainian]
4. DSTU HOST 7.1-2006. Bibliographic note. Bibliographic description. General requirements and composition rules [Valid from 2007-07-01]. Kyiv: Derzhspozhyvstandart Ukrainy, 2007. 47 p. [in Ukrainian]
5. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]
6. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]
7. XIX international scientific conference for students and PhD students "Youth and Progress of Biology", dedicated to the 90th anniversary of academicians of the National Academy of

Sciences of Ukraine, professor Schelyag-Sosonko Yury Romanovych: information letter [Electronic resource]. 2023. URL: <https://bioweb.lnu.edu.ua/wp-content/uploads/2023/03/Informatsiynyy-lyst-2023-En-1.pdf>.

8. Meniv N., Halushka A., Hnatush S. Phylogenetic analysis of *Streptomyces* genus isolates from the spoil heap of central enrichment factory “Chervonohradska” // The 1st Ukrainian-Polish Scientific forum “Agrobioperspectives”, September 29–30, 2021: proceedings. Lviv, 2021. P. 79.
9. Boretska I., Bonchuzhna M., Onyskiv S., Halushka A., Meniv N., Hnatush S. Properties of heterotrophic microorganisms, isolated from the grey-yellow rock in Central enrichment factory “Chervonohradska” spoil heap // XIX International Scientific Conference for Students and PhD Students “Youth and Progress of Biology”, Lviv, April 26–28, 2023: Abstracts. Lviv, 2023. P. 141–142.

7. Preparation of a poster report

A poster presentation should contain a limited amount of information. A report overloaded with results obscures the central idea; in this case, you can hear that the results of research are unclear.

Only the essence of the problem should be presented in the poster presentation. The main provisions should be clear and without additional explanations.

The poster presentation must necessarily contain drawings that should be well read from a distance of one or two meters. Do not try to increase the number of pictures or text by reducing their size or compressing them, it is better to remove unnecessary elements. If the poster is difficult to read, it will not be effective. Audiences should be attracted by clarity, simplicity and interesting illustrations.

The title containing the title of the report, surnames and initials of the authors, etc., are placed at the top of the poster. The author's photo can be placed in the header.

The title should be short, informative and interesting. It must have a height of at least 3 cm (100 pt or more). For example, such a title is informative, but long: "Oxidative modification of proteins and the state of the membrane of *Chlorobium limicola* IMV K-8 under the influence of different concentrations of copper (II) sulfate." The best version is: "Adaptation of *Chlorobium limicola* IMV K-8 cells to exposure to copper (II) sulfate."

In scientific articles, sentences are often long and complex. Verbosity is contraindicated for a poster presentation. Short sentences should be separated by spaces. Keywords should be at the beginning of the sentence.

Usually, the text of a poster report contains an introduction, methods, results, conclusions, a list of references, often - acknowledgments. The names of these sections should be available on the poster. It is better to choose sans serif fonts (Helvetica, Arial, etc.). The height of the text should be at least 24 pt and be read freely at a distance of 1–1.5 m. Abbreviations and jargon should be avoided, and terms should not be misused.

A colored background should be used whenever possible. Color should help the perception of the material. It is better to place less important parts on a background of cold or neutral colors (blue, green, gray), and the "heart" of the poster - on a background of warm colors (red and yellow).

The minimum size of the graphs is 20x30 cm.

When placing the material, remember that we read from left to right, top to bottom. The most important information should be at eye level. For a broad report, it is better to divide the space into two or three parts. Then you can read the chapter standing still. It is advisable to leave more free space, the text should "breathe", densely placed material is tiring.

It is recommended to use elements of different sizes and proportions. For example, an introduction on an A4 sheet, methods in a square, drawings in a circle, etc. But you need to know the measure.

Tasks for the independent work. Prepare a poster report (in electronic form) based on the results of own research.

Lesson progress. Students discuss reports, the teacher summarizes.

Recommended literature:

1. Research methods handbook. GO-GN, 2020. 79 p.
2. Mishra S. B., Alok S. Handbook of research methodology: a compendium for scholars & researchers. Dwarka: Educreation Publishing, 2017. 160 p.
3. DSTU 8302:2015 Bibliographic reference. General statements and composition rules [Valid from 2016-07-01]. Kyiv: UkrNDNC, 2016. 26 p. [in Ukrainian]
4. DSTU HOST 7.1-2006. Bibliographic note. Bibliographic description. General requirements and composition rules [Valid

- from 2007-07-01]. Kyiv: Derzhspozhyvstandart Ukrainy, 2007. 47 p. [in Ukrainian]
5. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]
 6. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]

8. Preparation and design of qualification (master) thesis

A master's thesis is mandatory at the final stage of students' studies at the university for the assignment of the master's educational qualification level.

A master's thesis is a final qualification thesis of scientific content, which is characterized by internal unity and a reflection of the progress and results of the development of the chosen topic. It should correspond to the current level of scientific development in a certain field, and its topic should be relevant. The master's thesis is submitted in a form that allows you to determine how fully reflected and substantiated are its provisions, conclusions and recommendations, and their novelty. The totality of the results obtained in such a work indicates that its author has initial skills of scientific work in the chosen field of professional activity.

The master's thesis has all the characteristics that are typical for scientific works, since it is very specific as a scientific work. First of all, it is distinguished from other scientific works by the fact that in the system of education and science it performs a qualification function, that is, it is prepared for the purpose of public defense and obtaining the appropriate educational and professional master's level. In this regard, the main task of its author is to demonstrate the level of his educational and scientific qualifications, first of all, the ability to independently conduct scientific research and solve specific scientific problems.

The master's educational profession program includes two components that are approximately equal in scope — educational and research. The content of the master's research work is determined by an individual plan. At the same time, a scientific supervisor is appointed, who must have a scientific degree and/or an academic title and work at this higher educational institution.

The master's thesis is an independent, completed, integral study that reveals the topic chosen by the author at the appropriate level.

In the master's work, the student must demonstrate in-depth knowledge of his field of science, mastery of scientific research skills, methods of experimental work, the ability to think, analyze and generalize, draw conclusions.

Preparation and defense of a master's thesis contributes to increasing the level of knowledge and skills of students, mastering the necessary forms and methods of scientific work, developing creative thinking, and acquiring the ability to analyze research results.

The value of a master's thesis is determined by its scientific significance, as well as logic, reasonableness, and a clear presentation of the material.

A master's thesis can be a continuation and development of course and bachelor's theses.

The preparation and defense of the master's thesis is carried out in several stages:

- selection and clarification of the topic, selection and study of literature;
- development of a work plan;
- conducting and analyzing research;
- preparation of the text of the master's thesis and its design;
- preparation of thesis for defense, including preliminary defense at the meeting of the department;
- defense of the master's thesis at the Examination Commission meeting.

The topic should be relevant, significant, such that it provides an opportunity to apply the knowledge, skills and abilities of the graduate as much as possible. It is desirable to establish a connection with the profile of his future work. If the student is directed to study by a certain organization or institution, then it is advisable to agree on the topic of the master's thesis with the customer in advance. Leading teachers of faculties and departments act as supervisors of master's work. As an exception, the master's thesis can be jointly supervised by teachers of two faculties or two departments of the same faculty in cases where the master's thesis is written at the intersection of two specialties.

In choosing the topic of the qualification work, the student can be helped by such methods as reviewing the catalogs of defended theses and getting acquainted with the dissertations completed at the department, as well as the latest research results in related fields of knowledge. The

selection and study of literature on the topic of research should be carried out in accordance with the general requirements for searching for information in the process of scientific work.

The student has the right to submit to the department his wishes regarding the candidature of the scientific supervisor of his master's thesis. The final decision is made by the department with the consent of the teacher and in accordance with the planned number of qualification works that this teacher should manage.

The supervisor provides constant assistance to students at all stages of preparation of the master's thesis: helps with the formulation of the topic, development of its concept and structure; gives recommendations on literature selection and processing of material, research methods; monitors the progress of its implementation, checks the form and content of the master's thesis; prepares a written response to the work. He also supervises the preparation for the defense of the master's thesis at the meeting of the Examination Commission.

Master's theses topics are approved at the meeting of the academic council of the faculty.

The following structure of a master's thesis is considered acceptable:

- title page;
- content;
- introduction;
- sections and subsections of the main part;
- conclusions;
- literature;
- appendices (if necessary).

The content of each part of the master's thesis is determined by its topic. The names of the sections of the master's thesis should not duplicate the title of the thesis itself.

The response of the scientific supervisor of the qualification work is submitted in an arbitrary form. It defines:

- level of preparation of the graduate to perform professional duties;
- the degree of independence in performing the qualification work;
- the novelty of the questions and the originality of their solution;

- ability to use literature;
- degree of mastery of research methods;
- completeness and quality of topic development;
- logic, consistency, argumentativeness, literacy of the presentation of the material;
- the possibility of practical application of the qualification work or its individual parts;
- a conclusion on the extent to which it meets the requirements for qualifying works.

The review of the qualification work is provided by a specialist-practitioner of the appropriate qualification. It also has an arbitrary shape. In it, special attention should be paid to the relevance of the topic and the student's ability to apply theoretical knowledge to solve specific practical tasks and, in addition, to the presence of personal suggestions and recommendations in the work, their novelty, perspective, practical value, reliability of the results and reasonableness conclusions of the graduate. The presentation style and design of the work is also evaluated. At the end of the review, the shortcomings of the work are noted.

The review should end with a general conclusion.

Tasks for the independent work. Get acquainted with such topics:

1. The sequence of completion of diploma works.
2. Requirements for persons receiving a master's degree.
3. Signs and features of a master's works.
4. Selection of the topic and structure of the master's thesis.
5. Preparation of the text of the master's thesis and its design.
6. Preparation for the defense and defense of the master's thesis.
7. Supervision and review of master's theses.

Lesson progress. Lesson is performed by the "take position" technology. Teacher suggests some statements and students choose whether they agree or not. Then one or several students by teacher's choice have to argue their position.

Recommended literature:

1. Research methods handbook. GO-GN, 2020. 79 p.
2. Mishra S. B., Alok S. Handbook of research methodology: a compendium for scholars & researchers. Dwarka: Educreation Publishing, 2017. 160 p.

3. DSTU 8302:2015 Bibliographic reference. General statements and composition rules [Valid from 2016-07-01]. Kyiv: UkrNDNC, 2016. 26 p. [in Ukrainian]
4. DSTU HOST 7.1-2006. Bibliographic note. Bibliographic description. General requirements and composition rules [Valid from 2007-07-01]. Kyiv: Derzhspozhyvstandart Ukrainy, 2007. 47 p. [in Ukrainian]
5. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]
6. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]

3. CONTROL TASKS

1. Determination of the purpose, tasks, object and subject of research.
2. Academic integrity.
3. Formulation of the topic of research and definition of the working hypothesis.
4. Scientific etiquette.
5. Basic principles of ethics of scientific society.
6. Violation of scientific ethics.
7. Drawing up an application for an invention (utility model).
8. Documentation of research and storage of source materials.
9. Scientific ethics in the process of publishing.
10. Types and signs of scientific research.
11. Peculiarities of experimental research of objects.
12. Labor safety, biosafety and biosecurity during microbiological research.
13. Searching for information in the library.
14. Common features and differences between scientific discovery and invention.
15. Technical and financial support of scientific teams.
16. Finding sources of funding for research.
17. Definition of science, its significance for humanity.
18. The emergence and evolution of science.
19. Classification of sciences.
20. Theoretical and methodological principles of science.

21. Methodology and methods of research.
22. Organization of scientific activity in Ukraine.
23. General characteristics of research processes.
24. Carrying out theoretical and applied research.
25. Electronic search of scientific information.
26. Measures to implement the results of research.
27. Ethics of the relationship between science and society.
28. Drawing up a report on the completed research work.
29. Rules for compiling a bibliographic description for lists of literature and sources.
30. Location of bibliographic descriptions in lists of literature.
31. Types of scientific publications.
32. Scientific monograph.
33. Scientific article.
34. Scientific report.
35. The main scientometric bases, the citation index of the authors of scientific articles in them and the impact factor of journals that publish scientific articles.
36. Conference abstracts.
37. Work on the text of course and qualification (master's) thesis and its design.
38. Preparation for defense and defense of coursework and qualification (master's) thesis.
39. Bibliographic apparatus of scientific research.
40. Rules for citations and bibliographic references in the texts of scientific works.
41. Management and review of course and qualification papers of the master's educational and qualification level.

4. STUDY RESULTS ASSESSMENT SYSTEM

Assessment is carried out on a 100-point scale. Current monitoring of learning success is carried out in the form of control work and assessment of activity in practical classes and independent work.

- Control work:
 - tests: 19 tests of 1 point each;
 - theoretical question - 5 points.
- Activity in practical classes – 56 points (7 points per class).

- Examination of independent work: 10 points - drawing up a report on the completed research work, 10 points - writing a scientific article.

In the case of distance learning, instead of 19 tests and a theoretical question, the control work contains 24 tests of 1 point each, which students perform on the Moodle platform.

Assessment scale: by higher education institution, national and ECTS

ECTS mark	Points	By the national scale
A	90–100	Passed
B	81–89	
C	71–80	
D	61–70	
E	51–60	
FX	21–50	Not passed
F	0–20	

5. INFORMATION RESOURCES

Libraries

- V. Stefanyk Lviv National Scientific Library of Ukraine – 2 Stefanyka str., Lviv.
- Lviv Regional Universal Scientific Library – 13 Shevchenko Ave., Lviv
- Scientific library of Ivan Franko National University of Lviv – 5 Drahomanova str., 17 Drahomanova str., Lviv.

Electronic resources

- Ukrainian National Office for Intellectual Property and Innovations – <http://www.ukrpatent.org/>.
- Digital patent library – <https://library.ukrpatent.org/>.
- Google – <http://www.google.com.ua>.
- High Wire – <http://highwire.stanford.edu/>.
- PubMed – <http://www.ncbi.nlm.nih.gov/pubmed/>.
- The Prokaryotes – <http://www.springer.com/life+sciences/microbiology/book/978-0-387-25499-9>.
- Wikipedia – <http://www.wikipedia.org/>.

- Yahoo – <http://www.yahoo.com>.

Journals

- Studia Biologica.
- Biosystems Diversity.
- Visnyk of Lviv University. Series Biology.
- Microbiologichny zhurnal.
- Microbiology and Biotechnology.
- Applied and Environmental Microbiology.
- FEMS Microbiology Letters.
- FEMS Microbiology Reviews.
- Microbiology.

Publishing houses

- Publishing centre of Ivan Franko National University of Lviv.
- Naukova dumka.
- Svit.
- Academic Press.
- Blackwell.
- Cambridge University Press.
- Elsevier.
- J. Willey Interscience.
- Oxford University Press.
- Springer-Verlag.

REFERENCES

1. XIX international scientific conference for students and PhD students “Youth and Progress of Biology”, dedicated to the 90th anniversary of academician of the National Academy of Sciences of Ukraine, professor Schelyag-Sosonko Yury Romanovych: information letter [Electronic resource]. 2023. URL: <https://bioweb.lnu.edu.ua/wp-content/uploads/2023/03/Informatsiynyy-lyst-2023-En-1.pdf> (accessed 23.08.2023).
2. Biosystems diversity [Electronic resource]. URL: <https://ecology.dp.ua/index.php/ECO> (accessed 23.08.2023).
3. DSTU 3008:2015 Information and documentation. Reports in the field of science and technology. Structure and rules of design [Valid from 2015-06-22]. Kyiv: UkrNDNC, 2016. 26 p. [in Ukrainian]
4. Mokin B. I., Mokin O. B. Methodology and organization of research. Vinnytsia: VNTU, 2014. 180 p. [in Ukrainian]

5. Basics of methodology and organization of research / ed. by A. Y. Konverskyi. Kyiv: Centre for the Educational Literature, 2010. 352 p. [in Ukrainian]
6. The Fundamental Values of Academic Integrity [Electronic resource] / International Center for Academic Integrity. 2021. URL: https://academicintegrity.org/images/pdfs/20019_ICAI-Fundamental-Values_R12.pdf (accessed 25.08.2023).
7. Ukrainian law "About the Education" // Vidomosti of Verkhovna Rada of Ukraine. 2017. N 38–39. Art. 380. [in Ukrainian]