



INSTITUTE OF
MOLECULAR
BIOLOGY



NATIONAL ACADEMY
OF SCIENCES OF ARMENIA

VERITAS
STRUCTURAL DEVELOPMENT OF THE THIRD CYCLE BASED ON SALZBURG PRINCIPLES



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INTERNATIONAL SCIENTIFIC
EDUCATIONAL CENTER

PhD PROGRAM IN MOLECULAR AND CELLULAR BIOLOGY

Yerevan 2017

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EXECUTIVE SUMMARY

The Institute of Molecular Biology of the National Academy of Sciences of Armenia (IMB) was established in 1966 to promote the development of molecular and cell biology in Armenia. The research conducted in during the Soviet times had a significant impact on elucidation of structural and functional organization of nucleic acids, proteins, cells and organelles. In addition, as a part of National Academy of Sciences, the Institute offered PhD programs in Genetics and Molecular Biology, Biochemistry and Biophysics.

Current research objectives of IMB are focused on elucidation of regulatory mechanisms of cell activity in health and their alterations in complex human and animal diseases, with special focus on mediators of the immune and signal transduction systems. Our researchers use a wide variety of biological systems (from clinical samples to animal models and computational models) and use a battery of molecular and cell biology and immunology methods, including PCR, antibody based methods, sequencing and protein chemistry. An important area of the research is the characterization of Armenian genome based on patho-, eco-, immuno-, and population genomics approaches.

The important activities of IBM are the participation in educational processes and preparation of skilled and experienced researchers who will contribute to the development of knowledge-based economy in Armenia and worldwide. These activities are clearly stated in the Institute's statutes. IBM currently offers 3 PhD programs in Molecular and Cellular Biology, Genetics and Biochemistry. The primary educational objective of the IBM is to offer research-oriented degree programs capable of fulfilling the needs of prospective students, as well as taking into account the current and forthcoming workforce demand in national and global market.

This program is aimed at delivery of comprehensive information on PhD program in Molecular and Cellular Biology. This PhD program is based on the Strategic Plan of “Molecular Biology” PhD Program approved by the Scientific Council of the Institute in 2015. It contains several sections covering various aspects of PhD education starting from the legal framework, in particular:

General information on the legal framework for PhD education in Armenia and institutional procedures will be given in the first part of the roadmap.

The Molecular and Cellular Biology PhD program will be presented in detail and its content will be defined in the second part of the document.

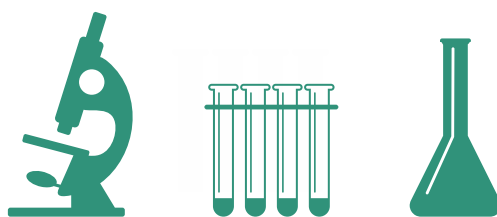
The third part is devoted to the analysis of the capacity of the IMB of NAS RA, which offers this program.

INTRODUCTION

The ultimate aim of PhD program in Molecular and Cellular Biology offered by the Institute of Molecular Biology NAS RA is to provide, for each student, individual depth of experience and competence in the chosen major specialization; understanding of a substantial body of knowledge which is at the forefront of the academic discipline; the development of such skills as critical analysis, evaluation and synthesis of new and complex ideas, as well as other qualities and transferable skills that will enable them to continue self-education after formal training, to undertake new research at an advanced level and to serve his or her field productively through a long career.

All higher education institutions in the Republic of Armenia function under the same regulations set by the respective state agencies (Ministry of Education and Science of the Republic of Armenia, Supreme Certifying Commission), as well as National Center for Professional Education Quality Assurance (ANQA). General information on the legal framework for PhD education in the RA and institutional procedures will be given in the first part of this document.

It should be noted, however, that PhD program providers have certain amount of freedom in such spheres as organizing admission, developing questionnaire for entrance examinations, appointing supervisors, providing the content of the PhD programs, monitoring the dissertation writing process, reviewing the articles and organizing the pre-defense. Thus, the higher education institutions should develop and formulate their quality standards which can be used as a basis for their own internal quality evaluation and benchmarking between institutions. This, in its turn, will help to safeguard the PhD as a research degree and strengthen career opportunities for PhD graduates. Higher education institutions (HEIs) should promote the future researcher from the very first steps of education, thus, ensuring the proper interconnection among all education cycles. That is, the amendments of the third cycle should be aligned with parallel efforts to reform the first and second cycles of higher education with special focus on Master Programs which are essential for successful PhD programs.



PhD program in Molecular and Cellular biology has been developed to comply with all regulations set forth by the state agencies with special focus on delivering high-quality, research oriented program capable of meeting needs of prospective students for their future career development. The PhD education procedures are performed through concerted activities of several structures acting both within the Institute of Molecular Biology (IMB) of the National Academy of Sciences of the Republic of Armenia (NAS RA) and the International Scientific-Educational Center of NAS RA (ISEC). ISEC is in charge of organizing admission procedures in line with the regulations and decrees of competent governmental bodies and the educational unit of PhD program, while Scientific Secretary and Scientific Council of the provide the appropriate support for the enrolment procedures, selection of supervisors and research topics, as well as evaluation of study progress and completion.

Additional information is available at the official website of ISEC

(http://isec.am/index.php?category_id=4&blog_id=&lang=eng). The detailed information about the program is provided in the second part of the document. The PhD program in Molecular and Cellular Biology is developed in alignment with 10 basic Salzburg principles for the third cycle education (see Bologna Agreement of “Doctoral Programs for the European Knowledge Society” (Salzburg 3-5 February 2005)).

The third part is devoted to the analysis of the capacity of the of NAS RA, which offers this program.



PART 1:

LEGAL FRAMEWORK AND INSTITUTIONAL PROCEDURES FOR PHD EDUCATION IN THE REPUBLIC OF ARMENIA

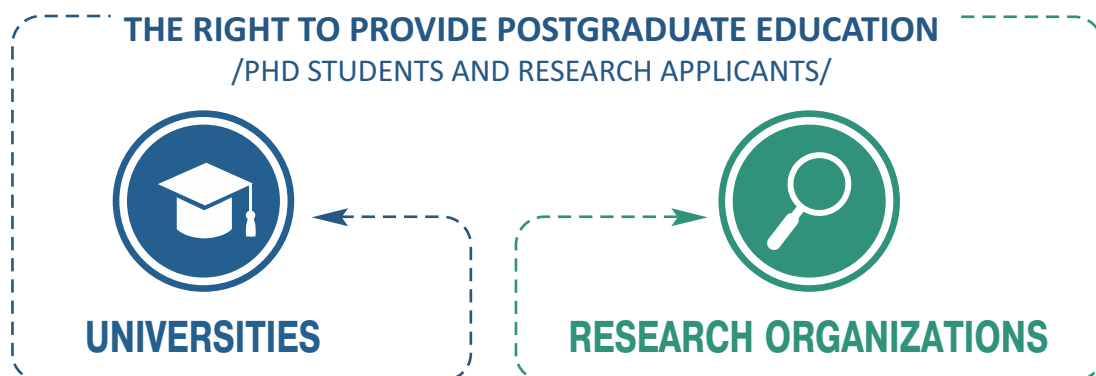
The right to provide postgraduate education (PhD students and research applicants) is granted only to the universities and research organizations which have highly qualified scientific academic staff and up-to-date research and experimental base, and participate in the development and implementation of national and international scientific-educational programs and projects.

Hence, the postgraduate education in the RA is implemented in compliance with the following legal regulations set by the Ministry of Education and Science and the Supreme Certifying Commission:

- ⇒ The Law of the Republic of Armenia on Higher and Postgraduate Professional Education (<http://www.anqa.am/en/about-us/legal-field/laws/law-of-the-republic-of-armenia-on-higher-and-postgraduate-professional-education/>)
- ⇒ Regulations on Awarding Degrees in the Republic of Armenia (<http://boh.am/jurist.php?langid=1>)
- ⇒ Regulations on Postgraduate and Doctoral Studies in the Republic of Armenia.

In the Republic of Armenia PhD education is conducted in full-time and part-time modes; either free (funded by the Armenian Government) or on paid basis. The maximum duration of full-time studies is 3 years, while for part-time studies it is 4 years.

Not less than 6 months before the beginning of every academic year, according to the established procedures, RA Ministry of Education and Science receives applications from universities and organizations that provide postgraduate education, and in cooperation with RA Ministry of Finance and RA Ministry of Defense submits the number of PhD places according to study mode (full-time and part-time) and financing (free or paid) for the approval of the Armenian Government.



PART 1:

Admission requirements are specified in the regulations for postgraduate and doctoral studies in the Republic of Armenia. However, the PhD admission committee and specialization qualification examination committee are formed from the leading specialists of the respective field based on the decree issued by HEI Rector. The members of the committee themselves compile the questionnaire and examination tickets.

PhD admission examinations include a specialization examination, a foreign language examination (English, French or German) and a quiz (Informatics and/or Computer literacy test). The applicants whose major is English, French or German should take an examination in a foreign language different from their major. The professional examination should precede all other examinations.

Unlike PhD admission regulations, admission requirements for research applicants are established by HEI; accordingly, the applicant must present a research paper or two published articles. If a research applicant applies for a degree in a different field (i.e. MA major and PhD major are different), he or she must also take a professional examination in the research field in accordance with the established procedures of RA Supreme Certifying Commission.

The research applicants are registered and allowed to do research in the particular HEI or research organization based on the decree issued by HEI Rector or the head of a research organization. The duration of studies for research applicants is 5 years.

DURING THE STUDIES PHD STUDENTS/ RESEARCH APPLICANTS MUST:

- a) have a working plan approved by the scientific council of the given HEI or research organization and have no less than 36 hours of teaching workload (refers to University PhD students),**
- b) take specialization and other qualification examinations in accordance to the Regulations on Awarding Degrees in the Republic of Armenia.**

PART 1:

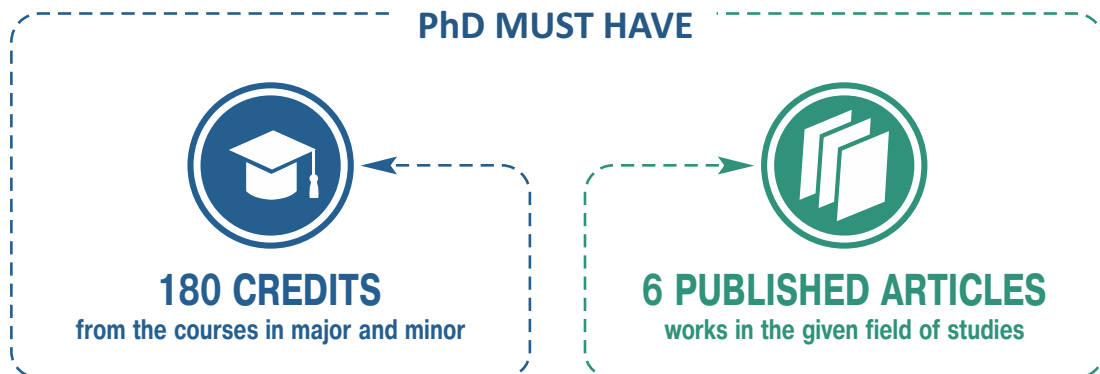
PhD qualification examinations set out by RA Supreme Certifying Commission are also conducted by HEI's leading specialists who compile the questionnaire as well as the examination tickets. PhD qualification examination committees are formed by HEI, but confirmed by RA Supreme Certifying Commission.

The Supreme Certifying Commission has set the PhD qualification examination periods (both for PhD students and research applicants): autumn semester (October-November) and spring semester (May-June), however the sequence and dates of examinations are set by the HEI.

The dissertation topics and scientific supervisors are approved no later than 3 months after the admission of PhD students in accordance with the procedure established by Supreme Certifying Commission.

As a rule, a scientific supervisor is a doctor of science who works at HEI/research organization or a PhD confirmed by Supreme Certifying Commission in accordance with the procedures established by Ministry of Education and Science (to be confirmed as a scientific supervisor a PhD must have 30 published articles/works in the given field of studies). Each scientific supervisor may have no more than 5 PhD students and research applicants at a time.

PhD students/research applicants must accumulate 180 credits from the courses in major and minor, internships, participation in conferences and seminars. The quantity of credits is determined by RA Ministry of Education and Science. However, the HEI regulates the development of the curriculum and individual work plans for PhD students/research applicants.



PART 1:

According to individual research plans, PhD students/research applicants present/submit an annual progress report which is assessed by the relevant Chair, Department (sector, laboratory). The Chairs, Department Councils of HEIs, Scientific Councils of research organizations regularly discuss and review the reports of PhD students/research applicants and their supervisors. PhD students/research applicants who fail the report may be expelled by the order of Rector of HEI or the head of research organization.

During their studies PhD students have access to the equipment, laboratories, computers, libraries on equal terms with the employees of the HEI or research organization.

After completion of dissertation a pre-defense is organized by the relevant chair, after which the PhD student may apply to defend the dissertation in the relevant Specialized Council. It should be noted, however that under the current RA regulations a PhD student/research applicant has the right to apply to the Specialized Council for public defense even if he or she fails the pre-defense. The decision of the Specialized Council is sent to the Supreme Certifying Commission for confirmation.



EQUIPMENT



LABORATORIES

During their studies PhD students have access to the equipment, laboratories, computers, libraries on equal terms with the employees of the HEI or research organization.

PART 2:

PHD PROGRAM IN MOLECULAR AND CELLULAR BIOLOGY

DESCRIPTION AND RATIONALE

Qualification awarded: PhD in Molecular and Cellular Biology

Program duration: 3 years full-time (4 years part-time, 5 years for research applicants)

Formal admission requirement: Master's degree or Diploma Specialist's degree in Biology or Biochemistry or other equivalent degree (bachelor is not sufficient).

Rationale of the PhD Program: The Institute of Molecular Biology of NAS RA has been promoting the development of Molecular Biology in Armenia since 1966. The emergence of a highly competitive and integrated economy, rapid scientific and technological innovation, and a growing knowledge base will continue to have a profound impact on the country's development. In order to meet the modern society challenges the Molecular and Cellular Biology Curriculum will provide a platform for developing scientific literacy and building up fundamental scientific knowledge and skills for lifelong learning in science and technology.

Program description: The objective of the Molecular and Cellular Biology program is to facilitate the development of independent and highly motivated students into creative molecular and cellular biologists. Students acquire a broad knowledge about current developments in molecular and cell biology, learn to be effective scientific communicators and are trained to perform independent scientific research. Research areas include Genetics, Molecular Biology, Cell Biology, Structural Biology, Immunology and Neurobiology. The program is launched at the Institute of Molecular Biology of NAS RA in 2016-2017 academic years.

Career Opportunities: Alumni from the PhD program have pursued a variety of career paths. Our graduates have held postdoctoral research positions at academic research institutions or in the biotechnology industry in Armenia and abroad.

PROGRAM DURATION:

3 years /full-time/

4 years /part-time/

5 years /for research applicants/

PART 2:

PROGRAM OBJECTIVES

The program is intended at the development of following skills and abilities:

1. Do individual research, solve a scientific problem independently and acquire professional knowledge; be part of a team of experts doing research on the same topic.

Necessary knowledge of the particular research field and sufficient knowledge of research topic:

- present research results through articles, presentations and/or dissertation (also by involving Master students in various research groups within base funding programs);
 - conduct analysis, surveys, fact finding, and evaluation developing and strengthening analytical and critical thinking;
 - have command over databases and statistics, use appropriate literature.
- 2. Acquire soft skills**
- communicate both with their peers in a teamwork allowing and promoting researchers' participation in various seminars and conferences (with either a report or a poster are mandatory); the competences to present own research are important, but to CARRY OUT individual research and guidance to do that are the central point;
 - Support of the Academy in the research organization of seminars and/or other relevant events by the researcher's initiative;
 - Promotion by the Academy in the ability of providing clear communication and presentation skills via special course on communication skills during the course of study;
 - Taking lectures: researchers are required to obtain academic and paper writing skills thus strengthen their competences and knowledge of the field.
- 3. Teamwork ability skills, team management and fundraising skills**
- PhD researchers are to manage organized student groups and conduct mentorship of student groups thus strengthen their teamwork abilities and team management;
 - Academy offers seminars and round tables over different mechanisms of grant proposals including successful grant projects, different ways and types of searching and applying for grants.
- 4. Teaching, supervision and/or mentorship skills**
- PhD program equips researchers with teaching and other practical competences like mentorship through mandatory courses which are to be lectured by researchers.
 - Individual autonomy, initiative, entrepreneurship skills
 - Ethical behavior, good scientific practice, sustainability, accountability, professional behavior

PART 2:

At the end of the education, PhD candidates should:

- Have written and performed new knowledge through original research with sufficient quality to encompass the review by peers, which guarantee that the research is at the forefront of the discipline and is worth of being published;
- Have acquired and understood a body of knowledge that is in the avant-garde of the academic discipline;
- Be able to conceptualize, design and implement a project to generate new knowledge, apply or have the understanding of a discipline, and adjust the design based on unforeseen problems;
- Have reached a detailed understanding of techniques to carry out the research;
- Demonstrate academic mastery in the interrelated biological disciplines encompassing at Molecular Biology and Cellular Biology;
- Understand safe laboratory practices and perform basic and advanced molecular biology techniques;
- Be able to apply skills and knowledge in solving research problems in the fields of biomedicine, biotechnology and agriculture.



PART 2:

ADMISSION POLICY

Admission of local students

PhD program applicants should have completed master's degree program or have certified professional qualifications.

To be eligible for PhD studies an applicant should pass tests in foreign language, informatics and computer skills according to the minimum grade threshold defined by RA Ministry of Education and Science for the current academic year.

Submission of documents for a full-time PhD program starts in May in line with the number of PhD student positions allotted and schedule defined by RA Ministry of Education and Science. PhD applicants submit their documents to PhD Studies Department at ISEC NAS RA, while professional examinations are held within the first ten days in June.

Submission of documents for a part-time PhD program starts in October, while professional examinations are held during the first ten days in November.

The list of the documents to be submitted is laid down in the internal regulation of ISEC NAS RA.

Professional examinations are held in the relevant research organizations of the Academy.

Admission of foreign students

The admission of the foreign students is carried out in line 'Regulation on Admission of Foreign Students to Higher Educational Institutions of the Republic of Armenia, As Well As Admission of Family Members of Diplomats Working in Diplomatic Service Bodies of the Republic of Armenia Operating in Foreign Countries' № 700-Ն dated on 28 April 2011.

All the governmental resolutions, decrees and internal regulations regulation admission process at the Academy can be found on the website of ISEC at:

http://isec.am/index.php?category_id=4&blog_id=&lang=arm.

The state regulations on admission policy provide the basic criteria to ensure objective evaluation and selection of candidates. While full-time PhD positions are limited and regulated by governmental decrees, may have almost unlimited external PhD positions for local and foreign students.

PART 2:

MODULES OF THE PROGRAM

Duration of PhD program:

1. The duration of a full-time PhD program is 3 years and part-time is 4 years. The PhD program is implemented according to PhD student's individual study plan adhering to the requirements laid down in the regulations.
2. The educational program of a PhD program consists of two interrelated parts: educational and research. The overall load of the program is equivalent to 180 ECTS credits (or 180 credits x 30 hours = 5400 hours including classroom hours, extracurricular activities and independent work). 50 ECTS credits are designed for educational component, while 130 ECTS credits are designed for research. The structure, content, assessment forms, educational and research overloads are distributed in line with the table below:

NAMES OF COMPONENTS AND COURSES	CREDITS
EDUCATIONAL COMPONENT	50
Compulsory Courses and Examinations	30
Professional Course Under Specialization Code	8
Research Methodology	4
English for Specific Purposes (ESP)	4
New Information and Educational Technologies	4
Internship	10
Elective Courses and Tests	20
RESEARCH COMPONENT	130
Number of Minimum Articles Published in Line with Research Topic	30
Annual Attestations	20
PhD Dissertation and Positive Opinion/Conclusion on PhD Dissertation by Institution Having Approved PhD Topic	80
TOTAL	180

PART 2:

ASSESSMENT SYSTEM AND SCALE

The traditional 5 unit scale is used for PhD student's assessment which is submitted below:

ASSESSMENT SCORE	GRADE
5	"Excellent"
4	"Good"
3	"Satisfactory"
2	"Unsatisfactory"
Abs.	"Absent"
Passed/Not passed	"Passed/Not passed"

No credits are given for the courses from which the student has scored less than 3 points or has been marked as not passed.

THE ORGANIZATION PROCEDURE OF THE PROGRAM EDUCATIONAL PART

At the beginning of the first semester a PhD student involved in the research program together with his supervisor must complete his individual study plan, where the component courses and scientific-educational modules of the academic and research parts are presented by years.

The course list with grades is mentioned in the individual study program and is confirmed by the scientific council of the research organization. Enrolment on courses/modules included in the individual study program is held in PhD Studies Department of ISEC. All PhD students must get enrolled until beginning of the semester.

During the upcoming terms PhD student can make changes in his individual study plan, if necessary, with prior consent of the supervisor and the Scientific Council. The PhD student is responsible to ensure exactness and completeness of his individual study work plan.

The International Scientific-educational Center of NAS RA is entitled to postpone any course if insufficient number of PhD student is enrolled on.

PART 2:

THE ORGANIZATIONAL PROCESS OF THE PROGRAM RESEARCH PART

At the beginning of the academic year (during the first 2 weeks) the supervisor draws up the research work plan for the given year (the timetable of the scientific-educational modules as laid down in the program research part) and gives it to the PhD student according to the form given in PhD student's individual study work plan.

An attestation is held in order to check the scientific-educational modules of the performance. The attestation of the scientific seminar, individual scientific-research work and the internships is carried out by the PhD student's supervisor, who personally hands the attestation paper to the PhD Studies Department.

The PhD dissertation title confirmation and the appointment of the supervisor are carried out in the first semester not later than within 3 months after PhD student's admission, according to the regulation confirmed by the Supreme Certifying Committee of RA.

PhD student is attested by the appropriate research institute's scientific council according to the work plan and based on the annual report. The appropriate research institute listens to and examines the PhD student's report. Those students who don't pass the attestation are expelled from PhD studies according to the NAS RA appropriate scientific organization scientific council.

The PhD dissertation defense is conducted according to the procedure confirmed by RA Higher Certifying Commission.



PART 2:

PHD DISSERTATION AND ORIGINAL RESEARCH

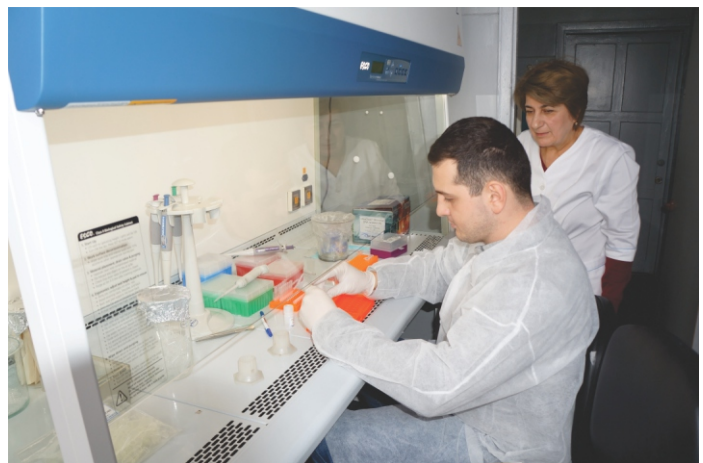
The PhD dissertation must be an independent, scientific work complying with high academic standards with regard to research questions, examination of concepts, methodological, theoretical and empirical basis and form of presentation. The PhD dissertation determines whether the PhD candidate is ready to carry out independent, original and scientifically significant research, and to critically evaluate work done by others. PhD candidates must prove that the results are recognized in the domestic scientific fields as well as internationally. Candidates, prior to defending their dissertation, are required to publish their work in a defined number of papers published in internationally recognized, distinguished, peer-reviewed journals, conferences, domestic journals, etc.

The dissertation completeness, originality and novelty are assessed at multiple stages of review by:

- Supervision and mentoring team;
- Two internal reviewers nominated by Scientific Council;
- Scientific council through pre-defense presentation.

The dissertation can be defended only after obtaining positive response during all stages of review.

After the dissertation is released for the Institute the PhD student follows the procedures defined by Supreme Certifying Committee RA.



PART 2:

DISSERTATION DESIGN

All PhD students are required to carry out research which would ideally be linked to both types of internship. Researchers are expected to choose an area of study within the broad field of life science. The topic chosen will be agreed with the Scientific Council of MAS RA and should be related either to the current professional field of work of PhD Supervisor, or to an area of research the Institute is engaged in.

A series of workshops and tutorial sessions will be arranged in the course of the program to support researchers with their project. PhD Students and research applicants are also supposed to take the following qualification examinations (currently conducted) before the defense of dissertation: qualification examination in Foreign Language (English, French or German), qualification examination in Computer Science, and finally qualifying examination in Specialization (Molecular and Cellular Biology).

The PhD dissertation should comprise 100-150 pages, including references. The main findings and inferences of the dissertation should be published in refereed international and national journals. National journals should be from the list of publications, confirmed by the Supreme Certifying Commission of RA (<http://boh.am/periodicals.php?langid=1>).

At least six scientific articles are required for PhD dissertation, out of which two without co-authors, or three scientific articles, out of which at least one should be included in the Web of Science or Scopus publications and another one without co-authors.

The Scientific Council of IMB of NAS RA organizes a pre-defense with two reviewers and the participation of all members of the Scientific Council. After a successful pre-defense, the Scientific Council recommends the dissertation for public defense in the relevant Specialized Council.

For writing the PhD dissertation and synopsis researchers should check the guidelines under the “Instructions” on the following page:

<http://boh.am/instructions.php?langid=3>.

The dissertation can be written in Armenian or Russian. However, it can be written in English if authorized by the Specialized Council. The Synopsis should comprise 22 pages, including the summary in two languages different from the Synopsis language (2 pages for each language). For instance, if the Synopsis is written in Armenian, it will need a summary in Russian and English.

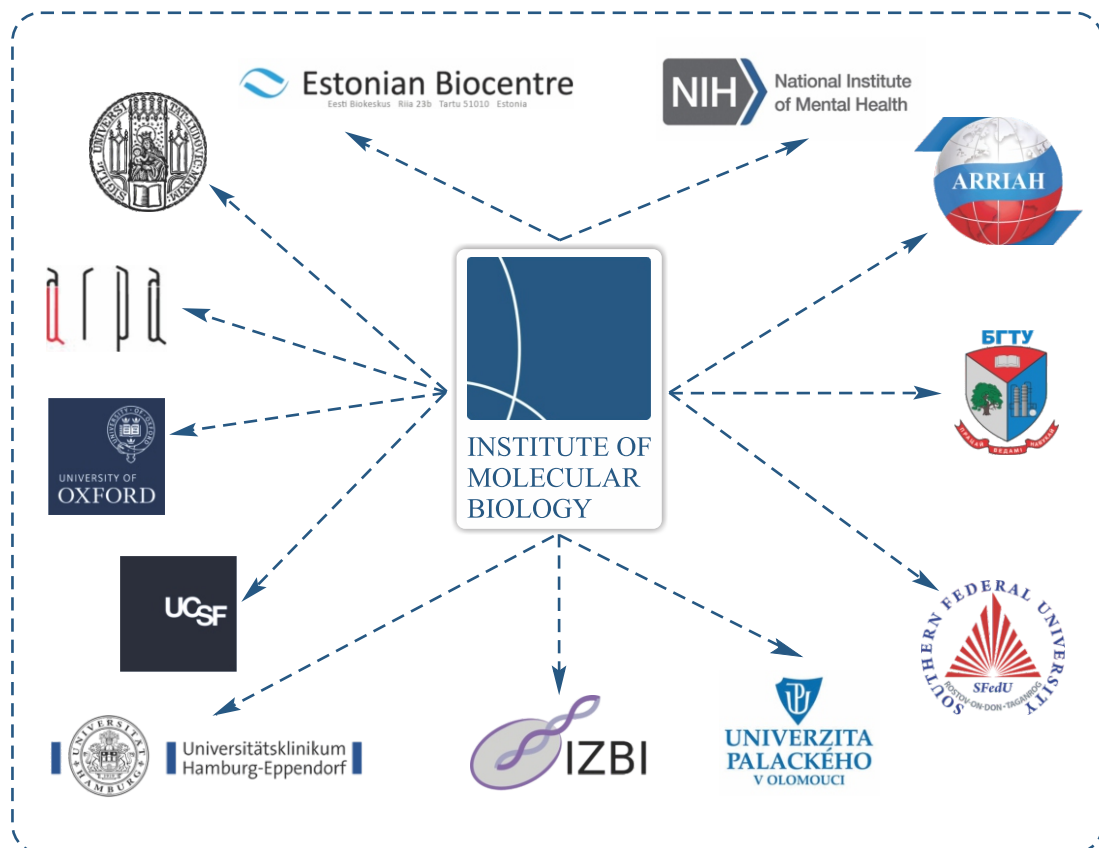
PART 2:

STUDENT ASSESSMENT

Prior to annual attestation students will be asked to complete evaluations for supervisor and PhD program in general.

MOBILITY

IMB is integrated in the international research area establishing close partnership with internationally acknowledged research and educational centers and units worldwide (<http://molbiol.sci.am/collaboration>), which facilitates the mobility of PhD Students. PhD students are encouraged to apply for short-term travel fellowships to conduct part of their research in partner organizations abroad and to participate in international scientific events relevant to the field of their PhD topic. In addition, supervisors are advised to allocate funds for travel while applying for research grants, where applicable.



PART 3:

CAPACITY OF THE IMB OF NAS RA ON EDUCATION MANAGEMENT AND PLANNING

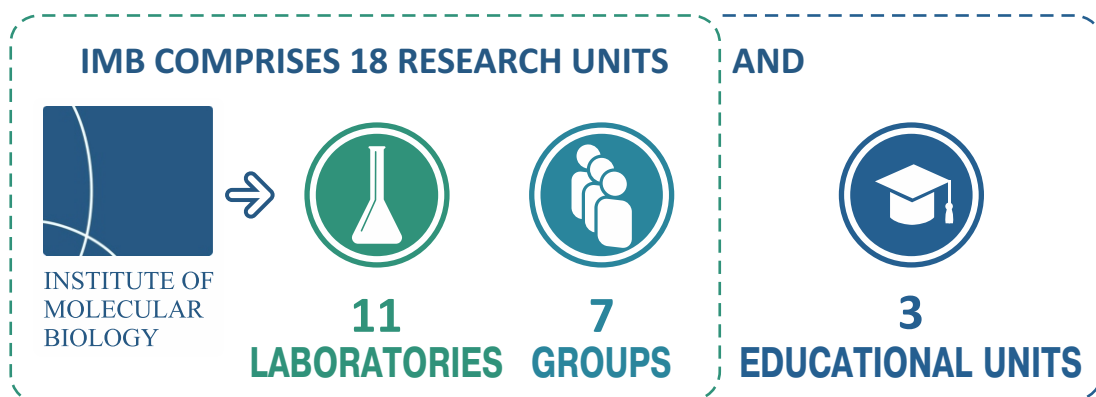
ANALYSIS OF THE ACADEMIC STAFF OF THE IMB OF NAS RA (2015-2016)

The National Academy of Sciences of the Republic of Armenia is the highest self-governing scientific organization founded in the Republic of Armenia. With its special status it organizes, performs and coordinates fundamental and applied research required for knowledge-based economy, social and cultural development. The Academy unites 34 research organizations, scientific-technological centers and other organizations.

Main directions and issues of the Academy's activities are organization, development and coordination of fundamental and applied research, as well as preparation of highly qualified scientific and pedagogical human resources through Master's degree programs, PhD programs, and Doctoral Studies (corresponds to Habilitation in several EU countries, e.g. Germany).

The Institute of Molecular Biology (IMB) of the National Academy of Sciences of the Republic of Armenia (NAS RA) was founded in 1966 to promote the development of molecular biology in Armenia. Current research activities of are focused on investigation of regulatory mechanisms of cell activity and its alterations in a number of pathologic conditions including autoimmune, autoinflammatory, cerebrovascular, infectious, cancer and psychiatric disorders.

IMB comprises 18 research units (11 laboratories and 7 groups), and 3 educational units. Three laboratories and 4 research groups are included in the Department of Applied Molecular Biology. IMB also harbors Institutional Scientific Council, Young Scientists Council and Ethics Committee. Institutional supporting units include Sequencing Center, Human DNA Samples Bank, Cell Line Collection, Animal Facility and Library.



PART 3:

INSTITUTIONAL STRATEGIES AND POLICIES

An important activity of IMB is the participation in educational processes and preparation of skilled and experienced researchers who will contribute to the development of knowledge-based economy in Armenia and worldwide. These activities are clearly stated in the Institute's statutes. The mission of IMB in the field of Master and PhD education is to offer high-quality, clearly defined degree programs capable of fulfilling the needs of prospective students as well as taking into account needs of the labor market worldwide.

Currently, IMB offers PhD programs in Molecular and Cellular Biology, as well as Genetics, Master's degree program in Molecular and Cellular Biology, training courses in Bioengineering and Bioinformatics. In addition, workshops, summer schools and seminars are regularly organized by IMB staff (<http://molbiol.sci.am/conferences>.)

Within the institute, strong research environments and mechanisms to enhance the quality of doctoral programs have been built and are maintained continuously. Moreover, the PhD programs at IMB are the successful starting points for future career development in industry or academia.

Though IMB has recorded huge advance in increasing the quality of PhD education, several strategic actions should be implemented in order to put these efforts at more formal levels. The steps here should mainly include development, formalization and dissemination of regulations and guidelines in doctoral programs.



PART 3:

MENTORING

As a rule, a scientific supervisor should hold a degree of Doctor of Sciences (Habilitation) or Candidate of Sciences (PhD), if s/he has the permission of RA SCC. Doctors of Sciences in the respective field and also Candidates of Sciences who are allowed by RA SCC to mentor a PhD student can be appointed as a scientific supervisor.

A co-supervisor might also tutor a PhD candidate in doing research in the related fields. To get a mentoring permission, it is required to submit RA SCC the application of the Head of relevant research organization, the list of published research papers and an extract from the minutes of the scientific council meeting. RA SCC makes a decision within one month after the submission of the documents. PhD mentoring permission is given to candidates who have at least 30 published research articles covering respective topic.

A scientific supervisor is allowed to simultaneously mentor not more than five PhD students and PhD degree seekers.

The Supervisor is chosen by IMB Scientific council based on the following criteria:

- 1.** Research activity, which is indicated by the number of publications in peer-reviewed journals, books/chapters, participation in the international scientific events;
- 2.** Sufficient resources and funding, which is indicated by the number of previous and ongoing project funded by local and international agencies;
- 3.** Previous history of PhD student supervision (not required for “newcomer” supervisors).

The young scientists start their supervisor career, usually after completing the PhD degree, by supervising master theses, then working with PhD students as co-mentors.

In addition, PhD student is also co-mentored non-formal mentoring team, which is formed by all supervisors from the IMB (usually 3-4). The mentoring team works in close collaboration with PhD student and supervisor, monitors the progress of the study independently of annual assessment and participates in handling of supervisor-student conflicts.

Table 1.

Staff Involvement in professional and scientific research activities in 2011-2015

LAST NAME, FIRST NAME	DEGREE	ORGANIZATION	POSITION
ARAKELYAN ARSEN	PhD	Laboratory of Human Genomics and Immunomics	Head of Laboratory, Senior researcher
MKRTCHYAN GOHAR	PhD	Laboratory of Human Genomics and Immunomics	Senior researcher
ZAKHARYAN ROKSANNA	PhD	Laboratory of Human Genomics and Immunomics	Researcher
TSAKANOVA GOHAR	PhD	Laboratory of Human Genomics and Immunomics	Researcher
KARALYAN ZAVEN	PhD, D.Sc.	Laboratory of Cell Biology and Virology	Head of Laboratory, Leading researcher
KARALOVA ELENA	PhD, D.Sc.	Laboratory of Cell Biology and Virology	Leading researcher
NAZARYAN KAREN	PhD, D.Sc.	Laboratory of Computational Modelling of Biological Processes	Head of Laboratory, Leading researcher
YEPISKOPOSYAN LEVON	PhD, D.Sc., Prof.	Laboratory of Ethnogenomics	Head of Laboratory, Leading researcher
KHACHATRYAN ZARUHI	PhD	Laboratory of Ethnogenomics	Senior researcher
AKOPIAN JEAN	PhD	Laboratory of Molecular Enzymology	Head of Laboratory, Leading researcher
NERSESOVA LYUDMILA	PhD	Laboratory of Molecular Enzymology	Leading researcher
KTSOYAN JANNA	PhD	Laboratory of Molecular Genetics	Head of Laboratory, Leading researcher
HOVSEPYAN LAURA	PhD	Laboratory of Molecular Membranology	Head of Laboratory, Leading researcher
MAYILYAN KARINE	PhD, D.Sc.	Group of Eco-genetics of Populations	Head of Group, Leading researcher
MANUKYAN GAYANE	PhD	Group of Molecular and Cellular Immunology	Head of Group, Senior Researcher

Table 2.

Performance statistics by supervisors in 2011-2015

LAST NAME, FIRST NAME	BOOK CHAPTERS	PAPERS IN REFEREED JOURNALS (INT/NAT)	COMMUNI- CATIONS TO SCIENTIFIC MEETINGS (INT/NAT)	ACADEMIC FELLOWSHIPS AND VISITS	RESEARCH GRANTS/ AWARDS
ARAKELYAN ARSEN	1	14/4	2/4	1	3
MKRTCHYAN GOHAR	2	8/2	5/4	-	2
ZAKHARYAN ROKSANNA	1	15/4	6/2	1	3
TSAKANOVA GOHAR	2	5/1	-/1	1	2
KARALYAN ZAVEN	1	13/4	-	-	1
KARALOVA ELENA	1	11/2	-	-	-
NAZARYAN KAREN	-	1/1	-	-	-
YEPISKOPOSYAN LEVON	1	22/2	8/1	-	3
KHACHATRYAN ZARUHI	-	3/2	2/-	-	-
AKOPIAN JEAN	-	5/2	-	-	-
NERSESOVA LYUDMILA	-	4/1	-	-	-
KTSOYAN JANNA	-	7/2	-	-	2
HOVSEPYAN LAURA	-	2/2	1/1	-	-
MAYILYAN KARINE	-	2/1	1/-	-	3
MANUKYAN GAYANE	-	5/1	2/-	3	3

PART 3:

OVERVIEW OF TOPICS OF CURRENT RESEARCH OF PHD STUDENTS AT THE IMB OF NAS RA

IMB has 18 research units (11 laboratories and 7 groups), and 3 educational units. Three laboratories and 4 research groups are included in the Department of Applied Molecular Biology. Institutional supporting units include Sequencing Center, Human DNA Sample Bank, Cell Line Collection, Animal Facility and Library. The detailed information on the research activities of individual groups can be found at <http://molbiol.sci.am/resunits>. The most contemporary research topics by labs and groups are presented below:

The laboratory of human genomics and immunomics studies of the relation between genetic background and antipsychotic treatment response in patients with schizophrenia.

The laboratory of cell biology and virology aims at elucidation of viral ecology and pathogenesis, using cultivated cell lines such as Hela, BHK, RD, Vero, Cos, etc.

The laboratory of computation modeling of biological processes is using modern methods of bioinformatics and computational biology for modeling and *in silico* analysis of the processes of protein-protein, protein-ligand interactions and its regulation.

The laboratory of ethnogenomics conducts research on reconstruction of the genetic history of Armenians and other neighboring peoples of the Near East and the South Caucasus.

The laboratory of molecular membranology studies the role of oxidative processes (peroxidation of proteins and lipids) leading to the damage the function of cell membrane lipids, as well as to changes in the immune system in normal ageing and age-related diseases.

The laboratory of regulation of cellular activity is aimed at investigation of dysfunctions in the lipid modification and signal transduction mechanisms in human peripheral blood mononuclear cell plasma membranes in diverse types of blood and solid tumors.

The group of cell technologies conducts research on cellular mechanisms of mutagenesis and *in vitro* safety testing programs for potential therapeutic agents, biopharmaceuticals, medical devices, chemicals, agrochemicals, cosmetics and radiation.

The group of molecular and cellular immunology elucidation of the mechanisms that drive the abnormal activation of neutrophils and monocytes in patients with auto-inflammatory and autoimmune syndromes using *in vitro* models.

The group of bioinformatics aims at understanding molecular pathomechanisms of complex human diseases and cancers using computational approaches.

APPENDIX 1:

QUESTIONNAIRE FOR PROFESSIONAL EXAMINATION IN MOLECULAR AND CELLULAR BIOLOGY

Amino acids as a protein structural unit, classification of amino acids. The general concept of recombination (site-specific and homologous recombination). Simple and complex proteins, biological functions of peptides and proteins. Gene conversion, asymmetry. The classification of enzymes. Site-specific recombination. Enzymes involved in recombination in *E. coli*. Regulation of enzymatic activity, multienzyme complexes. Mobile genetic elements in pro- and eukaryotes. Protein primary. Bacterial transposons (Tn3, Tn5, Tn9, Tn10), mechanisms of transcription. Protein secondary structure. Eukaryotic transposons. Horizontal transmission of transposons. Protein tertiary structure. Characterization of normal to cancer cell transformation on molecular and structural-functional levels, α -domain structures. Formation of domain from four α -helices. RNA-polymerase structural features, α / β domain structures. Proteins containing β -helices. Transcription in eukaryotes. Eukaryotic promoters. Transcription factors. Transcription regulation in prokaryotes. External stimuli of gene transcription. Signaling pathways. Proto-oncogene families as transcription factors. Recognition of DNA by eukaryotic transcription factors. Structural regulation of nucleosomes. Nucleosomes and transcription. Eukaryote-specific transcription factors. Chromatin structure differences in sex chromosomes related to compensation of the gene numbers in the X chromosome of different genders. Structure of proteins belonging to cell signaling pathways. Description of RNA-processing. Introns and splicing. Classification of introns. Factors of protein synthesis. Reverse transcription, its role in genome evolution and instability. Pseudogenes. Structure of antibodies. Antigen-antibody interaction, immune complexes. Main classes of cellular and viral RNAs and their functions. Cytokines, their functional role. Genetic code, its properties and decoding, exceptions of the universal genetic code. Functional role of complement system, key components and ways of complement activation. tRNA, its functions. Secondary and tertiary structure of tRNA. Hydroxylation, acetylation, ADP-ribosylation, phosphorylation and glycosylation of proteins. Morphology and structure of eukaryotic and prokaryotic ribosomes. Lipoproteins. Ribosomal proteins: nomenclature, diversity, structural organization, localization in ribosome. Protein-protein interactions. Genetic mapping. Genome polymorphism. Molecular genetics of personal identity. Protein production using site-specific mutagenesis. De novo protein synthesis. Regulation of translation. Proteomics: description, objectives and goals, main methodological approaches. Protein biosynthesis. Phases of translation. Types of prokaryotic and eukaryotic translations. Structure, functions and biosynthesis of nucleic acids.

APPENDIX 1:

Genomics and its description. Nucleotide sequence comparison as a method of gene functions investigation. RNA and DNA. Types of RNA. Nanotechnology for genomics: new generation of DNA/RNA sequencers, DNA/RNA microarrays, self-replicating genomes. Viral nucleic acids, prokaryotic and eukaryotic nucleic acids. Chromosomal aberrations. Structural composition of DNA. Single and repeat nucleotide sequences. RNA-coding genes. Protein-coding genes. Replication of DNA, polymerases participating in replication, their enzymatic activity. Mutations, reasons. Reasons of DNA damage. Genome defense systems from mutations. Characteristics of eukaryotic DNA polymerases. p53 protein, the role in reparation and apoptosis. Inactivation of p53 in cancer cells. Initiation of replication. Start Site structure of replication. Termination of replication. Stem cells, description, main characteristics, classification. Sources of stem cells in organism. Application of stem cells in medicine. DNA reparation, participating enzymes. Transformed cells and cancer features. Cancer genes and promoters of cancerogenesis.

Basic principles of cellular theory. Cells as main building blocks of organism. Cell architecture, relationship of cell form and size with their functional specialization. Biological membranes - construction, main properties and functions. Cellular membrane. Structural and chemical peculiarities and functions. Structural and chemical mechanisms of cell interactions. Cellular adhesion and its main forms. Cytoplasm. Organelles (organoides). Characterization and classification of organelles. Organelles with common and specific meanings. Membranous and non membranous organelles. Endoplasmic reticulum - architecture and functions. Golgi complex - architecture and functions. Lysosomes - architecture, chemical composition and functions. Peroxisomes - architecture, chemical composition and functions. Mitochondriones - architecture and functions. Ribosome - architecture, chemical composition, functions and role in the protein biosynthesis. Aging and apoptosis. Aging preventing means. Cytoskeleton, basic components. Cell nucleus - architecture, role in the reservation and transmitting of genetic information. Role of nucleus in the protein biosynthesis. Chromatin architecture and chemical composition. The role of acid and basic proteins in regulation of metabolic activity and structural organization of chromatin. Conception of nucleosomes: the mechanism of chromatin compaction. Chromosome structure. Sex chromosomes.



APPENDIX 1:

Nucleolus: chemical composition, structure and functions. Nuclear membrane; structure and functions. Karyoplasm (nucleoplasm); physic-chemical properties, chemical composition and its role in the biological activity of the nucleus. Synthetic processes in the cell. The interrelationship between cell components during anabolic and catabolic processes. Intracellular regeneration: general description and biological role. Structural and functional alterations of cells and distinct cellular components in the processes of reactivation and adaptation. Cell cycles and phases. Telomeres and the telomerase. Mitotic cycle and its phases (interphase mitosis). Biological role and mechanisms of mitosis. Meiosis: mechanisms and biological role. Description and main factors of the molecular mechanisms of aging. Role of genetic mutations during aging processes. Hypotheses of the genetic mechanisms of aging, p-53 gene and cell aging. Cell death: degeneration, necrosis, biological significance.

Methods for determining protein content. Methods for cleaning of protein (severance, separation), determination of molecular weight, isoelectric point. Methods to determine the primary structure of proteins. Method for enzymatic fragmentation of the polypeptide chain. Specific chemical methods for fission of peptide bonds. Determination of the N-terminal sequence and amino acid composition. Peptide mapping. X-ray structural research methods of biological molecules. Mass Spectrometry Methods. Protein extraction and separation methods. Method for the isolation and purification of DNA. Polymerase chain reaction (PCR). Ion-exchange, biospecific thin-layer and adsorption chromatography. Methods to study protein-protein interactions. Separation of individual lipid fraction from biological membranes. Nucleic acid extraction, DNA/RNA isolation. Criteria for the purity of protein preparations. Enzyme-linked immunosorbent assay (ELISA). Isolation and purification of liposome from individual lipids and mixes. Application of fluorescence in the biological research. DNA and RNA extraction methods. X-ray structural study methods of protein. DNA hybridization. Method for quantitative determination of nucleic acid. Determination of nucleotide sequences in nucleic acid. Gene location mapping. The principle of creating a genes library. Vectors. Method for screening of genes libraries.

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