1. Identification data:	
Institution name:	Automous University of Nuevo León
Dependency name:	Medical School
Name of the educational program:	Clinical Chemist Biologist
Learning unit name:	Molecular Biology
Theory and/or practical classroom hours, total:	100
Frecuencies per week:	6
Overtime, total:	50
Modality type:	Schooled
Type of academic period:	Fifth Semester
Type of learning unit:	Mandatory
Curricular area:	ACFB
UANL Credits:	5
Production date:	21/06/2018
Last update date:	10/06/2024
Responsible (s) for design and updating:	Design: Celia Nohemí Sánchez Domínguez, PhD María Del Carmen Villalobos Torres, PhD Antonio Alí Pérez Maya, PhD Ana María G. Rivas Estilla, PhD Update: Ana María G. Rivas Estilla, PhD Ma. del Carmen Barboza Cerda, PhD Sonia A. Lozano Sepúlveda, PhD Celia N. Sánchez Domínguez, PhD

2. Presentation:

The purpose of the Learning Unit (LU) of Molecular Biology (MB) is for the student to understand the importance of the main macromolecules of life: DNA, RNA, and proteins (Central Dogma of Molecular Biology), analyzing structural aspects, as well as the interactions and metabolic processes that occur between them and the application of molecular diagnostic tools.

In this learning unit, the contents are divided into 3 phases. In the first phase, the molecular bases of the Central Dogma (structure of nucleic acids; DNA replication, RNA transcription and protein translation, as well as gene regulation) are reviewed. In the second phase, the student knows the principles and foundations and identifies the main tools of molecular biology used for the manipulation and study of nucleic acids, which are crucial in real-world research and diagnostics. Finally, in the third phase, the applications of molecular biology are studied for the understanding of molecular medicine, molecular mechanisms of pathogenicity, the diagnosis of genetic and infectious diseases, gene therapy and biotechnological processes, all of which have direct applications in the field. During stages 2 and 3 the student will have the opportunity to execute basic molecular biology laboratory techniques, preparing them for their future careers in the field.

At the end of the LU, as an integrative product of learning, the student will develop a research project on the bases and techniques of Molecular Biology, as well as its applications in molecular medicine, the diagnosis of human diseases, and biotechnological processes, through exposure by the team before the group in a seminar and a final theoretical

3. Purpose (s):

The purpose of the Learning Unit (LU) of Molecular Biology (MB) is for the student to analyze the structural aspects, interactions, and metabolic processes that occur between the main macromolecules of life: DNA, RNA, and proteins (Dogma Central of Molecular Biology). Likewise, you will learn and analyze the fundamentals and applications of Molecular Medicine, molecular diagnostic tools used for the interpretation of genetic and infectious diseases, and biotechnology.

This learning unit is located in the fifth semester. It is part of the basic instruction that the Clinical Chemistry Biologist student must acquire to base their professional practice within Molecular Medicine and Molecular Diagnostics. For this LU, use is made of the knowledge acquired in the LU of Biochemistry since it allows it to integrate the metabolism of biomolecules, including amino acids and nucleotides as fundamental elements of proteins and nucleic acids, respectively, of Morphological Sciences to recognize their aspects. Structural and functional of cells and tissues of

medical physiology by basing the homeostatic processes of the organism. In turn, the LU of MB contributes to obtaining the LU's competencies in both Clinical Biochemistry by providing basic knowledge of the molecular tests used in the diagnosis of molecular diseases and Clinical Pathology by implementing and interpreting laboratory tests for the diagnosis of molecular diseases.
Likewise, the LU of MB will be the basis of the optional UA of Molecular Diagnosis and Biotechnology since it will use the knowledge acquired in applying the tools of Molecular Biology to the molecular diagnosis of diseases (monogenic, multifactorial, and infectious), the studies of individual identification (forensic, paternity, and chimerism), and biotechnology.
The LU of MB serves as a platform for promoting logical, critical, and purposeful thinking in students. It encourages them to analyze the structural characteristics of the macromolecules of life in relation to their function and their impact on the organism's functioning. Moreover, it provides opportunities for students to discuss societal health challenges, fostering interventions with a critical attitude and professional commitment. This LU also contributes to the general well-being of students and their colleagues, promoting respect for working conditions in the classroom and laboratory.
The LU of MB is not just about theoretical learning; it's also about skill development. Students are encouraged to apply their knowledge of the Central Dogma of Molecular Biology to solve problems. They also develop skills for executing chemical and/or biological procedures in the analysis of samples, which are crucial for the clinical diagnosis of genetic diseases. Furthermore, they learn to apply their knowledge to understand and interpret the production of recombinant proteins, their purification, and their use in solving health problems.

4. Graduation profile competencies:

General competencies to which this learning unit contributes:

Instrumentals

1. Use logical, critical, creative, and purposeful thinking to analyze natural and social phenomena that allow you to make relevant decisions with social responsibility in your sphere of influence.

Personal and social interaction

2. Intervene in the face of the challenges of contemporary society, locally and globally, with a critical attitude and human, academic, and professional commitment to contribute to consolidating general well-being and sustainable development.

Integrators

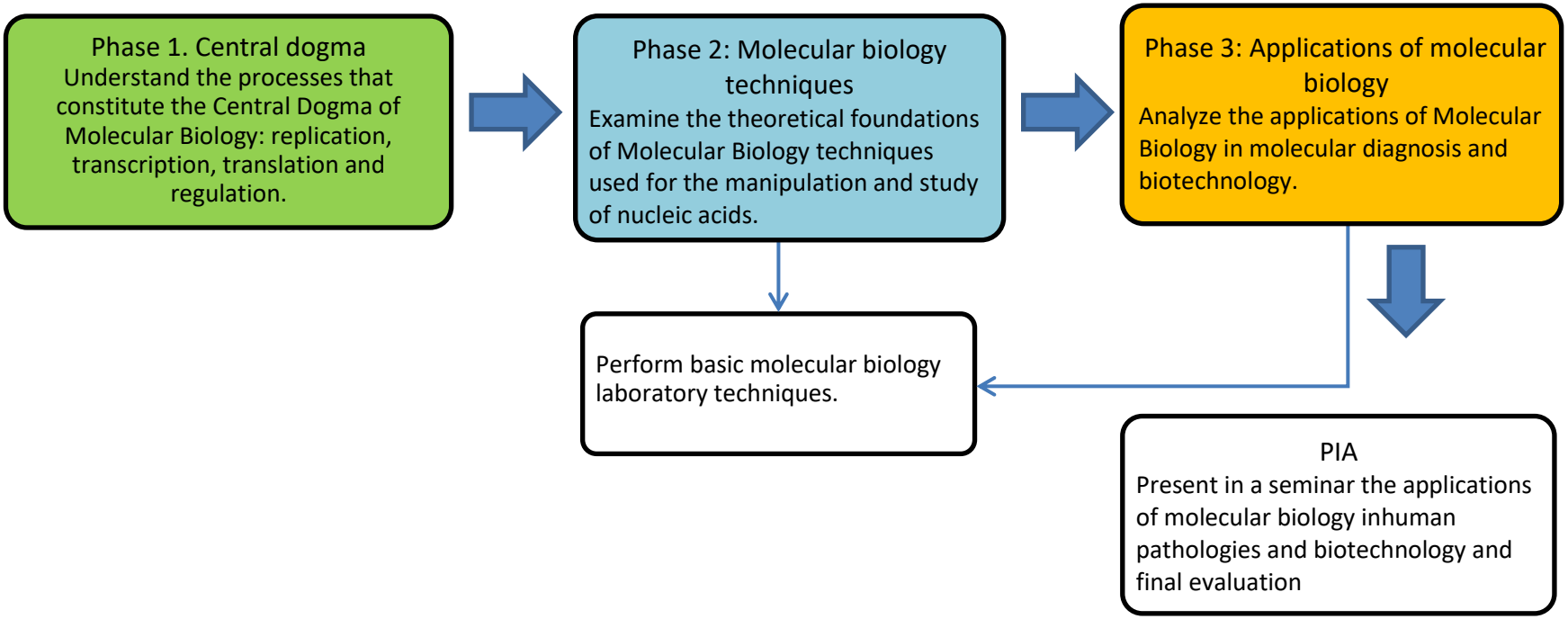
3. Resolve personal and social conflicts following specific techniques in the academic field and their profession for appropriate decision-making.

Specific competencies of the graduation profile to which the learning unit contributes:

1. Solve problems by applying knowledge of the chemical composition of matter, as well as its physicochemical properties to determine analytes in biological, environmental and food matrices.

2. Execute physical, chemical and/or biological procedures in obtaining, handling, storing and analyzing samples to contribute to a reliable clinical, toxicological, chemical, food, forensic and environmental diagnosis.

5. Graphic representation:



PHASE I: The Central Dogma of Molecular Biology

Element of competence: Understand the processes that constitute the central dogma of molecular biology, considering the normal bases of the molecular processes of the cell, to identify the consequences of its alterations

Evidence of learning	Performance criteria	Learning activities	Contents	Resources
Evidence 1 *First partial evaluation on the processes that constitute the Central Dogma of Molecular Biology.*	Individually solve a partial evaluation on the established date and time that includes the contents corresponding to phase 1.	• The teacher explains the topic and asks guidance and contextualization questions to consolidate concepts and resolve doubts. • • • The student reads the corresponding chapters of the Biochemistry book (8th edition) by Emine E. Abalí according to the class calendar. • • The student actively participates in the sessions to review the contents • • The student accesses the Moodle and MS Teams platforms to retrieve teaching material published by the teacher and deliver the ponderable activities. • • The student analyzes the information corresponding to each topic after reading the corresponding chapter.	DNA structure, replication and repair - DNA structure - Stages in the synthesis of DNA in prokaryotes. - DNA replication of eukaryotes. - Organization of eukaryotic DNA. - DNA repair. - Characteristics and organization of viral genomes and plasmids • Structure, synthesis and processing of RNA. - Structure of RNA. Transcription of prokaryotic genes. - Transcription of eukaryotic genes. - Post-transcriptional modification of RNA • Protein synthesis.	Computer equipment or smart devices with Microsoft Office and internet connection Electronic presentations Biochemistry 8th Edition. Emine E Abali Chapters 31, 32, 33 and 34. Current articles provided by the teacher Moodle platform for delivery of ponderable activities Microsoft Teams platform for organizing joint activities, delivering documents of ponderable activities, reviewing teaching materials and discussion between students and teacher.

		• The student presents as a team during the session a topic from phase 1 assigned by the teacher. • • **Considerable activity 1**. Comparative tables of the Central Dogma of Molecular Biology. As a team, organize the information from chapters 31, 32 and 33 reviewed during phase 1 into tables, comparing the process between prokaryotes and eukaryotes. It is delivered on the established date and time through the MS Teams or Moodle platforms in accordance with the instructional guide and checklist. • • **Considerable activity 2**. Written work on the genetic code. Individually, prepare a written work about a disease caused by alteration of the genetic code. • It is delivered on the established date and time through the MS Teams or Moodle platforms in accordance with the instructional guide and checklist.	- The genetic code. - Components necessary for translation. - Codon recognition by tRNAs. - Stages in protein synthesis - Co-translational and post-translational modification of polypeptide chains. - Translation in prokaryotes and eukaryotes. - Co-translational and post-translational modification. ● Regulation of gene expression in prokaryotes and Eukaryotes. - Regulatory sequences and molecules. Regulation of gene expression in prokaryotes. - Regulation of gene expression in eukaryotes. - Role of MiRNAs, RNAi, lncRNA, IRES and Crispr/Cas9 in the processes of regulation of gene expression and editing	MS Forms platform for daily evaluations. Electronic resources: Google Scholar/google scholar National Center for Biotechnology Information (NCBI) Web Pages: YouTube: DNA replication process (Free Science), transcription (process, intron removal and post-transcriptional modifications), translation and regulation of the Lac operon (Virtual Cell).

Phase 2. Molecular Biology techniques in the manipulation and study of nucleic acids.
Competition element(s):
Examine the fundamentals of molecular biology procedures used for the isolation, study, analysis, and manipulation of nucleic acids from different biological, environmental, and food matrices to justify their use in the various fields of application of Molecular Medicine, molecular biology, and biotechnology.

Evidence of learning	Performance criteria	Learning activities	Contents	Resources
Evidence 2 Second partial evaluation: molecular biology techniques used for the study of nucleic acids	Individually solve a partial evaluation on the established date and time that includes the contents corresponding to phase 2.	• The teacher explains the topic and asks guidance and contextualization questions to consolidate concepts and resolve doubts. • According to the class calendar, the student reads chapter 35 of the book Biochemistry 8th Edition. Emine.E. Abali, and the material that corresponds to each topic. • The student accesses the Moodle and Microsoft Teams platforms to consult the teaching material published by the teacher. • Additionally, the student consults the videos provided by the teacher through the Microsoft Teams platform to complement the content reviewed in class. • The student presents as a team during the session a topic from phase 2 assigned by the teacher.	● Fundamentals of basic molecular biology techniques. - Fundamentals for the management and preparation of samples for molecular studies: humans, animals, water, food, environment. - Techniques and fundamentals for the isolation of DNA and RNA. Nucleases, proteins, buffers - Qualitative and quantitative analysis of nucleic acids. Spectrophotometry and Electrophoresis. - Molecular tools for genetic manipulation: hybridization, Restriction Endonucleases, DNA Cloning. - Polymerase chain reaction and its variants: PCR-RFLP, real-time PCR, RT-PCR, hot start PCR, long PCR, nested PCR, inverse PCR, PCR with	Computer equipment or smart devices with Microsoft Office and internet connection Electronic presentations Biochemistry 8th Edition. Emine.E. Abali, Chapter 35 Web Pages: YouTube: Nucleic acid extraction, electrophoresis, cloning, PCR, sequencing and microarrays. Molecular biology and genetic engineering 2nd. Edition. Angel Herráez. Chapter 14, 15 and 16 Molecular biology. Fundamentals and applications in health

		• Considerable activity 3. Mind Map of molecular biology techniques. • The student individually creates a Mind Map of the nucleic acid extraction, electrophoresis and hybridization techniques. • It is delivered on the established date and time through the MS Teams or Moodle platforms in accordance with the instructional guide and checklist. • Considerable activity 4. Comparative table of Molecular Biology techniques. • The student individually prepares a comparative table of the techniques of PCR, cloning, library preparation, sequencing and microarrays where he describes the fundamentals, description of the technique, variants, applications, interpretation of results. • It is delivered on the established date and time through the MS Teams or Moodle platforms in accordance with the instructional guide and checklist..	adapters, asymmetric PCR and digital PCR. - Fundamentals of genomic sequencing and the human genome project (HUGO) - Exome, transcriptome and proteome - Analysis of gene expression: qPCR and Microarrays.	sciences, 2nd edition. Salazar Montes, AM. Current articles provided by the teacher. Moodle platform for delivery of ponderable activities Microsoft Teams platform for and discussion between students. MS Forms platform for daily evaluations. Electronic resources: Web Pages: YouTube: Nucleic acid extraction, cloning, electrophoresis, PCR, sequencing and microarrays
Evidence 3 Laboratory practices:	Review the theoretical foundations of the practice including the material to	•The student individually prepares the flow chart and the corresponding concept map,	• Biosafety and hygiene standards in the Molecular Biology laboratory.	Teaching laboratory Molecular Biology Laboratory Practice Manual.

3.1 1 Safety in the Molecular Biology laboratory 3.2 Quality control 3.3 Genomic DNA extraction 3.4 Total RNA extraction and solid phase purification	work in the laboratory and the established safety standards. Prepare the activities that support the corresponding practice. It presents the necessary material to work properly in the laboratory, taking care of the established safety standards. Prepare the corresponding activities, work in an organized and team manner on the proposed experiments. The student will review the requirements to carry out the practice cleanly, in a responsible and orderly manner, complying with the safety and hygiene standards established for the correct use of the facilities. and correct waste disposal. Appears to laboratory sessions on the established date and time. The report is delivered on the established date and time in accordance with	delivering it at the beginning of each session through the Moodle platform. • The corresponding team explains the theoretical foundations of the practice, for which they prepare a Power Point presentation. • The teacher complements the explanation of the practice presented by the designated team by asking questions and providing examples that reinforce the theoretical knowledge of the practice. • Students prepare a report collaboratively using experimental data, following the format established in the practice manual.	• - Safety signs. • - Waste disposal. • - Proper use of equipment and reagents. • • Quality parameters: precision and accuracy. • - Organization of a Molecular Biology Laboratory. • - Proper use of micropipettes. • • Extraction of human genomic DNA from a blood sample with the organic phenol-chloroform extraction technique. • - DNA analysis by UV spectrophotometry. • • Total RNA extraction and solid phase purification from eukaryotic cell culture. • • - RNA analysis by UV spectrophotometry.	Digital, audiovisual or digital reading resources Moodle platforms for delivery of ponderable activities

3.5 Agarose gel electrophoresis for nucleic acids.	the instructional guide and checklist.		• • Agarose gel electrophoresis for nucleic acids (DNA and RNA). • - Determination of DNA and RNA integrity by analyzing images of agarose gels stained with ethidium bromide. • Biosafety and hygiene standards in the Molecular Biology laboratory. • - Safety signs. • - Waste disposal. • - Proper use of equipment and reagents. • • • Quality parameters: precision and accuracy. • - Organization of a Molecular Biology Laboratory. • - Proper use of micropipettes. • • • • Extraction of human genomic DNA from a blood sample with the organic phenol-chloroform extraction technique. • • - DNA analysis by UV spectrophotometry. •	

			• Total RNA extraction and solid phase purification from eukaryotic cell culture. - RNA analysis by UV spectrophotometry. • Agarose gel electrophoresis for nucleic acids (DNA and RNA). - Determination of DNA and RNA integrity by analyzing images of agarose gels stained with ethidium bromide.	

PHASE: 3 General applications of Molecular Biology in molecular diagnosis and biotechnology.

Competition element:
Analyze the general applications of Molecular Biology techniques in molecular diagnosis and biotechnology to substantiate their usefulness in Biomedicine and Industry.

Evidence of learning	Performance criteria	Learning activities	Contents	Resources
Evidence 4 Third partial evaluation on molecular diagnosis and biotechnology.	Individually solve a partial evaluation on the established date and time that includes the contents corresponding to phase 3.	The teacher presents the key points of the topic, asks guidance and contextualization questions to consolidate concepts and resolve doubts with the support of infographics, videos and power point presentations. Prior to the theoretical session, the student reviews didactic material published by the teacher. • The student actively participates in the online sessions to review the contents. • Considerable activity 5: Table on different types of molecular diagnoses. Analyzes the molecular tests	Scope and applications of Molecular Medicine. • Molecular Diagnosis: - Applications in hereditary diseases - Applications in the molecular diagnosis of multifactorial diseases and cancer - - Applications in the identification of pathogenic agents: bacteria, fungi and viruses.	Computer equipment or smart devices with Microsoft Office and internet connection Electronic presentations - Moodle platform for delivery of ponderable activities - Books: Biochemistry 8th Edition. Abali Emine.E. Chapter 35 Colleman W.B, Tsongalis G.J., Molecular Diagnostics For the Clinical Laboratory. Chapters 22, 23 and 34 to 38. Cox T. M., Molecular Biology in Medicine. Chapters 6 and 7. Nussbaum R. L. Genetics in medicine. Chapter 11.

		used in the molecular diagnosis of hereditary, multifactorial (cancer) and infectious diseases. Prepare as a team a table showing different diagnostic tests and deliver it on the date indicated by the teacher through the Moodle or Microsoft Teams platforms in accordance with the instructional guide and checklist. • • Considerable activity 6: Summary of the fundamentals and technical requirements to obtain a biotechnological product, using as an example a vaccine, transgenic organism or recombinant protein.		Antokoletz, A. F. G., Sarmiento, M. Á., Gaetan, R. A., Guzmán Rastelli, M. C., Carrera, M. F., Díaz, et al (2014). Biotechnology: Between cells, genes and human ingenuity. Ministry of Education of the Nation. Free book. Download from http://www.bnm.me.gov.ar/giga1/documentos/EL005063.pdf Current articles provided by the teacher. Electronic resources: Google Scholar /google scholar ClinicalKey OMIM pages Web Pages: Induction, SDS-PAGE and biological activity. You Tube Web Pages: Obtaining cDNA, Cloning
Evidence 5 Laboratory practice reports: **5.1**	Review the theoretical foundations of the practice including the material to work in the laboratory and the	• The student individually creates the flow chart and the corresponding conceptual map. • • A team previously designated by the teacher	• • PCR amplification of a fragment of the □-globin gene. • - Verification of the amplified product in agarose gel. •	Computer equipment with Microsoft Office and internet connection. Platforms: -Microsoft Teams -Microsoft Forms - Moodle

Polymerase chain reaction (PCR). **5.2 DNA digestion with restriction enzymes** **5.3 Medical Bioinformatics.**	established safety standards. Prepare the corresponding activities. Work virtually, organized and as a team on the proposed experiments. If the practice is carried out in person, the student will review the requirements to carry out the practice cleanly, in a responsible and orderly manner, complying with the safety and hygiene standards established for the correct use of the facilities and the correct disposal of waste. It is presented on the established date and time. The report is delivered on the established date	will make a Power Point presentation and explain the theoretical foundations of the practice, • The teacher complements the explanation of the practice presented by the designated equipment and other audiovisual tools, asks questions and provides examples that reinforce the theoretical knowledge of the practice, indicates the important technical details for the adequate development of the experimental methodology to obtain results. optimal results. • Students review the data, images and videos provided by the teacher as a team. • The student prepares the practice report as a team following the established format, uploading it to the Moodle platform on the established date and time.	• • • Digestion of the amplified α-globin product with the restriction enzyme Bsu 36 I. • - Verification of the digestion of the amplified □-globin product with the restriction enzyme Bsu 36 I. • - Analysis of results and usefulness of this test in the identification of the Glu6 →Val mutation. • - Molecular diagnosis of sickle cell anemia by identifying the Glu6 →Val mutation. • • • • Usefulness and importance of bioinformatics in biology and molecular diagnosis. • - Analysis of the α-globin gene sequences using bioinformatics tools. • -In silico implementation of the molecular diagnosis of sickle cell anemia through the	Power Point Presentations Molecular Biology Laboratory Practice Manual. Digital, audiovisual or digital reading resources

5.4 Presentation, review and general discussion of the results of the laboratory practices. Experience in a Molecular Biology laboratory	and time through the MS Teams or Moodle platforms in accordance with the instructional guide and checklist..		identification of the Glu6 →Val mutation. • • • General review of the results obtained by the group in all laboratory practices. Guided tour of the department's molecular biology laboratories to learn about research applications of the different techniques evaluated.	

7. Evaluation scheme of the Learning Unit broken down by Stages and Evidence of Learning:

Phase	Learning Challenge		Weighing
First phase (22%)	Ponderable activity 1	Comparative tables of the Central Dogma of Molecular Biology	2 %
	Ponderable activity 2	Written work of the genetic code	2 %
	Evidencia 1	First partial evaluation (phase 1)	18 %
Second phase (31.5%)	Ponderable activity 3	Mental map of nucleic acid extraction techniques, electrophoresis, hybridization.	2 %
	Ponderable activity 4	Comparative table of PCR techniques, sequencing, cloning, library preparation and hybridization techniques	2 %
	Evidencia 2	Second partial evaluation (phase 2).	19 %
	Evidencia 3 (3.1 a 3.5)	Laboratory (includes flow charts, concept maps, reports, presentations and class presentation of evidence 3.1 to 3.5)	9.4 %
Third phase (26.5%)	Ponderable activity 5	Table with examples of molecular diagnoses.	2 %
	Ponderable activity 6	Summary of the fundamentals and technical requirements to obtain a biotechnological product.	2 %
	Evidencia 4	Third partial evaluation (phase 3).	14 %
	Evidencia 5 (5.1 a 5.4)	Laboratory (includes flow charts, concept maps, reports, presentations and class presentation of evidence 5.1 to 5.4)	7.6 %
PIA (20%)	Integrative learning product	Final Evaluation	10%
		Research Seminar on the molecular diagnosis of human diseases or any biotechnological application of biomedical interest	10%

8. Sources of support and consultation:

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