1. Identification data:

Name of the learning unit:	**Structural biology**
Guided time (theory and practice):	**80 hours**
Guided time per week:	**4 hours**
Total autonomous time:	**10 hours**
Modality:	**Non scholarly**
Number and type of academic period:	**1er. semester**
Type of learning unit:	**Mandatory**
Cycle:	**First cycle**
Curricular area:	**Introductory to the profession initial training (ACFI-IP)**
UANL credits:	**3**
Elaboration date:	**21/04/21**
Responsible for elaboration:	**Dra. Alina Olalla Kerstupp** **Dr. José Ignacio González Rojas**
Date of last actualization:	**Does not apply**
Responsible for actualization:	**Does not apply**

2. Presentation:

The Structural Biology Learning Unit is fundamental in the training of Biological Sciences students as it provides the basic knowledge that allows the student to understand the structure, function, adaptation and evolution of living beings thus providing a holistic view of Biology. The Learning Unit is composed of 3 elements of competence and is developed in three phases of knowledge. In phase 1 the student will recognize the scientific character of Biology and examine the steps of the scientific method. In phase 2 the student will distinguish the characteristics, structural components, metabolic processes and recognize mechanisms of inheritance that provide living beings with their essence. In phase 3, the student will review the different theories about the origin of the universe and life to explain its history, as well as the fundamental principles of evolution that have contributed to the great diversification of life forms. Through this sequence of knowledge acquisition and as an Integrative Learning Product, the student will be able to distinguish the morphological characteristics, as well as the structural and metabolic components of two organisms of different taxonomic groups to understand how they have adapted and evolved over time.

3. Purpose:

The purpose of the Learning Unit (UA) is for the student to recognize the characteristics, cellular structure, metabolism and inheritance patterns of living beings to understand how they have adapted to their environment and have evolved over time, resulting in the great biodiversity that exists.

The above will provide the student with basic fundamentals of knowledge that will be useful to address UA professionalizing of higher semesters. This UA strengthens and deepens the knowledge on biochemical/cellular structure, metabolism and theories of the origin of the universe and of life acquired in the UA The nature of life, Chemical phenomena in the environment and Biology in health taught in the baccalaureate of the UANL. On the other hand, by integrating the basic knowledge of the structure and function of living beings, this UA prepares the student to directly address the UA of Biological Diversity and Integral Laboratory of biology that are studied in the 2nd semester of the common trunk of the Faculty of Biological Sciences. In the case of the UA biological diversity, the student will use this information not only to identify taxonomically the different groups of organisms, but also understand the role they play in ecosystems. In turn, the UA of Structural Biology and Integral Laboratory of Biology are perfect complements, because the first shows the student the theoretical aspects of the structure and function of living beings while, in the second, the student will be able to verify for himself through experimentation these fundamentals.

The UA of Structural Biology contributes to the development of three general competences of the UANL. The UA promotes logical and analytical thinking by identifying ideas, concepts and obvious data about Biology (5.1.1) because by understanding the basic principles that govern life, the student will be able to explain natural phenomena from a scientific perspective, assuming with this attitudes that lead him to the care and conservation of his environment. By working on activities in a group way, the student accepts the cultural and social diversity of his peers and respect is encouraged among the members of the team (9.1.3) to establish agreements between the different parties that allow an impartial environment during the elaboration of activities (14.1.3).

It contributes to the development of a specific competence of the Biology educational program since, by knowing the structural and metabolic bases, as well as the mechanisms of change of the species over time, the student will be able to recognize during his working life, those environmental risk factors that affect the organisms and therefore estimate the ecological impact on the ecosystems when any of these factors are altered (E2-B).

It contributes to the development of two specific competences of the educational program of Chemistry, Bacteriology and Parasitology because by knowing the correct way to implement the scientific method as well as the structure / function of the biochemical-cellular components of the organisms, it will allow the student to eventually enter the field of research where he can apply and / or design experimental protocols (E1-QBP) of laboratory to contribute to the solution of health, industrial, agricultural and / or environmental problems without affecting the availability of biotic resources (E2-QBP), as well as the diagnosis of biochemical diseases through the application of the steps of the scientific environment to guarantee the health of living beings (E3-QBP) and, ensure the quality of biological chemical processes through the use of their knowledge about morphological characteristics , as well as structural and metabolic components (E4-QBP).

It contributes to the development of the specific competences of the program in Genomic Biotechnology by achieving that the student can eventually design and apply experimental protocols related to structural biology thanks to his knowledge about the function of biochemical-cellular organisms for the conservation of biotic resources (E1-LBG), as well as the development of molecular diagnostics through the use of the scientific method in order to detect pathogenic organisms s (E2-LBG), through strategies for the identification and selection of genomes in living beings (E3-LBG), which will contribute to the design of drugs and clinical treatments for disease prevention using their knowledge about structural components and metabolic

processes (E4-LBG).

It contributes to the development of a specific competence of the educational program of Food Science since the student by integrating knowledge about the composition of food (biochemical and cellular level) will be able in the future to apply techniques that allow to manage the conservation of food to guarantee its quality and safety (E1-LCA).

4. Competencies of the graduate profile:

Specific competences to which the learning unit contributes:

Biology:
To estimate the ecological impact of ecosystems at the local, regional and national levels through the investigation of the biological mechanisms involved in the evolution of species and populations in relation to the environmental risk factors that affect population dynamics within ecosystems in order to ensure that conservation programs lead to their persistence as viable and self-sustaining populations in nature.

Food Science:
To estimate the ecological impact of ecosystems at the local, regional and national levels through the investigation of the biological mechanisms involved in the evolution of species and populations in relation to the environmental risk factors that affect population dynamics within ecosystems in order to ensure that conservation programs lead to their persistence as viable and self-sustaining populations in nature.

Genomic Biotechnology

1. Design experimental protocols related to biological chemistry, using theoretical, methodological and instrumental knowledge, traditional and cutting-edge, of the exact sciences, biology and chemistry, which are applied in the study of natural phenomena and biodiversity, in a logical, creative and purposeful way, in order to conserve biotic resources and the environment for the benefit of society.
2. Develop molecular diagnostics through the identification of pathogenic organisms, applying traditional and cutting-edge techniques effectively, as well as the use of innovative tools in their detection, which allow the study and treatment of genetic diseases in the health, economic and social fields.
3. Design strategies for the detection, modification and selection of genomes, through the identification of genes, proteins or cellular metabolic components, following the current regulations on biosafety of Genetically Modified Organisms (GMOs) and evaluating their competitive advantage when compared to what is traditionally used, in order to develop biotechnological products, processes and services in the health, agricultural, livestock, industrial and environmental sectors.

4. Design drugs and clinical treatments, through the selection of microorganisms with productive metabolic pathways in the market of prebiotics, probiotics and additives, as well as viral genomes of biotechnological application in the agricultural, livestock, industrial and environmental sectors that allow it to develop products and processes in the prevention of diseases.

Chemistry, Bacteriology and Parasitology

1. Design experimental protocols related to biological chemistry, using the theoretical, methodological and instrumental knowledge, traditional and cutting-edge, of the exact sciences, biology and chemistry, which are applied in the study of natural phenomena and biodiversity, in a logical, creative and purposeful way, in order to conserve biotic resources and the environment for the benefit of society.
2. Implement analytical methodologies in chemical-biological, microbiological and biotechnological laboratories that are applied to biomedical, agricultural, industrial and/or environmental problems, to provide results supported by the validation of the processes used, for the benefit of the health and economy of the community.
3. Contribute to the diagnosis of autoimmune, metabolic and infectious diseases through the biochemical study of the cellular response in living beings, to contribute to the treatment that guarantees an optimal state of health.
4. Develop systems of continuous improvement and quality assurance of chemical-biological, microbiological and biotechnological processes, applying current national and international regulations through compliance with the established requirements, to determine in a rigorous and objective way the properties of the products obtained, for the good of society.

5. Structuring in stages or phases:

Phase 1. Biology as a life science.
Element of competence: Apply the scientific method to the study of biology for the generation of biological knowledge.

Evidence of learning	Performance criteria	Learning activities	Contents	Resources
1. Flowchart "How does science work? "	Analyzes the chronology of a scientific investigation Identifies the different steps of the scientific method in the process. It includes the concepts of biology as well as its field of action. It mentions the steps of the scientific method. Develop the evidence as a team. Delivery in the hour, day and a medium indicated by the professor	The professor introduces the UA by presenting the analytical program. The student draws up a concept map on the relationships of Biology with related sciences. The professor will present a case study, for the identification of the steps of the scientific method, the students will respond to direct questions.	Biology Definition and object of study Field of action Interdisciplinarity Basic features of science Steps of the Scientific Method Applied to Biology observation Problem- based approach Prior information hypothesis Experimental design experimentation Analysis of results Conclusions Written report	Computer equipment with audiovisual system Internet access Digital libraries and repositories Presentation Power Point or Sway Educational platform s (Nexus and Microsoft teams) Videos and interactives from the HHMI Biointeractive platform Instructional guides Instruments of evaluation

	Meets the performance criteria set forth in the instructional guide.	The student presents the first multiple reagent exam (weighted activity 1.1).	Advances in Biology and its importance for society	Audesirk, T., Audesirk, G., & Byers, B. E. (2008). Biology. La vida en la tierra. Prentice Hall. Fowler, S., Roush, R., & Wise, J. (2013). *Concepts of Biology*.

Phase 2. What defines a living being?

Element of competence: Distinguish characteristics, cellular components, types of metabolism and patterns of inheritance to recognize the fundamental differences between living beings.

Evidence of learning	Performance criteria	Learning activities	Contents	Resources
2. 3D model of a eukaryotic cell.	Use recycled materials to make the 3D model. Makes a three-dimensional model of a eukaryotic cell. Indicates each of the organelles. Make a creative video for the explanation of the model. It includes the function of organelles, a type of metabolism used to obtain energy, as well	The student takes notes as a synoptic table, to recognize the role of inorganic and organic molecules of importance in the structure of organisms. The student watches the educational videos: “The chemical structure of DNA”, “The fate of fat”, on HHMI Biointeractive. The student makes a comparative table on the differences and	● Levels of organization of matter ● Characteristics of living beings ● Bioelements that form living beings ● Biological function of the inorganic compounds that form living beings: 1. water 2. Mineral salts	• Computer equipment with audiovisual system • Internet access • Digital Libraries and Repositories • Presentation Power Point or Sway • Educational platform s (Nexus

	as the location and function of chromosomes responsible for the inheritance of characteristics. Meets the performance criteria of the instructional guide.	similarities between the different cell types. The student relies on the interactive video: "The eukaryotic cell cycle and cancer" of the HHMI Biointeractive platform to understand the processes that allow the growth and division of a cell. The student analyzes the video: "Meiosis" of the HHMI Biointeractive platform, to understand how sex is assigned in an individual. Through the series of 7 audiovisual segments of the topic Photosynthesis of the HHMI Biointeractive platform, the teacher and students discuss processes and structures involved.	● Biological function of the main organic biomolecules 1. carbohydrates 2. lipids 3. proteins 4. Nucleic acids ● The cell ● Cell theory ● Cell types ● Structure and function of prokaryotic cells 1. nutrition 2. reproduction 3. morphology ● Structure and function of eukaryotic cells 1. Vegetable cell 2. Animal cell 3. Fungal cell ● Eukaryotic cellular organelles and their function ● Cellular reproduction and metabolism	and Microsoft teams) • Videos and interactives of the HHMI Biointeractive platform • Instructional guides • Evaluation tools • Howard Hughes Medical Institute. (s. f.-c). *Understanding the variation of skin color in humans.* • Howard Hughes Medical Institute. (s. f.-f). *The origin of the species: the beak of the finch*.

		The student observes the effect of limiting factors on oxygen production in plants through a virtual photosynthesis simulator. The student indicates by means of a flowchart the connection that some metabolic processes keep. The student uses a virtual whiteboard to represent the process of protein synthesis. By means of a Punett's table, the student determines the probability that an organism presents a particular genotype, since this allows to observe each possible combination to express, the dominant and recessive alleles.	● Cell cycle 1. interface 2. Phase M 3. ● Mitosis 1. prophase 2. metaphase 3. anaphase 4. telophase ● Cytokinesis 1. vegetable 2. Animal ● Meiosis 1. Homologous chromosomes 2. recombination 3. Stages of Meiosis ● Metabolism (energy flows between living beings) ● Function of ATP in living beings ● Role of enzymes in biological processes	

		The student performs the activity: "Understanding the variation of skin color in humans" of the HHMI Biointeractive platform in which he uses the SNPs of an individual to infer his ancestry based on the allelic frequencies observed in different populations. The student presents the second multiple reagent exam (weighted activity 2.1).	● Anabolic processes related to autotrophic nutrition 1. Chemosynthesis 2. photosynthesis ● Catabolism processes that favor the obtaining of energy in organisms 1. Aerobic cellular respiration 2. fermentation ● Protein synthesis 1. Forms of packaging of genetic material (DNA) 1. Gen 2. chromosome ●Mendel's work and derived concepts 1. allele 2. Dominant and recessive characters 3. genotype 4. Heterozygous 5. Homozygous 6. phenotype	

			● Mendel's laws 1. Law of uniformity 2. Segregation law 3. Independent distribution law ● Generalities of genetic mutations and their role in obtaining physical and/or metabolic adaptations.	

Phase 3. Origin of the universe, life and its evolutionary progression.
Element of competence: Explain the history of the astronomical, physical, chemical and physiological phenomena that allow life on our planet to infer the evolutionary progression of life over time.
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Evidence of learning	Performance criteria	Learning activities	Contents	Resources

3.Timeline "Events culminating in the appearance of modern humans".	• Design an interactive timeline.
	• It includes the creation events of the universe, our solar system, planet earth, and the various forms of life to culminate in the appearance of modern man "*Homo sapiens*".
	• It includes the moments of the theories of the big bang and cosmic inflation.
	• It synthesizes the theories of the origin of
		Students in teams participate in a debate about which theory of the origin of life has a stronger justification.
		
		As an extra-classroom activity, the student enters the "EarthViewer" tool of the HHMI Biointeractive platform through which it visualizes the conditions of our planet in 4 time scales the movements of the tectonic plates, temperature levels, oxygen,
			• Definition of universe and its components.
			
			• Theories accepted today about the origin of the universe.
			  • Big Bang
			  • Cosmic inflation
			
			• Theory of the origin of the solar system
			
			• Theories of the origin of life:
			  • abiogenesis
			  • Panspermia
				• Computer equipment with audiovisual system
				
				• Internet access
				
				• Digital Libraries and Repositories
				
				• Presentation Power Point or Sway
				
				• Educational platform s (Nexus and Microsoft teams)

	life by mentioning each of the revised ones. • Identifies evidence of evolution. • He analyzes Darwin's theories. • It delivers the evidence by team in the hour, day and a half that the teacher indicates. • Meets the performance criteria of the instructional guide.	CO and observe$_2$,duration of the day, luminosity and biodiversity among others. Supported by the video: "The origin of species: the beak of the finch" of the HHMI Biointeractive platform, the student analyzes how a 4-decade study has demonstrated the emergence and diversification of this group of birds. Through a timeline, the student connects the transient forms within the evolution of cetaceans. The teacher lists human vestigial structures, and the student compares them with other groups of vertebrates to deduce what was the usefulness of each of them through our evolution. With the click and learn activity "Comparative Anatomy of Domestic	• Abiotic synthesis • hydrothermal • Choacervates • Primitive bacteria • Endosymbiotic theory (primitive eukaryotes) • Concept of evolution • Theory of catastrophism • Lamarck • Law of use and disuse • Law of the inheritance of the acquired characters • Darwin's premises • adaptation • overproduction • variation • Limits to population growth • Survival of the fittest • natural selection • Wallace • Evidence of evolution • Paleontology (fossils)	• Videos and interactives of the HHMI Biointeractive platform • Instructional guides • Evaluation tools • Starr, C., Taggart, R., Evers, C., & Starr, L. (2018). *Biology. The unity and diversity of life*. • Karp, G. (2011). *Cellular and Molecular Biology, Concepts and Experiments*. • Howard Hughes Medical Institute. (s. f.-i). *The chemical structure of DNA*.

		Chicken" on the HHMI Biointeractive platform, the student follows the evolutionary history of birds by comparing the shapes and structures of certain chicken bones with those of some of their living and extinct relatives. The student presents the third multiple reagent exam (weighted activity 3.1).	• Comparative anatomy (homologous, analogous and vestigial organs) • embryology • biogeography ○ molecular biology	

6. Comprehensive evaluation of processes and products (weighting / summative evaluation).

PHASE I		Ponderation
EVIDENCE	Evidence 1. Flowchart How does science work?	9%
EXAM	Exam (weighted activity 1.1).	12%
	SUBTOTAL	**21%**
FASE II		
EVIDENCE	Evidence 2. 3D model of a eukaryotic cell.	11%
EXAM	Exam (Weighted activity 2.1)	13%
	SUBTOTAL	**24%**
FASE III		
EVIDENCE	Evidence 3. Timeline "Events culminating in the appearance of modern man"	10%
EXAM	Exam (weighted activity 3.1).	15%
	SUBTOTAL	**25%**
LEARNING INTEGRATION PRODUCT		**30%**
	TOTAL	**100%**

7. Learning integration product:
Written and illustrated monograph on the morphological characteristics, structural components and type of metabolism of two organisms of different taxonomic groups arguing how they have adapted and evolved over time.

8. Literature:

Audesirk, T., Audesirk, G., & Byers, B. E. (2008). *Biología. La vida en la tierra.* Prentice Hall.

Bases de Datos UANL. (s.f.). *Biblioteca Digital*. Recuperado de https://www.dgb.uanl.mx/?mod=bases_datos el 15 de Julio de 2020.

Clark, M.A., Douglas, M., and Choi, J. (2018). *Biology 2e.* Open Stax. Recuperado de https://openstax.org/details/books/biology-2e el 14 de Septiembre de 2020.

Fowler, S., Roush, R., & Wise, J. (2013). *Concepts of Biology*. Open Stax. Recuperado de https://openstax.org/details/books/concepts-biology el 14 de Septiembre de 2020.

Gilbert, S.F. (2005). *Biología del Desarrollo.* Panamericana.

Howard Hughes Medical Institute. (s. f.-a). *HHMI Bionteractive*. HHMI Bionteractive. Recuperado de https://www.hhmi.org/biointeractive el 06 de Septiembre de 2020.

Howard Hughes Medical Institute. (s. f.-b). *Anatomía comparada del pollo doméstico*. HHMI Biointeractive. Recuperado de https://www.biointeractive.org/es/classroom-resources/anatoma-comparada-del-pollo-domstico el 06 de Septiembre de 2020.

Howard Hughes Medical Institute. (s. f.-c). *Comprendiendo la variación del color de la piel en los humanos*. HHMI Biointeractive. Recuperado de https://www.biointeractive.org/es/classroom-resources/comprendiendo-la-variacin-del-color-de-la-piel-en-los-humanos el 06 de Septiembre de 2020.

Howard Hughes Medical Institute. (s. f.-d). *Earth Viewer*. HHMI Biointeractive. Recuperado de https://media.hhmi.org/biointeractive/earthviewer_web/earthviewer.html el 06 de Septiembre de 2020.

Howard Hughes Medical Institute. (s. f.-e). *El ciclo celular eucarionte y el cáncer*. HHMI Biointeractive. Recuperado de https://media.hhmi.org/biointeractive/click/spanish/cellcycle/ el 06 de Septiembre de 2020.

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Howard Hughes Medical Institute. (s. f.-g). *Fotosíntesis*. HHMI Biointeractive. Recuperado de https://media.hhmi.org/biointeractive/click/spanish/photosynthesis_ES/ el 06 de Septiembre de 2020.

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Howard Hughes Medical Institute. (s. f.-j). *The fate of fat*. HHMI Biointeractive. Recuperado de https://www.biointeractive.org/classroom-resources/fate-fat el 06 de Septiembre de 2020.

Karp, G. (2011). *Biología Celular y Molecular, Conceptos y Experimentos*. McGraw-Hill Interamericana S. A de C.V.

Miller K. R., & Levine, J. (2014). *Biology*. Pearson Education, Inc.

Repositorio UANL. (s.f.). *Repositorio Académico Digital*. Recuperado de http://eprints.uanl.mx/ el 15 de Julio de 2020.

Repositorio Nacional. (s.f.). *Repositorio Nacional*. Recuperado de https://www.repositorionacionalcti.mx/ el 15 de Julio de 2020.

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Solomon, E.P., Berg, L.R., & Martin D. W. (2013). *Biología*. México: Cengage Learning Editores S.A. de C.V.

Starr, C., Taggart, R., Evers, C., & Starr, L. (2018). *Biología. La unidad y diversidad de la vida*. Cengage Learning Editores.

Anexo 1. Instructional Guide PIA

Written and illustrated monograph on the morphological characteristics, structural components and type of metabolism of two organisms of different taxonomic groups to understand how they have adapted and evolved over time.

instructions:	Lthe documents will be delivered at the time, day and a half that the teacher indicates. Each document must contain a cover page with the identification data of the institution and the student, as well as the information requested in the section of criteria and rubric provided.
Value:	30%
Evaluation criteria:	**Of the two elected bodies:** **Information related to the contents of Stage 1:** . Indicate the divisions or specializations of Biology to which they belong. . Describe its morphological characteristics. . Explain the characteristics they have to be considered living beings, that is, investigate their cellular organization, DNA location, growth, metabolism, homeostasis, movement and / or displacement, stimuli to which it reacts and form of reproduction. . List the functions that each of the following chemical elements fulfill in their organisms (Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, Sulfur and Phosphorus), either at the level of structure or physiology. **Information related to the contents of Stage 2:** . Identify the type of cell that makes them up (prokaryote or eukaryotic) and include the characteristics of that cell. . In the case of being eukaryotic, identify if it is of the animal, vegetable or fungus type and include the characteristics of said cell. . List the organelles present, their function and highlight which ones are exclusive to this cell type. . Indicate and illustrate the metabolic processes by which your cells synthesize energy (ATP). **Information related to the contents of Stage 3:** . Investigate the existence or not of subspecies or races given by genetic variations. . Signpost in a tree of living beings the "evolutionary path" of their organisms. ● Highlight the adaptations they had to develop throughout their evolution.
Mode:	Individual