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Astrobiology as a didactic strategy to develop academic competences and skills

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Abstract. A course in Astrobiology has been integrated as an optative subject in the graduate programs of Biology and Chemistry at Universidad Autónoma del Estado de Morelos for the last ten years. The course is taught as an interactive workshop where enrolled students have the opportunity to develop some of the competences and skills needed in basic research areas. Together with other efforts, this has helped to foster a solid astrobiology community in Mexico.

Key words. Astrobiology – education – academic competence – SOMA

1. Introduction

Astrobiology seeks to scientifically understand the origin, evolution, distribution, and destiny of life in the Universe. To achieve these goals the coordinated efforts of specialists from different academic backgrounds, geographic locations, and expertise are of prime importance. Laboratory facilities, specialized instrumentation and staff are also required. In Mexico some coordinated efforts have been initiated by the Sociedad Mexicana de Astrobiología (SOMA) to bring together researchers developing scientific and technological programs directly or indirectly related to astrobiology with undergraduate and graduate students matriculated in basic research areas to foster different collaborative links. The celebration of five National Schools in Astrobiology and eleven National Astrobiology Meetings have considerably contributed to these efforts. Astrobiology as a subject has a multidisciplinary identity that requires a common language and empathic interactions between specialists of different disciplines to understand complex problems and to tackle them in a successful way. Taking advantage of the attractiveness of some of the topics important to astrobiology such as the potential discovery of extraterrestrial life forms, the recognition of planets around stars different from the Sun, the existence of organisms living in extreme environments, or the study of the Universe with robotic mission, students are highly motivated to know the current status of these and other topics, locally and globally, and also to explore the possibilities to participate in a research group dealing with any of the mentioned topics.

2. Astrobiology in Mexico

In Mexico we do not have an academic program exclusively devoted to Astrobiology aimed to the academic preparation of young students. However since the last two decades ago or so, academics interested in the promotion of astrobiology have proposed courses where the basic concepts of astrobiology, space exploration, extraterrestrial intelligence, life on Earth, and some others are taught. Specific examples are the postgraduate programs of Astrophysics, Earth Sciences and Biomedical Sciences offered by Universidad Nacional Autńoma de México (UNAM) in Mexico City, as well as the Basic Sciences program offered at Universidad Autńoma del Estado de Morelos (UAEM) in Cuernavaca, Morelos. Courses have also been prepared for the Earth Sciences, Biology, Chemistry, Mathematics, Physics and Chemical Engineering graduate programs offered by UNAM in Mexico City, for the Biology graduate program at UAEM in Cuernavaca, Morelos and for the Basic Sciences graduate program offered by Universidad Autónoma de Baja California (UABC) in Ensenada, Baja California. Students matriculate the course either as an optative or as a mandatory subject into their curricula. In some cases, they take it as a specialized subject that gives an important support to the development of their thesis project.

3. Astrobiology at UAEM

At UAEM, the Astrobiology course has adopted the format of a workshop that not only addresses the fundamental questions and topics important to the discipline, but also promotes the development of academic competences, skills, attitudes and behaviors needed by an astrobiology professional when he/she is integrated into the field, either in the academic, technological, or administrative area (Fig. 1). The academic and administrative tasks of the UAEM are ruled by the Modelo Universitario (MU) approved in 2010. In agreement with national and international educational standards, the MU promotes an integral university education for students based on four basic premises:

- Learn to learn
- Learn to be
- Learn to undertake challenges
- Learn to live with others

Notably the student is the integral subject around which all the processes are articulated. Following the philosophy dictated by the MU at UAEM, the Astrobiology course has been organized as an interactive workshop that looks for the development of competences that any student of the basic research areas needs to master. This strategy has proved to be useful first of all because the course receives students from different areas, typically chemistry, biology, biochemistry, or physics that are in their last year of preparation, meaning that they have a certain degree of expertise in their particular area that need to be communicated and shared with their mates. Second because the students actively participate in shaping the dynamics of each lesson, so they have the opportunity to express themselves and to listen to their classmates. They find that it is imperative the correct use of technical language, symbols, and accurate information if they look for a positive understanding. They are presented with current questions and problems face in Astrobiology, they are organized in multidisciplinary teams, and are asked for potential answers. In this way they recognize that scientific and technological problems can be approach from different perspectives, and that inductively as well as deductively reasonings are needed to categorize data, to formulate hypothesis and to draw conclusions. Aspects like curiosity, inventiveness, critical thinking, and identification of accurate data and information are a constant throughout the course.

Competences have been defined as the combinations of attitudes, skills and knowledge that students develop to apply for successful learning, living and working. The main competences promoted during the Astrobiology course at UAEM are shown in figure 1. Ideally the students en-rolled in the course would finish it with a certain degree of dominance in each one of them. The truth is that each generation of students, and specifically each student is a case. The experience accumulated in almost a decade teaching the course has demonstrated that a lot of organization, patience and guidance are required. Luckily the registration varies around a dozen of students, or less

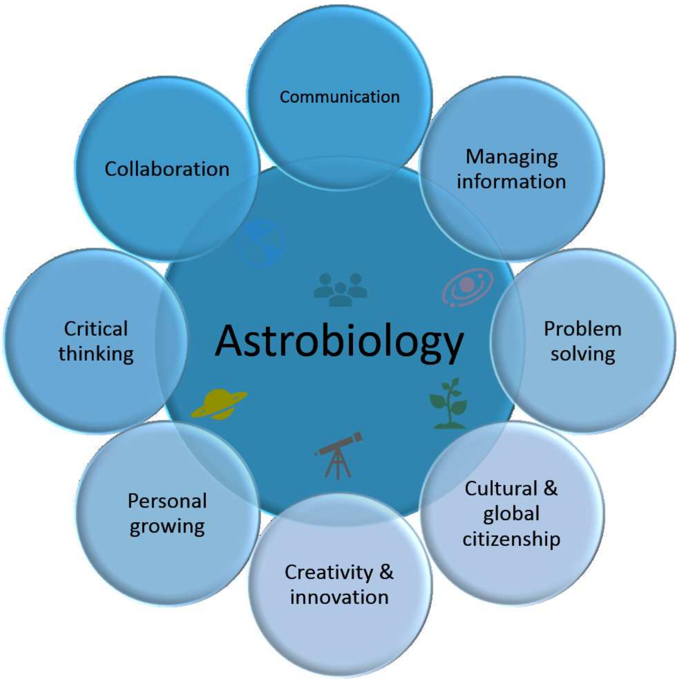

Fig. 1. The Astrobiology course at UAEM is taught as an interactive workshop to students from the chemistry, biology or biochemical areas, and it emphatically promotes the development of the competences and skills shown.

in some semesters, an aspect that facilitates a quasi-personalized tutoring during the course. Nevertheless, the experience has been rewarding and what is more important, a solid group of young students have been habilitated in this growing and highly interactive field that Astrobiology represents. Some of the students have been integrated into research activities to collaborate in projects related to the biochemistry of halophilic bacteria, or the study of the chemistry of Titans atmosphere, and have satisfactorily concluded their thesis projects. Some other have decided to continue with their academic preparation in a different University, either in Mexico or abroad, and there are some who have decided to continue in an area very different from Astrobiology. But the experiences and knowledge they got will help them to more easily tackle unfamiliar and challenging situations.

4. Conclusions

Ten years of teaching Astrobiology at UAEM have provided a great deal of experience. The students curiosity in the central astrobiological questions is taken as an introduction to formal knowledge and to the development of competences required in basic sciences

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