

## EDUCATIONAL GAMES: A FUNNY WAY TO TEACH ASTROBIOLOGY

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### Abstract

Astrobiology is a new multi and trans-disciplinary field of knowledge concerned with the study of the origin, distribution, and destiny of life in the universe and, naturally, in our planet. To reach these goals we must include this new field of knowledge in the curricular domain to establish future open minded citizens. In this sense, we must develop the most adequate tools for teaching this science both in schools and universities and plan strategies for an adequate public outreach. An educational game can be an excellent tool to achieve these aims.

In this work we propose a game called *Astrobiotica* composed of questions and tasks. Through this dynamic activity, students can find out new data about Astrobiology, discover its history, its scientific principles and develop critical perspectives.

### Introduction

Astrobiology tries to answer a vital question: “How did life appear and evolve?”, a problem whose solution is not definitive, which allows the students to create moments of reflection, questioning and creativity. Dealing with such problem, which can have several approaches, can lead to an adequate critical reflection on the nature of science and its inter-relations with other areas of knowledge, such as natural sciences, philosophy, theology and sociocultural studies. The integration of this science in the *curricula* will contribute to explain the construction of scientific knowledge and allow the incorporation of disciplines, which are traditionally kept apart<sup>1,2</sup>. New *curricula*, with a more open mind, must be established for the formation of the present and future generations of students and also, in our point of view, of teachers<sup>1</sup>.

In this sense, we must focus our attention on the way we develop both Astrobiology tools for teaching and researching in schools and universities and also strategies for an adequate public outreach<sup>1,2</sup>. An educational game can be an excellent tool to achieve these aims.

### The game: *Astrobiotica*

*Astrobiotica* is a new board game composed of questions and tasks on Astrobiology that can play an important role for teaching this science (see fig. 1). This

game allows students to discover new data about Astrobiology, learn about its history, its scientific principles and develop critical perspectives.

There are four main themes in *Astrobiotica*, each of them associated to a different colour: *History and Evolution of Astrobiology* (yellow) – includes the main landmarks in the development of this science and the principles of the scientific method; *Endogenous Model of the Origin of Life* (blue) – concerns with the Oparin-Haldane theory and the Miller experiment on the origin of life; *Exogenous Model of the Origin of Life* (green) – related with the hypothesis that the chemical main blocks of life were originated outside of Earth – and *Cosmological Data* (red) – includes relevant paleontological and planetological data associated with the origin and development of life. During the game, questions are asked on the four themes and to win the game, every team has to perform a different task from each of these themes. The proposed tasks are one of the main innovations brought by this board game in relation to others of similar kind. They allow moments of discussion where the teacher can guide the activities so that students can build up their knowledge. It also promotes cooperative learning where students have an active role and are responsible for their own learning<sup>3</sup>. Below are some of the tasks proposed for each theme:

#### *History and Evolution of Astrobiology:*

- Using cards with expressions related with the scientific method, students have to put in order the steps of this method.
- Using cards with different relevant discoveries in Astrobiology, students have to put them into chronological order.

#### *Endogenous Model of the Origin of Life:*

- Using 3D models of inorganic molecules, students must rebuild an organic molecule present on primitive Earth.
- Using cards with the different steps of the Miller experiment, students have to put them into correct order.

#### *Exogenous Model of the Origin of Life:*

- Using two types of cards (cards with terrestrial extremophiles and cards with extraterrestrial environments), students have to make a correspondence between the microorganisms that live in extreme conditions on Earth and extraterrestrial environments where they could possibly exist<sup>4,5</sup>.

### Cosmological Data:

- Using cards with different cosmological data (paleontological and planetological) students must choose which of them supports the Endogenous Model of the Origin of Life and explain their choice.
- Using cards with different cosmological data (paleontological and planetological) students must choose which supports the Exogenous Model of the Origin of Life and explain their choice.

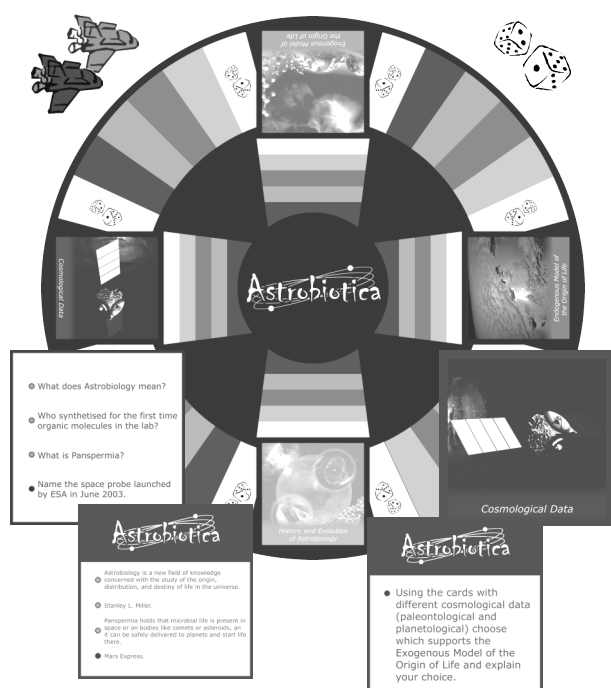


Fig. 1. *Astrobiotica*'s board including examples of questions and task cards.

### *Astrobiotica*'s rules:

1. To play this game we need two teams.
2. To start the game, each team has to roll the dice to see who gets the highest number, that team will be the first to start playing.
3. The score obtained in each roll will indicate the number of houses to go through.
4. A question related to the colour of the house obtained should be made. If the answer is correct the team will play again, if the answer is wrong it will pass to the other team.
5. When a team gets to a theme-house, they will have to perform a task related with that theme.
6. The game will be won by the team that successfully performs the four different proposed tasks.

### Final Remarks

Astrobiology concerns a problem whose solution is not definitive, which allows students to create moments of critical reflection, questioning and creativity. The

integration of this science in the *curricula* will contribute to explain the construction of scientific knowledge, allow the incorporation of disciplines which are traditionally kept apart and will enable the development of more holistic learning.

Through *Astrobiotica* students can find out new data about Astrobiology, discover its history, its scientific principles and develop critical perspectives. All these activities can lead students to challenge their scientific concepts and also to promote and improve their lab skills in order to obtain clues to this science's unsolved problems.

In a more global perspective, it can also be considered as a contribution to fight back the scientific illiteracy in the society and as an instrument to understand science nowadays.

### References

- <sup>1</sup> CARRAPIÇO, F., LOURENÇO, A., FERNANDES, L. & RODRIGUES, T. (2002) "A Journey to the Origins. The Astrobiology Paradigm in Education". *Proceedings of SPIE*, 4495: 295-300.
- <sup>2</sup> STALEY, J. T. (2003) "Astrobiology, the transcendent science: the promise of astrobiology as an integrative approach for science and engineering education and research". *Current Opinion in Biotechnology*, 14: 347-354.
- <sup>3</sup> ARENDS, R. (1995) "Aprender a Ensinar". McGraw-Hill (ed.), Lisboa.
- <sup>4</sup> RANDALL, C. (2000) "Astrobiology in your classroom – Life on Earth ...and elsewhere? Educator Resource Guide". NASA Astrobiology Institute (<http://nai.arc.nasa.gov/library/downloads/erg.pdf>).
- <sup>5</sup> The Astrobiology curriculum (2003) – <http://astrobio.terc.edu/>

This article is dedicated to Dr. Gilbert Levin's work and his contribution to the construction and development of Astrobiology as a modern science, and to Dr. Patricia Ann Straat who shared with him the discovery of possible life activity on Mars during the 1976 Viking Mission.