BACTERIA FROM MARS IN ALENTEJO: TEACHER PERSPECTIVE ON STUDENTS' ASSESSMENT

Luísa Encarnação[1]
[1] *São Julião da Barra Schools, Oeiras, Portugal*

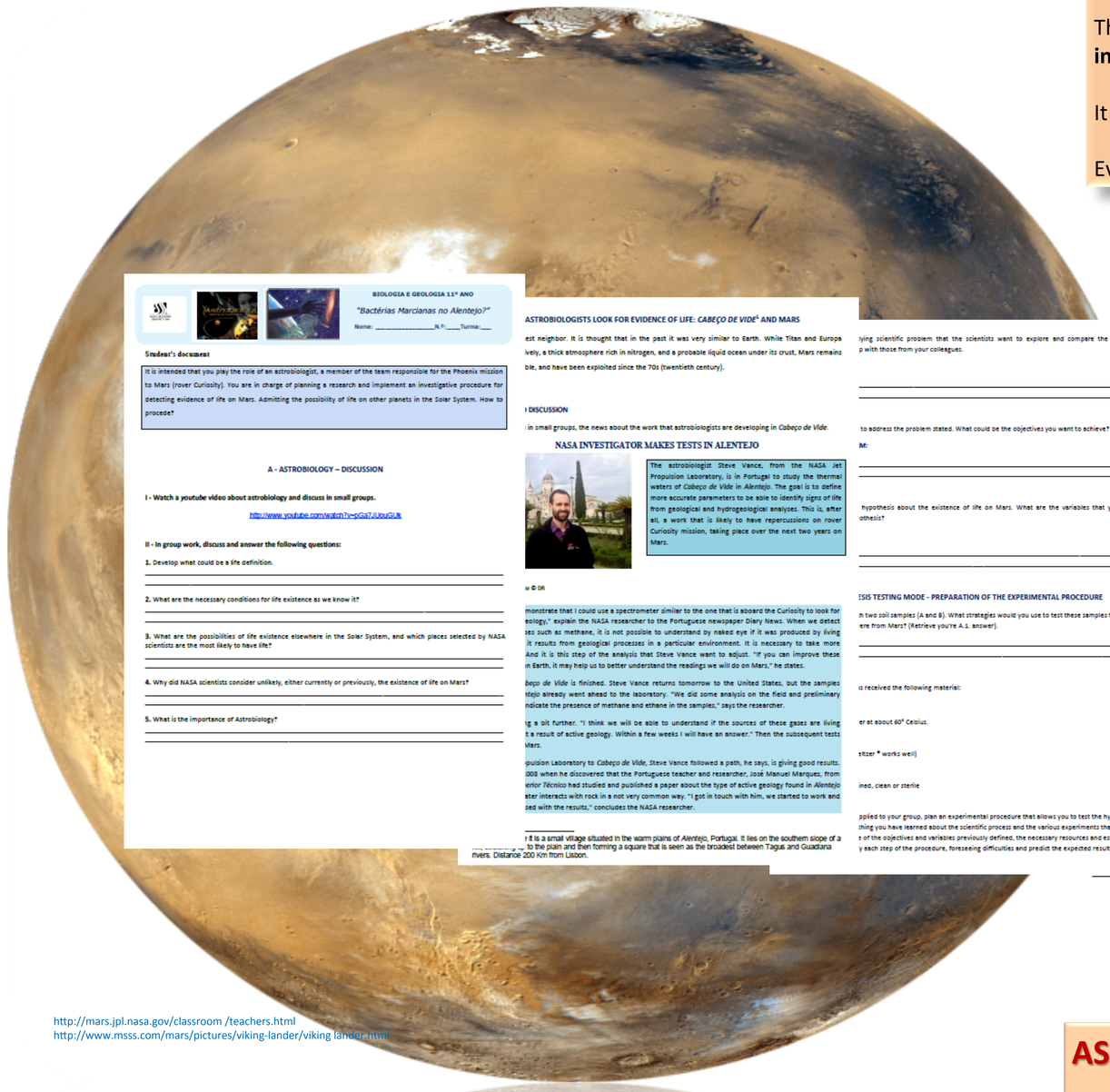
CASE STUDY: *MARTIAN BACTERIA IN ALENTEJO?*

Inquiry assignment designed in the context of **astrobiology** and the experiments carried out by ***Viking Landers*** on **planet Mars** in the seventies. [2,3,4].

Challenging context
Transdisciplinary work
Understanding of inquiry process

ASSESSMENT OPPORTUNITIES

Students' assessment could be based on aspects such as:
- **Understanding the terms and concepts involved;**
- **The rigor in the development of the experiments and the handling of materials;**
- **The accuracy of data register;**
- **The adequacy of the proposed Protocol, namely in terms of the possibility of being tested experimentally and to answer back the question.**



BIOLOGIA E GEOLOGIA 11º ANO

"Bactérias Marcianas no Alentejo?"

Nome: _____ N.º:____ Turma:___

Student's document

It is intended that you play the role of an astrobiologist, a member of the team responsible for the Phoenix mission to Mars (rover Curiosity). You are in charge of planning a research and implement an investigative procedure for detecting evidence of life on Mars. Admitting the possibility of life on other planets in the Solar System. How to proceed?

A - ASTROBIOLOGY – DISCUSSION

I - Watch a youtube video about astrobiology and discuss in small groups.

http://www.youtube.com/watch?v=pGal7JUouGUk

II - In group work, discuss and answer the following questions:

1. Develop what could be a *life* definition.
2. What are the necessary conditions for life existence as we know it?
3. What are the possibilities of life existence elsewhere in the Solar System, and which places selected by NASA scientists are the most likely to have life?
4. Why did NASA scientists consider unlikely, either currently or previously, the existence of life on Mars?
5. What is the importance of Astrobiology?

ASTROBIOLOGISTS LOOK FOR EVIDENCE OF LIFE: *CABEÇO DE VIDE*[1] AND MARS

est neighbor. It is thought that in the past it was very similar to Earth. While Titan and Europa ively, a thick atmosphere rich in nitrogen, and a probable liquid ocean under its crust, Mars remains ble, and have been exploited since the 70s (twentieth century).

DISCUSSION

in small groups, the news about the work that astrobiologists are developing in *Cabeço de Vide*.

NASA INVESTIGATOR MAKES TESTS IN ALENTEJO

The astrobiologist Steve Vance, from the NASA Jet Propulsion Laboratory, is in Portugal to study the thermal waters of *Cabeço de Vide* in *Alentejo*. The goal is to define more accurate parameters to be able to identify signs of life from geological and hydrogeological analyses. This is, after all, a work that is likely to have repercussions on rover Curiosity mission, taking place over the next two years on Mars.

© DR

monstrate that I could use a spectrometer similar to the one that is aboard the Curiosity to look for eology," explain the NASA researcher to the Portuguese newspaper Diary News. When we detect ses such as methane, it is not possible to understand by naked eye if it was produced by living it results from geological processes in a particular environment. It is necessary to take more And it is this step of the analysis that Steve Vance want to adjust. "If you can improve these n Earth, it may help us to better understand the readings we will do on Mars," he states.

beço de Vide is finished. Steve Vance returns tomorrow to the United States, but the samples tejo already went ahead to the laboratory. "We did some analysis on the field and preliminary ndicate the presence of methane and ethane in the samples," says the researcher.

g a bit further. "I think we will be able to understand if the sources of these gases are living t a result of active geology. Within a few weeks I will have an answer." Then the subsequent tests Mars.

pulsion Laboratory to *Cabeço de Vide*, Steve Vance followed a path, he says, is giving good results. 008 when he discovered that the Portuguese teacher and researcher, José Manuel Marques, from erior Técnico had studied and published a paper about the type of active geology found in *Alentejo* ster interacts with rock in a not very common way. "I got in touch with him, we started to work and ed with the results," concludes the NASA researcher.

lying scientific problem that the scientists want to explore and compare the problem p with those from your colleagues.

to address the problem stated. What could be the objectives you want to achieve?

M:

hypothesis about the existence of life on Mars. What are the variables that you must othesis?

ESIS TESTING MODE - PREPARATION OF THE EXPERIMENTAL PROCEDURE

h two soil samples (A and B). What strategies would you use to test these samples for ere from Mars? (Retrieve you're A.1. answer).

s received the following material:

er at about 60º Celsius.

ditzer ® works well)

ined, clean or sterile

pplied to your group, plan an experimental procedure that allows you to test the hypothesis thing you have learned about the scientific process and the various experiments that you s of the objectives and variables previously defined, the necessary resources and estimated y each step of the procedure, foreseeing difficulties and predict the expected results.

dure: compare the procedure proposed by your group with the procedures presented by other nclusions do you make about its correctness / errors / improvements needed?

ting your experiment, discuss how and what are the results you will measure / quantify and ou will communicate the results to the other groups.

III - IMPLEMENTATION OF THE EXPERIMENTAL PROCEDURE

ials not provided:

procedure:

measurements:

results/conclusions:

If it is a small village situated in the warm plains of *Alentejo*, Portugal. It lies on the southern slope of a to the plain and then forming a square that is seen as the broadest between Tagus and Guadiana rivers. Distance 200 Km from Lisbon.

http://mars.jpl.nasa.gov/classroom /teachers.html
http://www.msss.com/mars/pictures/viking-lander/viking lander.html

INTRODUCTION

The scientific study of the origin of life remains one of the greatest unanswered scientific questions in the twenty-first century. The study of life origins must integrate and articulate the contributions from diverse scientific fields, such as biology, geology, chemistry, geophysics, and astronomy, among others.[1]

LEARNING SEQUENCE

For **Secondary Education students** (11th grade - course of science and technology).

Involved **Biology and Geology** curricular areas and "Diversity in the Biosphere" and "Classification and Taxonomy" themes.

It consisted of **Five lessons** (**150 min** each).

IMPLEMENTATION

I**nvolved 45 students**, ranging from **15 to 17 years old**, and extended over two weeks.

A **problem-situation** [5,6] was given to students, who worked in **small groups** (3-4 elements).

The task included four **inquiry skills**, namely: **diagnosing a problem**, **planning and implementing an investigation** and **peer debate.**

It was built **a specific rubric for each one of the skills**, allowing marking students' answers.

Evaluation: **class observations** and **teacher and students' written records**

ASSESSMENT INSTRUMENT

[1] Assessment instrument - *Diagnosing a Problem* and *Peer Debate*

SKILL	INVOLVED OPERATIONS	DESCRIPTORS (PERFORMANCE LEVELS 1, 2 AND 3)	
DIAGNOSE PROBLEMS	1. Identify a specific question	1. Identifies a specific question to be answered and frames it	1. Does not identify a specific question
	2. S… expl…		
	3. F…		
	4. F…		
	5. P… argu…		

SKILLS	INVOLVED OPERATIONS	DESCRIPTORS (PERFORMANCE LEVELS 1, 2 AND 3)	
DEBATE AMONG PEERS: COMMUNICATE RESULTS	1. Present results	1. Presents results in an appropriate format with correction	1. Does not present the results
	2. Inte…		
	3. Co… gener…		
	4. Pro…		

[2] Assessment instrument – *Planning an Investigation*

SKILLS	INVOLVED OPERATIONS	DESCRIPTORS (PERFORMANCE LEVELS 1, 2, 3 AND 4)	
PLAN AN INVESTIGATION	1. Define goals	A. Defines coherent goals according to the problem	1 – Does not define goals 2 – Defines coherent goals according to the problem 3 – Defines coherent goals according to the problem but does not include them all 4 – Defines coherent goals according to the problem
	2. Operationally define variables	B. Operationally defines the variables of the proposed study	1 – Does not define the variables proposing to be studied 2 – The variables are inaccurately defined 3 – Operationally defines some of the variables proposing to be studied 4 – Operationally defines the variables proposing to be studied
	3. Define strategies and procedures to achieve those goals	C. Defines strategies and procedures that enable him/her to achieve the goals	1 – Does not define strategies or procedures 2 – Defines strategies and procedures that do not enable him/her to achieve the goals 3 – Defines strategies and procedures that enable him/her to achieve some of the goals 4 – Defines strategies and procedures that enable him/her to achieve the goals
	4. Conceive and experimental design that allows variable control	D. Experimental design includes control variables	1 – In the experimental design does not include control variables 2 – In the experimental design includes inaccurate control variables 3 – In the experimental design includes some appropriate control variables 4 – In the experimental design includes appropriate control variables
	5. Know and chose adequate resources (e.g.: instruments, materials, conditions, observations, etc.)	E. Chooses appropriate resources according to the goals and strategies	1 – Does not choose resources 2 – Does not choose the adequate resources according to the goals and strategies 3 – Does not choose all the adequate resources according to the goals and strategies 4 – Chooses all the adequate resources according to the goals and strategies

ASSESSMENT

- **BEFORE CLASS**
  1. Built an assessment instrument: operations, performance levels, weighing; Main focus: diagnosing problems, planning an investigation, peer debate .
  2. Adapt to students and to the context.
- **IN CLASS**
  1. Clarify the assessment criteria;
  2. Apply a semantic differential to students.
- **AFTER CLASS**
  1. Assess students' productions and produce a written feedback;
  2. Reflect on the assessment process.

FINAL REMARKS

The instrument applied allowed us to evaluate the established competences.
It was of easy applicability and feasible in other similar contexts.
In the process, we realize that the performance levels had to be more detailed.

The oral feedback given during classes and the final written feedback were fundamental for students to gain a broader comprehension of what was expected, and an opportunity to discuss the work of their colleagues and to reformulate their own work before implementation.

This way, they had the opportunity to experiment and go through the several steps of the scientific process and became aware of their lesser strong points in order to improve their work.

References
1. Pereira, L., Rodrigues, T., Carrapiço, F. (2012). A Symbiogenic Way in the Origin of Life. In J. Seckbach (ed.), *Genesis – In The Beginning: Precursors of Life, Chemical Models and Early Biological Evolution*, *Cellular Origin, Life in Extreme Habitats and Astrobiology*, 22, 4-36. Springer.
2. Bybee, R. (1997). *Achieving scientific literacy. From purposes to practices.* Portsmouth, NH: Teachers College Press.
3. Harlen, W., & Allende, J. (2006). *IAP Report of the Working Group on the International Collaboration in the Evaluation of IBSE programs.* Fundación para Estudios Biomédicos Avanzados, Facultad de Medicina, University of Chile.
4. Linn, M. C., Davis E.A., & Bell, P. (2004). *Internet Environments for Science Education. Mahwah, NJ.: Lawrence Erlbaum Associates.*
5. Holbrook, J. & Rannikmae, M. (2013). *The Nature of Science Education*. Tartu, University, Estonia. IBSE - Workshop 3, Lisbon, Portugal.
6. Galvão, C. (2013). *Inquiry Concept, National and International Importance.* IBSE- Workshop 2, Lisbon, Portugal.

Strategies for Assessment of Inquiry Learning in Science

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 289085