

Astrobiology in Nigeria: The Challenges of NASRDA

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Abstract: Astrobiology is a space science discipline that studies the dawn of life and its distribution in the universe. In Nigeria, the study and scientific research on Astrobiology has its challenges which impede scientific growth and development. The Astrobiology Unit of the Centre for Basic Space Science (CBSS), National Space Research and Development Agency (NASRDA) identified these challenges and made recommendations capable of promoting Astrobiology in Nigeria and beyond. The challenges of the unit include data integrity, unavailability of Astrobiology laboratories, lack of collaboration with Nigerian Universities because they don't offer part or full-time courses in Astrobiology, absence of an Astrobiology Institute in Nigeria and paucity of awareness about Astrobiology to the general public. The awareness level of Astrobiology to the general public was identified in this paper using two quantitative research surveys. The first survey was combined among the staff of CBSS-NASRDA and the University community of the University of Nigeria (UNN). The second survey was among students from senior secondary classes in sixteen selected schools. The sample size (n) for the survey was generated using the standard Fisher's formula and a sample size of 968 was used. The recommendations of the unit include the introduction of Astrobiology as an emerging field of science to the Nigerian Universities Commission (NUC) by NASRDA, the incorporation of Astrobiology laboratories across different NASRDA Centres, the establishment of a National Institute of Astrobiology through inter-ministerial collaborations, and incorporation of Astrobiology awareness in NASRDA outreach activities.

Keywords: Astrobiology, Life, Awareness Survey, CBSS, NASRDA

1. Introduction

Astrobiology is a scientific discipline that seeks to answer essential questions about the genesis of life, its adaptability and evolution. According to Thombre et al. [14], Astrobiology is an interdisciplinary scientific field that studies the origin, evolution, distribution and future of life in the universe. National Aeronautics and Space Administration (NASA) Astrobiology Institute [9] opined that Astrobiology is a scientific field that requires an integrated understanding of biological, geological, planetary and cosmic phenomena. The genesis and early evolution of life are an integral part of the discipline astrobiology. Panspermia, RNA world and Hydrothermal vent theories are part of the major origin of life theories in Astrobiology geared to satisfy human curiosity

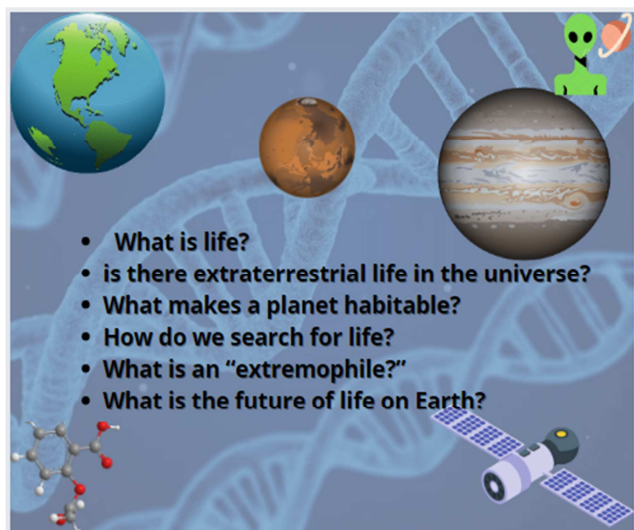
about our existence. Astrobiology as an interdisciplinary scientific field encompasses research on the origin of planetary systems, rock-water-carbon interactions, the origin of organic compounds in space, abiogenesis on Earth, planetary habitability research on biosignatures for life detection, and studies on the potential for life to adapt to challenges on Earth and outer space [3-5].

Critical questions on Astrobiology are shown below in Figure 1.

The study of Astrobiology for the first time presented our generation with a unique privilege to search for life in our solar system and beyond. Globally, the current focus is on the search for candidate nonintelligent microbial forms. Scientists are optimistic about the possibility of an alien civilization in the universe and are working on various means

to detect and initiate contact with extraterrestrials [8]. According to the University of Washington [15], some space missions focused on exploring worlds in our solar system for signs of past, present or precursors of life on Mars include Phoenix, Pathfinder and Global surveyor, while on Titan (Cassini-Huygens). Furthermore, the curiosity and perseverance rovers on Mars are searching for evidence of ancient life as well as plains related to primeval rivers or lakes that may have been habitable [10, 11, 13]. The significant advances in telescope technology (Kepler, James Webb Space Telescope) have allowed researchers the opportunity to search for habitable planets outside our solar system and in deep space.

In Nigeria, Astrobiology is an undermined field of study which needs expeditious exploration. This novel field will engage various Centres/ laboratories in the National Space Research and Development Agency (NASRDA) for scientific and innovative expeditions. The mandate of CBSS entails the development of skills and knowledge of scientific officers, this is a rare opportunity to promote the Agency globally.



Source: Astrobiology Unit, CBSS-NASRDA

Figure 1. Critical Questions on Astrobiology.

2. The Challenges

Astrobiology is an emerging science and various space institutions across the globe are currently exploring its theories. Space agencies like NASA, European Space Agency (ESA) and China National Space Administration (CNSA) are renowned for various Astrobiological research and experiments. According to Domagal-Goldman et al. [6], Astrobiology extends past "the search for life beyond Earth", instead, it's a discipline that also develops our capability to conduct and understand the results from a search for life elsewhere. In Africa, only a few countries like South Africa, Botswana and Zambia are currently exploring this novel field to understand the origin of life in the universe.

In 2022, NASRDA Nigeria through CBSS instituted its Astrobiology Unit. The Unit as part of its enormous obligations

is mandated to ensure that Astrobiology becomes a brand name in the Nigerian space sector and institutions. Currently, the Unit harnesses its data for scientific research and publication from NASA and ESA data archives. The major challenge faced by this Unit is data integrity. Apart from mining space data generated using satellites and probes from other space agencies, Nigeria has the essentials to explore its environments of biotic and abiotic sources of organic compounds. Furthermore, the Unit can also explore extremophiles, biosignatures, habitable worlds and the synthesis/ function of macromolecules in the genesis of life. These researches will be based on the major Astrobiology theories.

The unavailability of Astrobiology laboratories has been a major challenge because Astrobiology requires a serene environment to achieve positive results. The unavailability of these labs has undermined the study of biodiversity and the search for candidate extremophiles that can be of therapeutic use. These laboratories can be used to study ancient life and its increasing intricacies. The major scientific research collaborators of agencies like NASRDA are the Universities. Unfortunately, Nigerian Universities are yet to adopt Astrobiology as a course or as a preliminary subject in the biological, natural or physical sciences. The unavailability of Astrobiology as a course of study has hindered tremendous scientific research in this novel field of study and impedes Nigerians from engraving their names on the book of discoveries.

There are various Astrobiology institutes like the NASA Astrobiology Institute (NAI), European Astrobiology Institute (EAI), Australian Centre for Astrobiology (ACA) and the Indian Astrobiology Research Centre (IARC). The unavailability of an Astrobiology institute in Nigeria has hindered the development of research infrastructures, inter-country data sharing, data management plans, the share of intellectual property, and the share of technology and innovations. According to Aydinoglu et al. [1], even though sharing of data has its barriers, its benefits are enormous which include reanalysis to authenticate results, reinterpretation of data using alternate disciplinary methods, preservation of data integrity, circumvention of redundant data collection and use of data as a tutoring tool for beginners.

The CBSS Astrobiology Unit in January 2022 carried out two quantitative research surveys on the awareness of Astrobiology in Nsukka. The first survey was combined among the staff of CBSS and the University community of the University of Nigeria (UNN). The second survey was among students from senior secondary classes in sixteen selected schools. For sample size determination (n), the study population is unknown, the study generated its sample size using the standard Fisher's formula [7] where $p = 0.5$, as modified by Onsong and Kiarie [12] shown in Equation 1. The Sample size was calculated as follows:

$$n = \frac{Z^2 pq}{d^2} \quad (1)$$

Where n = sample size

Z = standard deviation which corresponds to confidence

interval (1.96).

p = proportion of the study population having the characteristics.

$q = (1 - p)$

d = degree of precision i.e., the margin of error that is acceptable (0.05).

Therefore;

$$n = 1.96^2 \times 0.5 \times 0.5 / (0.05)^2$$

$$n = 3.8416 \times 0.25 / 0.0025$$

$$n = 384$$

From the formula above, the sample size for each of the two survey groups is $n = 384$. The sample size used for the first survey was 400 participants, while the second survey was 568 participants. The survey adopted a cross-sectional research design.

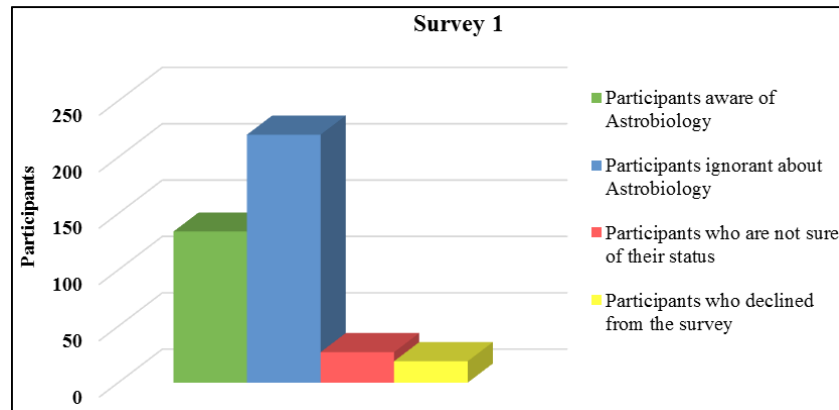


Figure 2. Astrobiology Awareness Survey amongst CBSS Staff and the University community, UNN.

The results from the first survey as shown in Figure 2 show that only 134 (33.5%) of the participants knew about Astrobiology, 220 (55%) of the participants are ignorant about Astrobiology, 27 (6.75%) of the participants are guessing their awareness about astrobiology while 19 (4.75%) of the participants declined to participate.

Astrobiology were 183 (67.77%), the participants who guessed their awareness of Astrobiology were 26 (9.62%), while the participants who declined to participate were 14 (5.18%).

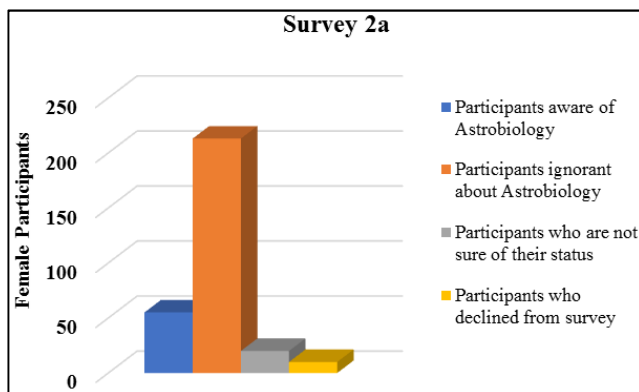


Figure 3. Astrobiology Awareness Survey Among Female Participants.

The second survey among the senior secondary school students involved both male and female participants. The total number of female participants was 298, while the male participants were 270. Figures 3 and 4 show the awareness of Astrobiology among the female and male participants, respectively. Figure 3 shows that 55 (18.45%) of the participants knew about Astrobiology, 213 (71.47%) of the participants are ignorant of Astrobiology, 20 (6.71%) of the participants guessed their awareness about astrobiology while 10 (3.35%) of the participants declined to participate. Figure 4 shows that participants with prior knowledge of astrobiology were 47 (17.40%), the participants who are ignorant about

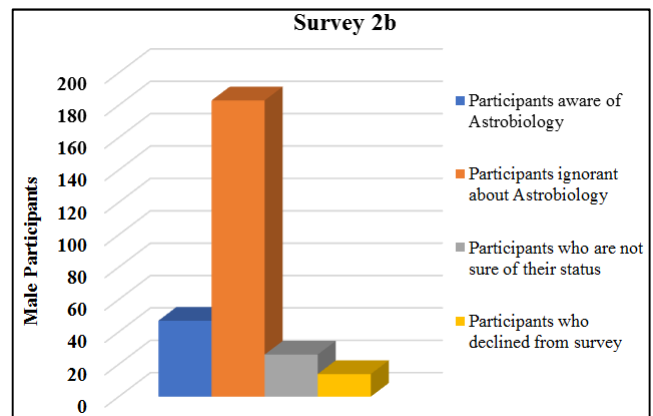


Figure 4. Astrobiology Awareness Survey Among Male Participants.

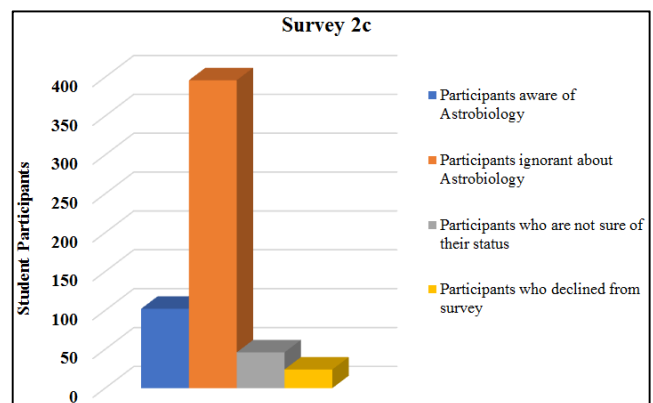


Figure 5. Cumulative Astrobiology Awareness Survey Among Student Participants.

Figure 5 shows a cumulative chart of the Astrobiology awareness survey among both female and male participants. The chart shows that the awareness level among the students was 102 (17.96%), 396 (69.72%) of the students were ignorant about the discipline, 46 (8.10%) of the students were uncertain about their awareness of astrobiology, while 24 (4.22%) of the students declined to participate.

The survey provided an insight into the awareness level of Astrobiology in Nsukka and it was statistically low. The survey observed that most of the participants who declined to participate were ignorant of Astrobiology. The findings of this survey concur with Baratoux et al. [2] that Africa has enormous potential to provide insights into planetary and space sciences, but it has remained largely untapped because it's underrepresented.

3. Conclusion

The exploration of Astrobiology is unique and will help scientists to understand our universe better. The study of Astrobiology will help in Earth's planetary protection because it's currently the only known planet that hosts life. Also, the exploration of Astrobiology will promote NASRDA and present its scientists with the privilege of novel scientific discoveries.

4. Recommendations

NASRDA, Nigeria should introduce Astrobiology as an emerging field of science to the Nigerian Universities Commission (NUC). This should be incorporated into the University system as a course of study or preliminarily as a subject in biological, natural and physical sciences. This will help to provide the future generation with a detailed understanding of our universe.

The Agency should incorporate Astrobiology laboratories across different NASRDA Centres to help develop and grow this field of space science. This will prompt more scientific research, development and findings, which will also promote the understanding of space science.

NASRDA, Nigeria should through its inter-ministerial collaborations establish the "National Institute of Astrobiology" which will serve as a special regulatory body for Astrobiology experiments and scientific research.

The Agency should incorporate Astrobiology awareness and education in its outreach activities to secondary and tertiary institutions. CBSS, Nsukka hosts the West African Regional Office of Astronomy for Development (WAROAD) which is an avenue for proper publicity across West Africa.

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