BRINGING AUTHENTIC STEM EXPERIENCES TO K-14 STUDENTS: ASTROBIOBOUND! THE SEARCH FOR LIFE IN THE SOLAR SYSTEM

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Introduction: The NRC Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas [1] and the Next Generation Science Standards (NGSS) [2] have infused new and dynamic capabilities for teaching and learning science. The interdisciplinary nature of NGSS allows teachers to bring more authentic questions and challenges to their students and fosters an environment that will help students understand how science really works in the world (the nature of science). This is an important step in the effort to produce a more science literate nation.

Injecting Engineering into the Science Classroom: NGSS introduced many changes for teachers. However, most of these changes did not produce the level of angst that the inclusion of engineering in the science classroom did. Most existing science curriculum does not include or teach engineering concepts. The professional development training that most science teachers receive does not give them the knowledge and understanding necessary to teach engineering at the level NGSS is now requiring.

NASA’s Opportunity to Support Science Education: NASA Science Mission Directorate (SMD) has a great opportunity to engage classrooms in authentic STEM experiences by sharing their big science questions and challenges. In this case, Astrobiobound! introduces the question, “Are we alone?” NASA SMD has the capability of providing compelling “real world” (or out-of-this-world) examples of how engineering enables the advancement of science. Using science as a context to help students engage in the engineering practices and engineering disciplinary core ideas laid out by NGSS is an essential step to students’ understanding of how science drives engineering and how engineering enables science. Real world examples and applications are critical for students to see how these disciplines are integrated. Furthermore, the interface of science and engineering raise the level of science understanding, and facilitate higher order thinking skills through relevant experiences.

Astrobiobound! The Search for Life in the Solar System curriculum is not only aligned but more importantly designed for NGSS and College and Career Readiness Standards. In addition, students are immersed in and build upon 21st Century workforce development skills [3] such as incorporates 21st Century Skills such as critical thinking and problem solving, communication and collaboration, information literacy, and flexibility and adaptability when applying their scientific knowledge and reasoning skills to new areas of study. Students will practice and develop these skills throughout this simulation.

Astrobiobound! helps students see how science and systems engineering are integrated to achieve a focused scientific goal. Students engage in the engineering design process to design a mission to an astrobiologically-interesting target which requires them to balance the return of their science data with engineering limitations such as power, mass and budget. Risk factors also play a role during this simulation and add excitement and authenticity to this simulation.

Astrobiobound! presents the authentic first stages of NASA mission design process. This simulation mirrors the NASA process in which the science goals, type of mission, and instruments to return required data to meet mission goals are proposed within mission budget before any of the construction part of engineering can begin.

The Development of Astrobiobound! Astrobiobound reflects best practices in education [4] and uses pedagogical approaches that are rooted in education research. The lessons were developed following the Biological Sciences Curriculum Study (BSCS) 5E learning cycle [5] and are structured to enable teachers and students without deep knowledge of planetary geology or solar system objects to have a successful experience. Astrobiobound! is flexible and allows for many avenues of investigation that connect with the traditionally taught disciplines, such as Earth science, biology and chemistry [6]. To better meet the needs of teachers desiring to use Astrobiobound! in their classroom, the ASU Mars Education Team has expanded their professional development to provide more resources with include step-by-step lesson plan instructions which are designed to give better insights and overviews as to the the lesson components and additional resources available (e.g., “How-to-teach Astrobiobound” Powerpoint and an Overview Powerpoint for use with their students,. The ASU Mars Education staff also maintains virtual office hours to be available as the need arises for quick responses to teachers’ needs. All of the materials to implement Astrobiobound! are available online. Astrobiobound! is currently being submitted to NASA SMD Product Review.
To ensure the accuracy of the content and mission concepts, NASA Astrobiology scientists and engineers were consulted in the development of this curriculum to make sure Astrobiobound! is an authentic simulation of their mission proposal process.

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References: