Astrobiology in a High School Curriculum: Selecting and Evalutating Useful Skills while Maintaining Student Interest. A. Z. Krug[1]. [1]The Pennsylvania State University, University Park, PA 16802

Introduction: As the field of astrobiology advances, engagement with students at the high school level is increasingly necessary in order to recruit students into college programs. However, due to the complexity of the material and rapid advancements in the field, evaluating students solely on content becomes counterproductive, as a) the material is beyond the level of understanding of the students and risks alienating even high-level students, and b) the pace of advancement in the field will make a lot of content obsolete by the time students revisit the material in college or graduate school. Here, I suggest that astrobiology content is best introduced in secondary education through project-based learning that utilizes the astrobiological concepts to develop a set of scientific skills not found in other courses. For the past two years, I have led a high school course entitled *Evolution of the Biosphere* at Flint Hill School, and independent school in Northern Virginia. The focus and content covers the spectrum of astrobiological topics, from the initiation of life on Earth to mass extinction events. The goal of the course is to develop scientific skills that prepare students to engage scientists, keep up with new discoveries, and communicate effectively with others.

Structure The *Evolution of the Biosphere* course is designed to model the experiences of a first year graduate student looking for a potential dissertation. The goal is for students to discover on their own what has been discovered, which scientists are actively researching those topics, and what future avenues of research are available. The semester is broken up into five units, each of which is involves long-term, collaborative project. Units include 1) the origin of the solar system, Earth's place in the habitable zone and the possibility of life in the solar system and on extrasolar planets, 2) the origin of life on Earth, the LUCA, and interpreting gene trees; 3) early Earth climates, including Snowball Earth, the Rise of Oxygen, and the Faint Young Sun Paradox; 4) Early Earth biospheres, including Ediacara and Burgess, and 5) Mass Extinctions. Class time is dedicated to student collaboration and exploration. Each unit ends with a presentation, focusing on a different method of communication commonly used by scientists, including poster presentations, abstracts, scientific papers, and blogs, none of which are familiar to high school students. The goal is to introduce students to the experience of a scientific conference, a skill set rarely introduced in high school courses.

Skills and Evaluation Skills assessed in every unit are a) discovery and interpretation of the scientific literature (only peer-reviewed journals are permitted in the course); b) identifying major scientists and summarizing their contributions; c) interpreting and reproducing scientific graphs and data; and d) determining important gaps in knowledge and proposing future avenues of research. Though content is never directly assessed, the ability to accurately discuss the contributions of individual scientists and to display, interpret, and defend graphs and data demands that students master it. However, because the students are free to explore the topics in whatever direction they desire, each unit is tailored to the students' own interest and the content is far less intimidating. Throughout every unit, each group must make public progress reports to the class describing their discoveries and any gaps in their progress or understanding. The purpose here is to simulate a professional lab meeting. The class is evaluated on its ability to ask questions and make suggestions. Because every group's project is related, this process of peer-review forces students to apply their own research to the work of their colleagues. Each group also has private meeting times in class to discuss their progress with the instructor. The groups are graded on progress and effort here, so students can be proactive in seeking help and developing their understanding of the content.

Evaluating the Success of the Course The *Evolution of the Biosphere* course has run for two years, and enrollment from year one to two tripled. Roughly one-third of the students have applied for summer internships at NASA, and three have pursued active research with NASA-related scientists in their first year in college. One pursued a month-long senior project with a NASA scientist and was honored by the school for his success. Though the sample-size is small, the positive reaction of students despite the high demands of the course is a positive sign for the future.