TRANSFORMING THE ONLINE CLASSROOM VIA AN INNOVATIVE ASTROBIOLOGY COURSE. L. B. Horodyskyj[1], S. R. Buxner[2], D. Ben-Naim[3], S. Semken[1], A. D. Anbar[1]. [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ (LevH@asu.edu), [2]Teaching, Learning, and Sociocultural Studies, University of Arizona, Tucson, AZ, [3]Smart Sparrow, Sydney, Australia.

Introduction: Traditional large lecture classes are fundamentally passive and teacher-centered. Most existing online courses are as well, including massive open online courses (MOOCs). Research tells us that this mode of instruction is not ideal for student learning. The unique attributes of the online environment have thus far been mostly underutilized. We hypothesize that new tools and the innovative curricula they enable can foster greater student engagement and enhance learning at large scale.

Course Structure: Over the past three years, Arizona State University developed and offered Habitable Worlds, an online-only introductory-level astrobiology lab course. The course curriculum is based on the Drake Equation, which integrates across disciplines. The course pedagogy is organized around a term-long, individualized, game-inspired project in which each student must find and characterize rare habitable planets in a randomized field of hundreds of stars using concepts learned in the course. The curriculum allows us to meaningfully integrate concepts from Earth, physical, life, and social sciences in order to address questions related to the possibility of extraterrestrial life. The pedagogy motivates students to master concepts, which are taught through interactive and adaptive inquiry-driven tutorials, featuring focused feedback and alternative pathways that adjust to student abilities, built using an intelligent tutoring system (Smart Sparrow's Adaptive eLearning Platform - AeLP). Through the combination of the project and tutorials, students construct knowledge from experience, modeling the authentic practice of science. Because the tutorials are self-grading, the teaching staff is free to dedicate time to more intense learner-teacher interactions (such as tutoring weaker students or guiding advanced students towards broader applications of the concepts), using platforms like Piazza and Adobe Connect.

Initial Results: The AeLP and the design of our course allow us to record and analyze a significant amount of data on how students interact with lessons. Initial high-level analyses of the data from the recently completed Fall 2013 term show several interesting patterns that inform us when adapting the exercises for future use. High median completion times and low completion rates for certain activities allow us to identify problematic questions to target for redesign. For example, we have discovered that students have difficulty with the concept of light-matter interactions throughout the course. Interactions between instructor and students in weekly live chats and on the class discussion board did not indicate significant problems with the concept. However, the frequency and persistence of certain mistakes in exercises related to the concept indicated persistent weaknesses with this topic. This information allows us to target exercises focusing on this concept for redesign or resequencing before offering the course again.

Pre- and post-tests were also administered. Students completed pre- and post-surveys on their attitudes towards science. Initial results show that students have a positive view of science and their ability to participate in the endeavor, and these attitudes show little change during the term. However, we see a significant shift in student attitudes towards what science is: a set of procedures that allow us to understand our universe, and not just the information that those procedures have allowed us to discover.

Pre/post-tests were also administered in association with lessons about the greenhouse effect and its relationship to planetary habitability. Pre-test results show the expected misconceptions on the cause of the greenhouse effect (humanity, rather than a natural result of light-atmosphere interactions) and specific details of the process (carbon dioxide as the major greenhouse gas rather than water vapor, ultraviolet radiation as the major cause of the greenhouse effect rather than infrared radiation). We see significant improvements in student knowledge of the greenhouse effect and its specifics after completion of the activity. However, retention surveys carried out at the end of the class indicated that many of the gains did not last.

Conclusion: Our innovative and interactive course design, coupled with a powerful engine for delivering the content and recording student interactions with it, gives us significant insight into student misconceptions and the effectiveness of our pedagogy in correcting those misconceptions. The flexibility of the AeLP platform allows us to quickly redesign problematic content, which can be discovered through analysis of the student data. Students consistently give the course high marks in terms of novelness, interest, and instructor availability.