# Bringing Exoplanet Habitability Investigations to High School Mary Anne Woody<sup>1</sup>, Linda Sohl<sup>2</sup>

At its core, habitability is a temperature-dependent quality that is introduced and **A. Introduction** Habitability, a.k.a. habitat suitability, is a explored during the Energy unit. Students conducted a research project with the goal of topic typically discussed in Biology class. We present here a determining the habitability state for a chosen exoplanet. curriculum unit that introduces the topic of global-scale Classroom implementation was modeled after the CCRI scientist-mentor's actual planetary habitability in a Physics classroom, allowing research plan. Students first discussed 4 basic habitability factors and explored these students to emulate the process of doing cutting-edge variables through climate modeling software. Students then chose an exoplanet to science and re-framing an otherwise "typical" physics unit evaluate using these habitability factors, an activity that required them to perform in a more engaging and interactive way. authentic research on the exoplanet and its host star.

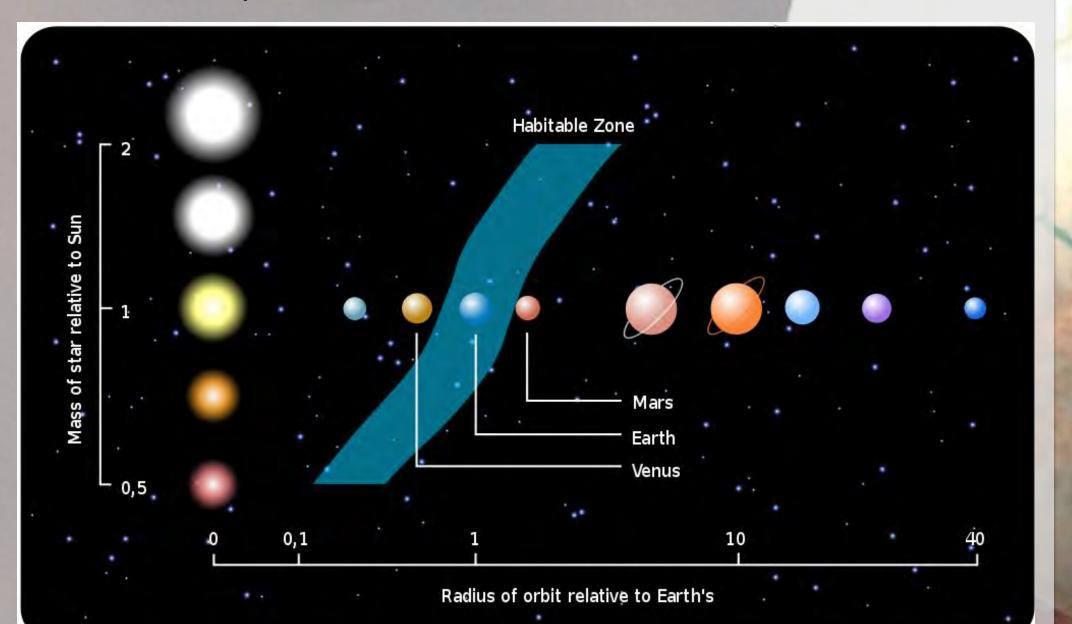
## **B. CCRI Program**

**Program Overview:** The NASA GISS Climate Change Research Initiative (CCRI)<sup>1</sup> provides an opportunity for STEM educators to work directly with NASA scientists, lead research teams, and develop STEM curricula for their current classes.

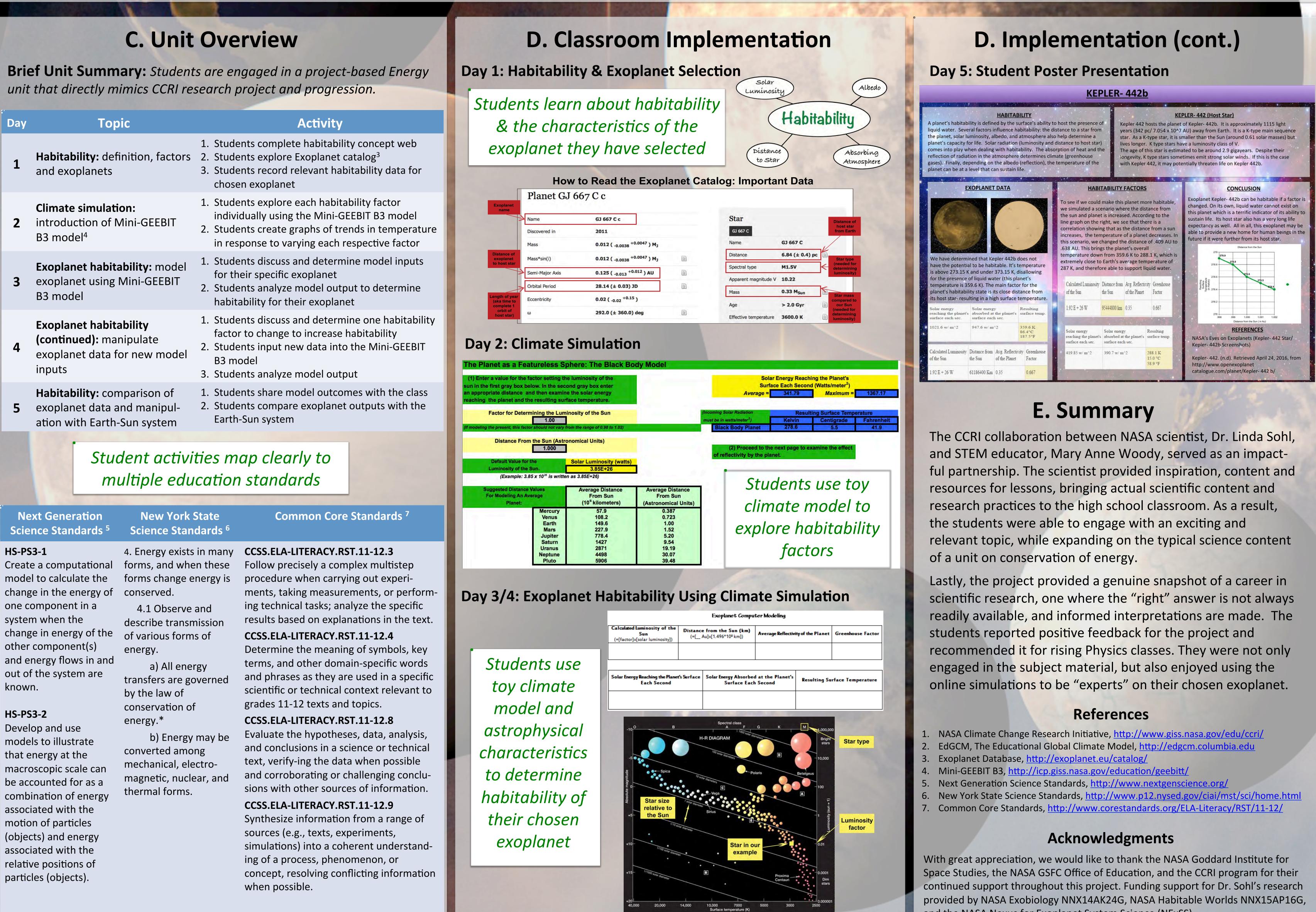
Fall	Spring	Summer
rimary Research Team	Conduct Research/Design Curriculum/Outreach	Expand Teams & Finalize Research Output
GISS Mentors	Focus is for mentor to oversee and participate th research and design process.	
Graduate Interns	Focus is to conduct and implement research plan while collaborating with teacher researcher.	Primary Research Team + Undergraduate + High School Student
Teacher Researcher	Focus is to conduct research and design STEM curriculum and perform education outreac	h. COMprehensive Science Research Poster
CC	RI Benefits:	Climate Science PowerPoint Presentation at GISS
k k	onger terms with specialized one to one focus etween GISS Mentors, Graduate Interns and Teacher esearchers allowing for development of research nd curriculum.	Applied Research STEM Curriculum Unit Portfolio Final Research Paper
a	xternal mentors can choose their research teams lowing them to customize the focus of their research nd continue to support NASA education goals.	(CUNY CREST STEM Symposium)

**Research and Methods:** The research project that inspired the unit plan described here involved the exploration of various factors that can influence an Earth-like planet's habitability state. A planet is considered potentially habitable for life as we know it if the planet receives enough energy from its host star to maintain liquid water on its surface (0°C < t<sub>surf</sub> < 100°C).

The habitable zone (HZ) marks that orbital region around a star where the planet is neither too warm nor too cold for life as we know it. The CCRI team used EdGCM<sup>2</sup>, an educational version of the NASA/GISS global climate model, to conduct experiments exploring orbital constraints on habitability. This project is an offshoot of funded research exploring the history of habitability in the Solar System.



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Students also developed hypotheses about factors beyond currently available mission data, such as atmospheric composition and surface albedo of their exoplanet. They then used the modeling software to collect data, test hypo-theses, and draw conclusions. Lastly, students communicated their findings in a poster session and presentation at the high school's annual science symposium.

By bringing actual science and research practices to the classroom, the students were not only more actively engaged with the required Physics course content, but also gained a better understanding of how scientific research is done.



and the NASA Nexus for Exoplanet System Science (NExSS).