YALE NATIONAL INITIATIVE
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Curriculum Units by Fellows of the National Initiative
2022 Volume IV: Alien Earths

Introduction

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"Are we alone?" and "Are there other planets like the Earth?" are two questions that are often asked. The "Alien Earths" seminar tried to address these questions. In the seminar, we examined other planets in the solar system and compared and contrasted them to Earth to examine if any of those could be habitable. We discussed how planets around other stars, exoplanets, are detected and characterized. We talked about the "Goldilocks zone" around stars where we might expect planets to harbor life. But before all of this, we pondered how one could define "life" so that we can recognize life on an alien planet. Turns out, that is not easy, given that we only know of life on Earth and all life-forms on Earth share the same genetic code. We discussed the question of habitability of a planet, and examined how spectroscopy would allow us to determine the constituents of an exoplanets atmosphere to gauge habitability. And then looked into the idea of "biosignatures," spectroscopic signatures of chemicals that would indicate the presence of life. In a happy coincidence, the first James Webb Space Telescope detection of the presence of water on an exoplanet was released while the seminar was going on. This gave us ample time and opportunity to discuss the results and how they were obtained. This seminar has resulted in the creation of seven curriculum units covering grades 2 to 6; they cover a vast range of topics.

We start with the unit written by Lauren Freeman, an English Language and Arts teacher who will use material discussed in the seminar to teach her students about our solar system and exoplanet systems and use that to increase their vocabulary and introduce them to writing science fiction where the students can let their imaginations soar. Emily Turner uses exoplanetary systems as a backdrop to discuss life and habitability, and branches into ecosystems. On the way, her unit discusses the characteristics of life and its requirements and takes a detour to describe how constituents of exoplanetary atmospheres are studied. The unit is designed to teach language, science and mathematics with activities integrated into the whole day.

Elizabeth Isaac's unit introduces her students to planets within, and beyond, our solar system. Targeted mainly towards students on the Diné Nation, this unit connects modern astronomy to Navajo mythology about the solar system and the Universe.

Valerie Schwarz's unit discusses planet formation, planets and dwarf planets in the solar system as well as exoplanets; the unit also discusses habitability. Data in planets is used to teach students how to compare different quantities. Malcolm McConner also introduces solar-system planets and exoplanets, and then discusses the Goldilocks zone; he also examines the possible habitability of solar-system moons Titan and Europa.

Karen Cameron's units covers the characteristics of life on Earth and Earth's geological and biological history.

She also compares and contrasts Earth and Mars and their atmospheres.

The last unit in this volume, that by Lisa Yau is quite different. In the unit, Lisa talks of gravity ¾ the force that led to the formation of the solar system and its planets, and the force that keeps us bound to the Earth. She also delves into the effects of microgravity, usually called weightlessness, on human physiology.

The seven units in this volume are a testament to the dedication and hard work of all the Fellows. I hope these will be as useful to other teachers that they will be to the authors of the units.