National Center
for Earth and Space Science Education

Universities Space Research Association

Introduction to the *Journey through the Universe* Program and the *Building a Permanent Human Presence in Space* Module's Grade 9-12 Lessons

1. The Program

Journey through the Universe (http://journeythroughtheuniverse.org) is a national science education initiative that engages *entire* communities—students, teachers, families, and the public—using education programs in space exploration and the space sciences to inspire and captivate. The initiative embraces the notion that—*it takes a community to educate a child.*

Journey through the Universe programming is tailored to a community's strategic needs in science, technology, engineering, and mathematics (STEM) education, and is a framework for partnership between school districts, museums and science centers, colleges and universities, civic and business organizations, and the public. The cornerstone philosophy for all programming is—*inspire… then educate.*

2. The Grade K-12 *Building a Permanent Human Presence in Space* Education Module

Building a Permanent Human Presence in Space is one of several Education Modules developed for the *Journey through the Universe* program. The Module contains activities at three grade levels (K-4, 5-8, 9-12). Each grade level package is called an **Education Unit.** The Module also includes one Family and Home activity, and one activity on the Process of Science. Both are suitable for use at all grade levels.

The United States and its partners around the world are building an International Space Station (ISS), arguably the most sophisticated engineering project ever undertaken. ISS will provide a permanent human presence in low Earth orbit. The scientific motivation for developing ISS derives from the extreme nature of the space environment relative to what we experience here on Earth. ISS provides researchers long-term access to space, with its extreme temperature variation; near vacuum conditions; pervasive high-energy radiation; and free-fall conditions that produce the experience of 'weightlessness'. If humans are to extend their presence beyond Earth, these challenges to life in space must be overcome, and ISS provides a laboratory for such research.

Substantial national investment in ISS is grounded in a broad set of needs to explore beyond the confines of our own home. Motivations for *why* we explore are as old as the human race, and should be studied if students are truly going to understand what drives exploration on *every* frontier of human activity.

Motivation, however, is not enough for ISS to be realized. *How* we build a permanent human presence in space requires significant engineering 'know-how' to both lift payloads into orbit and build space habitats.

Therefore the storyline approach adopted for this Module is to address three questions at each grade level:

- What is the space environment like?
- Why do people want to go into space?
- How will we build a place to live in space?

Each grade-level Education Unit has a lesson addressing each of these questions.

3. The *Building a Permanent Human Presence in Space* Grade 9-12 Lessons

This document provides a description of each lesson and the embedded inquiry-based activities for the *Building a Permanent Human Presence in Space* **high school (grade 9-12)** Education Unit. Also provided are connections to grades 9-12 National Science Education Standards.

Building a Permanent Human Presence in Space: The 9–12 Education Unit Progression	
Lesson Title	Lesson Description
Lesson 1: Radiation Exposure	*Storyline question addressed: What is the space environment like?* Astronauts living and working in space are exposed to hazardous radiation more than persons on the surface of Earth. In this lesson, students will begin by estimating how much radiation they were each exposed to in the preceding year. Students will compare their own exposure to the radiation exposure for astronauts living and working aboard the International Space Station (ISS). Students will synthesize this information with knowledge of the solar activity cycle, as well as radiation exposure guidelines used to evaluate the risks and safety measures for astronauts in space.
Lesson 2: Ethics of Exploration	*Storyline question addressed: Why do people want to go into space?* Space exploration is currently led by government-based agencies like the U.S. National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and others. Space exploration is now justified by the pursuit of scientific knowledge. Sooner or later, however, commercial interests will pursue space exploration to turn a profit. Once that occurs, what rules should regulate the exploitation of resources in space and celestial bodies by governments and private industry? What, if anything, can a government or private company claim to own in space? These questions are not considered explicitly in the existing treaties governing international exploration and cooperation by governments, but they will have to be considered soon. Is the pristine space environment at risk? Is that important? These are issues that students will debate in this lesson.
Lesson 3: Building Your Space Station	*Storyline question addressed: How will we build a place to live in space?* The International Space Station is arguably the greatest engineering undertaking of our time. Thousands of criteria had to be considered in the design of each station segment and in planning the final assembly. One of the most powerful design tools used by engineers in developing the station design is scale modeling, allowing engineers to test ideas for station construction by actually building the station themselves, in workshops on Earth, many times over. In this lesson, students will directly experience the station design process by using scale modeling to design and test space stations of their own. Students will be provided with a broad set of performance demands and will explore how much variation these criteria permit in the design of a complete station. Students will also develop an understanding of some of the limitations of scale modeling as a design tool.

Connection to Standards

This Education Unit has been mapped to the National Science Education Standards (National Research Council, National Academy Press, Washington, DC, 1996). A complete explanation of the Standards can be found at: http://www.nap.edu/html/nses/html/. Core standards for each lesson are indicated by a "√"; related standards are indicated by an "x."

	Education Standards In Building a Permanent Human Presence in Space 9-12 Education Unit					
	National Science Education Standards					
	Standard A: Science as Inquiry		Standard B: Physical Science	Standard E: Science and Technology	Standard F: Science in Personal and Social Perspectives	
	A1: Abilities necessary to do scientific inquiry	A2: Understandings about scientific inquiry	B6: Interactions of energy and matter	E1: Abilities of technological design	F5: Natural and human-induzed hazards	F6: Science and technology in local, national, and global challenges
Lesson 1: Radiation Exposure	x	x	√		√	
Lesson 2: Ethics of Exploration	x	x				√
Lesson 3: Building Your Space Station	x	x		√		