

### Unit 3: Human Exploration (18 days)

#### Standards/Benchmarks:

1. Understanding the characteristics & scope of technology (ITEA/STL – 1)
  - a. New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (Benchmark F)
2. Understanding the core concepts of technology. (ITEA/STL – 2)
  - a. Trade-off is a decision process recognizing the need for careful compromises among competing factors. (Benchmark S)
3. Understanding the relationships among technologies and connections with other fields of study. (ITEA/STL – 3)
  - a. A product, system, or environment developed for one setting may be applied to another setting. (Benchmark E)
  - b. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems. (Benchmark F)
4. Understanding the effects of technology on the environment (ITEA/STL – 5)
  - a. The management of waste produced by technological systems is an important societal issue. (Benchmark D)
5. Understanding the role of society in the development and use of technology (ITEA/STL – 6)
  - a. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies. (Benchmark D)
6. Understanding the attributes of design (ITEA/STL-8)
  - a. Design is a creative planning process that leads to useful products and systems. (Benchmark E)
  - b. There is no perfect design. (Benchmark F)
  - c. Requirements for a design are made up of criteria and constraints. (Benchmark G)
7. Abilities to apply the design process (ITEA/STL-11)
  - a. Apply a design process to solve problems in and beyond the laboratory-classroom. (Benchmark H)
  - b. Specify criteria and constraints for the design. (Benchmark I)
  - c. Make two-dimensional and three-dimensional representations of the designed solution. (Benchmark J)
  - d. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed. (Benchmark K)
  - e. Make a product or system and document the solution. (Benchmark L)
8. Understanding of and abilities to select and use information and communication technologies (ITEA/STL – 17)
  - a. The design of a message is influenced by such factors as the intended audience, medium, purpose, and nature of the message. (Benchmark J)
9. The Nature of Technology (SFAA Benchmark 3 - Technology and Science)
  - a. Technology is essential to science for such purposes as access to outer space and other remote locations, sample collection and treatment, measurement, data collection and storage, computation, and communication of information.
  - b. Engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems. But they usually have to take human values and limitations into account as well.

10. The Physical Setting (SFAA Benchmark 4)
  - a. The Universe - Nine planets of very different size, composition, and surface features move around the sun in nearly circular orbits. Some planets have a great variety of moons and even flat rings of rock and ice particles orbiting around them. Some of these planets and moons show evidence of geologic activity. The earth is orbited by one moon, many artificial satellites, and debris.
  - b. The Earth - The earth is mostly rock. Three-fourths of its surface is covered by a relatively thin layer of water (some of it frozen), and the entire planet is surrounded by a relatively thin blanket of air. It is the only body in the solar system that appears able to support life. The other planets have compositions and conditions very different from the earth's.
11. The Physical Setting (SFAA Benchmark 4 - Energy Transformations)
  - a. Energy appears in different forms. Heat energy is in the disorderly motion of molecules; chemical energy is in the arrangement of atoms; mechanical energy is in moving bodies or in elastically distorted shapes; gravitational energy is in the separation of mutually attracting masses.
12. The Designed World (SFAA Benchmark 8 - Energy Sources and Use)
  - a. Energy from the sun (and the wind and water energy derived from it) is available indefinitely. Because the flow of energy is weak and variable, very large collection systems are needed. Other sources don't renew or renew only slowly.
13. Numbers and Operations – Compute fluently and make reasonable estimations (NCTM Standard Numbers and Operations 3)
  - a. Develop, analyze, and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios. (Benchmark N)
14. Represent and analyze mathematical situations and structures using algebraic symbols (NCTM – Algebra Standard 5)
  - a. Use symbolic algebra to represent situations and to solve problems, especially those that involve linear relationships. (Benchmark H)
  - b. Recognize and generate equivalent forms for simple algebraic expressions and solve linear equations. (Benchmark I)
15. Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them (NCTM Data Analysis and Probability Standard 14)
  - a. Formulate questions, design studies, and collect data about a characteristic shared by two populations or different characteristics within one population (Benchmark H)
  - b. Select, create, and use appropriate graphical representations of data, including histograms, box plots, and scatterplots. (Benchmark I)
16. Select and use appropriate statistical methods to analyze data. (NCTM Data Analysis and Probability Standard 15)
  - a. Discuss and understand the correspondence between data sets and their graphical representations, especially histograms, stem-and-leaf plots, box plots, and scatterplots. (Benchmark F)

**Big Idea:** Humans have always had an innate desire to explore past the boundaries of earth to the moon and beyond. To that end, there are many technological, societal, and safety-related challenges that are associated with travel to and habitation of the lunar surface.

**Unit Objectives:**

At the completion of this unit, students will be able to:

1. Explain the benefits and challenges of lunar colonization.
2. List and explain the types of technology that are needed to safely and efficiently colonize on the lunar surface.
3. Utilize computer technology to develop print media material.
4. Communicate orally, in writing, and by graph, the results of a public opinion survey regarding colonization on the moon.
5. Design and construct a scale model of space habitats by following an engineering design process.

**Assessment Tools/Methods:**

<b>Big Idea/Unit Objectives</b>	<b>Below Target</b>	<b>At Target</b>	<b>Above Target</b>
Explain the benefits and challenges of lunar colonization.	Is unable to articulate the benefits lunar colonization	Recognizes that lunar colonization has benefits and challenges, but is unable to clearly give reasonable examples.	Clearly can describe and exemplify the benefits and challenges of lunar colonization for this and upcoming generations.
List and explain the types of technology that are needed to safely and efficiently colonize the moon.	Is only able to explain 1 or 2 types of technology involved in lunar colonization.	Can list and give good examples of 3 or 4 types of technology related to lunar colonization.	Able to describe and explain numerous examples of technology used in lunar colonization and why they were chosen.
Utilize computer technology to develop print media material.	Is not computer literate enough to develop an appropriate print media material.	Can use a compute to design print media material, but struggles with basic commands.	Proficiently, regularly & easily uses various software programs to design print media material.

Communicate orally, in writing, and by graph, the results of a public opinion survey regarding colonization on the moon.	Is unable to articulate in any form (writing, orally or graphically), from a neutral position, public opinion data gathered from a survey.	Can articulate, from a neutral position, public opinion data, but not all material is based on survey results and the articulation is either flawed mathematically or the articulation is not of consistent quality for oral, written and graphical presentations	Highly articulates, from a neutral position, public opinion data gathered from a survey using accurate information in oral, written and graphical forms.
Design and construct a scale model of a lunar habitat by following an engineering design process.	Lunar habitat is poorly constructed and engineering design process was not followed. No attention was paid to making the model to scale.	Engineering design process was somewhat followed and lunar habitat was constructed. Scale was somewhat followed but was inconsistent.	Lunar habitat is excellent and the engineering design process carefully followed. Attention was paid to build the model to scale.

<b>Standard &amp; Benchmark</b>	<b>L 1</b>	<b>L 2</b>	<b>L 3</b>	<b>L 4</b>	<b>L 5</b>
STL 1F	X				
STL 2S			X		
STL 3E				X	
STL 3F				X	
STL 5D					
STL 6D	X		X	X	
STL 8E		X	X		
STL 8F			X		
STL 8G		X	X		
STL 11H		X	X		
STL 11I		X	X		
STL 11J			X		
STL 11K			X		
STL 11L			X		X
STL 11M			X		
STL 17J			X		X
SFAA 3	X		X		
SFAA 4	X	X			
SFAA 8		X			
NCTM 3N			X		

NCTM 5H	X				
NCTM 5I	X				
NCTM 14H				X	
NCTM 14I				X	
NCTM 15F				X	

### Lessons for Unit 3

[U3L1 – Understanding the Challenge](#) (3-4 hours)

[U3L2 – Experts Coming Together](#) (3-4 hours)

[U3L3 – Lunar Colony Design and Development](#) (7-8 hours)

[U3L4 – Going Public](#)

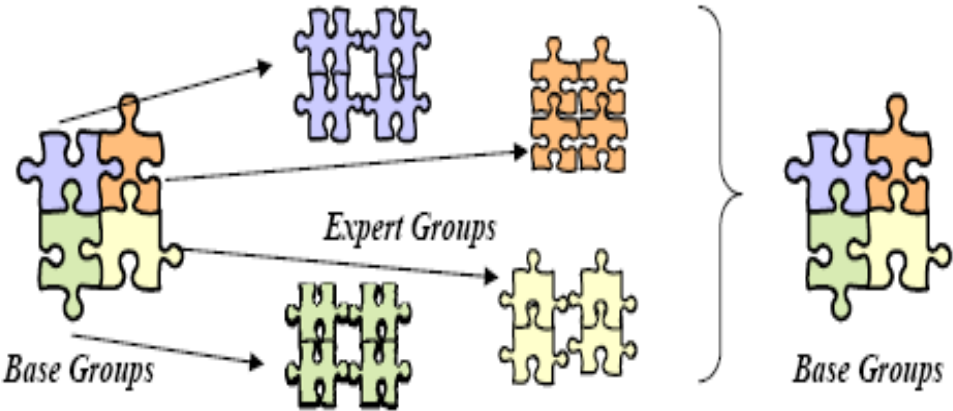
[U3L5 – Putting it all Together](#)

This unit is designed around the cooperative learning method Jigsaw II developed by David Johnson and Roger Johnson (*Circles of Learning*, ASCD, 1994). Students will begin by forming base groups of 4 students that are determined by the teacher. These groups will be mimicking an engineering design team by dividing the tasks that need accomplished. Each student will then be responsible to join an expert group to study about a particular aspect of the design challenge and then report back to their base group. From there, the base group will begin to develop solutions by pulling their resources and knowledge together.

### Design Challenge

The National Aeronautics and Space Administration (NASA) has made a commitment to inhabit the moon with a research laboratory by 2020. The research lab will be used to study mineral resources, improve technological abilities, prepare for habitation on Mars, and many more. In engineering teams of 4 students will be faced with the challenge of how to inhabit the moon. They will need to design and build a mock-up of a space research colony while considering the necessary survival, transportation, and communication aspects of the colony. To validate their learning, teams will be responsible to produce the following items.

1. A timeline to should show the overall scope of the lunar colonization project.
2. A brochure to help the public understand the lunar colonization project.
3. Develop, conduct, and compile a survey to determine what the public feels about the lunar colonization project.
4. Build a mock-up structure that may resemble a lunar colony. The mock-up will be based on student designs.



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## Unit Content Outline

1. Planning for Space Exploration
  - a. Long Range Planning
  - b. Cost
  - c. Technology Readiness Levels
  - d. Technology Development Process
  - e. Safety Concerns
2. Moon Characteristics
  - a. Temperature
  - b. Atmosphere
  - c. Radioactivity
  - d. Day/Night Cycle
  - e. Surface Material Make-up
  - f. Topography
  - g. Size & Orbit
3. Lunar Colonization
  - a. Requirements & Constraints
  - b. Historical Events
    - i. First Landing
    - ii. Pioneers
    - iii. Timeline
  - c. Shelter Design
    - i. Materials
    - ii. Construction
  - d. Energy Systems
    - i. Solar
    - ii. Nuclear
  - e. Living Conditions
    - i. Heating Generation
    - ii. Cooling
    - iii. Oxygen Production
    - iv. Water
    - v. Food
    - vi. Exercise
    - vii. Recreation
    - viii. Communication
4. Model Design
  - a. Sketching
  - b. Documentation
  - c. Mock-ups
  - d. Scale
  - e. Modeling Materials
5. Public Sentiment & Input
  - a. Survey Design
  - b. Data Collection
  - c. Communication with Public
  - d. Graphing Results
6. Print Media Design
  - a. Brochures
  - b. Pamphlets
  - c. Posters
  - d. Press Releases

Unit Sequence of Events

Day	<i>Lesson #1: Understanding the Challenge</i>
1	Pretest Space Travel & Exploration KWL & Discussion Introduction NASA Video
2	Researching the Moon & Lunar Colonization
3	Getting to the Moon: Past, Present, & Future

Day	<i>Lesson #2 Experts Coming Together</i>			
4-5	Base Group Formation			
	<b>Energy</b>	<b>Shelter Design</b>	<b>Transportation</b>	<b>Sustainability</b>
	Nuclear Photovoltaic Solar Sails	Materials Requirements Safety	On lunar surface Earth to Moon to Earth	Food Water Future
6	✓ Identifying the Challenge ✓ Limitations & Constraints ✓ Safety			

Day	<i>Lesson #3: Lunar Colony Design and Development</i>
7-8	Exploring Ideas ✓ Research Summary from Expert Groups ✓ Individual Colony Sketches → Group Final Sketch
9-13	Plan & Develop ✓ Model Planning ✓ Model Creation

Day	<i>Lesson #4: Going Public</i>
14-16	Test & Evaluate ✓ Survey Design & Review ✓ Survey Implementation ✓ Data Compilation ✓ Model Evaluation

Day	<i>Lesson #5: Putting it all Together</i>
17-20	Present the Solution ✓ Presentation Planning ✓ Team Presentations ✓ Survey Data Presentation ✓ Team/Individual Self-reflection