Summer of Innovation

Mars Exploration
4^{th} – 9^{th} grade

Introduction

The goal of the NASA Summer of Innovation Mars Exploration camp is to excite young minds and inspire student trainees toward future science, technology, engineering, and mathematics (STEM) pursuits. Raising trainee achievement in STEM pursuits begins by leading trainees on a journey of understanding through these highly engaging activities. The activities and experiences in this guide come from across NASA's vast collection of educational materials.

This themed camp outline provides examples of one-day, two-day, and weeklong science and engineering programs. Each day contains 6-8 hours of activities totaling more than 35 hours of instructional time. The camp template will assist you in developing an appropriate learning progression focusing on the concepts necessary to engage in learning about Mars. The Mars Exploration camp provides an interactive set of learning experiences that center on the past, present, and future exploration of Mars. The activities scaffold to include cooperative learning, problem solving, critical thinking, and hands-on experiences. As each activity progresses, the conceptual challenges increase, offering trainees full immersion in the topics.

Intended Learning Experiences

Through the participation in these camps future scientists and engineers will have the opportunity to explore Mars. Student trainees gain learning experiences that help make scientific careers something they can envision in their lives. Trainees realize that they have the potential to make a contribution to this field and ignite their curiosity to see what they might create during the program. The learning experiences also anticipate that trainees will have the opportunity to:

- Sequence major milestone missions in the exploration of Mars
- Describe how NASA collects data about other planets and deep space objects
- Compare and contrast Earth and Mars
- Apply the engineering design process within various projects
- Demonstrate the concepts of trajectory, propulsion, and planet distances
- Create a systems design that addresses human needs for space travel and the establishment of permanent settlements on Mars
- Think creatively within a team environment to plan for human exploration of Mars

Professional Development

Educator Professional Development (PD) experiences are available. Webinars, NASA Digital Learning Network (DLN) programs, training videos, and online meeting spaces will help you implement the program. We hope that you and your trainees have a memorable and successful experience implementing these activities.

Professional Development Resources

- The NASA Educator Online Network is a great resource for STEM educators to share and learn about STEM topics. The Mars Exploration camp hosts a group that will provide a place for sharing about the activities, additional resources, extension ideas, and support.
- Visit the Summer of Innovation homepage for an extensive catalog of news, media resources, and educational materials.

Format of the Guide

The Six E's

Each day or section of activities utilizes the 5-E Instructional Model. Included in this program guide is a sixth 'E' for Excite. This additional 'E' shows you how to incorporate NASA's unique information and resources to excite trainees with career connections, real world examples, spinoffs from NASA research, and more. Learn more about the 5-E Instructional Model.

$ Requires simple materials common in the classroom or relatively inexpensive to obtain.

$$ Requires purchasing unique materials such as poster board, duct tape, or hot glue guns.

$$$ Requires purchasing or building higher-cost items, though many are one-time purchases that may used for many trainees over several years.

Title	Overview	Time	Cost	Additional Resources
The title hyperlinks to the activity.	An overview describes the main concepts and strategies used in the lesson, activity, or demonstration.	The time listed includes time for an introduction, activity time, and conclusion time.	Please find this camp or the activity you are using in the Resource Repository for more information on costs and tips.	Suggested resources may include additional lesson plans, posters, images, or other learning support materials.

Engage: Question?

Icons may appear throughout the program

The apple icon helps to identify educator tips.

The pencil icon helps to identify the journal.

The spacecraft icon identifies mission links.

Journal

Journals are an optional element of your camp. Throughout the camp template, you will find reflective questions, ideas, and guidance in creating a journal. Journals also provide trainees with a unique souvenir of their experiences. Learn more about how scientists and engineers use journaling at NASA by watching this eClip video: Journaling in Space.

One-Day Camp: Why and How Do We Explore Mars?

Trainees learn to think like explorers today! Their exploration journals provide a platform for discussion, reflection, and data collection. Before any exploration begins, the explorers must have a goal – centered on a question, know how to accomplish the goal, and have the equipment necessary to support their exploration. The culmination of the program is to plan a mission to Mars and lay the groundwork for a human settlement. As the day progresses, trainees gain knowledge and skills that help them achieve their goal.

Title	Overview	Time	Cost	Additional Resources
Journal Journaling in Space NASA eClips Video	Trainees will create a journal to use during the day. Use this time to create the cover.	0.5 hrs	$	Journal Template on NEON
	The journal will be used in group discussions after individual reflection. Journals can serve as assessment. Time should be given at the beginning/ end of activities to journal key ideas.			
Engage: Remote Sensing – How Can We Explore from a Distance?				
Strange New Planet	This activity demonstrated how planetary features are discovered by the use of remote sensing techniques.	45 min	$$	Mars Exploration Program JPL Website
Mission Link	Mariner 3, 4, 6, 7 – Flybys 1964 & 1969 Mariner 8 & 9 – Orbiters 1971 **Post these missions in the classroom. These missions are in the timline.**			
	Journal Reflection and Discussion Time: Trainees will document their predictions, designs, and understanding of remote sensing and robotics exploration.			
Explore: Is There Life on Mars?				
Looking for Life	Trainees will research characteristics of living organisms and develop a chart that will help them define important features of a living organism. They will then use their definition to determine whether there is anything alive in three different soil samples, an experiment similar to the Mars Viking Lander in 1976. Trainees will record their observations and draw pictures as they collect data from the samples.	45 min	$	Could the Red Planet Support Life? eClips Our World: Life on Other Worlds

Journal Reflection and Discussion Time				
Mission Link Viking 1 & 2 – Orbiters and Landers 1975 & 1976 **Post these missions in the classroom. These missions are in the timline.**				
Mission Timeline	Trainees learn about the various missions to Mars and put the events in order along a timeline. These missions are connected throughout the program in the section entitled “Mission Link.”	0.5 hrs	$	See lesson on NEON.
Explain: How Do Mars and Earth Compare?				
Do Similar Physical Processes Occur on Both Earth and Mars?	This investigation compares and contrasts physical processes that occur on both Earth and Mars. Trainees are given unidentified images of Earth and Mars. Their task is to arrange the images into pairs that show evidence of similar physical processes.	0.5 hrs	$$	Sibling Rivalry: A Mars/Earth Comparison Background Information
Mapping Mars	Trainees approach studying the surface of Mars in the same way as photogeologists. They will interpret evidence showing river channels that once flowed and caused erosion.	0.5 hrs	$	Geologic Features of Mars
Walking the Planet Distances Pages 29 – 36	Trainees explore the planet sizes relative to one another and walk the scaled distance.	45 min	$	Eyes on the Solar System Website
Mission Link Mars Observer – Orbiter 1993 (contact lost) Mars Global Surveyor – Orbiter 1996-1997 Mars Climate Orbiter – Orbiter 1998 (lost on arrival) Mars Odyssey – Orbiter 2001 Mars Express – Orbiter with ESA 2003 Mars Reconnaissance Orbiter – Orbiter 2005- 2006				

Extend: How Do We Design a Craft That Can Land on Mars Safely?				
Mars Pathfinder Egg Drop	Trainees use the design process to design a lander that simulates a Martian landing.	1.0 hrs	$	Curiosity Landing System Drop Test
Mission Link Mars Pathfinder – Lander 1996 Mars Polar Lander/Deep Space 2 – Lander 1999 (lost at arrival) Mars Exploration Rovers – Lander 2003 and 2004 Phoenix – Lander 2007 Mars Science Laboratoy 2011 Lander – Landing 2012 **Post these missions in the classroom. These missions are in the timline.**				
Evaluate: Putting It All Together – Let's Do a Mars Mission!				
Let's Create a Mars Settlement	Trainees design a Mars settlement. Using the knowledge gained about Mars, teams of trainees are tasked with creating a model of one of the essential systems of a Mars settlement – life support, transportation, communication, power, recreation, and waste management. The teams design the system and then create the model from recyclable items.	2.0 hrs	$	Space Settlement Basics Mars Colony Project Resources Living and Working in Space: Habitat Living and Working in Space: Habitat Trainee
Open House	Trainees have stations set up around the room and outside for parents and the community. Trainees may demonstrate what they learned about Mars Exploration.	0.5 hrs	$	Open House Template on NEON
Total		**6.25 hrs**		

Two-Day Camp – Day One: Why and How Do We Explore Mars?

Trainees learn to think like explorers during this two-day camp. Their exploration journals provide a platform for discussion, reflection, and data collection. Before any exploration begins, the explorers must have a goal – centered on a question, know how to accomplish the goal, and have the equipment necessary to support their exploration. The culmination of the program is to be a part of a team that plans a mission to Mars and lays the groundwork for a human settlement there. As the camp progresses, trainees gain knowledge and skills that help them achieve their goal.

Title	Overview	Time	Cost	Additional Resources
Journal Journaling in Space NASA eClips Video	Trainees will create a journal to use during the day. Use this time to create the cover.	15 min	$	Journal Template on NEON
	The journal will be used in group discussions after individual reflection. Journals can serve as assessment. Time should be given at the beginning/end of activities to journal key ideas.			
Engage: Remote Sensing – how can we explore from a distance?				
Strange New Planet	This activity demonstrated how planetary features are discovered by the use of remote sensing techniques.	45 min	$$	Mars Exploration Program JPL Website
Mission Link	Mariner 3, 4, 6, 7 – Flybys 1964 & 1969 Mariner 8 & 9 – Orbiters 1971 **Post these missions in the classroom. These missions are in the timline.**			
	Journal Reflection and Discussion Time			
Explore: Is there life on Mars?				
Looking for Life	Trainees will research characteristics of living organisms and develop a chart that will help them define important features of a living organism.	45 min	$	Could the Red Planet Support Life? eClips Our World: Life on Other Worlds
	Journal Reflection and Discussion Time			
Explore: Do the Physical Processes on Earth that Led to an Environment Suitable for Life Also Exist on Mars?				
Do Similar	This investigation compares and contrasts physical	0.5 hrs	$	Sibling Rivalry: A Mars/Earth

Physical Processes on Both Earth and Mars?	processes that occur on both Earth and Mars. Trainees are given unidentified images of Earth and Mars. Their task is to arrange the images into pairs that show evidence of similar physical processes.			Comparison Background Information
Mapping Mars	Trainees will approach studying the surface of Mars in the same way as photogeologists. They will interpret evidence showing river channels that once flowed and caused erosion.	0.5 hrs	$	Geologic Features of Mars
Walking the Planet Distances Pages 29 – 36	Trainees with explore the planet sizes relative to one another and walk the scale distance.	45 min	$	Eyes on the Solar System Website
Journal Reflection and Discussion Time				
Mission Link Mars Observer – Orbiter 1993 (contact lost) Mars Global Surveyor – Orbiter 1996-7 Mars Climate Orbiter – Orbiter 1998 (lost on arrival) Mars Odyssey – Orbiter 2001 Mars Express – Orbiter with ESA 2003 Mars Reconnaissance Orbiter – Orbiter 2005- 2006 **Post these missions in the classroom. These missions are in the timline.**				
Explain: How Did the Volcanoes, Craters, and Water Flow on Mars Define the Landscape?				
Making and Mapping a Volcano	Trainees will construct a model volcano and produce a sequence of lava flows. They will draw inferences as to how the volcanoes on Mars were formed.	1.0 hrs	$$	Olympus Mons – Mars Atlas
Impact Craters, pages 61 - 70	Trainees take on the role of Mars geologists to simulate impact craters on the surface of Mars. The activity comes from the Exploring the Moon Guide. A more intensive study may be undertaken using the Planetary Geology Guide.	45 min	$	Or - Lesson Plans from Planetary Geology Guide Pages 51-75 Mars – Exposed Video
How Does Flowing Water Shape a Surface	Using a stream table, trainees develop an eye for features associated with flowing water. Trainees will use what they learn to interpret images of Mars.	45 min	$$	Is There Liquid Water on Mars? Possible Water Flows on Mars Video

Mission Link

Mars Express – Orbiter with ESA 2003
Mars Reconnaissance Orbiter – Orbiter 2005- 2006
Post these missions in the classroom. These missions are in the timline.

Journal Reflection and Discussion Time: Discuss the trainees' observations.

Evaluate: What Have We Discovered Today?				
Debrief	Review key concepts of the day	0.5 hrs		Spirit Rover Finds Mars Past Could Have Supported Life
Total		**6 hrs**		

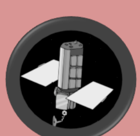
Two-Day Camp – Day Two: What Is Mars Like?

Title	Overview	Time	Cost	Additional Resources
Engage: What Missions Have Explored Mars?				
Mission Timeline	Trainees will learn about the various missions to Mars and put the events in order along a timeline. These missions are connected throughout the program in the section entitled "Mission Link."	0.5 hrs	$	See lesson on NEON.
Mission Link	Mars Pathfinder – Lander 1996 Mars Polar Lander/Deep Space 2 – Lander 1999 (lost at arrival) **Post these missions in the classroom. These missions are in the timline.**			
Explore: What Transportation Systems Will We Need Once We Are on Mars?				
Roving on the Moon (Mars)	Trainees follow the engineering design process to design and build a rover out of cardboard, figure out how to use rubber bands to spin the wheels, and improve their design based on testing results.	1.0 hrs	$	Curiosity Rover Trailer
	Journal Reflection and Discussion Time: Discuss the trainees' observations.			
Extend: Putting It All Together – Let's Do a Mars Mission!				
Let's Create a Mars Settlement	Trainees design a Mars settlement. Using the knowledge gained about Mars, teams of trainees are tasked with creating a model of one of the essential systems of a Mars settlement – life support, transportation, communication, power, recreation, and waste management. The teams design the system and then create the model from recyclable items.	3 hrs	$	Space Settlement Basics Mars Colony Project Resources Living and Working in Space: Habitat Living and Working in Space: Habitat Trainee
Marsbound**!**	Trainees plan a mission to Mars.	1.0 hrs	$$$	Lunar Nautics Lunar Nautics Studens Handbook

Evaluate: What Have We Discovered Today?				
Debrief	Review key concepts of the day	0.5 hrs		
Open House	Trainees will have stations set up around the room and outside and will demonstrate to parents and community leaders what they learned and did over the week.	0.5 hrs	$	Open House Template on NEON
Total		**6 hrs**		

Weeklong Camp – Day One: Why Explore?

The first day of the program sets the stage for the program by having the trainees discuss past exploration. Why do humans explore? What do we need to know before we begin a new exploration? Trainees will begin to think like explorers today. Their exploration journals provide a platform for discussion, reflection, and data collection. Before any exploration begins, the explorers must have a goal centered on a question, know what to do to accomplish the goal, and have the equipment necessary to support their exploration. The culmination of the program is to be a part of a team that plans a mission to Mars and lays the groundwork for a human settlement there. Each day of the program, trainees gain knowledge and skills that will help them achieve their goal.

Title	Overview	Time	Cost	Additional Resources
Journal	Trainees create a journal to use during the program. Use this time to create the cover.	15 min	$	Journal Template on NEON
	The use of the journal documents concepts and ideas covered during the week. The journal will be used in group discussion after individual reflection. Journals can serve as assessment at end of week. Time should be given at the beginning/ end of activities to journal key ideas.			
Engage: How Do People Adapt to New Enviornments?				
Exploration Then & Now Human Needs	This activity investigates human needs and how humans adapt to new environments.	1.0 hrs	$	
Explain: Remote Sensing – How Can We Explore from a Distance?				
Strange New Planet	This activity demonstrates how planetary features are discovered by the use of remote sensing techniques.		$$	
Mission Link 	Mariner 3, 4, 6, 7 – Flybys 1964 & 1969 Mariner 8 & 9 – Orbiters 1971 **Post these missions in the classroom. These missions are in the timline.**			

Explore: Robotic Exploration – How Can We Use Robotics to Help Us Explore?				
Making and Using an ISS End Effector	Trainees design and construct a grapple fixture that will enable the end effector to pick up an object.	1.0 hrs	$	Our World: Collecting Data from Mars Using ARES NASA eClips Curiosity Poised to Begin Ambitious Exploration
	Journal Reflection and Discussion Time: Trainees will document their predictions, designs, and understanding of remote sensing and robotics exploration.			
Explain: Is There Life on Mars?				
Looking for Life	Trainees research characteristics of living organisms and develop a chart that will help them define important features of a living organism. They then use their definition to determine whether there is anything alive in three different soil samples, an experiment similar to the Mars Viking Lander in 1976. Trainees record their observations and draw pictures as they collect data from the samples.	1.5 hrs	$	Could the Red Planet Support Life? eClips Our World: Life on Other Worlds
Mission Link	**Viking 1 & 2 – Orbiters and Landers 1975 & 1976** **Post these missions in the classroom. These missions are in the timline.**			
Mission Timeline	Trainees learn about the various missions to Mars and put the events in order along a timeline. These missions are connected throughout the program in the section entitled "Mission Link."	0.5 hrs	$	
	Journal Reflection and Discussion Time: Discuss the trainees' observations. Make a chart on which each team puts their data.			

Evaluate: Debrief				
Debrief	Review key concepts of the day: • Human Needs • Remote Sensing • Definition of Life • Design Process • Scientific Investigation	0.5 hrs		Debrief questions located in Journal. Mars Science Laboratory NASA Webpage
Explore: NASA Connection – Excite!				
Journaling in Space NASA eClips Video	Journaling in Space Exploration Then & Now Video – Jamestown & Discovery (Becky) Mission Clips	0.5 hrs		
Total		**6.25 hrs**		

Weeklong Camp – Day Two: What Is Mars Like?

Trainees build their Mars knowledge by studying what interplanetary scientists have discovered about the planet. What is Mars geology like? How can we describe its climate and its atmosphere? How does it compare to Earth? How will learning about Mars help us explore? Trainees learn to think like interplanetary geologists on this day. Their exploration journals continue to provide a platform for discussion, reflection, and data collection. Before any exploration begins, the explorers have a goal. The culmination of the program is to be a part of a team that plans a mission to Mars and lays the groundwork for a human settlement.

Title	Overview	Time	Cost	Additional Resources
Engage: What Do We Know About Mars				
Earth vs. Mars Chart Page 15	Trainees compare and contrast Earth and Mars using a data chart. Trainees use a KWL (what we know, what we want to know, and what we've learned) chart to identify facts that need further research and exploration. Research the missing data using various books, encyclopedias, and internet sites. Create a Venn diagram to share with the class to show how Earth and Mars are alike and different.	0.5 hrs	$	Sibling Rivalry: A Mars/Earth Comparison Background Information
	Post the chart, have trainees copy data into their journals, and add more details to the chart throughout the program. Engage the trainees first by showing images of Earth and Mars, talking about science fiction, and humankind's fascination with Mars.			
Explore: How Are Images of Objects in Space Created?				
Paint by the Numbers	Using this pencil and paper activity, the trainees demonstrate how spacecraft and computers create images of objects in space.	0.5 hrs	$	Remote Sensing Tutorial
Mission Link	Mars Observer – Orbiter 1993 (contact lost) Mars Global Surveyor – Orbiter 1996-7 Mars Climate Orbiter – Orbiter 1998 (lost on arrival) Mars Odyssey – Orbiter 2001 **Post these missions in the classroom. These missions are in the timeline.**			

Explore: Do the Physical Processes on Earth that Led to an Environment Suitable for Life Also Exist on Mars?				
Do Similar Physical Processes Occur on Both Earth and Mars?	This investigation compares and contrasts physical processes that occur on both Earth and Mars. Trainees are given unidentified images of Earth and Mars. Their task is to arrange the images into pairs that show evidence of similar physical processes.	1.0 hrs	$	NASA Quest
Explain: How Did the Volcanoes, Craters, and Water Flow on Mars Define the Landscape?				
Making and Mapping a Volcano	Trainees construct a model volcano and produce a sequence of lava flows. As they observe where the flows travel and interpret the stratigraphy, they draw inferences as to how the volcanoes on Mars were formed.	1.0 hrs	$$	Olympus Mons – Mars Atlas
Impact Craters Page 61-70	Trainees take on the role of Mars geologists to simulate impact craters on the surface of Mars. The activity comes from the Exploring the Moon Guide. A more intensive study may be undertaken using the Planetary Geology Guide.	45 min	$	Or Lesson Plans from Planetary Geology Guide, pp. 51 - 75 Mars – Exposed Video
How Does Flowing Water Shape a Surface	Using a stream table, trainees develop an eye for features associated with flowing water. Trainees will use what they learn to interpret images of Mars.	45 min	$$	Is There Liquid Water on Mars? Possible Water Flows on Mars Video
Mission Link Mars Express – Orbiter with ESA 2003 Mars Reconnaissance Orbiter – Orbiter 2005- 2006 **Post these missions in the classroom. These missions are in the timline.**				
Journal Reflection and Discussion Time: Discuss the trainees' observations.				
Extend: How Can Scientists Use Their Knowledge of Geologic Features to Draw a Simple Features Map?				
Mapping Mars	Trainees approach studying the surface of Mars in the same way as photogeologists. They interpret evidence showing river channels that once flowed and caused erosion.	1.0 hrs	$	Geologic Features of Mars

Mission Link Mars Pathfinder – Lander 1996 Mars Polar Lander/Deep Space 2 – Lander 1999 (lost at arrival) **Post these missions in the classroom. These missions are in the timline.**				
Evaluate: What Have We Discovered Today?				
Debrief	Review key concepts of the day	0.5 hrs		Spirit Rover Finds Mars Past Could Have Supported Life
Total		**6 hrs**		

Weeklong Camp – Day Three: How Do We Get to Mars and What Can We Learn?

Title	Overview	Time	Cost	Additional Resources
Engage: How Far Is It to Mars? The Moon? Other Planets?				
Walking the Planet Distances	Trainees explore the planet sizes relative to one another and walk the scaled distance. Pages 29 – 36.	45 min	$	Eyes on the Solar System Website
Earth, Moon and Mars Balloons	Trainees construct a scale model of the Earth-Moon-Mars system in terms of planetary size. They will discover how far one might have to travel to get to Mars.	45 min	$	Earth, Moon, Mars Balloons Trainee Page
Journal Reflection and Discussion Time: Discuss the trainees' observations.				
Explain: How Can We Get to Mars?				
Heavy Lifting	Propulsion Activity: Trainee teams receive identical parts to construct a rocket. Trainees explore how a different amount of mass (payload) impacts lift.	1.0 hrs	$	Atlas V Lifts Off with MSL
Getting There: Navigation & Trajectory	Trainees model the orbital paths of Earth and Mars. Working in pairs, trainees plot the paths of a spacecraft traveling between Earth and Mars. These paths use the minimum amount of fuel, and take about six months to reach their destination.	1.0 hrs	$	How Do You Get to Mars
Journal Reflection and Discussion Time: Discuss the trainees' observations.				
Mission Link Mars Science Laboratoy 2011 Lander – Landing 2012 **Post this mission in the classroom. This missionis in the timline.**				

Can We Take It with Us?	Trainees work in teams to determine the maximum amount of payload that they can take on a Mars mission.	0.5 hrs	$	Lunar Nautics Trainee Handbook - page 2 Lunar Nautics Resource Page
Touchdown Challenge	Trainees design and build a shock-absorbing system that will protect two “astronauts” when they land on Mars.	45 min	$	
Journal Reflection and Discussion Time: Discuss the trainees’ observations.				
Explore: In What Ways Have We Studied Mars?				
Areology - The Study of Mars	Trainees examine a simulated Martian surface core sample, make observations, and match the sample with a known sample using candy bars.	0.5 hrs	$$	NASA eClips Scarab Rover Looks at Moon – coring operations to compare with Mars operations
Probing Below the Surface of Mars	Trainees record and graph temperature data to learn about the search for water on Mars.	45 min	$$	NASA Astrobiology Institute Website
Journal Reflection and Discussion Time: Discuss the trainees’ observations.				
Mission Link Mars Exploration Rovers – Lander 2003 and 2004 Phoenix – Lander 2007 **Post these missions in the classroom. These missions are in the timline.**				
Evaluate: What Have We Discovered Today?				
Debrief	Review key concepts of the day	0.5 hrs		Phoenix: A Tribute Video
Total		**6.5 hrs**		

Weeklong Camp – Day Four: What Do We Need for the Journey to Mars?

Title	Overview	Time	Cost	Additional Resources
Explore: What Life Support Systems Do We Need for the Journey and Settlement of Mars?				
Keeping Your Cool	Trainees investigate and experience the way the water cooling system in the space suit works.	0.5 hrs	$	Interactive Spacesuit Experience Website Activity
Solar Radiation and SPF Levels Page 62	Trainees investigate the effects of solar UV radiation on an object and analyze the effectiveness of different Sun Protection Factors (SPF).	0.5 hrs	$	Solar Radiation – Ask an Astrophysicist Webstie Background Information
Modeling Solar Damaged DNA Page 32	Trainees construct a model of DNA and alter the model to visualize what happens to DNA when it is damaged by radiation. A discussion of the electromagnetic spectrum is essential to this activity	1.0 hrs	$$$	Understanding Solar Radiation Fact Sheet
Food for Thought: Planning and Serving Food	Trainees plan a nutritionally balanced 5-day menu for astronauts	1.0 hrs	$$	Behind the Scenes: Food Lab
Water Filtration Device	Lessons 1 & 2: Trainees design and build a filtration device.	1.0 hrs	$$	NASA Found Water on Mars video

Journal Reflection and Discussion Time: Discuss the trainees' observations.

Mission Link

MAVEN – Future Mars Mission 2013
ExoMars/Trace Gas Orbiter – Future Mars Mission 2016
Post these missions in the classroom. These missions are in the timline.

Explain: What Transportation Systems Will We Need Once We Are on Mars?				
Roving on the Moon (Mars)	Trainees follow the engineering design process to design and build a rover out of cardboard, figure out how to use rubber bands to spin the wheels, and improve their design based on testing results.	1.0 hrs	$	Curiosity Rover Trailer
Explain: How Do We Communicate with Earth?				
Earth Calling	Trainees explore spacecraft radio communication concepts, including the speed of light and the time-delay for signals sent to and from spacecraft. They measure the amount of time it takes for a radio signal to travel to a spacecraft using the speed of light; demonstrate the delay in radio communication signals to and from a spacecraft; devise unique solutions to the radio-signal-delay problem.	45 min	$	NASA Antenna Gets Its Bearings – Mars Antenna
Explain: What Do We Need to Know About Waste Management?				
How Much Is Waste?	Trainees discuss waste management. In this activity, the trainees measure the mass and volume of a food package before and after repackaging for space flight and determine the usable and waste portions of food selected for space flight.	0.5 hrs	$	NASA – Recycling for Moon, Mars, and Beyond Webpage
Journal Reflection and Discussion Time: Discuss the trainees' observations.				
Evaluate: What Have We Discovered Today?				
Debrief	Review key concepts of the day	0.5 hrs		
Total		**6.5 hrs**		

Weeklong Camp – Day Five: Can We Successfully Set Up a Martian Settlement?

Title	Overview	Time	Cost	Additional Resources
Explain: How Do We Design a Lander that Will Land on Mars Safely?				
Mars Pathfinder Egg Drop and Landing (EDL)	Trainees use the design process to design a lander that simulates a Martian landing. The cargo (egg) should not be damaged during landing.	1.0 hrs	$$	Curiosity Landing System Drop Test
 Journal Reflection and Discussion Time: Discuss the trainees' observations.				
Extend: Putting It All Together – Let's Do a Mars Mission!				
Let's Create a Mars Settlement	Trainees design a Mars settlement. Using the knowledge gained about Mars, teams of trainees are tasked with creating a model of one of the essential systems of a Mars settlement – life support, transportation, communication, power, recreation, and waste management. The teams design the system and then create the model from recyclable items.	2.0 hrs	$	Space Settlement Basics Living and Working in Space: Habitat Living and Working in Space: Habitat Trainee
Marsbound!	Trainees plan a mission to Mars.	1.0 hrs	$$$	Lunar Nautics Lunar Nautics Studens Handbook
Alternate activity: Educator choice based on outcome of the game. Marsbound is about getting there; Field Trip is about settlement.				
Field Trip to the Moon	Trainees engage in critical thinking and problem solving to sustain a lunar base. This activity may then be compared and contrasted to a Martian base.	3.0 hrs	$$$	

Evaluate: What Did We Learn about Building a Mars Settlement?				
Debrief	Review	15 min		MAVEN Teaser Video
Mission Link Mars 2018 Mission with ESA – Future Mars Mission 2018 Mars Sample Return – Future Mission Beyond 2020 **Post these missions in the classroom. These missions are in the timline.**				
Open House	Trainees have stations set up around the room and outside and will demonstrate to parents and community leaders what they learned and did over the week.	1.0 hrs	$$	
Total		**6.25 hrs**		