BUZZ ALDRIN'S SHARE SPACE FOUNDATION

GIANT MARS MAP CURRICULUM

SHARESPACE.ORG

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The *Giant Mars Map Curriculum* is intended for use with Buzz Aldrin's ShareSpace Foundation's Giant Destination Mars Map™.

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LETTER FROM DR. BUZZ ALDRIN

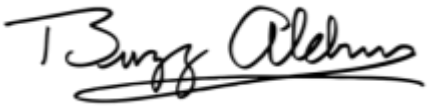
Educators,

Inspiring children to explore our universe by using their imaginations is a passion I know we share. Since walking on the Moon, I've set my sights on getting us to Mars and even establishing a settlement there for humans. My hope for the Giant Destination Mars Map and this accompanying curriculum is for your students to be empowered by what they discover, invigorated by their natural curiosities, and excited about a future that includes traveling to a new planet.

On the Giant Destination Mars Map, students will see first-hand what the surface of Mars looks like, where we have sent landers and rovers to explore, and many of its distinguishing geological characteristics. The accompanying curriculum encourages thorough exploration of Science, Technology, Engineering, Arts, and Math (STEAM). Through these lessons, students will learn what we know about Mars, understand what we've done there and why we explore, and even plan their own visits to Mars. After completing the lessons they'll even receive their very own Certificates of Completion, allowing them to join you in the ShareSpace Foundation Mars Map Society as Junior Members!

I couldn't be more excited to introduce students to Mars through this program. Who knows—the first person to set foot on Mars may be sitting in your classroom or walking through the doors of your museum. Thank you for your ongoing dedication to children's space education. You make a profound difference in every young life you touch!

Ad astra!



Dr. Buzz Aldrin
NASA Astronaut
Gemini 12, Apollo 11

SPECIAL NOTE TO TEACHERS

As a recipient of the ShareSpace Foundation Giant Destination Mars Map™, we'd like to ask the following of you:

- Join our online network of other Mars Map Teachers
- Participate in discussions about how you've been using the Map, how your students are interacting with it, new lessons you've created or found, questions you have or issues you've come across, etc.
- Regularly post pictures and/or videos of the Map in use on the Mars Map Teacher discussion page

What you can expect from us:

- New lessons posted to the Mars Map Teacher discussion page
- Your school and name displayed on the ShareSpace Foundation website
- Video activities posted once a month encouraging simultaneous participation from every Mars Map school
- Ongoing logistical, technical, educational, and/or moral support!

ABOUT THE GIANT DESTINATION MARS MAP™

CARING FOR THE MAP

→ Keep map stored while not in use
→ Remove shoes before walking on map
→ Wipe down map before storing
→ Fold and roll up map for storage
→ Map should be used indoors

USING THE MAP

→ Place the map in a large open area such as a gymnasium, cafeteria, media center or lobby
→ Explain how to care for the map to children before usage
→ Allow children plenty of time to explore on their own!

MAP TIPS & IDEAS

→ Teach students about the scale of Mars by having them use their hands, feet, and bodies to measure distances between landmarks, or by forming a line across the Map.
→ Keep up with Mars rover and exploration news as a class at mars.nasa.gov. Have students identify the places or names they hear mentioned on the map.
→ Have students identify areas of the map that seem similar to Earth.
→ Place students in pairs or groups and ask them to describe what they see on the map in as many words as possible.
→ While reading to them about Mars, have them quickly locate areas on the map that are mentioned either individually or in pairs.
→ Follow the curriculum included in this booklet.
→ Have fun!

ABOUT THE CURRICULUM

The *Giant Mars Map Curriculum* (2017) provided by Buzz Aldrin's ShareSpace Foundation and Purdue University is a problem-based curriculum unit designed to provide students in grades 4-6 an opportunity to explore Mars through a combination of children's literature (*Welcome to Mars* book by Buzz Aldrin) and engaging real-world lessons directly utilizing the *Giant Mars Map*. The curriculum is organized in five main lessons:

- Surviving on Mars
- Landing on Mars
- The Mars Expedition
- Learning from Experience – Revised Mars Expedition
- Occupying Mars

Your students will work in collaborative, real-world based teams to complete the integrated series of research and challenges. Each lesson within the curriculum utilizes the research-based 5E Instructional Model, which has been linked in several studies to improving student STEAM content knowledge and 21st Century Learning Skills (www.p21.org). The 5E model is comprised of the following steps:

- **Engagement** – where the topic of study is introduced in a manner to pique student interest and gauge student prior understanding.
- **Exploration** – where student teams are provided time to actively explore the concept through research, design, construction, and/or inquiry.
- **Explanation** – where students explain their thinking and the teacher provides additional information and support for learning.
- **Extension** – an activity or task that asks students to extend their thinking or apply their learning in a different setting.
- **Evaluation** – though ongoing throughout the lesson using formative assessment, the evaluation step also includes summative assessment forms and an opportunity for the teacher to gauge student learning.

For more information on the 5E model used in space science instruction, visit: http://www.nasa.gov/audience/foreducators/nasaeclips/5eteachingmodels/.

Giant Mars Map Curriculum

Lesson 1: Surviving on Mars

Duration
Three 45-minute class periods

Lesson Overview
In this lesson students will be introduced to Mars and will learn about the challenges associated with traveling to and visiting Mars. Students will begin reading *Welcome to Mars* book and will engage in an initial exploration of the surface of Mars to develop a list of potential needs for a visit to Mars.

Lesson Objective
Students will learn about Mars and the difficulty of exploring the surface (limited oxygen, limited energy/fuel for Rovers, limited food and water).

Next Generation Science Standards Addressed
Science and Engineering Practices
Asking Questions and Defining Problems
Analyzing and Interpreting Data
Developing and Using Models

Disciplinary Core Ideas
ESS1.A The Universe and Its Stars
ESS1.B: Earth and the Solar System

Crosscutting Concepts
Patterns
Scale, Proportion, and Quantity
Systems and System Models
Cause and Effect

Materials
- *Welcome to Mars books* – one for each pair of students
- *Giant Mars Map*

Teacher Preparation Instructions
The teacher will place students in teams of 2-3 students. Students will work in these teams throughout the Giant Mars Map Expedition. Copies of the *Welcome to Mars* book are needed for this activity. Note: There are supplemental activities within the

Welcome to Mars book that can be incorporated if the teacher has appropriate time. These activities are not figured into the time estimates for this lesson. The teacher will need to prepare the *Giant Mars Map* for student exploration during the lesson.

Engagement

Part One – *Welcome to Mars* book reading session – 40 minutes

- **Read:** Introduction: Why Mars? And Ch. 1 All Aboard! – **Book Activities Optional**
- **After Reading Have Students Discuss:**
  - Why should we go to Mars?
  - What will we need to survive on Mars even for a short visit?
  - Why is it so hard to get to Mars?

Exploration

Part Two –Activity – Building Your List of Needs – 40 minutes

Teacher Directions

The teacher should deliver the directions to students (listed below – student activity directions) and give teams 20 minutes to brainstorm ideas in their group. Once all groups have finished their brainstorming and have generated list ask them share out to the whole class and compare ideas.

Student Activity Directions

One part of your Giant Mars Map Expedition will be to collect the items you will need on Mars to survive your visit there. Take a few minutes to look at the *Giant Mars Map*. Make note of the appearance of the surface and any resources you think you might be able to get from Mars. Assuming you have only a very limited supply of resources (enough for one half day) make a list of what you would need daily to support your team.

Additional Teacher Directions

After the whole class discussion provide student teams 5 minutes to revise their lists in their notebooks and save for later.

Explanation

Activity – NASA Research – 30 minutes

Teacher Directions

Students should use computers to explore the following NASA website to learn more about the specific facts regarding the composition of Mars and comparisons between Earth and Mars.

http://mars.nasa.gov/allaboutmars/facts/#?c=inspace&s=distance

After student teams have had time to explore, engage the group in a discussion of similarities and differences, as well as potential challenges to visiting Mars.

Evaluation/Assessment

Student teams will be evaluated through formative assessment methods during the lesson. Teacher questioning of groups and gathering evidence of learning such as there generated lists and constructed passport (in Extension section next) will provide evidence that can be used to adjust instruction within the lesson and in subsequent lessons.

Extension

Activity - Passport to Mars – 25 minutes

Teacher Directions

The teacher will explain to the groups that they will use their new knowledge, as well as their unanswered questions to construct a Mars Passport. The teacher will show the class images of a real passport. Teams will have time to design and create their passports that they will use to track the places they will visit on the *Giant Mars Map*. The passports can be created for each individual or one for each team.

Student Directions

Your assignment is to create a Mars Passport. The passport you will create will be the size of ½ sheet of standard copy paper. You will need to have 30 pages within your passport and it should be stapled so that there is a front and back cover. You can work with the supplies your teacher has available to design the artwork for your passport. The front cover should have an image of Mars that is drawn and colored appropriately. Other things that must be included in your Mars Passport are:

1. Your front cover is page 1 and back cover is page 30.
2. Passport Stamp Pages (pages 2-11) for stamps to be collected from the places you will visit on the *Giant Mars Map*. Label pages as Expedition Stop One through Expedition Stop Ten. You may or may not need all 10 pages.
3. Pages 12-15 should be labeled "My Questions" and this is where you will write your questions you have about Mars.
4. Pages 16-20 should be labeled "My Data" and this is where you will make note of what you are learning about Mars.
5. Pages 21-30 are for "Other Thoughts" that you may have about Mars during your exploration of the *Giant Mars Map*.

Duration
Four 45-minute class periods

Lesson Overview
In this lesson student teams will learn about how travel to Mars has been portrayed in the popular media and in movies and will compare/contrast this to reality. In addition, teams will begin to understand what has been learned through past Mars exploration missions. Finally, teams will begin to examine potential sites on the *Giant Mars Map* that would have the best options for harvesting water on Mars.

Lesson Objectives
Students will understand what humans have learned about Mars through past exploration. Students will also learn about the differences in depictions of Mars through popular media and real exploration to the planet.

Next Generation Science Standards Addressed
Science and Engineering Practices
Analyzing and Interpreting Data
Developing and Using Models

Disciplinary Core Ideas
ESS1.A The Universe and Its Stars
ESS1.B: Earth and the Solar System

Crosscutting Concepts
Patterns
Scale, Proportion, and Quantity
Systems and System Models
Cause and Effect

Materials
- *Welcome to Mars books* – one for each pair of students
- *Giant Mars Map*
- *Post-its*
- *Mars Rover*
- *Obstacle course objects (3-ring binders, etc.)*

Teacher Preparation Instructions

Copies of the *Welcome to Mars* book are needed for this activity. Note: There are supplemental activities within the *Welcome to Mars* book that can be incorporated if the teacher has appropriate time. These activities are not figured into the time estimates for this lesson. The teacher will need to prepare the *Giant Mars Map* for student exploration during the lesson.

Engagement

Part One – *Welcome to Mars* book reading session – *70 minutes*

- **Read:** Ch. 2 Off to Mars and Ch. 3 Approaching Mars - – **Book Activities Optional**
- **After Reading Have Students Discuss:**
  - What are your favorite movies or cartoons with Martians?
  - Why have people thought there are living things on Mars?
  - What have we learned from our rovers going to Mars?

- **Read:** Ch. 4 Riches of Mars – **Book Activities Optional**
- **After Reading Have Students Discuss:**
  - Where should we land on Mars?
  - What do we need to wear on Mars?
  - How will we breathe, eat, and get water to drink on Mars?

Exploration

Part Two –Activity – Getting What We Need on Mars – 20 minutes

Teacher Directions

The teacher will provide directions to students and give them 10 minutes to brainstorm in their group. Once all groups have finished their lists have them share out to the whole class and compare ideas.

Student Directions

Where on Mars do you think would be the best places to find water and get it in the most efficient manner possible? Take some time to explore the *Giant Mars Map* and make notes on the different features of the surface including areas where you might find water. Discuss with your group and then place your team water post-it on the location of where you would get your water.

Part Three – Rover Races – 45 minutes

Teacher Preparation

You should use things like three-ring binders and other items to create an obstacle course that teams will need to navigate around on the map to reach the other side. You may mark the course out with post its or painters tape (this will come off of the map easily without damaging it. The goal is to have some things the rover must drive over and around to get to the finish line.

Teacher Directions

Introduce students to the Mars rover model. Show students how to operate it. Explain that they will work with a partner to compete in the Mars Rover Race. One partner will be the rover driver and the other will be the rover navigator. The rover driver will be positioned 15 feet away from the map. The rover navigator will give verbal directions to help the driver navigate around the obstacle course to the finish line.

After the Rover Race is completed, discuss with students why navigating a vehicle remotely on Mars is challenging. Have students share ideas they may have for improving this process.

Explanation

Once all groups have marked their spots on the Map, discuss the pros and cons of the selected locations using the background knowledge sheet and any other NASA resources you would like to use. This discussion will take at least 10 minutes.

Evaluation

Student teams will be evaluated through formative assessment methods during the lesson. Teacher questioning of groups and gathering evidence of learning such as their generated lists and constructed passport (in Extension section next) will provide evidence that can be used to adjust instruction within the lesson and in subsequent lessons.

Extension

Activity – Explore Mars Exploration Rovers NASA JPL website – 45 minutes

As an extension to this lesson the teacher can provide the student teams with an opportunity to visit the NASA JPL Mars Exploration Rovers website (listed below). Each team should select (draw these or be assigned) a past or current rover mission and will report back three interesting things to the larger group that they learn about the mission. Student teams should also provide an overview of the mission as well as when it took place and what the goal of the mission was.

http://mars.nasa.gov/mer/home/

Duration
Four 45-minute class periods

Lesson Overview
In this lesson teams will plan, implement and redesign their Mars expedition. Teams will learn about the required resources for conducting a Mars expedition as well as the importance of planning ahead and acquiring the necessary resources needed for survival and success of the mission.

Lesson Objectives
1. Students will develop a plan for their Mars expedition based upon their prior knowledge and research conducted in this lesson.
2. Students will reflect on their expedition and have the opportunity to revise their plan and re-execute the mission.

Next Generation Science Standards Addressed
Science and Engineering Practices
Analyzing and Interpreting Data
Developing and Using Models

Disciplinary Core Ideas
ETS1.A. Defining and Delimiting Engineering Problems
ETS1.B: Developing Possible Solutions
ETS1.C. Optimizing the Design Solution
ESS1.B: Earth and the Solar System

Crosscutting Concepts
Influence of Science, Engineering, and Technology on Society and the Natural World
Scale, Proportion, and Quantity
Systems and System Models
Cause and Effect

Materials
- *Giant Mars Map (provided)*
- *String (160cm segments – 9 per team)*
- *assorted stamps (provided)*
- *ink pad (provided)*

- *meter sticks*
- *small version of Giant Mars Map*
- *Mars passports*
- *4 colors of Post Its (50 each)*
- *Scissors (one pair per team)*

Teacher Preparation Instructions

This activity will require some preparation of the *Giant Mars Map* and associated sites to visit prior to the lesson.

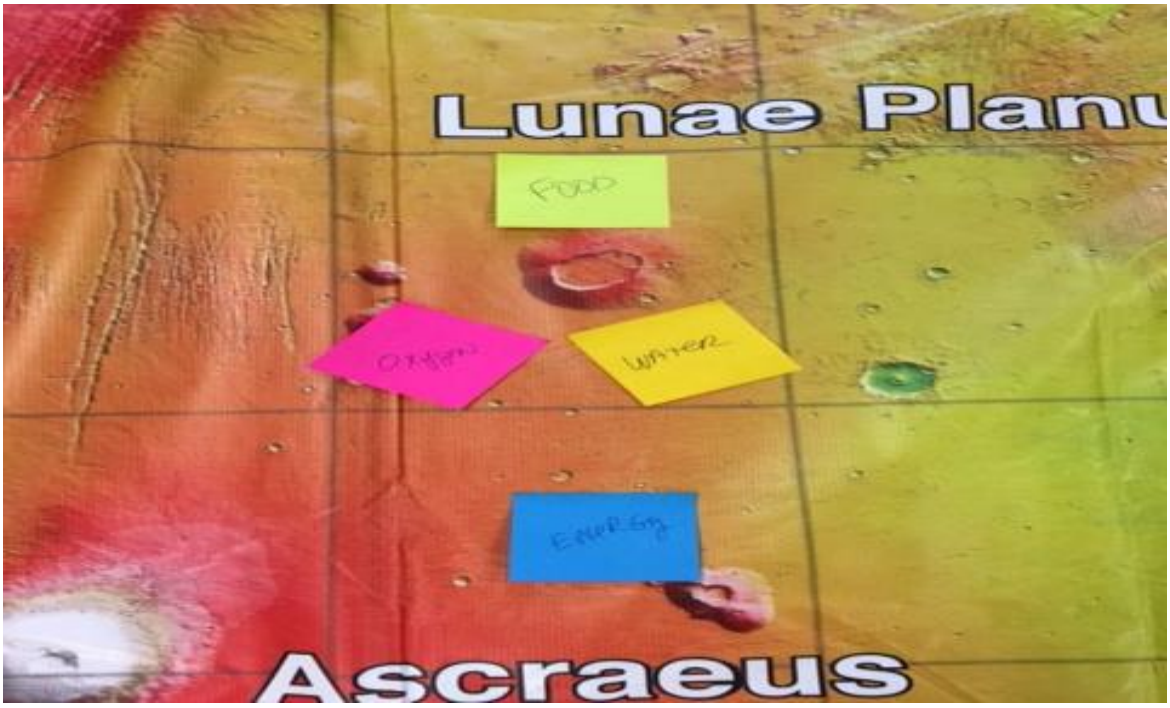
Engagement

Part One – Challenge – 10 minutes

Teacher Preparation

For this lesson you will need to do about 30 minutes of preparation. Follow these steps:

1. Unfold the *Giant Mars Map* and place on the floor, removing all wrinkles and making sure the surface is smooth.
2. Student teams should include 2-4 students. Teams will all start their expedition from the Phoenix landing site. Teams need to be assigned one of three destinations (Viking 2, Spirit, Curiosity). The purpose of three starting places is to spread out the student teams working on the map. Do not have more than three teams (one for each starting point) working on the map at a given time. After the first three teams have crossed the mid-point of the map you may start three more teams.
3. Create the Mars habitat (Hab) stations that student expedition teams will visit using Post Its. Each Hab station will have one Post It representing each of the following (water, food, oxygen, and energy). Any color will work for this lesson, but you will need 4 distinctly different colors.
    a. Use blue Post Its to represent WATER – 50 each
    b. Use green Post Its to represent FOOD – 25 each
    c. Use yellow Post Its to represent OXYGEN – 25 each
    d. Use orang Post Its to represent ENERGY – 25 each
4. The placement of Hab stations are outlined in the tables below. You will create these Post Its by writing the associated names on each. Place each post it at the map coordinates as shown in each table. A photo of the Hab you are creating is provided below to help you with assembly. The Hab should be set up like the photo with the food, oxygen and water in its' own cluster. The energy (recharge station) should appear below in the next area. The goal is to make these some small distance apart. The additional water Post-Its should be placed solo where indicated in the tables below. Explain to students that the rover has a difficult time carrying a lot of water due to its' weight. This is why they have to stop for water more often than for other resources.



Spirit Team Destination Coordinates

Coordinates	Hab or Water Station
140° 130°	Hab (water, food, oxygen, energy)
120° -30°	Water
100° -30°	Hab (water, food, oxygen, energy)
80° -30°	Water
60° -20°	Hab (water, food, oxygen, energy)
40° -20°	Water
20° 0°	Hab (water, food, oxygen, energy)
0° -10°	Water
-20° 0°	Hab (water, food, oxygen, energy)
-40° 0°	Water
-60° 10°	Hab (water, food, oxygen, energy)
-80° 10°	Water
-100° 20°	Hab (water, food, oxygen, energy)
-120° 20°	Water

Curiosity Team Destination Coordinates

Coordinates	Hab or Water Station
100° 20°	Hab (water, food, oxygen, energy)
80° 20°	Water
60° 30°	Hab (water, food, oxygen, energy)
40° 30°	Water
20° 40°	Hab (water, food, oxygen, energy)
0° 40°	Water
-20° 50°	Hab (water, food, oxygen, energy)
-40° 50°	Water
-60° 50°	Hab (water, food, oxygen, energy)

-80° 50°	Water
-100° 50°	Hab (water, food, oxygen, energy)
-120° 6-°	Water

Viking 2 Team Destination Coordinates

Coordinates	Hab or Water Station
140° 60°	Hab (water, food, oxygen, energy)
120° 70°	Water
120° 60°	Hab (water, food, oxygen, energy)
100° 70°	Hab (water, food, oxygen, energy)
80° 70°	Water
60° 70°	Hab (water, food, oxygen, energy)
40° 70°	Water
20° 70°	Hab (water, food, oxygen, energy)
0° 70°	Water
-20° 70°	Hab (water, food, oxygen, energy)
-40° 70°	Water
-60° 70°	Hab (water, food, oxygen, energy)
-80° 70°	Water
-100° 70°	Hab (water, food, oxygen, energy)
-120° 70°	Water

Extra Destination Coordinates

Coordinates	Hab or Water Station
100° 60°	Water
80° 60°	Hab (water, food, oxygen, energy)
60° 60°	Water
40° 60°	Hab (water, food, oxygen, energy)
20° 60°	Water
0° 60°	Hab (water, food, oxygen, energy)
-20° 60°	Water
-40° 60°	Hab (water, food, oxygen, energy)
-60° 60°	Water

5. You should also prepare the stamps for this lesson. The teacher (or a student helper) will monitor the progress of the three teams and provide a stamp to them in their passport as they gather resources for each leg of their journey.

Teacher Directions

Present the student challenge to teams and provide necessary student directions. Allow teams to explore on the *Giant Mars Map* their origination point and destination points. They should also explore the Hab (Mars habitat) clusters on the map (energy depot, oxygen station, food station, water station) to visit and associated resources they might gather from areas.

All teams will start their mission from the Phoenix landing site (top left hand side of map). The Viking 2 team will start at -140° 70°. The Spirit team will start at 140° 30°. The Curiosity team will start at -140° 60°.

Assign your first three teams (of 2-3 students) to visit one of the three following destinations: Curiosity rover landing site, Spirit rover landing site, and Viking rover landing site. Explain to students that in reality these are very far destinations. For example, the Viking 2 landing site is projected to be about 2,945 km from Phoenix based on terrestrial planet mileage calculator by NASA. You should remind students that the map is a flat representation of the round planet Mars. Show them that to get from Phoenix to Viking 2 the rover would actually go around the short way (it would travel to the left and around to Viking 2, not actually across our Giant Mars Map). For this exercise, rovers must start at Phoenix and go to the east or right from the starting spot.

Explain to students that current Mars rovers can only travel up to 200 meters a day. However, for this exercise they are working with a rover of the future that can go 20,000 meters a day, meaning it would take about 147.25 days for the team to make it to Viking 2 and possibly even longer to get to other destinations on Mars if they were really doing this in the real world. Share with students that for this activity we will be doing a small scale simulation of what a Mars expedition might be like.

Teams will only be provided with 160 centimeters of string to start (each 160 centimeter segment of string is 20 day's fuel or 400,000 meters). Teams will need to gather several more string segments (from their refueling and recharging stops along the way) to have enough energy and resources to reach their destination. It is estimated that the Curiosity team will need 7 more segments, Spirit team will need 8 more segments, and the Viking 2 team will need 7 more segments.

Teams will also only be provided with 20 days of food and oxygen to start. These can be recharged at each Hab station each segment of their expedition. To start they will have 10 days of water. Each team will need to make a plan to visit different sites along the way to gather necessary energy (recharging station), food (greenhouses), water (water station) and oxygen (oxygen station) at the Hab.

During the first class period they will plan out their trip, including determining where they will go, what resources they will need. The second and third days they will conduct their trip. The fourth day they will reflect on their expedition and redesign their plan and execute it on the fifth day.

Students will use their string as their gauge for how far they can go between Hab (water, food, oxygen, energy) and additional water stops. As they visit each stop they will cut off the amount of string it took to get from their starting point to the spot they are visiting. Additionally, as they move from areas of the Hab (water, food, oxygen, energy) they must also have enough string to reach each Post It.

For three student teams the roles that should be assigned are:

1. Mission captain – is in charge of communicating the team plan and using the string to determine where the team will visit. The captain will cut off the "used" string at each stop and provide it to the
2. Mission navigator – is in charge of collecting the resources (stamps) and recording notes related to the expedition.
3. Resource officer – works with the navigator to determine what resources are needed and also collects the used string to be placed in the nearest used fuel bucket after each Hab and other sites are visited.

If you have only two students in a team combine roles 2 and 3.

Student Directions

Your team has been challenged to develop a plan to get a super-fast Mars Rover from the Phoenix landing site to visit your teacher assigned destination. Your rover is not like today's rovers that can travel only 200 meters a day – it can go 20,000 meters per day or charge. As an example, the Viking 2 site is 2,945 km away from the Phoenix site. In this Mars Expedition, you will build a plan to conduct this mission on a very small scale, *the Giant Mars Map*. Because it is on a very small scale, compared to the actual size of Mars, we can complete this mission in about 90 minutes from start to end. You will have one full class period (45 minutes) to plan out your trip, along with what you will need in regards to food, water, oxygen, and fuel for the trip. There will be stations along the way where you can gather each of these items – but you will need to plan carefully to make sure it does not extend your mission.

To start you will have:

1. 20 days of fuel = 160 centimeters of string (you will need to gather more of these to complete the mission).
2. 20 days of food for your crew.
3. 10 days of water for your crew.
4. 20 days of oxygen for your crew.

Take a look at your copy of the small version of the *Giant Mars Map*. Fuel stations are indicated by a **star**, food stations are indicated by an **leaf**, water stations are indicated by **cup**, and oxygen is indicated by a **heart.** You will need to gather these resources as you visit the sites as stamps in your passport.

Your team will map out your plan using your provided string. You may not visit any locations that you do not have enough string for. At each Hab you will receive 160 centimeters of yarn = 20 days of fuel. At water station you will receive 10 days rations. At the oxygen and food stations you will receive 20 days of rations. The amount of rations you need will depend on the route you choose to get to your final destination. Your team will need to estimate and calculate it based on your expedition plan.

Once you reach your destination you will receive the **smiley face** stamp and will have completed your journey.

Exploration

Part Two – Activity - Plan the Expedition – 35 minutes

Student teams will plan out the Expedition on provided small scale *Giant Mars Map* paper – explore different options and pathways, determine what resources are needed to make the trip successful, develop a plan and begin to map it out. The teacher will work the room guiding student thinking.

Part Three – Activity – Conduct the Expedition – 90 minutes

Provide teams with their resources needed to start the expedition. The teacher will monitor and support the teams as they move along the map. Once teams finish they can begin thinking about and recording their successes and challenges to share out with the whole group.

Explanation

Part Four – Discussion – 20 minutes

Teacher Directions

Lead the group in sharing out for each team what their successes and challenges were in the *Giant Mars Map* Expedition. Ask the groups to spend ten minutes outlining what they would have done differently in their expedition. This opportunity to redesign mirrors what engineers and other STEM professionals do in the real world. NASA also runs several simulations to prepare astronauts for space travel. Each group shares out their thoughts on what they would do differently.

Evaluation

Student teams will be evaluated through formative assessment methods during the lesson. Teacher questioning of groups and gathering evidence of learning such as there generated lists and constructed passport (in Extension section next) will provide evidence that can be used to adjust instruction within the lesson and in subsequent lessons.

Extension

Part Five – Redesign – 25 minutes

Student Directions

Student teams are provided an opportunity to redesign their plan and map out their course of execution. The next day student teams will execute their redesigned plans.

Duration
Two 45-minute class period

Lesson Overview
In this lesson student teams will have the opportunity to utilize their knowledge generated in the previous lesson to execute a redesign of their Mars expedition on the *Giant Mars Map*.

Lesson Objective
Student teams will conduct their revised Mars expedition and will reflect on the successes and challenges of their revised plans.

Next Generation Science Standards Addressed
Science and Engineering Practices
Analyzing and Interpreting Data
Developing and Using Models

Disciplinary Core Ideas
ESS1.A The Universe and Its Stars
ESS1.B: Earth and the Solar System

Crosscutting Concepts
Patterns
Scale, Proportion, and Quantity
Systems and System Models
Cause and Effect

Materials
- *Giant Mars Map*
- *string*
- *assorted stamps*
- *assorted items for gathering*
- *Mars Rovers* optional*
- *meter sticks*
- *small version of Giant Mars Map*
- *Mars passports*

Teacher Preparation Instructions

The teacher should prepare the *Giant Mars Map* and other items as in Lesson 3.

Exploration

Part One - Revised Rover Exploration – 75 minutes

Student teams will use their revised plan to complete their revised *Giant Mars Map* Expedition and collect their associated resources. See Lesson 3 for more details.

Explanation

Part Two - Reflection – 15 minutes

Student team members individually write an essay describing their plan(s), their outcomes, their expedition successes and challenges.

Evaluation

Student teams will be evaluated through formative assessment methods during the lesson. Teacher questioning of groups and gathering evidence of learning such as there generated lists and constructed passport (in Extension section next) will provide evidence that can be used to adjust instruction within the lesson and in subsequent lessons.

Extension

To extend this lesson the teacher can provide teams an opportunity to engage in further exploration of actual Mars missions completed to date on the NASA and other related websites.

http://mars.nasa.gov/mer/home/

Lesson 5: Occupying Mars

Duration
Three 45-minute class periods

Lesson Overview
In this lesson student teams will engage in further study of Mars through using the *Welcome to Mars* book and considering what a long-term habitat on Mars would need to successfully support human life. Student teams design and plant their flags on the *Giant Mars Map* to officially signify occupying Mars.

Lesson Objective
Students will understand what it would take to occupy Mars long term.

Next Generation Science Standards Addressed
Science and Engineering Practices
Analyzing and Interpreting Data
Developing and Using Models

Disciplinary Core Ideas
ETS1.A. Defining and Delimiting Engineering Problems
ETS1.B: Developing Possible Solutions
ETS1.C. Optimizing the Design Solution
ESS1.B: Earth and the Solar System

Crosscutting Concepts
Influence of Science, Engineering, and Technology on Society and the Natural World
Scale, Proportion, and Quantity
Systems and System Models
Cause and Effect

Materials
- *Welcome to Mars books* – one for each pair of students
- *Giant Mars Map*
- *art supplies for creating flags such as markers, colored pencils, paper, etc.*
- *flagpoles (star card holders) –9 (1 per team of 3 students)*

Teacher Preparation Instructions
The teacher will want to gather *Welcome to Mars* books, prepare the *Giant Mars Map* and provide art supplies necessary for students to complete the lesson.

Engagement

Part One – *Welcome to Mars* book reading session – 30 minutes

- **Read:** Ch. 5 Martian Home and Ch. 6 Green Mars – **Book Activities Optional**
- **After Reading Have Students Discuss:**
  - What would a long-term Mars habitat look like?
  - What would be the most important parts of the habitat?
  - How will Mars be transformed over the next 1,000 years with human habitation?

Exploration

Part Two – Activity – Planting Your Flag – 40 minutes

Teacher Directions

Engage students in a discussion of how settlers on Earth as well as other places (Buzz Aldrin on the moon) mark their territory when they settle or discover a new place. Explain to teams that they will create a flag using a post-card for their team and plant it on the *Giant Mars Map* using the provided "flagpole". Students will use a variety of art supplies that are available to create a flag. Students will need to include at least two symbols and explain their significance, as well as their team name. When all student groups have finished, the class can have their flag planting ceremony.

Explanation

Part Three – Flags on the Moon – 20 minutes

To explain the importance of placing flags on newly discovered bodies in the universe, as well as new countries on Earth in the past; the teacher should as the students to research the significance of flags and why these are important and symbolic to society. Teams should share their findings with the whole class after a short time of engaging in research on the Internet or using other resources.

Evaluation

Student teams will be evaluated through formative assessment methods during the lesson. Teacher questioning of groups and gathering evidence of learning such as there generated lists and constructed passport (in Extension section next) will provide evidence that can be used to adjust instruction within the lesson and in subsequent lessons.

Extension

Activity - Building your colony – 45 minutes

In this activity, the teacher will challenge student teams to develop an identity for their colony to be established in the near future. Each team should consider and develop a short outline of the following to present to class in a PowerPoint:

1. Where on Mars (using the *Giant Mars Map)* would they settle and why?
2. What resources would be easily accessible to their settlement?
3. What resources would they need to bring from Earth (each student can bring only 4 personal items)?

4. What would be the main rules that their colony would have that would keep the order?
5. What would their habitat look like?