



## Earth to Mars Engineering Design Challenge

### Prep Time

20 minutes

### Lesson Time

70 minutes + presentation time

### Essential Questions

What elements need to be included in the design of a Mars habitat to ensure safety and sustainability?  
What resources are needed to sustain human life inside a habitat on Mars?

### Objectives

SWBAT discuss and display knowledge of engineering design, basic needs for a Martian habitat, and creative habitat structure design for use on Mars.

### Standards

HS-ETS1-2 Engineering Design  
HS-ETS1-3 Engineering Design

### Teacher Notes/Background

The students of today may very well be called on to create the technology and design the mechanisms to allow for habitation on Mars.

In order to prepare our students to think like the engineers of tomorrow, we need to challenge them with unique, creative design challenges that spark imagination and provide opportunities for brainstorming and rapid design iteration.



## Earth to Mars Engineering Design Challenge

<b>Engage</b> 5 minutes	<b>Pre-mission brief</b>  Show PowerPoint presentation to give engineering design objectives.	<b>Materials</b>  PowerPoint presentation
<b>Explore</b> 18 minutes	<b>Research Stations</b>  <b>PHASE I: 10 minutes</b> Review key NASA and aerospace research briefs highlighting components that need to be incorporated in Mars habitat designs for them to meet the needs of NASA  HOW: Tables will be set up with research stations (5 stations total) that are separate from where the project teams will work. At the beginning of the activity, each group will select 1 student to represent their project at each research station. Students will be given 10 minutes to read through the research and discuss the needs with their colleagues (from other groups). They receive a graphic organizer to fill out key information so when they rejoin their project teams they have specs to share and reflect on during the design stage.  <b>PHASE II: 8 minutes</b> Students come back together at their home stations and each student briefs the project team about the research they just reviewed and what component needs to be addressed in their design.	<b>Materials</b>  Research briefs Tables Research graphic organizer Clipboards Pencils
<b>Explain</b> 15 minutes	<b>PHASE III: 10 minutes</b> Each student team is provided with a template (8 ½ x 11) to create a rough mockup of their idea for a potential habitat structure. Students will be informed that this should not be drawn to scale or made too explicit in details, this stage is supposed to capture the initial ideas from each member of the project team.  <b>PHASE IV: 5 minutes</b> Gallery Walk – Each team’s template is then displayed on the table as the other project teams visit each initial sketch/design, noting positive ideas to carry over to the potential final design. Students can provide feedback on sticky notes as they visit each team’s table to view their draft design.	<b>Materials</b>  Paper Pencils Sticky notes



## Earth to Mars Engineering Design Challenge

**Elaborate**  
+30 minutes

### **PHASE V:** 30+ minutes

Design – The group will split into two teams, one will design the outside structure of the Mars habitat using 3D printing pens, and the other will design the inside of the Mars habitat using surface pro drawing software.

The outside structure group will need to consider strength of design and shape to be able to withstand the harsh conditions on Mars.

The group designing the inside of the habitat will need to consider the elements in the research briefs and the placement of these elements for maximum safety and comfort.

Having identified components of individual student drafts that are exciting, innovative and might meet the needs of NASA (connection back to the storyline/pitch), the group designing the inside of the habitat begins creating their prototype design. Students will be supported by volunteers to ensure they know that the quality of artistry is not their focus, the rapid iteration process should drive their work and discussions.

#### Notes:

- Students should get at least 30 minutes to work, but that time can be extended to give students more time to build more elaborate structures.
- This portion of the lesson can use alternative materials:
  - o Recyclable materials or basic craft supplies to create the Mars habitat model.
  - o Drawing portion can be done on a white board or paper instead of using Surface Pro and software.

### **Materials**

3D printing pens (5)

Printing filament (5 boxes)

*Alternative to 3D printing pens:*

Recyclable materials, craft supplies

Surface Pros (5) with stylus and drawing software installed

*Alternative to Surface Pros:*  
Whiteboards or Drawing paper and Markers

Completed graphic organizers for reference

**Evaluate**  
2 minutes

### **PHASE VI:** 2 minutes

Wrap Up – Bring student teams together for a wrap up and congratulate them on completing their design mission.

An optional sharing activity can follow. See Extension Activities.

### **Materials**



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### Extensions and Enrichment

#### Project Presentations:

Each student team will have 5 minutes to share their Mars habitat model and interior plan. Surface Pro can be used to project the interior plan up on the display screen in the room. Habitat models can be displayed or a picture can be taken of each one to display on the larger screens while sharing.

#### Notes:

- If alternative materials were used, have student share work in a “gallery walk” where every student has a chance to look at projects around the room and ask the creators questions about their work.
- Presentations can also be given to the whole group in a more traditional presentation format.

### Additional Resources

For additional information about Mars to share with your students visit: <https://mars.nasa.gov/>. Here you will find current, real-world projects and missions developed by NASA to further the exploration of Mars.