Build a Habitat

Objective: Students will be learning about the different modules that are a part of a Mars habitat and building their own design using augmented reality and a 3D printing pen or Play-Doh.

Materials Needed:
- Activity 1 – Mars Community App:
    - Tablet (or another mobile device)
    - 7 Trigger Cards
- Activity 2 – Mars Living Quarters Model Build:
    - 3D Printing Pen
    - Power Source (must be plugged in at all times)
    - Filament
    - Scissors (useful to have a few on-hand to trim filament)
    - Play-Doh

Summary of Student Action:
There are two activities in this station; they can be completed in any order.

Activity 1 – Mars Community App
There will be tablets set up at a station, with sets of 7 Mars AR cards. Using the Mars Community Builder app, students will use the 7 different trigger cards to learn about each module. The cards are: Mars Planet, Habitat Lander, Greenhouse, Recreation Module, Water Tanks, Communications Center, and Earth Return Vehicle. Each of the modules can also be accessed directly in the app. Some of the cards have a virtual reality component, where students can pan around the room.

Once students read about each of the components, they will be able to build in AR. The app guides them through the entire process. They will be selecting locations for each module that come with the lowest amount of risk.

Students can either use the provided tablets or can use their own devices to download the app and do the experience on that device.

Activity 2 – Mars Living Quarters Model Build
Students will build a model of the Living Quarters of their Mars Habitat using 3D Printing Pens. They can select any color filament they want, or a combination of several. Students may need a time limit for this station, as they can work for a while.

Students in middle and high school are typically the most successful in using the 3D Printing Pens; however, the pens can be used with younger students with adult assistance. Play-Doh can be used by younger students, or for any student who would prefer.

Setup Instructions:
- <u>Activity 1 – Mars Community App:</u>
    - Download the Mars Community App onto any devices that will be provided to students. It is available in the Google Play store. Set out several sets of trigger cards and a card with instructions to download the app to people's own devices (optional).

- <u>Activity 2 – Mars Living Quarters Model Build:</u>
    - Set out all the pens. They must be plugged in, so you may need power strips and extension cords. Set out the filament.
    - It could be useful for students to have an example, so feel free to make a 3D model and set that out for them to see. Making an example is also useful for familiarizing yourself with the pens and will better prepare you to assist students if issues arise.

Additional Notes:
- <u>Activity 1 – Mars Community App</u>
    - Students may need extra help getting used to using the triggers and keeping the AR experience
    - active. Familiarize yourself with the app and how to best use it to be able to support students as they first start using it.
- <u>Activity 2 – Mars Living Quarters Model Build</u>
    - The pens can be tricky for students, especially at first. It is important that you use the pens to prepare for questions and issues that may arise.
    - The biggest struggle for students is loading the filament. If there is an issue, here are things to check:
        - Make sure the speed slider is at max speed (furthest from the tip). This is on the side of the pen.
        - Make sure the red light has turned green. If it has not, press the down button until it has.
        - Make sure the student is holding the down arrow and gently pushing the filament into the hole.
        - Make sure the filament is going in as straight and level as possible
        - Make sure the end of the filament is even. Trim it if it has been previously used and is uneven.
        - If a student struggles with removing filament, check all the issues above. Make sure a student does not pull too hard or break off the filament because it can get jammed and it is impossible to unjam it.
        - For building, it is easiest if students build walls in 2D and then attach the walls together.
        - It is also best if they do shorter, smaller strokes to make the structure stronger.
        - To build directly in 3D, students should slow down the speed by pushing the slider closer to the tip. This makes it easier for the material to dry as it is released, but they will still need to use their hand or another object to support the filament as it dries.

PHASE FOUR: LIVING ON MARS

Augmented Reality:

You are responsible for building the first Mars Community. Using augmented reality, your goal is to create the most sustainable community possible for the first Mars crew. You will be learning about each of the modules, or components, of the Mars Community, and selecting the best location for each module.

How to use the Mars Community app:

1. Using the tablet, open the Mars Community Builder app.

2. You can also download the Mars Community Builder app onto your own mobile device from the Google Play or iTunes App store. It's free!

3. Follow the directions and use the Mars Community Trigger Cards to begin the AR Habitat Build.

3D-Printed Model Design:

You will be creating a model of the living quarters of the Mars Community using a 3D Printing Pen. Using the pen, create the outside structure of the habitat.

How to use the pens:

1. DO NOT TOUCH THE TIP OF THE PEN. IT IS HOT!

2. They must be plugged in at all times.

3. Press the down button near the tip of the pen. When the light changes to GREEN, it is ready to use.

4. To insert a color, place one end of the filament into the hole at the top of the pen. Hold the DOWN arrow as you gently guide and push the filament into the pen. It will take a minute or so for it to make its way out of the drawing tip of the pen.

5. When drawing, hold down the DOWN arrow. To change the speed at which the filament comes out, move the slider on the side of the pen up or down.

6. When you are building, give the filament a few seconds to dry before touching it.

7. When you are done with a color, hold the UP arrow and **GENTLY** pull the filament out of the pen.

Tips for building with 3D pens:

- Try building 2D walls on the table, then attaching the walls together to create the 3D structure.
- To build directly in 3D, slow down the speed of the pen. Draw directly up.
- If filament won't load properly, remove it. After you have fully removed the filament, cut off the end with scissors so it has a straight, clean edge and try again.

Play-Doh Model Design:

- *You will be creating a model of a Mars Habitat using Play-Doh. Some things you can put in your design include:*
    - *A living and sleeping quarter*
    - *A lab*
    - *An exercise room*
    - *A greenhouse*

HABITAT LANDER

BASIC INFO

The Mobile Habitat Lander allows the crew to land safely on Mars and to transport astronauts from one place to another. Due to the length of some trips, crewmembers should be able to live inside the lander for several days.

DRY MASS	3,300 Kg
PROPELLANT MASS	390 Kg
TOTAL MASS	3,690 Kg

15.5 METERS HIGH

CREW CAPSULE

10.0 METERS WIDE

MARS

COMMUNITY   BUILDER

WATER TANKS

BASIC INFO

The Water Tanks store and recycle water for the Mars community. The water tanks should be easy to access, fill, heat (to keep the water liquid), and must shield the water from radiation in the Martian environment.

17.2 METERS HIGH

MARS
COMMUNITY BUILDER

COMMUNICATIONS
CENTER

BASIC INFO

The Communication Center, has equipment and antennas that allow astronauts on Mars to communicate with each other and with people on Earth. The Communication Center also provides a space for multiple crewmembers to work on other projects simultaneously.

MAIN FUNCTION	Transmitting Data to Earth through Mars Orbiters
RADIO FREQUENCY	UHF band
TRANSMISSION RATES	Up to 2 megabits p/s

CREW CAPSULE

2.3 METERS HIGH

MARS
COMMUNITY   BUILDER

EARTH RETURN VEHICLE

BASIC INFO

The Earth Return Vehicle allows crew members to launch from, and land on, the surface of Mars in their reusable Mobile Habitat Lander. It can also support launches and landings of non-crewed cargo vehicles that carry things between Earth and Mars. Because it takes more powerful thrusters to launch than land, it will allow crew and cargo vehicles to connect to large reusable rocket thrusters.

48.1 METERS HIGH

MARS

COMMUNITY BUILDER
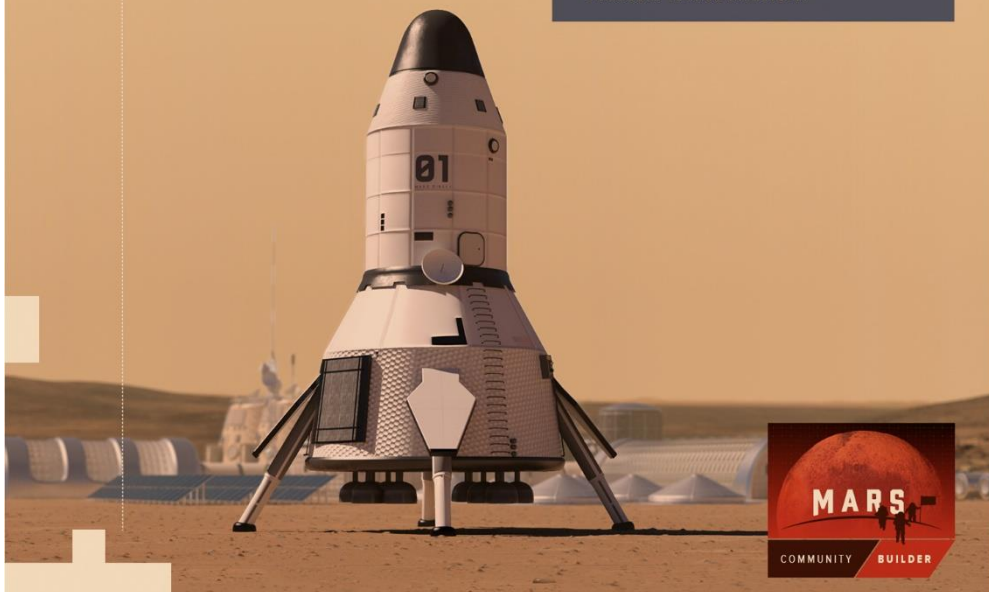
MARS PLANET

BASIC INFO

Mars is one of Earth's neighboring planets. It is the second smallest planet and is about half the size of Earth. The planet has a reddish color and is significantly colder than Earth, with an average temperature of -81°F.

APHELION	249200000 km
PERIHELION	206700000 km
SEMI-MAJOR AXIS	227939200 km
MASS	6.4171×10^{23} kg
SURFACE GRAVITY	3.711 m/s

MARS COMMUNITY 1

AXIAL TILT = 25.19°

VOLUME = 1.6318×10^{11} KM

MARS
COMMUNITY BUILDER

GREENHOUSE

BASIC INFO

The Greenhouse is a place to grow plants. Plants are important for cleaning air, producing oxygen, and growing food for crew members. Plants grown for food on Mars can supplement pre-packaged, dehydrated food brought from Earth.

17.2 METERS HIGH

MARS
COMMUNITY BUILDER

RECREATION
MODULE

The Recreation Module has space to build community and wellbeing: windows for the crew to look outside, large screens for research and entertainment, room for all crew members to dine together, and exercise equipment.

CREW CAPSULE

MARS

COMMUNITY BUILDER