

# GENERATION BEYOND



## YOUR PLACE IN SPACE

### FAMILY ACTIVITY ONE



STEM (Science, Technology, Engineering, and Math) is in the headlines a lot these days. But what does it mean to be an engineer? This is a chance to find out about how some engineering careers relate to space exploration.

Space exploration is complex. Each piece of space technology involves many people from various engineering backgrounds. From the original design through the manufacture and assembly processes, and finally to the launch and mission of the spacecraft, many factors must be considered. For example, the engineers of Orion — NASA's newest spacecraft that will carry crews to the moon or Mars — had to design a spacecraft capable of supporting 1,000-day missions millions of miles from home; protecting astronauts against deadly radiation storms; and maintaining a safe, habitable environment.

What about living in space? Currently plans are under way for a habitat needed for humans to live in for the long journey to Mars. Habitats are also needed for living on the surface of Mars.

But there is more involved than just spacecraft design. When launching a spacecraft and plotting its trajectory, engineers need to know where other objects are in space—like other satellites or debris—so collisions can be avoided. Lockheed Martin engineers are currently hard at work on Space Fence, a system that will track Earth-orbiting objects to help keep space technology and travelers safe.

Together with scientists, mathematicians, and technicians, engineers are currently working together to make these and other space exploration projects a success. Now is your family's chance to use your expertise to bring one of these projects to life while learning more about these important engineering careers. You will need to:

- Decide who in your family should take on each engineering role,
- Select a current exploration project team to join, and
- Carry out your tasks to complete a successful project!

## PART 1: WHICH MARS ENGINEER ARE YOU?

Use the following information to decide who in your family best suits each role.

### AEROSPACE/ASTRONAUTICS ENGINEER

Aerospace engineers are responsible for the design and construction of spacecraft and launch vehicles. Aerospace engineers are also responsible for conducting testing to make sure that the prototype works as designed, and for making any necessary modifications. They are people who like to tinker and understand how things work. They are analytic thinkers who are detail-oriented. They have to be able to communicate clearly with others to make their designs a reality.

Learn more about what aerospace engineers do, what the current job outlook is, and what it takes to become one by going [here](#). Who in your family would make a good aerospace engineer?

### BIOMEDICAL ENGINEERS

Biomedical engineers do research to understand how the human body works and how we can overcome injury, disease, or other health issues. These engineers are important for helping humans survive the long trip to Mars. They are analytical thinkers and use the scientific method to understand and solve problems. Having great communication skills is very important.

Learn more about what biomedical engineers do, what the current job outlook is, and what it takes to become one by going [here](#). Who in your family would make a good biomedical engineer?

### ELECTRICAL ENGINEERS

Electrical engineers are responsible for the design, development, and manufacturing of the electronic components needed for space exploration. This includes everything from navigation and communication systems for the mission spacecraft to electric motors and electronics for spacecraft or surface exploration vehicles. Electrical engineers are active listeners who can use critical and creative thinking to solve complex problems.

Learn more about what electrical engineers do, what the current job outlook is, and what it takes to become one by going [here](#). Who in your family would make a good material science engineer?

## **MATERIAL SCIENCE ENGINEERS**

Material Science engineers study different materials to discover or manufacture the best material for a specific performance specification, like heat shields on spacecraft or walls for space habitats. They conduct experiments and analyze the findings. They consider all angles of a problem to find possible solutions and communicate their ideas.

Learn more about what material science engineers do, what the current job outlook is, and what it takes to become one by going [here](#). Who in your family would make a good material science engineer?

## **MECHANICAL ENGINEERS**

Mechanical Engineers work with mechanical equipment to design and construct tools, engines, and machines, all of which are needed in space exploration. They conduct experiments to find the best solution. These analytical thinkers have to be able to communicate their plans to others.

Learn more about what mechanical engineers do, what the current job outlook is, and what it takes to become one by going [here](#). Who in your family would make a good Mechanical engineer?

## **SOFTWARE ENGINEERS**

Software engineers combine electrical engineering and computer science skills to develop computer hardware and software. They make computers faster, smaller, and more capable of complex work, which is very necessary for space flight. They have to be able to see how a system works as a whole and how changes in one part may affect other parts. They have good problem-solving skills and the ability to clearly communicate and work well with others.

Learn more about what software engineers do, what the current job outlook is, and what it takes to become one by going [here](#) or [here](#). Who in your family would make a good computer engineer?

## **SYSTEMS ENGINEERS**

Systems engineers integrate systems together using complex technologies to make sure everything works together. This is important when designing structures on the surface of Mars. They are creative problem solvers. They also have to be able to communicate clearly with others to make their designs a reality.

Systems engineering is interdisciplinary, and systems engineers may come a wide range of engineering fields. Visit the links above to find out more about what systems engineers do, the current job outlook, and what it takes to become one. Who in your family would make a good architectural engineer?

## **PART 2: JOIN A TEAM**

There are several projects crucial to space exploration that require engineers from many disciplines. Read through the information on each before making a decision about which team to join.

- **Spacecraft Habitat Module:** Astronauts will spend almost a year in their spacecraft before they reach their Martian destination. Orion and the habitat module will be their home millions of miles away from home. Your family must design the module that will keep them safe and comfortable on their journey.
- **Martian Surface Habitat & Research Station:** While humans are on Mars, they need a safe place to live and work. Oxygen, water, and a pressurized and temperature- and humidity controlled environment are essential. But what else is needed for humans to safely live, work, and even play on Mars? Your family must design a safe home and research station for the scientists on Mars.
- **Space Debris Mapping:** Fifty years of space flight has left a lot of debris in orbit around Earth. This debris may be anything from a satellite that

has lost power to a tool that an astronaut lost during a spacewalk. This orbital debris, or space junk, can cause issues for spacecraft. If a moving spacecraft collides with space debris, the collision speed is around 22,330 miles per hour. At that speed, a lot of damage can be done. Your family members must map “space debris” and navigate a “space vehicle” safely through the debris.

Which challenge will your family choose?

### **PART 3: COMPLETE THE ENGINEERING CHALLENGE**

Now that your family has joined a team, it’s time for each member to tackle his or her engineering responsibilities and bring your project to life. Use the attached blueprints to help plan your work.

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## SPACECRAFT HABITATION MODULE

Design the module that will keep astronauts safe and comfortable on their journey

Engineer #1 _____ Title/ Type of Engineer	_____ Name
Engineer#2 _____ Title/ Type of Engineer	_____ Name
Engineer#3 _____ Title/ Type of Engineer	_____ Name
Engineer#4 _____ Title/ Type of Engineer	_____ Name

Design Constraint	Engineer Responsible
How much space in the habitat is needed for each crew member?	
Where will the crew members eat?	
Where will the crew members sleep?	
What type of space is needed for the various activities for the crew to stay healthy?	
Is there a way to maximize the space by using the same area for different activities?	

Team Design Notes:

Use the space above to discuss the project and sketch your design. Once your blueprints is complete, create a model using household materials

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## MARTIAN SURFACE HABITAT & RESEARCH STATION

Design the structure that will house humans on Mars

Engineer #1 _____ Title/ Type of Engineer	_____ Name
Engineer#2 _____ Title/ Type of Engineer	_____ Name
Engineer#3 _____ Title/ Type of Engineer	_____ Name
Engineer#4 _____ Title/ Type of Engineer	_____ Name

Design Constraint	Engineer Responsible
How much space is needed for home life	
How much space is needed for work	
Where will the food be grown	
Is there a way to maximize the space by using the same area for different activities	
Will the habitat be movable	

Team Design Notes:

Use the space above to discuss the project and sketch your design. Once your blueprints is complete, create a model using household materials.

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## SPACE DEBRIS MAPPING

Map “space debris” and safely navigate a “spacecraft”

Engineer #1 _____ Title/ Type of Engineer	_____ Name
Engineer#2 _____ Title/ Type of Engineer	_____ Name
Engineer#3 _____ Title/ Type of Engineer	_____ Name
Engineer#4 _____ Title/ Type of Engineer	_____ Name

Design Constraint	Engineer Responsible
How will you simulate a debris field on Earth that you can use to model and test what is happening in space?	
How will you map a debris field , both in your model Earth and in space?	
How can you use models to determine a safe path through the debris field?	
Can you navigate through you debris field? Or do you need to develop a new spacecraft material that can withstand impact?	

Team Design Notes:

Use the space above to discuss the project and sketch your design. Once your blueprints is complete, create a model using household materials.