Mission Objective 6

Designing a Human Rated Rocket

Summary

Rocket science gets real when NASA crews are on board. In this MO, teams will design a rocket and a crew capsule that is safe and reliable enough to deliver their astronauts to the Moon and then safely return them home.

Materials Needed

Building Materials:

- Empty and clean 2-liter soda or water bottles
- Pringles chips
- Variety of additional craft and construction materials such as: duct or packing tape, glue, cardboard or balsa wood, popsicle sticks, plastic bags, tissue paper, string scissors and/or box cutters, rulers

Launching Materials:

- Bicycle pump with pressure gauge
- Grease or lubricant
- Aquapod Launchers (or similar)
- Estes Altitude Trackers

Resources from Companion Course Lesson 6:

- Engage Section: An activity to introduce how NASA prepares SLS for human flight and the test dummy Commander Moonikin Campos
- Explore Section: Slides and hands-on activities to teach concepts related to rocket stability
- Explain and Elaborate Sections: Guidance and worksheets to help students use the Engineering Design Process to construct and test their rocket and capsule
- Extend Section: An additional crew exploration vehicle activity and a guide on how to simulate their rocket's flight.

Additional Resources

- Video guide: NESSP AquaPod Rocket Tutorial
- Video guide: Designing and Testing a Crew Capsule (coming soon)

Getting up to Speed

The Artemis mission's Space Launch Systems Rocket (SLS) is the most powerful rocket in the world and NASA's only human-rated rocket, meaning it can safely take astronauts to the Moon and back. To achieve a human rating the SLS and the Orion Crew Capsule had to pass strict tests to ensure they can provide a safe and habitable environment for its human crew. Is your team ready to take on the challenge of building a safe and reliable rocket and capsule?

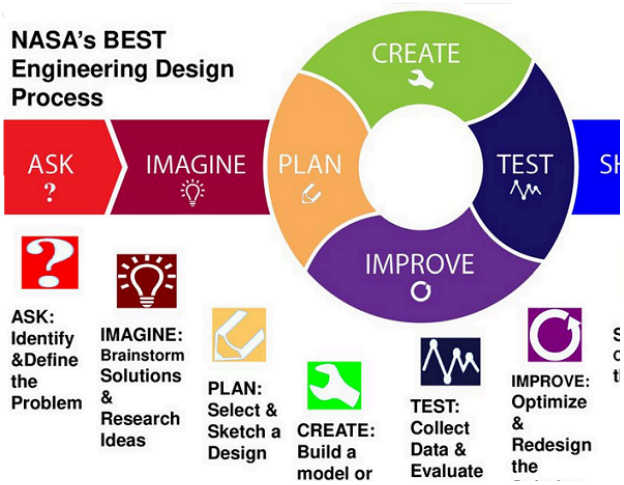
To learn more about how NASA designs and test rockets and crew capsules for human space flight, check out the resources in the Getting up to Speed with Artemis document.

Mission Guidance

In this MO, teams will design a water bottle rocket that can launch a test dummy chip-stronaut (Pringles chip) at least 50 feet into the air and bring them back safely to Earth. Teams should start by designing, building, and testing their rocket, trying different designs for the rocket's body length, width, nose cone, and fins to make sure it flies smoothly. Teams should also choose strong materials and build their rocket in a way that allows it to be flown multiple times without damage.

Next, teams will design a crew exploration vehicle that fits inside the nose cone of their rocket and is big enough to hold a test dummy 'chip-stronaut' (a Pringles chip). The capsule must have a hatch that can be easily opened so ground crews can insert and remove the chip-stronauts and take clear photos of it before and after the flight. The capsule can stay in the rocket during the flight or be ejected and land with a parachute—it's up to you!

Teams must follow the Engineering Design Process when designing their rocket and crew exploration vehicle.



The goal is to build a rocket and crew exploration vehicle that can be launched more than 50 feet in the air three times in a row without damaging the rocket or the chip-stronaut.

Teams should learn about the inspiration behind the name of the famous Artemis I test dummy by watching "Arturo Campos: The Man Behind the Artemis Moonikin" or reading "The Adventures of Commander Moonikin Campos and Friends" and name their astronaut test dummy after someone who motivates them.

Deliverables

As they work, teams should keep track of their results in their Science and Engineering Notebooks (SEN). At the end of the challenge teams will be asked to submit a Mission Development Log (MDL) to NESSP that shows how the students worked through the Mission Objective and summarizes their results. NESSP provides a Mission Development Log Template to help guide what teams should include in their MDL.

Heads up! This MO is part of the team's final mission! If your team plans to attend a NESSP in-person hub event (MO-8a), you will launch your rocket at the event as described in MO-8a. If your team does NOT plan to attend a NESSP Expo event, you will submit a video of your rocket launching (maximum of 5 minutes) as described in MO-8b.

MO-6 What must be in your Mission Development Log (MDL)?

Every MDL must include:

- A profile their chip-stronaut, including a picture or drawing, a name, and a description of the motivational figure it is named after.
- A summary of the Engineering Design Process taken by the team including:
  - A clear statement of the problem.
  - Labeled drawings or images of at least two initial designs of the rocket and the crew capsule.
  - Results of at least two test of the rocket and crew exploration vehicle, including:
    - before and after images of the rocket body and crew.
    - a written description of what happened to the rocket and crew exploration vehicle.
    - a quantitative description of the size and number of pieces the chip-stronaut.
    - how the team decided to improve the rocket after each test.
- An image and quantitative description of the final rocket and crew exploration vehicle design, including the height, width, and mass.
- A description whether the final design achieved the goal of being launched above 50 feet three times in a row without damaging the rocket or the chip-stronauts.
- A statement describing what the team would do to continue testing and improving their rocket and crew capsule design if they had more time.