SPACE FOR TEACHERS

Project Hail Mary Challenge

QUICK START GUIDE

SPACE FOR TEACHERS

THE CHALLENGE

This Is Your Hail Mary

The Project Hail Mary Challenge puts educators at the center of story. The Challenge invites educators to guide, shape, and ultimately fly student-designed projects in real microgravity.

Middle and high school classes design a small rotating space station based on the artificial gravity concept from *Project Hail Mary*. Selected teachers fly their students' winning designs in real microgravity during a parabolic flight.

GETTING STARTED

SPACE FOR TEACHERS

Submission Deadline:

May 4, 2026

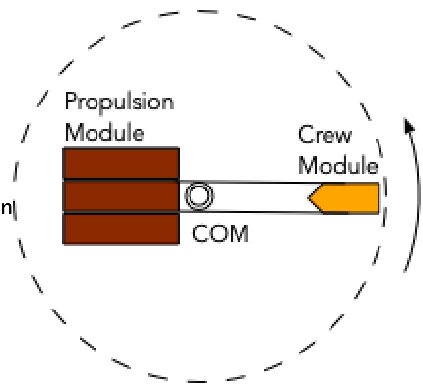
Divisions

I: K-8

II: High School Division: 9-12

Entry

- One classroom design per teacher.
- Collaboration across disciplines and grades is encouraged.
- Students may work in small groups, but all work results in a single final design.
- The teacher is the primary contact for the classroom entry.



Submission Materials

- Notebook: Labeled Sketches / Digital Design and Ground Validation
- Mission Patch Design
- Student Video (2-3 minutes)
- Video (1-2 minutes)

    Must show finished design

If your class is selected, Space for Teachers (SfT) works with you on technical reviews, payload integration, and flight preparation.

Note: You will travel to the flight location and fly with the 2026 SfT Embedded Teacher Cohort. Flight date TBD.

Submission details and full competition handbook at:

spaceforteachers.org/projecthailmary

THE DESIGN

Your class will design and print a two-module space station that produces gravity by centripetal acceleration. If selected, the performance of the design is evaluated in microgravity by you, their teacher, on a parabolic flight.

Core Design Features

- Two modules: Crew and Propulsion
- Unequal module masses so the center of mass (COM) is not at the midpoint.
- A tether or structural arm of length "L" between module centers.
- Station spins about its true COM so each module experiences a different effective gravity level.

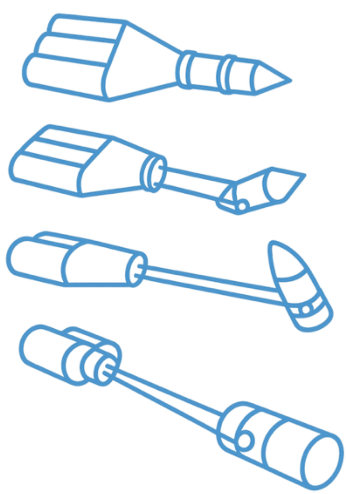
Classes May Target

Partial gravity at the crew module (e.g., 0.5 g)
Mars gravity at the crew module (~0.38 g)
Lunar gravity at the crew module (~0.17 g)

Gravity levels between 0.15 – 0.5 are appropriate for this challenge

Physical and Safety Constraints

- Maximum deployed diameter: 1.0 m
- Maximum total mass: 2.5 kg
- Maximum rotation speed during ground testing: 40 rpm
- Stowed size for flight: fits inside 30 cm × 30 cm × 15 cm volume
- No sharp edges, fragile projections, loose parts, or unsafe materials
- Robust tether attachment for "free float"
- 20-second testing window



The competition values both feasibility and artistic design. However, in order to advance through the competition, students must show, through ground testing and validation, that the station is physically secure and safe in concept. A 3D printer is helpful but not required.

SUBMISSION CHECKLIST

SPACE FOR TEACHERS

A detailed submission checklist with file names, formats, and upload steps is provided in the competition handbook.

✓ Digital Design Files

Labelled clearly:

- Digital design (.STEP) OR Sketches
- Shows (to scale) both modules, tether, tether attachment, center of mass (COM) location
- Front, top, right-side, and isometric views.
- Dimensions in mm, including:
  - Overall length "*L*" between module centers
  - Tether length and attachment points
  - Module dimensions (L,W,H),
  - Sensor: mount location, dimensions
- Mass
- Materials

✓ Student-led Video (2-3 minutes)

Students explain:

- The station design and key features
- How artificial gravity works in their design
- Safety features
- What they are learning from the challenge

✓ Test Plan and Calculations

Record of:

- Concept development & design reasoning
- Scientific and mathematical reasoning behind design

Example:

Team selected a dual-cylinder configuration with a mass ratio of 3:1. The rotation axis passes through the center of mass, reducing wobble during rotation. The masses for the crew and propulsion modules are: ___ and ___ grams.

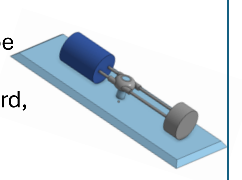
Team will use a series of small-scale spin tests (described) to choose the final tether length.

Middle school: Clear qualitative explanations of the proposed tests that will demonstrate artificial gravity.

High school: Calculations connecting:

- Mass and radius to COM
- Period to frequency and rpm
- Radii and rotation rate to approximate artificial gravity

Station testing can be accomplished on a turntable, a 1-m board, and spindle passing through COM.



✓ Teacher Video (1–2 minutes)

Teacher explains:

- Classroom and student context
- Why they chose to participate
- What students are gaining from the project experience
- Any outreach and collaboration

✓ Mission Patch Design

Image or PDF that:

- Connects to Project Hail Mary
- Represents a rotating dual-gravity station
- Includes team or class name and a short mission title or motto

FINALISTS AND FLIGHT TEAMS

Submission Review Team:

All submission materials are reviewed by a panel of experts. Classes are scored using a rubric for their division.

Finalists:

A group of middle school and high school finalists is selected based on:

- Technical quality and flight feasibility of the design
- Evidence of student reasoning and (for high school) calculations
- Creativity and aesthetics of design
- Safety and compliance with constraints
- Mission patch design and videos

Interviews:

Finalist teachers are invited to a short interview with a review panel

Interviews focus on:

- How the project was integrated into the class
- How students participated
- How the teacher plans to support ongoing student engagement

Flight team

From the finalists, the panel selects one classroom from each division

Teams may work with other classrooms on the final build and testing of the model.

Winning classrooms will conduct:

- Detailed flight safety reviews
- Final design adjustments
- Ground tests of constructed model, including “shake” test, strength and durability tests
- Integration and test planning for the parabolic flight
- Selected teachers are required to attend weekly check-ins with the Space for Teachers team prior to flight.

SPACE FOR TEACHERS

DESIGN AND SAFETY REQUIREMENTS

Parameter	Limit / Requirement	Why this matters
Max Diameter	**1.0 meter** (fully deployed)	Ensures safety on standard lab turntables and within test area.
Max Mass	**2.5 kilograms** (total system)	Keeps forces safe during high-speed rotation.
Max Rotation	**40 RPM** (Revolutions Per Minute)	Prevents excessive kinetic energy and tether strain.
Max g-level	**0.5 g**	Larger g-levels require high rotation rates and/or large diameters that are not flight-safe.
Stowed Size	**30 cm × 30 cm × 15 cm**	The station must fold/collapse to fit in a standard carry-on size.
Tether	**Flexible or Semi-Rigid**	Must allow smooth rotation without tangling.
COM Ring	**Required**	The tether must have a specific "Center of Mass Ring" or loop that fits over turntable spindle.

Allowed Materials: 3D-printed plastics (PLA, ABS, CF, PETG, Nylon), cardboard, standard metal hardware (screws, washers), string/paracord.

Prohibited Materials: Lead weights, glass or brittle ceramics, grains or liquids, and any sharp edges that can cut a tether or person.

Stable Balance: Clearly identify the Center of Mass and align it with the rotation axis to prevent wobble.

Secure Attachments: All modules and weights must be mechanically secured. Tape alone is not a structural fastener.

Safe Zone: Observers must maintain a safe distance during spin testing.

Safe-Grasp Zone: Include a designated area to safely hold or stop the rotating assembly without contact with moving tethers or modules. A common approach is a short rigid tube through the COM ring, so that it rotates smoothly

SPACE FOR TEACHERS

RUBRIC: ELEMENTARY AND MIDDLE SCHOOL

Category	Weight	Criteria for Excellence (5 pts)	Criteria for Needs Improvement (1 pt)
Technical Feasibility	25%	The design is clearly drawn (digital or hand-drawn) with measurements and labeled parts. Students explain how components fit together and remain within size and safety limits.	Drawings are unclear, missing labels, or incomplete. The design is oversized, unsafe, or impractical to construct.
Scientific Accuracy	20%	Students correctly describe that spinning produces an inward push ("artificial gravity") and attempt simple speed or g-level estimates. They understand how tether length and rotation relate.	Physics explanations are incorrect or unrelated (e.g., confusing rotation speed with gravity level, or misidentifying the center of mass). Students make no attempt to use the simple math provided.
Testing & Safety	15%	Students describe a safe method for spinning and measuring the station—such as using a barrier, wearing goggles, or stabilizing the setup. They clearly identify what they intend to measure.	The testing plan involves unsafe practices (e.g., spinning by hand) or does not mention protective measures.
Student Engagement	10%	All students contribute to the project and can explain what they learned. The work clearly reflects student ownership and participation.	Work appears to have been completed by only one or two students or built primarily by an adult. Students cannot explain the design.
Community Outreach	10%	Students share their project with others (another class, school event, library display, etc.) in age-appropriate ways that communicate what they learned.	No plan to share the project beyond the immediate team.
Aesthetic Design	10%	The station is visually creative and shows effort. The Mission Patch is colorful, meaningful, and connected to the mission story.	The station looks unfinished or generic. The Mission Patch is missing or low-effort.
Presentation	10%	The written summary is clear and easy to follow. The video is enthusiastic, audible, and tells a coherent story about the mission. Submission guidelines are followed.	Writing is unclear or extremely brief. The video is hard to hear, disorganized, or missing.

Younger participants are encouraged to collaborate with older grade levels.

RUBRIC: HIGH SCHOOL

SPACE FOR TEACHERS

Category	Weight	Criteria for Excellence (5 pts)	Criteria for Needs Improvement (1 pt)
Technical Feasibility	25%	The design is presented with professional-quality CAD or orthographic drawings, including dimensions and a realistic mass budget. Deployment mechanics are clearly workable, and safety factors are identified and justified.	The design violates constraints or appears impossible to build. Drawings are incomplete or missing dimensions. No mass estimates or safety considerations are provided.
Scientific Accuracy	20%	Calculations for rotation rate, g-level, and COM placement are correct, clearly shown, and based on appropriate physics (e.g., $a = \omega^2 r$). The submission demonstrates understanding of rotational motion.	Calculations are missing, incorrect, or based on guesses. Explanations confuse rotation with gravity or omit the physics relationships required for HS submissions.
Testing & Safety	15%	The testing plan is detailed and feasible, with clear measurement strategies (turntable timing or accelerometer). Risks such as detachment or tether behavior are identified alongside mitigations and safety measures.	The plan lacks detail, fails to identify hazards, or does not include a clear method for obtaining data. Safety considerations are absent or unrealistic.
Student Engagement	10%	Student roles are clearly defined, and the work shows meaningful student leadership, iteration, and ownership..	The project appears teacher-driven. Student roles are unclear, and there is little evidence of meaningful student participation or learning.
Community Outreach	10%	The team shares its project beyond the classroom (e.g., mentorship activities, public demonstrations, family or community events).	No outreach is attempted. The project remains entirely within the submitting classroom.
Aesthetic Design	10%	The station and Mission Patch are creative, coherent, and visually aligned with Project Hail Mary. Visual identity supports mission theme and technical intent.	The station is plain or unfinished, and the Mission Patch is missing or low-effort with no mission theme.
Presentation	10%	The written summary is clear and technically polished, and the video is organized, audible, and persuasive. All submission requirements are followed precisely.	The writing or video is unclear, incomplete, or poorly structured. Submission guidelines are not followed.

FREQUENTLY ASKED QUESTIONS

SPACE FOR TEACHERS

Design Requirements

- **Does our design need to look like the spacecraft in the book?**
  No. Designs should be inspired by Project Hail Mary but do not need to match the novel exactly. Creativity is part of the scoring.
- **Why must the masses be unequal?**
  Unequal masses shift the center of mass away from the geometric midpoint. This means the two modules orbit at different radii, producing two different levels of artificial – a key feature of the Project Hail Mary spacecraft.
- **Does my design have to be 3D printed?**
  No, teams may use 3D-printed parts, "found" objects, or standard hardware. See Section 3 of the handbook for acceptable materials. Regardless of construction method, the station must be sturdy with no loose parts. If selected for the parabolic flight, loose components will float away during microgravity. Your design must be sturdy enough to survive being shaken and inverted without parts detaching.

Testing and Measurement

- **How do teams demonstrate artificial gravity?**
  By rotating the station on a horizontal spin rig and measuring either (1) the rotation period using a stopwatch or video, or (2) the radial acceleration using a databot 2.0 accelerometer (or equivalent sensor). Detailed procedures are provided in Appendices A and B of the handbook.
- **What is the Center of Mass (COM)?**
  The balance point of the entire system. The station must rotate about this point to be stable.
- **What is the COM ring?**
  A required ring or loop installed at the center of mass. The turntable spindle, or fixed post, passes through this ring so the system rotates about its true COM.
- **I would like to plan for use of a databot ™ on our build, if selected. What are the mass and dimensions of a databot ™?**
  Specs: databot ™ 2.0
  Dimensions: 42.5mm x 42.5mm x 20mm
  Mass: 34 grams
  Teams should account for this mass when calculating the center of mass if the databot will be mounted during testing.

FREQUENTLY ASKED QUESTIONS

SPACE FOR TEACHERS

What is a Safe-Grasp Zone?

A designated area on the station where operators can safely hold or stop the rotating assembly without the risk of contact with moving tethers or modules. The recommended implementation is a short rigid tube that passes through the COM ring, allowing the ring to rotate smoothly.

Submission and Evaluation

- **What is the most important aspect of the design that judges evaluate?**
  Safety and feasibility. Designs that fail the feasibility gate are not scored.
- **When scoring creativity, what sort of things do you look for?**
  Judges evaluate the team mission patch, and the creativity expressed in the spacecraft design. Using unmodified 3D files downloaded from the internet is not considered creative. Examples of creative additions include interior compartment designs, custom module shapes, or narrative elements that connect to the *Project Hail Mary* story.
- **What do you mean by outreach?**
  Outreach means sharing this opportunity beyond your immediate team. Examples include presenting other classrooms or grade levels, hosting a display at a school science night, partnering with a classroom at another school, or demonstrating at a community event.
- **What do you mean by "supplemental" materials?**
  Supplemental materials include optional items that showcase or extend your work, such as photos of students working, interior design details, additional technical details, artistic / creative elements. **All imagery that identify students require a signed media release form.*
- **When is the submission deadline?**
  May 4, 2026, by 11:59 PM local time.

The Flight

- **If selected, when and where will the parabolic flight take place?**
  Likely Bordeaux, France. Selected participants must have a valid passport that does not expire within 3 months of the flight date. Flight date TBD.
- **Do I pay for the flight? What about travel to the flight?**
  If selected, Space for Teachers covers the cost of the parabolic flight and travel to and from the flight location.
- **What if I am selected and the flight is scheduled during a testing period at my school?**
  We encourage applicants to confirm availability and obtain necessary district approvals before submitting. Flight dates cannot be adjusted for individual participants, and schedules can easily change. Flexibility is required!

Thank you to Amazon MGM Studios, Project Hail Mary author Andy Weir, and Space Center Houston