SPACE CENTER HOUSTON

CARBON CAPTURE

STEM INNOVATION IN SCHOOLS

PRESENTED BY CHEVRON

# CHALLENGE GUIDE

Middle School-High School

Space Center Houston

## CHALLENGE OVERVIEW

An issue that is facing both the future of space travel and life on planet Earth is the accumulation of greenhouse gases in closed systems. As human beings, any environment we occupy will eventually show an increase in Carbon Dioxide. If unchecked, this can lead to a myriad of problems from carbon dioxide poisoning in a space-faring vehicle to climate change here at home.

Imagine waking up on the International Space Station and seeing a warning: $CO_2$ levels are rising. Astronauts need a safe, simple way to pull extra carbon dioxide out of the air—fast—without heavy equipment or lots of power.

NASA has experimented with different solutions for capturing carbon from the air in the past. As they look ahead to longer duration missions, many of these solutions will need to be improved or new, scalable solutions implemented. The STEM Innovation in Schools program will support your students as they attempt to solve this problem in unique ways.

Your mission in The Carbon Capture Challenge is to design and a space-ready concept for a $CO_2$ recapture device that could be used on the ISS, Lunar Gateway, or Artemis habitats. You'll focus on Design & Conceptualization and telling a clear story of how your idea would work in real life. (Testing + redesign are encouraged for older grades but are not required for scoring.)

# ELIGIBILITY

**Who Can Enter:**

Students in **K–12** who **live in or attend school in the Greater Houston Area** (public, charter, private, homeschool, and community-based programs are all welcome).

**Entry Type**

**Solo** or **team** entry.

Team size: **2–5 students.**

**Grade Divisions**

K–5, 6–8, 9–12.

**Entry Limits**

**One submission per student** (either solo or on one team). **One slide deck per team.**

**Location Requirement**

Participants must **reside in or attend school/programs within the Greater Houston Area**. (Multi-school teams are allowed if all members meet the location requirement)

**Original Work**

Entries must be the team's **own original work**. Properly **credit all sources** and images used.

## PRIZES

Every scholar who submits an entry for the STEM Innovation in Schools Challenge will receive a free ticket to Space Center Houston and a free invitation to our Awards Ceremony. Additional prizes include:

- ES/MS/HS Solo Division Prize: Explorer Camp or Space U Scholarship
- ES/MS/HS Team Division Prize: Family Membership to Space Center Houston

Space Center Houston also provides webinars, and individual support for teachers to make the implementation of this challenge as easy as possible in your classroom. Teachers with the highest participation levels will be invited to participate in professional development with our incredible instructors to gain skills that will help you further develop your classroom into an engaging, exploratory experience for your students.

## OBJECTIVE

**Design and pitch a space-ready concept for a $CO_2$ recapture device that could be used on the ISS, Lunar Gateway, or Artemis habitats. Project slide decks will include the following:**

1. Explain the mission problem and who will use your idea.
2. Show a workable concept for $CO_2$ recapture that respects key limits (mass, volume, power, safety, crew time, maintainability).
3. Include a system view and operations so judges can see how it fits into a real habitat day.
4. Describe the impact and trade-offs—why this design helps the crew and mission.

## DELIVERABLES (ONE SLIDE DECK PER TEAM)

Acceptable presentation formats include:

- Microsoft PowerPoint
- Google Slides
- PDF (Word or Google Document)

Acceptable video formats include (video can be included in your presentation):

- MP4
- MOV
- AVI

<u>Maximum Slide Deck Count: 8 slides</u>

## Required Sections (use these as slide titles)

1. TITLE & TEAM
   - What is the name of your innovation?
   - Who is on our team and what are our roles?
   - What grade and school are you representing?
2. MISSION CONTEXT & USERS
   - What problem are you solving?
   - Where will this be used (ISS, Gateway, Moon, Mars) and by whom?
   - Why does solving this problem matter for the mission or crew?
3. CRITERIA & CONSTRAINTS
   - What must your solution do to be considered successful?
   - What constraints (limits) do you have (mass, volume, power, crew time, safety, maintainability)?
   - Which constraint is the toughest, and how are you addressing it?
4. CONCEPT OVERVIEW & VISUAL— HOW IT WORKS
   - How does the concept work from start to finish (plain-language steps)?
   - What makes this idea different or better than a basic alternative?
   - What are the key features of your system?
   - What materials are needed to run this system successfully?

- How does your concept connect to habitat systems (air, power, data, crew tasks)?
- Which part is most critical, and what depends on it?
- Include a design drawing or digital diagram.

5. IMPACT & WHY THIS DESIGN
   - What mission benefits does this bring (crew health, time saved, reliability)?
   - What trade-offs did you consider, and why did we choose this path?
   - If given more time, what's the next most valuable improvement?
6. REFERENCES & CREDITS
   1. Which sources support your solution?
   2. Who created each image/diagram?
   3. Who helped you (mentors, teachers, classmates) and how?

## SUBMISSION

Submissions will be collected through a Microsoft Form. You can access the submission form with the following web address

https://forms.office.com/r/7yYnTRy1qy

# KEY VOCABULARY

- **$CO_2$ (Carbon Dioxide):** A gas we breathe out; in closed habitats it can build up and make people sick.
- **Carbon Recapture/Removal:** Pulling $CO_2$ out of the air so the cabin stays safe to breathe.
- **Life Support System:** Equipment that keeps people alive (air, water, temperature) in space.
- **Habitat:** A place where astronauts live/work (ISS, Gateway, lunar base).
- **Criteria (Must-Haves):** What your solution must do to count as a success.
- **Constraints (Limits):** Rules or limits you can't ignore (size, weight, power, time, safety).
- **Mass:** How heavy something is.
- **Volume:** How much space something takes up.
- **Power:** Energy needed to run a device (battery/electric).
- **Crew Time:** How much astronaut time it takes to use, clean, or fix a device.
- **Maintainability:** How easy it is to keep a device working (cleaning, replacing parts).
- **Concept of Operations :** The step-by-step story of how people use your idea in real life—normal use and what to do if something goes wrong.
- **Block Diagram (System View):** A simple picture showing inputs → process → outputs and how parts connect.
- **Trade-Off:** Choosing one benefit while accepting a cost (e.g., lighter but slower).
- **Feasibility:** Whether an idea seems doable with the limits you have.
- **Risk:** Something that might go wrong.
- **Mitigation:** What you do to reduce a risk or handle it safely.
- Artemis / Gateway / ISS: Current NASA programs with habitats/stations where your idea could be used.