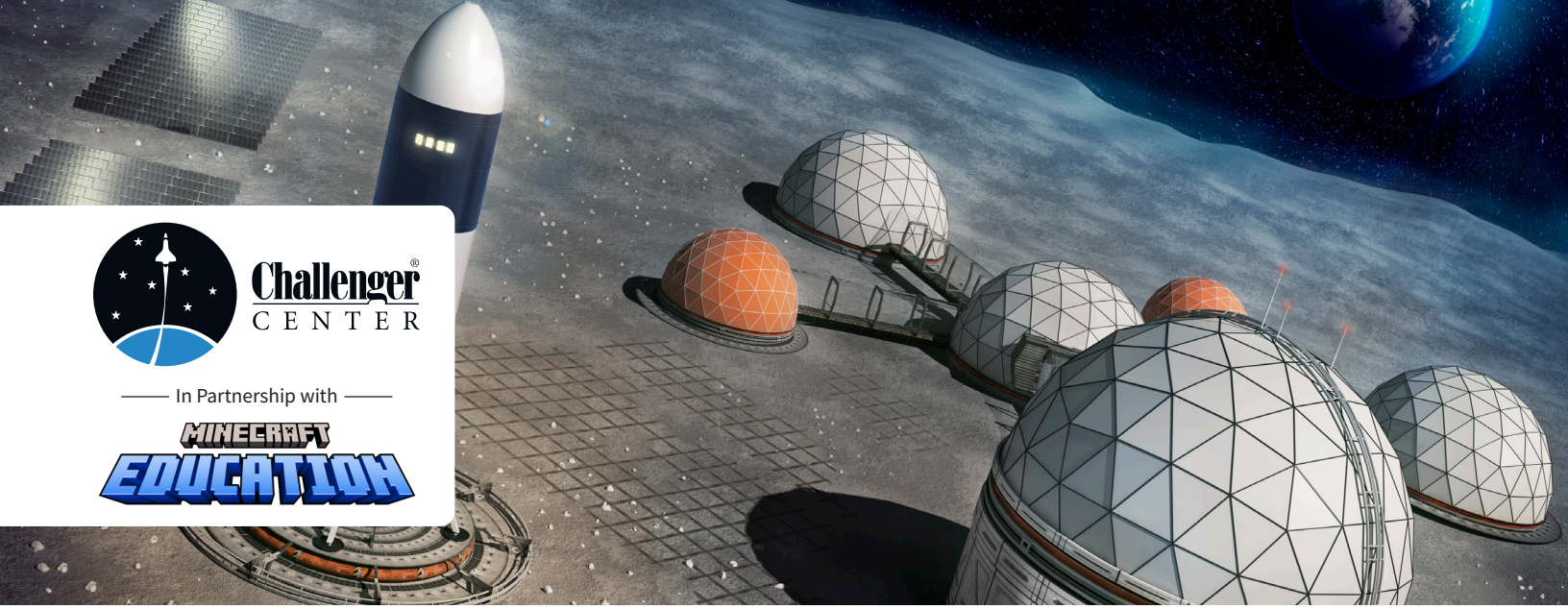


Challenger CENTER

In Partnership with

MINECRAFT EDUCATION

Moon Base Design Challenge

Design a Base Fit for Humans

LESSON OVERVIEW

Students will experience principles of Human-Centered Design to create the layout for a Moon habitat based on astronauts' needs.

LEARNING OBJECTIVES

Students will . . .

- understand how focusing on the desires of the user can impact design decisions,
- consider a broad range of factors that influence a habitat on the Moon, and
- compare multiple solutions to find the best prototype for a given challenge.

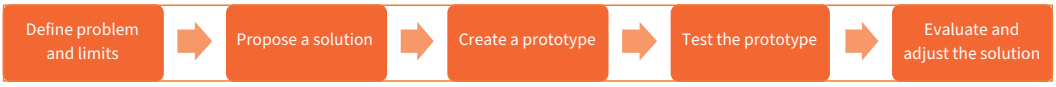
TEACHER NOTES AND PREP

Background

The last time humans went to the Moon was in 1972 as part of NASA's Apollo program. But recently, NASA was charged with taking the first woman and first person of color to the Moon in a new program named Artemis. In 2022, NASA launched Artemis I, an uncrewed mission to test the rocket. In 2024, the Artemis II mission will be the first crewed Artemis mission.

Later in the program, astronauts will be living and working on the surface of the Moon. In this lesson, students will be challenged to consider the design of a Moon base from a different perspective: Human-Centered Design.

You may be familiar with a traditional 'engineering design cycle,' a sequence of steps that engineers follow to find a solution to a problem. The steps can vary, but generally include problem solving processes such as:



Student Ages

8-13

Subjects

Art and Design
Science

Skills

Collaboration
Communication
Critical Thinking
Data Analyzing and Interpretation

Estimated Time

60 minutes

Educational Settings

Classroom
Informal *(museums, science centers, and camps)*

Human-Centered Design takes this a step further, placing the user and their needs at the center of the design process. This process can vary, but one breakdown from Stanford's design school (see External References to learn more) is:

- *Empathize*: the foundation of Human-Centered Design: getting to know the users
- *Define*: take what you've learned from the user to scope out a meaningful challenge you can help solve
- *Ideate*: generate a wide variety of ideas – both in number and in diversity
- *Prototype*: get your idea out of your head with a physical model, preferably one the user can interact with
- *Test*: gather feedback, refine your solutions, and keep learning about your user to find a useful solution

NASA uses Human-Centered Design thinking at their Center for Design and Space Architecture (CDSL). The CDSL team designs habitats and interiors that put the needs of the human first.

Preparation

Students will be challenged to design a Moon base that features elements NASA actually plans to include in the Artemis Base Camp . . . focusing on the astronauts who will use it. To inform their designs, students will read the Astronaut Interview Cards and discuss with their groups how to best design their base. These "astronaut interviews" hint at lots of possibilities taken right from NASA's Artemis plans, including:

- Dust mitigation
- Equipment repair station
- Science facilities
- Radiation protection
- Fitness facilities
- Organized storage
- In-Situ Resource Utilization (using environmental resources)
- Power collection and storage
- Mining
- Water collection
- Fuel collection
- Greenhouse
- Personal spaces and décor
- Food storage and preparation
- Recreation and entertainment
- Restrooms
- Waste processing

Not all of these need to be included in student designs. As noted below, there are many ways to adjust this activity. Younger students may have fewer "astronaut interviews" to read and may be expected to come up with fewer design features based on what they've read.

STUDENT ACTIVITIES

Supplies

For each group of four students:

- One set of Astronaut Interview Cards
- Four pencils or pens
- Activity Notes (pad of sticky notes or index cards)
- Large sheet of paper (chart paper is best)

Arranging the Room

If possible, set up the Astronaut Interview Cards in separate locations around the room. These will be your "Astronaut Interview Stations." If this isn't possible, have a stack of interview cards ready for each group and simply ask students to find a quiet place to read the interview cards when the time comes.

Warm-Up and Introduction (5-7 minutes)

- If possible, show students the artist's concept image of a Moon base from Smithsonian (see link in External References section) on a projector screen.
- Tell students that soon humans will be working on the Moon in habitats such as these.
- Ask the class: What elements would a lunar habitat need for humans to survive? If possible, record a handful of student answers.
- Ask the class: Who do you think designs habitats like these?
- Show the picture of Dr. Robert Howard, Lead of NASA's Center for Design and Space Architecture (see External References). He leads a team of industrial engineers to come up with designs for habitats, spaceship cockpits, control panels, and more using a process: Human-Centered Design. This is a way of designing that tries to keep the user (humans!) at the center of all design ideas.
- Tell students that today they will be industrial design teams and will use some Human-Centered Design to create a lunar habitat of their own.
  [EDUCATOR NOTE: For the rest of the lesson, refer to students as industrial designers to drive it home!]

Astronaut Interviews Activity (5-7 minutes)

- If possible, at the front of the room, write on a board or show on a projector the five steps of design thinking: Empathize - Define - Ideate - Prototype - Test
- Explain that the first part of Human-Centered Design is to *empathize*, which means getting to know the humans who will be using your design. In our case, it will be the astronauts staying in the Moon base.
- Have teams split up and send separate team members to each of the Astronaut Interview Stations. Have each team member bring a pen/pencil and some Activity Notes.
- Set a timer (suggested: 5 minutes, but adjust based on student levels) for students to read their Astronaut Interviews. Encourage students to take notes of things that they think will be important for designing the Moon base.

Team Discussion and Brainstorming (30 minutes)

When time is up, ask the groups to get back together:

- Next, students will complete a "story share-and-capture;" a way designers can share what was learned and compare with other team members to find patterns they might have missed.
- Ask each team member to grab a handful of Activity Notes and something to write with.
- One at a time, ask each team member to share about the astronaut they interviewed. As each team member shares, the rest of the team should listen and write down ideas or quotes.
  [EDUCATOR NOTE: Depending on your class structure, you may want to set a timer for each team member to share (e.g., "You have four minutes to share and then we'll switch to the next person."]
- When all team members are finished sharing, have the group look at their Activity Notes. To help them move from *empathizing* to *defining*, have teams arrange the notes in thematic groupings (e.g., piles on a desk, stuck to a wall) to find patterns. For example, if several team members mentioned a need for exercise, put those in a grouping.
- When teams have finished sorting, have them look at their groupings and brainstorm. What does this reveal they will need for their moon habitats? Groups may want to list these on a separate paper. Encourage students to consider WHY they're including each element they've decided upon.
- Finally, have teams move to the *ideate* stage by drawing prototype base designs on their large sheets of paper. They do not have to worry about scale at this point.

Design Showcase (15 minutes)

When time is up, gather the class' attention. Display each group's large prototype drawings and showcase the designs for all to see:

- Option 1: Do a "gallery walk," with each group rotating around the room to look at designs on their own. Students can use their Activity Notes to leave comments about things that worked well.
- Option 2: Have each group come up and explain their prototype to the class. Ask other students to share what they think works well and write these down.

Regroup and Discussion (10 minutes)

Ask students to share what they believe makes the Moon base designs successful:

- Why did they include those elements?
- How were those elements related to the astronauts' desires?
- What ideas did they see from other teams' designs that they liked?

Together, create a list of all the features the class believes are most important to include in a design proposal for NASA. Create a list somewhere students can refer to later.

Challenge students to imagine a base that incorporates all of these designs. Industrial Design Teams compare lots of solutions and use the best ideas to create their very best prototypes.

Congratulate students on their teamwork to design a habitat based on the users.

GUIDING IDEAS AND QUESTIONS

- What is required for a lunar habitat?
- What do the users need and want for a habitat?
- How can we incorporate the users' needs into an effective design?

PERFORMANCE EXPECTATIONS

Students will develop an understanding of Moon base design and see how the needs of the user can affect such a design process. They will practice social-emotional literacy in considering a user's needs and work together with others to meet their goals.

NGSS SCIENCE AND ENGINEERING PRACTICES

For educators based in the United States, the Next Generation Science Standards (NGSS) Science and Engineering Practices in this lesson are:

- analyzing and interpreting data;
- engaging in argument from evidence; and
- obtaining, evaluating, and communicating information.

EXTERNAL REFERENCES

Harvard Business School | What Is Human Centered Design?
https://online.hbs.edu/blog/post/what-is-human-centered-design

IDEO.com | What Is Human Centered Design?
https://youtu.be/musmgKEPY2o

NASA | Dr. Robert Howard
https://www.nasa.gov/nesc/academy/Dr-Robert-Howard-bio

NASA | Habitability Design
https://www.nasa.gov/feature/habitability-design

NASA | How Are We Going to the Moon?
https://youtu.be/_T8cn2J13-4

NASA | Lunar Living: NASA's Artemis Base Camp Concept
https://blogs.nasa.gov/artemis/2020/10/28/lunar-living-nasas-artemis-base-camp-concept/

Seeker | NASA's 2024 Artemis Moon Landing Mission Explained
https://youtu.be/B2lA3Uu29KI

Smithsonian | Four Things We Learned About NASA's Planned Base Camp on the Moon
https://www.smithsonianmag.com/science-nature/four-things-weve-learned-about-nasas-planned-base-camp-on-the-moon-180980589/

Stanford Institute of Design | An Introduction to Design Thinking (Process Guide)
https://web.stanford.edu/~mshanks/MichaelShanks/files/509554.pdf

Time Me | Countdown Timer
https://www.timeme.com/countdown-timer.htm

SUPPORTING FILES

- Vocabulary List
- Astronaut Interview Cards
  [EDUCATOR NOTE: There are four cards with a single star on them. These are the basic cards. For younger students, use only 3-4 of these cards. There are also bonus cards with two stars. For more advanced students, you can add extra cards so they have more information to learn.]

EXTENSIONS

LANGUAGE ARTS / WRITING EXTENSION

Write a short design report (e.g., written report, graphic organizer, poster) to give to the team of astronauts. In the report, list each element included in the design and explain why it was included.

STEAM EXTENSION

Use recycled materials (or LEGOs, blocks, etc.) to build a diorama of a lunar base that incorporates all the elements the class listed as important. This can be performed individually or as a team.

MATH EXTENSION

Ask students to draw a bird's-eye/top-down prototype base design on graph paper. Then, challenge students to calculate the total area of their design by counting the squares contained in the base. Finally, increase the difficulty and challenge them to redraw their base to use only ¾ of their current area.

TECHNOLOGY EXTENSION

Challenge students to take the list of best Moon base design elements created by the class and incorporate them into a Moon base build in an open Minecraft World.