INTRODUCTION

Founded by Blue Origin, Club for the Future is a nonprofit with the mission to inspire and mobilize future generations to pursue careers in STEAM (science, technology, engineering, arts, and math) for the benefit of Earth. Club and its partners are doing this through the Postcards to Space program, providing space-focused lessons and events, and activating ambassadors around the world.

This free Engineering Design Challenge packet is a collection of New Shepard inspired engineering challenges created by our very own Blue Astronaut/ STEM teacher Aymette Medina Jorge.

Interested in more lessons and activities? Visit https://www.clubforfuture.org/lessons to find free standards aligned lessons and more!

BACKGROUND

All rockets take off; not all rockets land. Named after astronaut Alan Shepard, the first American in space, New Shepard is Blue Origin's fully reusable, suborbital rocket system built for human flight from the beginning. During the 11-minute journey, astronauts soar past the Kármán line (100 km/62 miles), the internationally recognized boundary of space, experiencing several minutes of weightlessness and witnessing life-changing views of Earth. The vehicle is fully autonomous—there are no pilots. It features a pressurized Crew Capsule with six windows, Ring & Wedge Fins for stabilization, Drag Brakes to slow descent, and the BE-3 engine for controlled ascent and landing. Aft Fins assist with stabilization and steering, and Landing Gear is deployed for touchdown. Info: BlueOrigin.com

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CREW CAPSULE LANDING AND RECOVERY ENGINEERING CHALLENGE

YOUR CHALLENGE

Design and construct a physical capsule model with three parachutes and a crane-compatible connector that will enable lifting the model off the ground and transferring onto a platform.

CRITERIA AND CONSTRAINTS

Design and build a capsule that can safely return to the ground after a drop and be prepared for crane-assisted transport. Your capsule must land upright, deploy parachutes effectively, and connect seamlessly to a crane for relocation.

- The capsule must have six windows and a hatch.
- On top, include three parachutes. The parachutes must remain packed before the drop and deploy instantly when the capsule is released.
- Place a connector at the center of the top, covered by the parachutes. The connector must fit securely with the crane's hook.
- The capsule will be dropped from at least 6 feet during testing. All three parachutes must deploy automatically to slow the descent.
- It must land flat on the ground—no tilting or flipping allowed.
- A ring-shaped crushable bumper, should be mounted on the bottom of the capsule

ASK AND IMAGINE

Imagine what your capsule could look like! Consider all the key features your design needs and the materials you'll use to build it.

PLAN

Plan your build: What features are essential? Which materials will you use? How will you secure the parachutes and make them deploy after release? Create a 2D sketch of the capsule.

IMPROVE

How would you level up your design to make it recovery team-approved?

CREATE

Bring Your Capsule to Life!

Build a prototype of the capsule. Record each step, test parachutes, and document the results.

SHARE

Show off your masterpiece and your awesome upgrades!

CREW CAPSULE LANDING AND RECOVERY ENGINEERING CHALLENGE

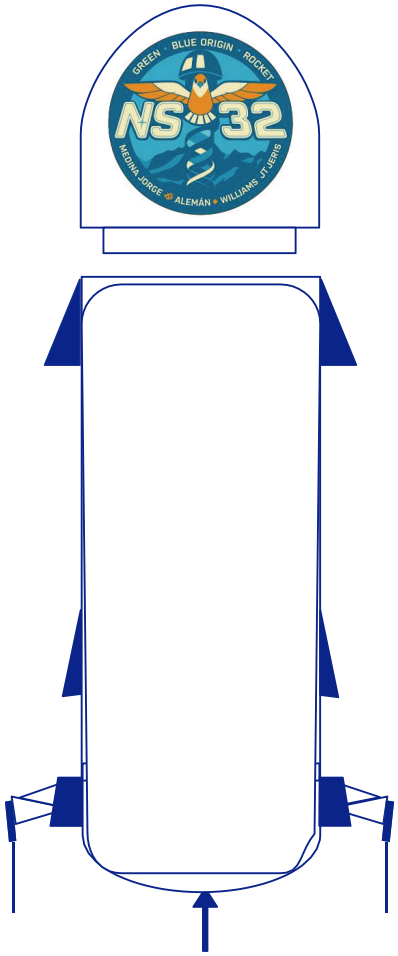
OBJECTIVES

- Demonstrate the Engineering Design Process.
- Evaluate the functionality of the design.

STANDARD

MS-ETS1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.



PROCEDURE

1. Discuss the Engineering Design Process.
2. Introduce the challenge with the video "Launch. Land. Repeat" from Blue Origin or visit the article related to the capsule, or use the picture as reference of the landing.
3. Explain the Student Activity Worksheet to the students.
4. Let the students explore the materials they have access to.
5. Allow students to work on their designs.
6. Allow time for students to complete the remainder of the Student Activity Worksheet.
7. Encourage your students to present their designs and discuss how the capsule can be improved.
8. **Bonus Mission!** If time permits, have students refine their prototypes by developing an improved version of the capsule. If this is a continuation of the booster and crane challenges, design the capsule's diameter to fit inside the booster and make the connector compatible with your crane system. Test the capsule by dropping it with one or two parachutes, then compare descent time, speed, and durability.

Crew Capsule landing

AEROSPACE INDUSTRY CAREERS

MANUFACTURING & TECHNICAL OPERATIONS

- Aerospace Technician
- Welder
- Crane Operator
- Quality Assurance Specialist
- Robotics Technician

FLIGHT & MISSION

- Astronaut Trainer
- Astronaut (Commercial or Government)
- Pilot (Test or Commercial)
- Flight Operations Specialist

FUTURE-FOCUSED & EMERGING

- Space Tourism Guide
- Space Habitat Designer
- Planetary Defense Specialist
- Space Lawyer

ENGINEER & TECHNICAL

- Electrical Engineer
- Mechanical Engineer
- Avionics Engineer
- Propulsion Engineer
- Structural Engineer
- Systems Engineer
- Software Engineer
- Test Engineer
- Researcher
- Aerospace Research Scientist
- Material Engineer

BUSINESS, MANAGEMENT & SUPPORT

- Program Manager
- Logistics Specialist
- Technical Writer
- Hospitality

Student name or Team name:
School or organization:
Grade:
City and State or Country:

STUDENT ACTIVITY WORKSHEET

ASK

IMAGINE

CREATE

IMPROVE

Student name or Team name:
School or organization:
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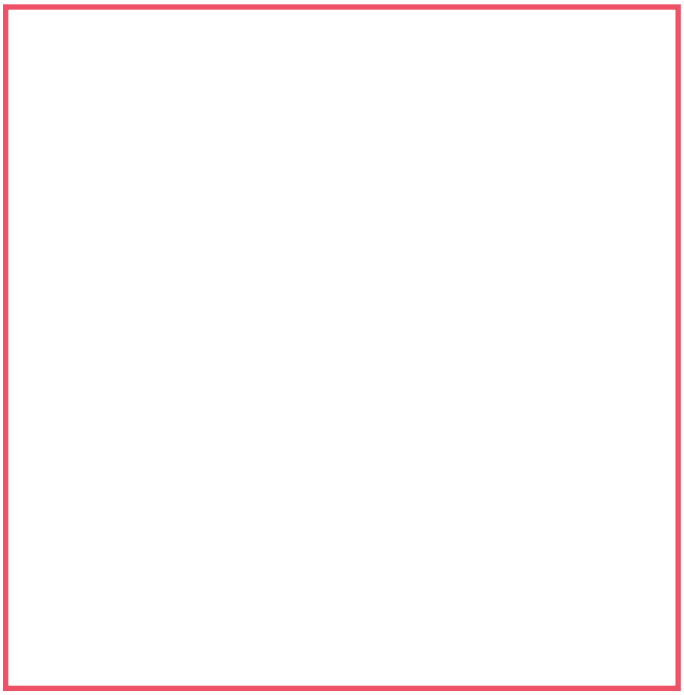
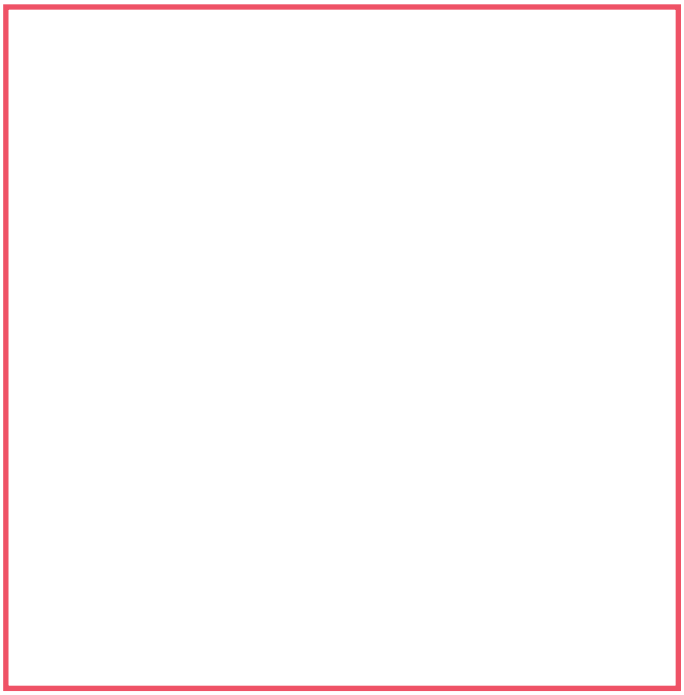
STUDENT ACTIVITY WORKSHEET

FRONT VIEW



TOP VIEW



SIDE VIEW

BACK VIEW

Student name or Team name:
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STUDENT ACTIVITY WORKSHEET

PICTURE (FINAL PRODUCT)

CRANE DESIGN CHALLENGE

YOUR CHALLENGE

Design and build a physical model of the crane using recycled materials or LEGO pieces. But don't stop there—your creation must come alive with at least one moving part powered by simple machines (think levers, pulleys, wheels & axles, gears) or a servo motor.

CRITERIA AND CONSTRAINTS

Design and built a crane that can lift the capsule from the ground and position it on the transport platform for delivery to the barn.

Your crane must have:

- Operator cabin
- Wheels
- Counterweight
- Outrigger cylinders, beam, and pads
- At least one boom
- Hoist line for each boom and joint if there are two booms
- Boom head
- Main load line
- Hook latch
- Hook

And here's the fun part: your model must include at least one moving part. Use your creativity to design at least one moving part powered by one or more simple machines or a servo motor.

ASK AND IMAGINE

Imagine what your crane could look like! Consider all the key features your design needs, the recycled materials or LEGO pieces you'll use to build it, and what part will move—and how you'll make it move.

PLAN

Plan your build: What features are essential? Which recycled materials will you use? What part will move—and how will you engineer its motion. Create a 2D sketch of the crane.

IMPROVE

How would you level up your design to make it recovery operations team – approved?

CREATE

Bring Your Crane to Life! Build a prototype of the crane. Record each step, test your moving part, and document the results.

SHARE

Show off your masterpiece and your awesome upgrades!

CRANE DESIGN CHALLENGE

OBJECTIVES

- Demonstrate the Engineering Design Process.
- Evaluate the functionality of the design.

STANDARD

MS-ETS1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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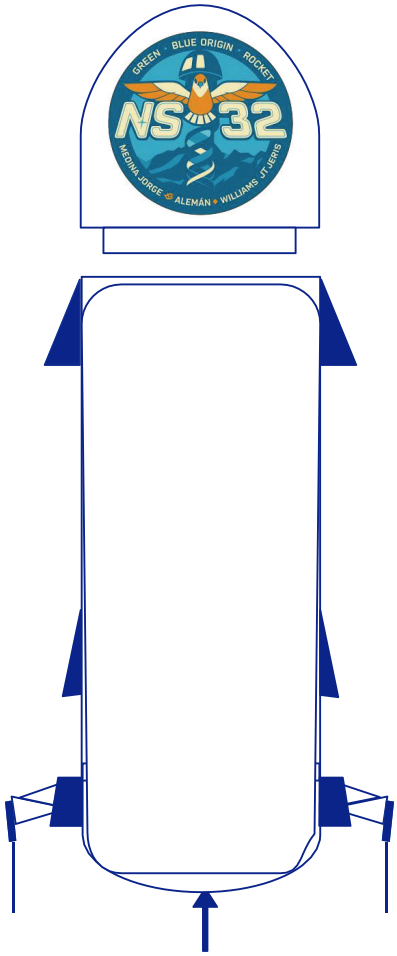

PROCEDURE

1. Discuss the Engineering Design Process.
2. Introduce the challenge with the video "The New Shepard Design" from Blue Origin or use the picture as reference of the actual crane.
3. Explain the Student Activity Worksheet to the students.
4. Let the students explore the recycled materials or LEGO pieces they have access to.
5. Allow students to work on their designs.
6. Allow time for students to complete the remainder of the Student Activity Worksheet.
7. Encourage your students to present their designs and discuss how the crane can be improved.
8. **Bonus Mission!** If there's time, challenge students to design a capsule connector that can safely and securely attach to the crane's hook for lifting and transport. Encourage them to incorporate additional moving or illuminated features, include the flatbed truck, or utilize CAD software if available.

Blue Origin's crane ready to lift the NS capsule.

AEROSPACE INDUSTRY CAREERS

MANUFACTURING & TECHNICAL OPERATIONS

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- Welder
- Crane Operator
- Quality Assurance Specialist
- Robotics Technician

FLIGHT & MISSION

- Astronaut Trainer
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- Structural Engineer
- Systems Engineer
- Software Engineer
- Test Engineer
- Researcher
- Aerospace Research Scientist
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- Program Manager
- Logistics Specialist
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- Hospitality

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STUDENT ACTIVITY WORKSHEET

ASK

IMAGINE

CREATE

IMPROVE

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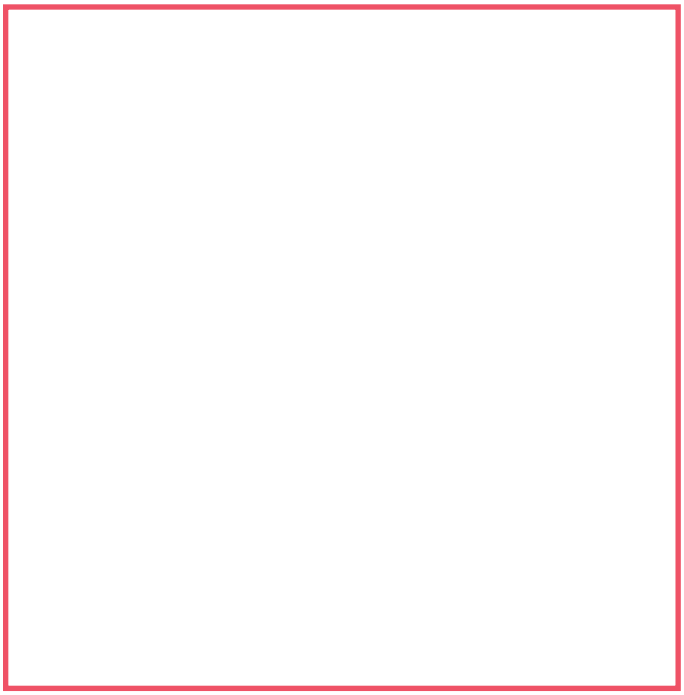
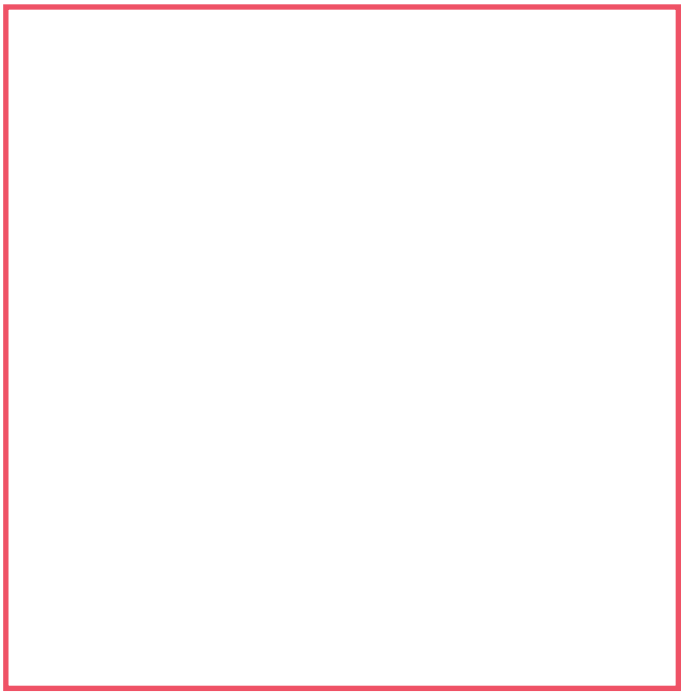
STUDENT ACTIVITY WORKSHEET

FRONT VIEW



TOP VIEW



SIDE VIEW

BACK VIEW

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STUDENT ACTIVITY WORKSHEET

PICTURE (FINAL PRODUCT)

CRAWLER DESIGN CHALLENGE

YOUR CHALLENGE

Design and build a physical model of the crawler using recycled materials or LEGO pieces. But don't stop there—your creation must come alive with at least one moving part powered by simple machines (think levers, pulleys, wheels & axles, gears) or a servo motor.

CRITERIA AND CONSTRAINTS

Design a crawler platform that can attach to a truck and safely carry the New Shepard rocket!

- At the front, create a semi-circular section to cradle and support the capsule.
- In the middle, add strong poles or support structures to hold the booster securely.
- At the back, build a sturdy frame to support a square base where the bottom of the rocket rests.

The crawler platform must be integrated into the transport system. This system will include:

- A front section designed to connect securely to the truck.
- A middle section that links to the crawler platform to support the rocket structure.
- A rear section with two rows of wheels, each row having four wheels, to ensure stability and smooth movement during transport.

And here's the fun part: your model must include at least one moving part. Use your creativity to design at least one moving part powered by one or more simple machines or a servo motor.

ASK AND IMAGINE

Imagine what your crawler could look like! Consider all the key features your design needs, the recycled materials or LEGO pieces you'll use to build it, and what part will move— and how you'll make it move.

PLAN

Plan your build: What features are essential? Which recycled materials will you use? What part will move—and how will you engineer its motion.
Create a 2D sketch of the crawler

IMPROVE

How would you level up your design to make it engineering team approved?

CREATE

Bring Your Crawler to Life! Build a prototype of the crawler. Record each step, test your moving part, and document the results.

SHARE

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CRAWLER DESIGN CHALLENGE

OBJECTIVES

- Demonstrate the Engineering Design Process.
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STANDARD

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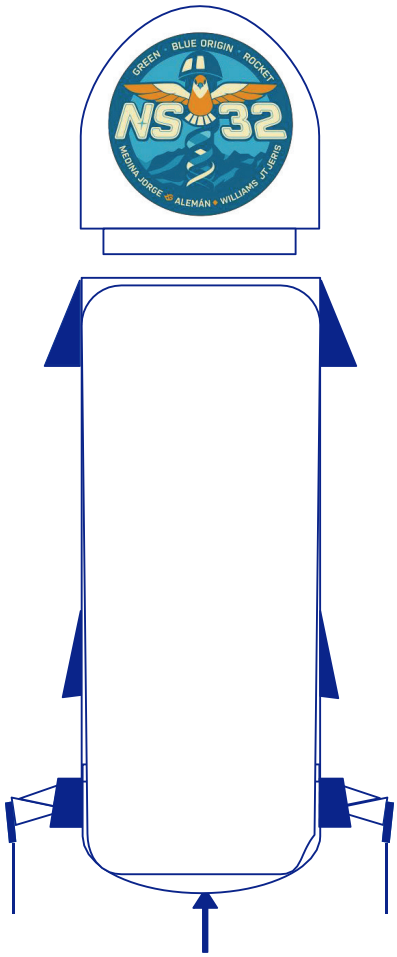

PROCEDURE

1. Discuss the Engineering Design Process.
2. Introduce the challenge with the video "Building the New Shepard Fleet" from Blue Origin or use the picture taken from the video as reference of the actual crawler.
3. Explain the Student Activity Worksheet to the students.
4. Let the students explore the recycled materials or LEGO pieces they have access to.
5. Allow students to work on their designs.
6. Allow time for students to complete the remainder of the Student Activity Worksheet.
7. Encourage your students to present their designs and discuss how the crawler can be improved.
8. **Bonus Mission!** If time permits, have students refine their prototypes by developing an improved version of the crawler. Encourage them to incorporate additional moving or illuminated features, include the truck in their prototype, or utilize CAD software if available.

Crawler platform holding New Shepard in the Barn

AEROSPACE INDUSTRY CAREERS

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- Material Engineer

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- Technical Writer
- Hospitality

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STUDENT ACTIVITY WORKSHEET

ASK

IMAGINE

CREATE

IMPROVE

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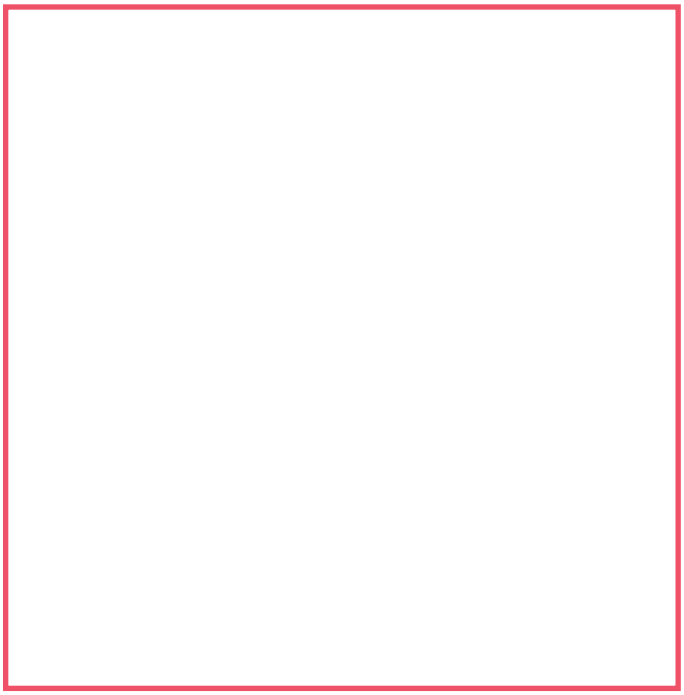
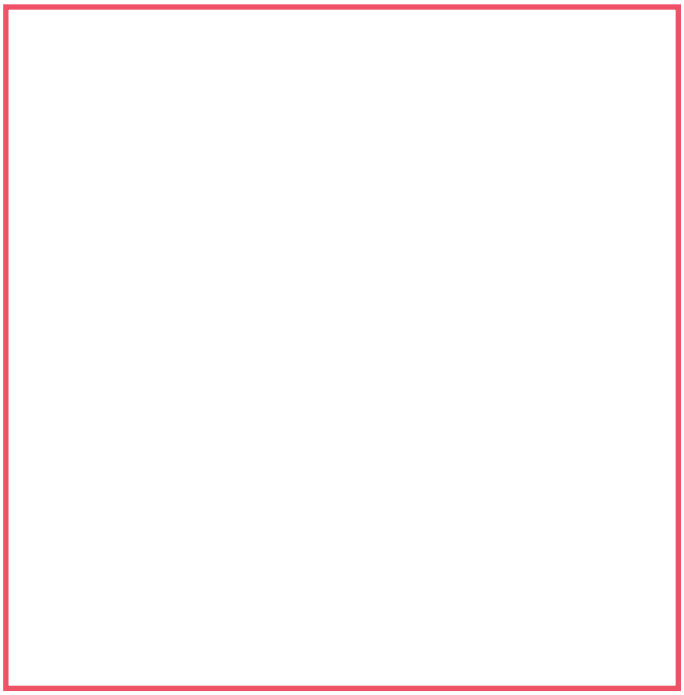
STUDENT ACTIVITY WORKSHEET

FRONT VIEW



TOP VIEW



SIDE VIEW

BACK VIEW

Student name or Team name:
School or organization:
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STUDENT ACTIVITY WORKSHEET

PICTURE (FINAL PRODUCT)

THE AIRSTREAM DESIGN CHALLENGE

YOUR CHALLENGE

Design and build a physical model of an astronaut's airstream (studio or flat) using recycled or repurposed materials. But don't stop there—Your creation must include at least one part that lights up.

CRITERIA AND CONSTRAINTS

Major changes are ahead for the astronaut's space—let's dream up the ultimate design! Your mission: create the new Airstream or the astronaut's studio or apartment. It should include a bedroom with at least one window, a common area featuring a kitchenette, a closet, and a couch with a coffee table—also with at least one window—and a bathroom with one window. You can choose whether to add the exterior details of the Airstream, such as a small balcony and a walkway connecting it to the village.

Here's the fun part: **Bring your project to life with at least one lighted component. Push your creativity and build a custom circuit to illuminate the Airstream.**

ASK AND IMAGINE

Imagine what your airstream could look like! Consider all the key features your design needs, the recycled materials you'll use to build it, and which part will light up and how will you make it shine?

PLAN

Plan your build: What features are essential? Which recycled materials will you use? What part will light up? Create a 2D sketch of the Airstream.

IMPROVE

How would you level up your design to make it astronaut – approved?

CREATE

Bring Your Airstream to Life! Build a prototype of the Airstream. Record each step, test your lighting part, and document the results.

SHARE

Show off your masterpiece and your awesome upgrades!

THE AIRSTREAM DESIGN CHALLENGE

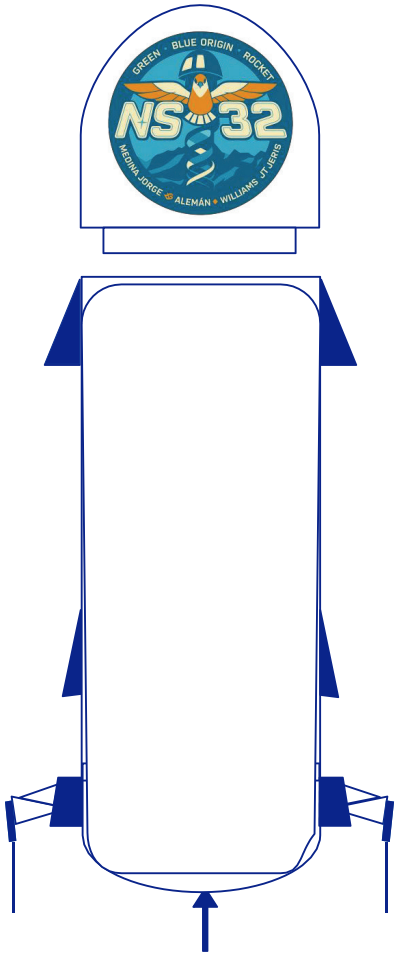
OBJECTIVES

- Demonstrate the Engineering Design Process.
- Evaluate the functionality of the design.

STANDARD

MS-ETS1-4 - Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

HS-ETS1-4. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.



PROCEDURE

1. Discuss the Engineering Design Process. Introduce students to circuits.
2. Introduce the challenge with the video "New Shepard Astronaut Experience" from Blue Origin or use the picture taken from the video as reference of the actual Airstream.
3. Explain the Student Activity Worksheet to the students.
4. Let the students explore the recycled materials they have access to.
5. Allow students to work on their designs.
6. Allow time for students to complete the remainder of the Student Activity Worksheet.
7. Encourage your students to present their designs and discuss how the Airstream can be improved.
8. **Bonus Mission!** If there's time, challenge students to refine their design for a new and improved version of the Airstream, this time using CAD, if available.

Airstream

ASTRONAUT VILLAGE JOBS

CIVIL ENGINEER
Plans and builds structures that can withstand extreme conditions

ENVIRONMENTAL ENGINEER
Ensures clean water, air, and waste systems for the village

ELECTRICS SPECIALIST
Coordinates supplies, materials, and transportation to keep the village running

SYSTEMS ENGINEER
Makes sure all the pieces (housing, power, water, transport) work together perfectly

ARCHITECT
Designs astronaut-friendly living spaces that are safe and efficient

SUSTAINABLE ENERGY SPECIALIST
Designs renewable energy systems for the village (solar, wind, hybrid)

PROJECT MANAGER
Leads the building process and ensures safety in every step

PLANNING SPECIALIST
Plans daily activities, schedules, and resource use to keep the village

TECHNICIAN AND VOCATIONAL JOBS

CONSTRUCTION TECHNICIAN
Helps build and maintain the structures of the village

HVAC TECHNICIAN
Keeps air systems working so astronauts have the right temperature and oxygen

ELECTRICAL TECHNICIAN
Installs and repairs power systems, lighting, and charging stations

HEAVY EQUIPMENT OPERATOR
Runs machinery to prepare and construct the village site

PLUMBING TECHNICIAN
Ensures water and waste systems work safely and efficiently

LOGISTICS COORDINATOR
Manages supplies, vehicles, and materials to keep operations running smoothly

ENERGY SYSTEMS TECHNICIAN
Monitors and repairs solar panels, batteries, and hybrid charging stations

KITCHEN
Prepares meals for astronauts and village staff

HOUSEKEEPING STAFF
Performs cleaning and laundry services in the village

DRIVERS
Operates hybrid vehicles to transport crew, staff, and supplies

Student name or Team name:
School or organization:
Grade:
City and State or Country:

STUDENT ACTIVITY WORKSHEET

ASK

IMAGINE

CREATE

IMPROVE

Student name or Team name:
School or organization:
Grade:
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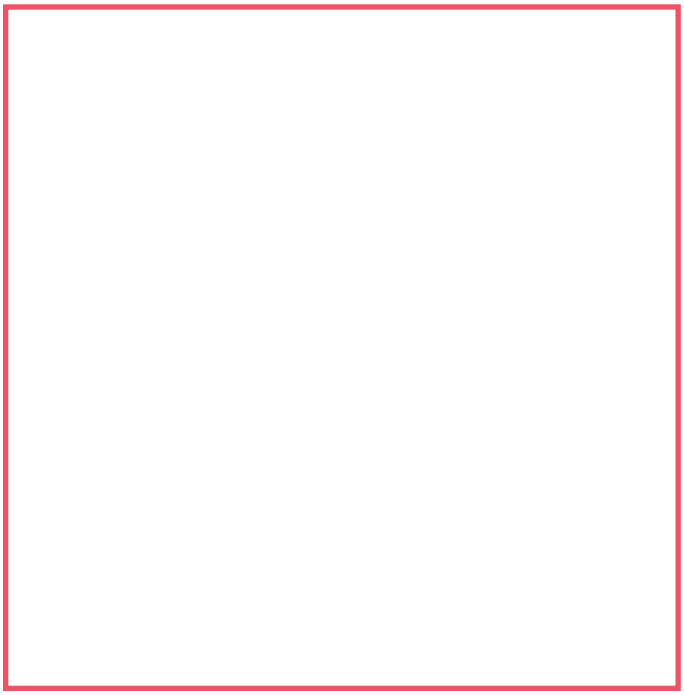
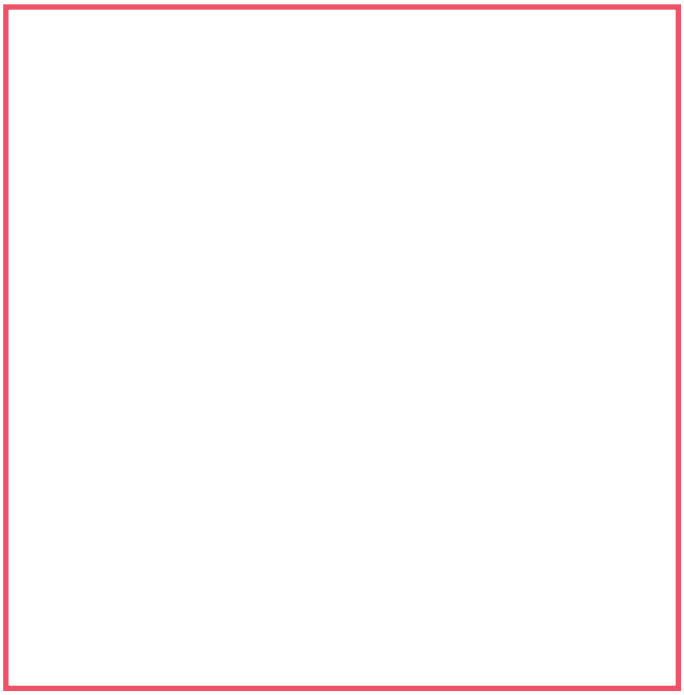
STUDENT ACTIVITY WORKSHEET

FRONT VIEW



TOP VIEW



SIDE VIEW

BACK VIEW

Student name or Team name:
School or organization:
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STUDENT ACTIVITY WORKSHEET

PICTURE OR SCREENSHOT (FINAL PRODUCT)

THE ASTRONAUT VILLAGE DESIGN CHALLENGE

YOUR CHALLENGE

Design and build a physical model of the astronaut village using recycled or repurposed materials. But don't stop there—your creation must come alive with at least one moving part powered by simple machines (think levers, pulleys, wheels & axles, gears).

CRITERIA AND CONSTRAINTS

Big changes are coming to the astronaut village—let's dream up the perfect design! Your mission: create a village that includes six cozy Airstreams for the astronauts, a dining hall with a kitchen, a welcoming outdoor common area with plenty of seating, a staff building to house and support the crew, a storage building, a housekeeping hub with workspace and supplies, a secure entry gate, a charging station for hybrid vehicles to zip staff and astronauts around, a fitness center to keep everyone in top shape, and trails or walkways that connect all the buildings and Airstreams. And here's the fun part: your model must include at least one moving part.

Use your creativity to design at least one moving part powered by one or more simple machines.

ASK AND IMAGINE

Imagine what your astronaut village could look like! Consider all the key features your design needs, the recycled materials you'll use to build it, and what part will move—and how you'll make it move.

PLAN

Plan your build: What features are essential? Which recycled materials will you use? What part will move—and how will you engineer its motion. Create a 2D sketch of the village.

IMPROVE

How would you level up your design to make it astronaut – approved?

CREATE

Bring Your Village to Life! Build a prototype of the village. Record each step, test your moving part, and document the results.

SHARE

Show off your masterpiece and your awesome upgrades!

THE ASTRONAUT VILLAGE DESIGN CHALLENGE

OBJECTIVES

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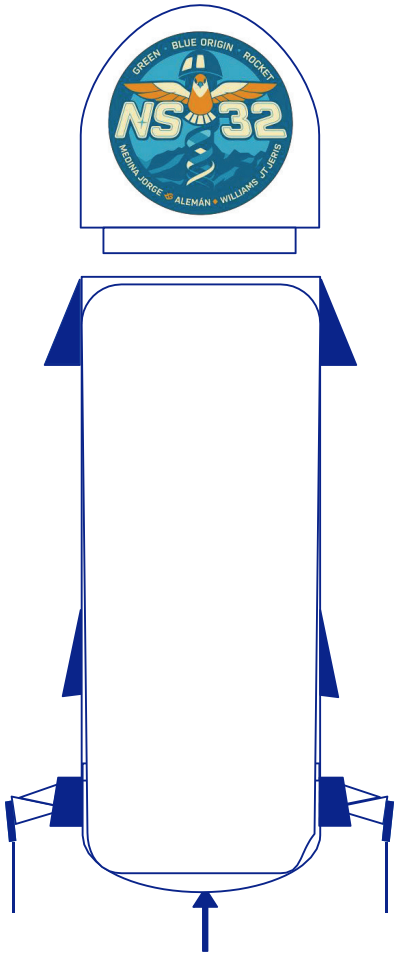

PROCEDURE

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2. Introduce the challenge with the video "New Shepard Astronaut Experience" from Blue Origin or use the picture taken from the video as reference of the actual astronaut village.
3. Explain the Student Activity Worksheet to the students.
4. Let the students explore the recycled materials they have access to.
5. Allow students to work on their designs.
6. Allow time for students to complete the remainder of the Student Activity Worksheet.
7. Encourage your students to present their designs and discuss how the village can be improved.
8. **Bonus Mission!** If there's time, challenge students to refine their design for a new and improved version of the village, this time using CAD, if available

Astronaut Village

ASTRONAUT VILLAGE JOBS

CIVIL ENGINEER
Plans and builds structures that can withstand extreme conditions

ENVIRONMENTAL ENGINEER
Ensures clean water, air, and waste systems for the village

ELECTRICS SPECIALIST
Coordinates supplies, materials, and transportation to keep the village running

SYSTEMS ENGINEER
Makes sure all the pieces (housing, power, water, transport) work together perfectly

ARCHITECT
Designs astronaut-friendly living spaces that are safe and efficient

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Designs renewable energy systems for the village (solar, wind, hybrid)

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STUDENT ACTIVITY WORKSHEET

ASK

IMAGINE

CREATE

IMPROVE

Student name or Team name:
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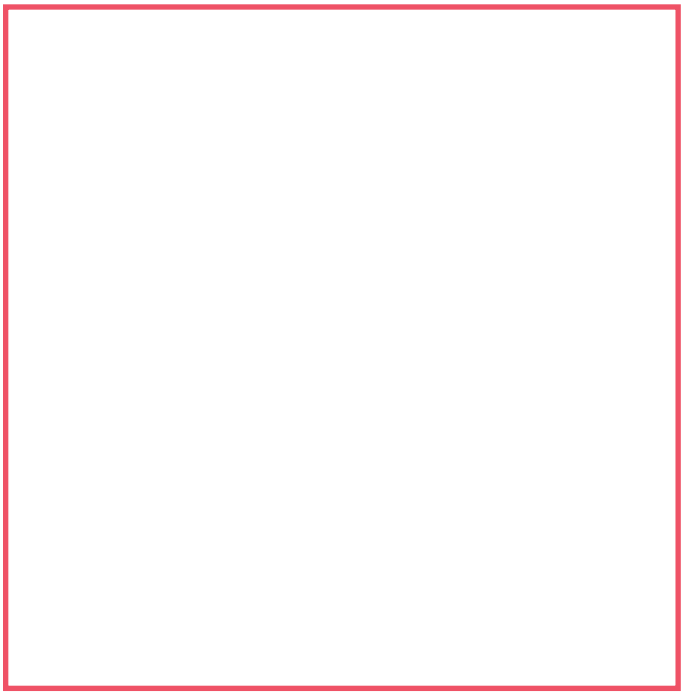
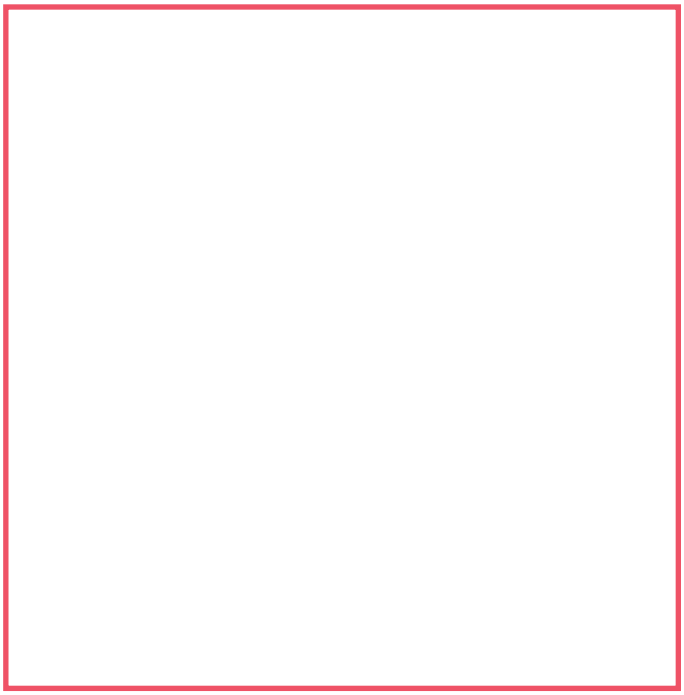
STUDENT ACTIVITY WORKSHEET

FRONT VIEW



TOP VIEW



SIDE VIEW

BACK VIEW

Student name or Team name:
School or organization:
Grade:
City and State or Country:

STUDENT ACTIVITY WORKSHEET

PICTURE OR SCREENSHOT (FINAL PRODUCT)