STEM

Space Club

Instructor Guide

This guide belongs to:

Mission to Moon

COSMIC LEAP FOUNDATION

NASA Partner

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Who We Are

STEM Space Club

Overview

Bring Space Club to your classroom!

Transform your students into a team of astronauts on an unforgettable space adventure! Developed by a team of aerospace engineers and science educators, Space Club includes STEM curriculum with instructional videos, virtual Career Chats, professional development, and a Space Colony Competition! Our semester-long units are low-prep engineering challenges following a space storyline to inspire, ignite curiosity, and launch your students into the exciting world of STEM!

Recommended for grades 4th - 8th

Real-World STEM

Hands-On Engineering

Space Club Sites

750+
Educators

12
Countries

25,000+
Students Served

[Click for map!]

Instructional Videos

> Space Club will bring excitement, enjoyment, and a lot of learning to any classroom! If you are looking for a way for students of all abilities to be creative and learn about science and engineering this program is for you! - *Marlene in Brooklyn, New York*
>
> This was the most well put together program I have ever used! It was really amazing to see how engaged students were and how much they learned. It also exposed them to careers they never knew existed. - *Mary in Bloom Carroll, Ohio*

Welcome to Space Club

Hello Space Club Educators,

I would like to personally welcome you to Space Club, a program designed to launch your students into STEM through the exciting world of space exploration!

As a kid, I hated math and science. But in 8th grade, a summer camp changed the trajectory of my life. It took just one model rocket launch, and I was hooked! In college, I decided to major in aerospace engineering, which led me to work as an engineer for the U.S. federal government. I conducted research on carbon nanotubes, studied the propagation of radio waves, and even supported the launch of a satellite to the ISS!

During that time, I volunteered as a math tutor and quickly became frustrated with the students' lack of interest in school. It became clear to me why—they saw math and science as nothing more than worksheets and rote memorization. No wonder they were bored! Reflecting on my own experiences, I began connecting fractions to asteroid mitigation and algebra to rocket trajectories. Suddenly, the students were engaged and excited, discovering the relevance of math to the awe-inspiring world of space exploration.

In 2014, I became the STEM Director at a nonprofit, tasked with developing programs to engage students at risk of dropping out of school. I established an afterschool Space Club program at 4 Title 1 middle schools with the hope that learning about space landers and astronauts could inspire lifelong learners and explorers. And despite warnings that middle school kids don't attend science clubs, I'll never forget that first meeting—over 60 students, from football players to chess club members, packed into a tiny portable classroom ready to learn about space and engineering. At the end of that first year, a 7th grader told me, "I can't believe we just launched a rocket! I never thought I was a STEM person, but now anything seems possible."

Over the next six years, I taught more than 2,000 students, hosted city-wide Space Colony Competitions, took busloads of students to NASA, and brought in local engineers to mentor teams. And the program delivered impressive results: Space Club students were **three times more likely to pursue a STEM track in high school**, and **89% of 8th graders demonstrated college readiness in math,** compared to just 25% of their peers.


First Space Club in San Antonio, Texas (2014)

In 2020, Space Club expanded further when we received a NASA grant to develop the **Educator's Portal, an online training and resource hub that allows educators to bring Space Club to their schools.** In 2023, a new non-profit organization was established, the **Cosmic Leap Foundation,** to grow and sustain these efforts. Today, more than 750 educators across the globe are running their own versions of Space Club, and each year, teams join us for the annual international Space Colony Competition.

Now **it's your turn to bring the exciting world of space exploration to your students**! Get ready for an epic adventure that will transform your classroom into a team of astronauts and engineers—ready to explore, collaborate, problem-solve, design, build, and grow together! And we are here to support you. If you have any questions, email us at programs@cosmic-leap.org.

Natasha Wilkerson, Ph.D.
Space Club Founder | President & CEO of the Cosmic Leap Foundation

Launching STEM Education
To Cosmic Heights!

Join us on our mission to empower K-8 educators to create transformative learning experiences through the lens of space exploration

25000	560	98	12
Students	Educators	Volunteers	Countries

The **Cosmic Leap Foundation** is a 501(c)3 organization with a mission to empower K-8 educators to create transformative learning experiences through the lens of space exploration.

Our flagship program, **Space Club** equips educators with **FREE training and curriculum** to implement low-cost, low-prep programs aimed at enriching STEM education. Together, with our annual **Space Colony Competition** and **Cosmic Career Chats**, we are creating inspiring and authentic STEM experiences that support educators and help students build confidence and experience success in STEM!

STEM space club | COSMIC CAREER CHATS! | SPACE COLONY COMPETITION

An **independent analysis** in 2017 of Space Club participants showed:

- 80% remained on a STEM track.
- 90% were from a low income family.
- 47% were female.

> Space Club was the most well put together program I have ever used! It was really amazing to see how engaged students were and how much they learned. It also exposed them to careers they never knew existed.
>
> Mary from Bloom Carroll Middle, Ohio

www.cosmic-leap.org | team@cosmic-leap.org

Get Involved!

Launch Space Club

Launch your students into STEM with a Mission to Moon or Mars! Space Club is a **completely free** K-8 STEM curriculum used by educators in classrooms, libraries, and camps around the world.

Share Your Story

Are you a STEM professional? We invite you to share your story on our Cosmic Career Chats! These virtual talks provide students with valuable insight into the different paths into a career in STEM.

Sponsor a School

With over **300 schools on our waitlist** to receive materials, consider making a donation on our website at **www.cosmic-leap.org** to support the Cosmic Leap Foundation's mission to launch STEM education to cosmic heights!

Volunteer

It takes a team to get to the moon, whether that is in a spacecraft or in a classroom. We are always looking for individuals passionate about space and education to help us launch STEM to cosmic heights! Sign up on our website today!

Looking to make a more long term impact? **Partner with Cosmic Leap!**

Do you own or work for a company that is looking for impactful ways to give back? Contact us at **team@cosmic-leap.org** for more information on how your company can join other industry leaders in STEM by contributing to a global initiative to improve early STEM education.

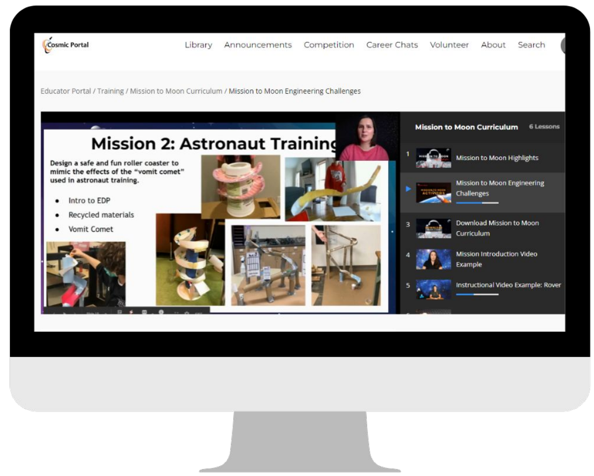
STEM Space Club

5 Steps to Launch

5 Steps to Launch

1: Access Cosmic Portal

The portal offers **on-demand training** to help you learn at your own pace, along with **announcements** to keep you informed about the latest Space Club news and events. You can access a **comprehensive curriculum** that includes lessons, teacher guides, and student handouts.



2: Review Curriculum

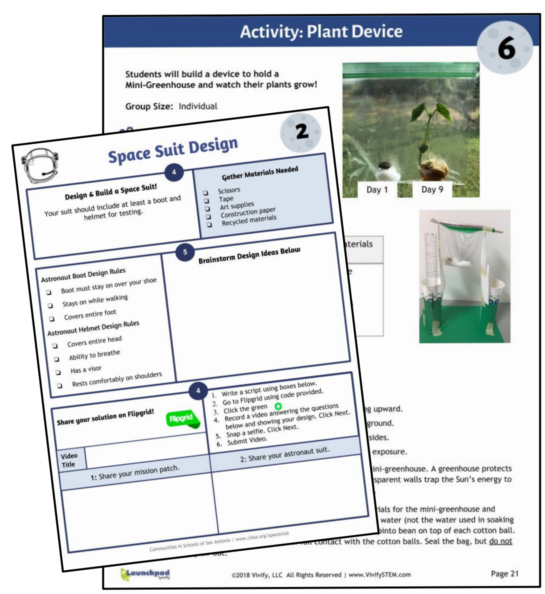
Download all teacher guide, student handouts, and other curriculum resources to implement your program.

3. Launch Programming

Whether an afterschool club, STEM elective, summer camp, or science classroom, implement Space Club at your own pace to meet your learning objectives. Gather supplies or purchase a Space Club kit from Pitsco Education: Mission to Moon or Mission to Mars.

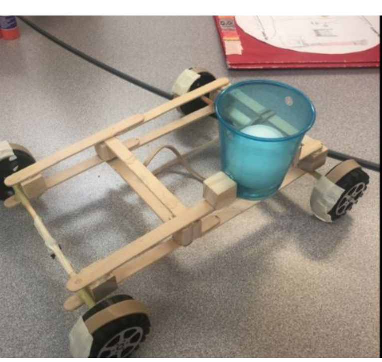
4: Watch Career Chats

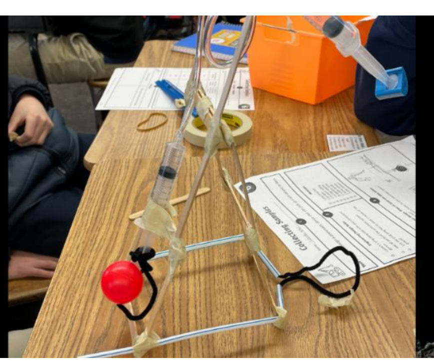
What is the day in the life of an astrobiologist? What does an astronaut do for fun? Cosmic Career Chats connect students with real STEM professionals as they share their inspirations, motivations, and journey to a STEM career.



5: Register for Space Colony Competition Click here

Space Club's capstone project is to design and build a colony on the Moon or Mars. Teams are invited to enter designs including a short video to the international Space Colony Competition! This virtual competition includes feedback to all teams from STEM professionals and a chance to win epic prizes like telescopes, robotics, and 3D printers! **Cost: $25 per team up to 6 students. Click here to register.**





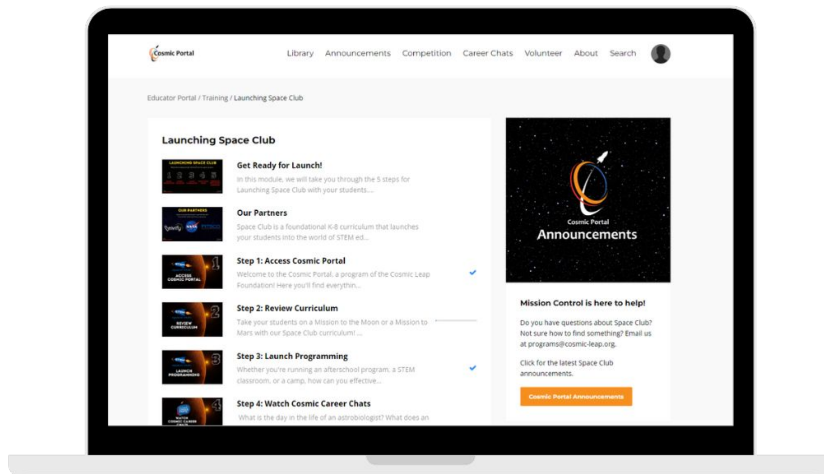
Cosmic Portal

700+ Educators

Join the Cosmic Portal!

Your gateway to engaging STEM education.

- On-demand training for educators
- Full access to curriculum materials
- Vibrant community of fellow educators



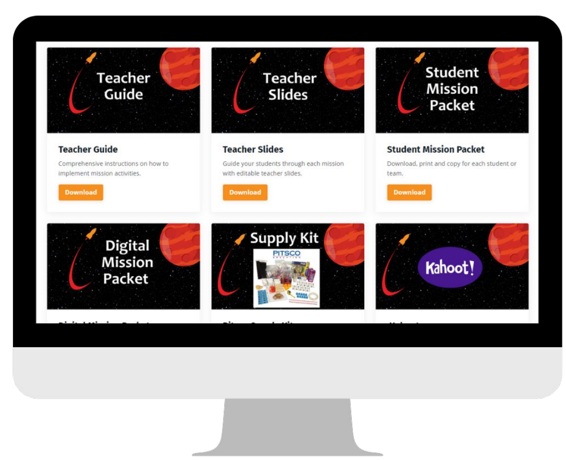
How to Access the Cosmic Portal

1. Visit www.cosmic-portal.org
2. Create a free Cosmic Portal account
3. Log in to the Educator's Portal
4. Watch training videos
5. Explore the curriculum
6. Launch Space Club!

What's Included?

The Cosmic Portal equips you with everything you need to successfully start and run Space Club with your students. All training and curriculum resources are **completely FREE**, with fresh content added throughout the year. Here's what you'll find:

- Introduction to Space Club and STEM education
- STEM Education Fundamentals
- Step-by-step guide to launching your Space Club
- In-depth look at Space Club lessons
- Real-world student examples
- Practical tips and feedback from seasoned educators
- Incorporating Cosmic Career Chats into your lessons
- Colony Competition overview and registration process

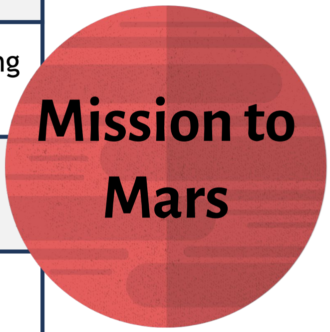


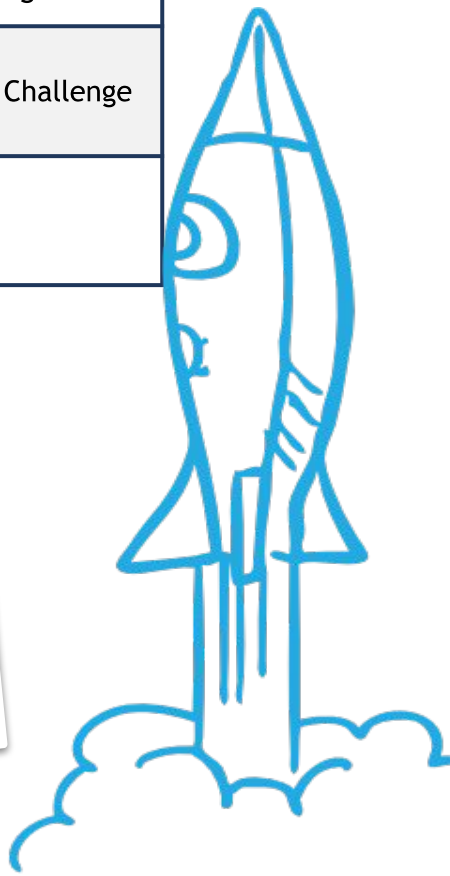
> Space Club curriculum is very well laid out & easy to use! WOW, there is so much wonderful information for the students to refer to & learn from! I absolutely plan to do Space Club again next year!!
> – Michelle at Chimacum Elementary (WA)

Curriculum Overview

In Space Club, students transform into a team of astronauts on an unforgettable space adventure! From robotic arms to rovers, students will complete engineering design challenges that connect to real-world space exploration and careers. Educators can choose to run Mission to Moon or Mission to Mars as semester-long STEM units.

Mission to Moon		Mission to Mars	
Meet the Crew	Mission Patch		
Astronaut Training	Roller Coaster Engineering Challenge	**Get to Mars**	Straw Rockets Engineering Challenge
Space Suit	Astronaut Suit Design Challenge	**Land on Mars**	Space Lander Engineering Challenge
Plants in Space	Hydroponics Engineering Challenge	**Explore the Surface**	Wearable Device Engineering Challenge
Welcome Tower	Solar-powered Engineering Challenge	**Live from Mars**	Mars Earth Matching Game “Live from Mars!” Video
Robot Arm	Robotic Engineering Challenge	**Collect Samples**	Pneumatic Device Engineering Challenge
Rover Exploration	Rover and Circuits Engineering Challenge	**Transport Samples**	Rover Engineering Challenge
Build A Base	*Final Capstone Project* Research, Design, and Build a 3D model of a Habitat Submit to Space Colony Competition!		





Curriculum Components

1: Instructor Guide: materials, mission lesson plans, teacher slides, project examples, video resources, websites, and extension activities.

2: Student handouts (editable Google Slides) are a guide through the engineering design process. Teachers can print or assign virtually. English and Spanish versions.

3: Digital Instruction

- **Mission Overview:** Space Club Mission Control provides an overview of each lesson. These are a great way to kick-off a Space Club session!
- **STEM Instructional Video:** Mission to Moon also includes longer instructional videos to support classroom and distance learning. Led by a team of engineers, these videos provide real-world and career connections, science content, NASA missions, and explanation for engineering design challenge.
- **Kahoot!:** Interactive quizzes will engage students and test knowledge learned during missions.

Cosmic Portal

Learning Goals

Space Club engages youth with space exploration and builds a foundation of STEM skills through real-world engineering design challenges.

The main goal of Space Club is to connect academic subjects to a real-world engineering problem through engaging and hands-on learning that is **authentic and attainable** for K-8 students. The curriculum is not meant to replace math and science courses. Instead, Space Club reinforces concepts taught in the classroom, provides an opportunity to apply knowledge, and connects subjects to authentic real-world scenarios and career pathways. Primary outcomes include:

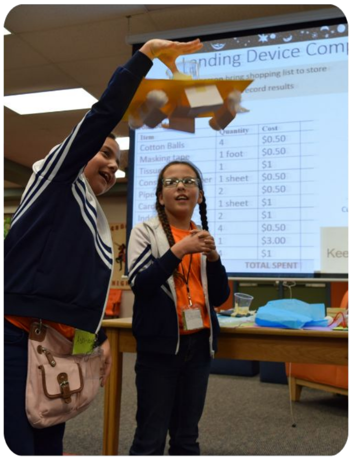
1. Increased academic confidence
2. Improve attitudes towards STEM pathways and subjects
3. Increase understanding of real-world STEM applications related to space exploration
4. Improve habits of mind and soft skills such as communication, collaboration, creativity, critical thinking, systems thinking, and persistence.
5. Increase understanding of engineering design practices and related knowledge

3 Stages of STEM

In a STEM program, students apply math and science to solve an engineering problem using technology. However, such STEM activities can range widely from a tower challenge to a complex research and design project. In Space Club, the 3 Stage of STEM framework is used to progressively build up skills and concepts. Each mission starts with working as a team and learning how to communicate and problem-solve together. Then, student tackle engineering design challenges like launching a rocket, learning about forces, and connecting to real-world technology applications. The final capstone project asks teams to design a habitat in space that requires students to balance trade-offs, consider mental health and engineering solutions, and receive feedback from real STEM professionals. Below is an overview of each stage. Learn more here.

Stage 1:
Team Activities

Stage 2:
Engineering Design Challenges

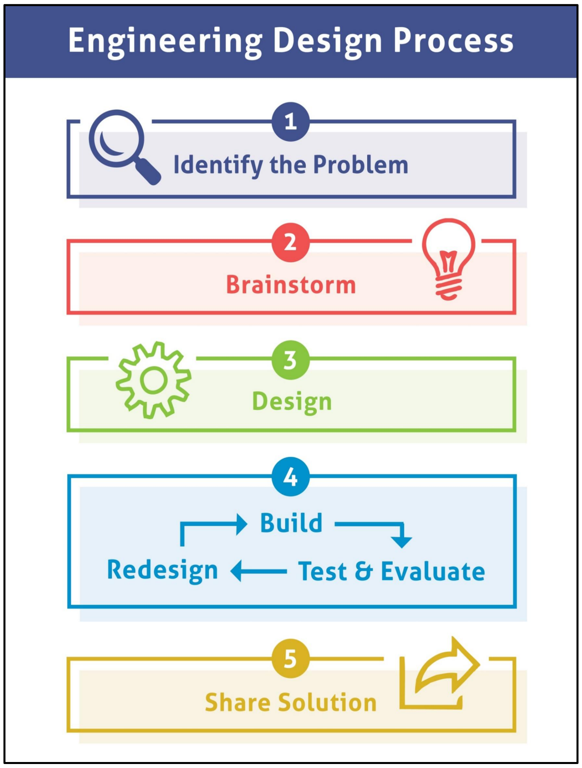


Stage 3:
Long Term Projects

A Closer Look at Engineering

The majority of lessons center around engineering, which is a separate discipline from science. Below is a comparison of the nature of science versus engineering work.

	Science	Engineering
Goal	Seek to understand the world around us	Solve problems to make our lives easier, healthier, and more fun
Method to Reach Goal	**Scientific Method:** Conduct experiments to collect data	**Engineering Design Process:** Apply knowledge to solve a problem
Example Activity	Students discover what happens when Mentos are placed into Diet Coke. Students hypothesize that adding more Mentos will increase the height of the Diet Coke geyser.	Students are challenged to build a device to launch a ball to knock over a tower. Students must use the stored elastic potential energy of rubber bands to build a catapult to launch the ball. Through continual testing and re-design they optimize their product until successful.
Related STEM Careers	Biology, Physics, Astronomy, Chemistry	Biomedical Engineering, Mechanical Engineering, Aerospace Engineering



Engineering Design Challenges

In most lessons, students will apply math and science concepts to problems using the Engineering Design Process. This process can be visualized with the diagram to the left. Instead of immediately building, students are guided through a process of brainstorming, designing, building, testing, re-designing, and sharing their solutions. For example, in the catapult challenge, students apply knowledge of elastic potential energy to design a catapult device to either hit a target or maximize distance. During the testing phase, students analyze catapult designs to re-design and improve their results. This process enhances student critical thinking skills while integrating math and science skills into an engaging hands-on engineering project. Real-world connections further enhance the activity.

Note: this is meant as a guidance for teaching and not a representation of real engineering work! - learn more here.

How to Run Space Club

Originally designed for informal, out-of-school programs, the Space Club curriculum can easily be adapted for classrooms, homeschools, afterschool programs, and virtual or hybrid settings. Missions are aligned with classroom standards to reinforce key content while introducing students to STEM, engineering design, and real-world connections. Whether you're interested in starting a club after school, running a virtual summer camp, or using Space Club as classroom enrichment, this curriculum is flexible to meet your needs!

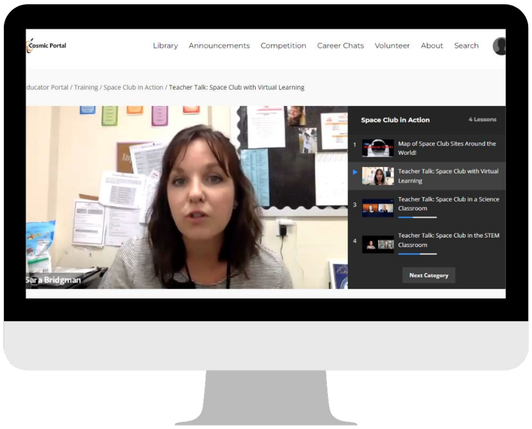
Considerations for a Successful Launch

Define Your Learning Goals: Before you dive in, consider the educational objectives you want to achieve through your Space Club. Then, be intentional and explicit about reaching your goals.

- Do you want to improve soft skills like teamwork and communication?
- How much emphasis do you want on making connections to classroom subjects like science or math content?
- How will you connect activities to real-world applications and professionals?

Logistics to Consider:

- When and where will Space Club meet?
- How will you recruit students?
- How many students will participate?
- How will you group students into teams?
- How will you incentivize participation?
- What help do you need?



Cosmic Portal

Explore Space Club in Action: Check out our growing library of videos in the *Space Club in Action* module, where educators share their experiences with launching Space Club. Learn tips and tricks from other educators on how to implement sessions in a variety of settings.

Session Planning

A Space Club session is typically 45 to 90 minutes. However, to fully utilize the engineering design process, a mission might last multiple sessions to fully complete the design, test, and reflection phases.

Mission 1	Icebreaker activities for the first session.
Mission 2-7	These missions center on an engineering design challenge and require 2+ sessions to get to all phases.
Mission 8	The final capstone project of designing a habit requires 8+ sessions depending on depth of the project.

Mission 2-7 (Design Challenges)

Part1: Background, Planning, Building

- Engage: Play mission video and review design challenge
- Brainstorm: Gather materials and sketch design ideas
- Build: Build initial prototype

Part 2: Review, Test, Modify, Reflect

- Review: Play another background video and review
- Build: Complete building
- Test & Modify: Test prototype and improve design
- Reflect: Connect back to science concepts and discuss success and failures

Mission 8 (Capstone Project)

Design a colony on the Moon or Mars to keep a crew alive and happy!

- Identify the Problem (1 sessions)
- Brainstorm Solutions (1 session)
- Design Colony Layout 1 sessions)
- Build Colony Model (3+ sessions)
- Record video and complete submission (2 sessions)

Tips for Running Space Club: Below are some tips with more on the Cosmic Portal!

- Have a clear transition to start the group. For afterschool, allow 15 minutes for snacks and socializing.
- Start the sessions with a hook to capture student interest. Video links are provided that are exciting ways to introduce the content and provide a real-world connection.
- Do not release students until work area is clean.
- Reflection at the end might be too chaotic. Another option is to go around teams and ask open-ended reflection questions during activities.

Get Supplies

Supplies & Materials Management
Consider what supplies you'll need and how to organize them:

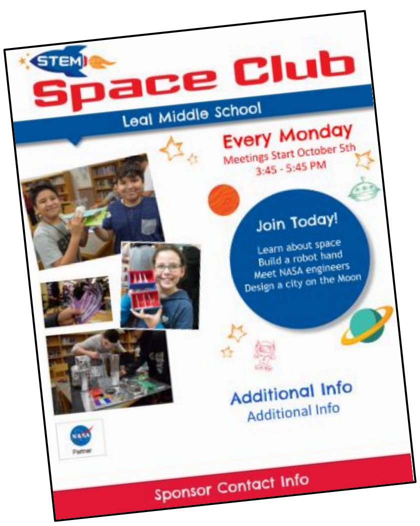
- Many mission supplies can be sourced from your local grocery store.
- Kits of materials are also available for purchase through **Pitsco**.
- You might need storage bins, bags for pre-sorting materials, or a table for students to pick up supplies.
- Some teachers like to include incentives like space-themed stickers or pencils to reward participation!

PITSCO EDUCATION

Space Club supply kits are now available for Mission to Moon and Mission to Mars units!

Space Club Toolkit

Access our Space Club Toolkit to support both informal and formal classroom facilitation. From **marketing flyers** to **student certificates** and **behavior contracts**, our ever-expanding toolkit equips you with everything you need to confidently launch and manage your Space Club. Empower yourself with these essential resources to create an engaging and successful program.



Access the Space Club Toolkit: Cosmic Portal

Classroom Management

Setting Expectations: At the beginning of Space Club, set expectations for appropriate behavior to create a positive, respectful environment for all Space Club members. One way to do this is with a behavior contract. Here's how to implement one effectively:

- **Student Agreement:** Have students read and sign the contract
- **Parent Involvement:** Share the contract with parents so they are aware of club expectations.
- **Reinforce Positivity:** Use the contract to acknowledge good behavior and provide constructive feedback when needed.
- **Consistency is Key:** Refer back to the contract throughout the program to maintain a focused and respectful atmosphere.

Working In Groups

- You can allow students to pick teams or randomly assign teams each week such as drawing a number out of a hat.
- Depending on size, teams typically are 3 - 4 students per group.
- Discuss the importance of collaboration and communication in teamwork.
- Do not allow one student to do all the work.
- Frustration is part of the engineering design process. Remind students that failure is important in engineering and allows them to learn from their mistakes.

Struggling Student Recommendations: Determine what the source of frustration is and then use the following suggestions.

- **Inability to work in teams:** Spend more sessions on team-building exercises. Determine if the best way forward to implement the curriculum is in partners or individually.
- **Frustration in failure**: Show video examples of failures in engineering. Discuss how failure is part of the engineering design process and that the best engineers learn and grow from their failures.

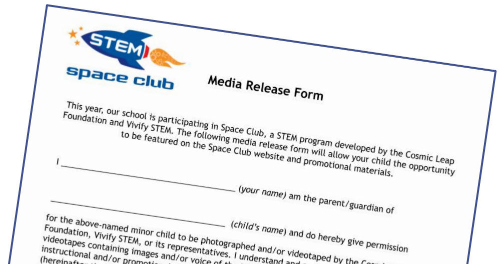
High Performing Student Recommendations

- Students will be able to go more in-depth with concepts. Consider having a laptop available for researching questions further such as science or real-world connections.
- Encourage students to research interesting careers.
- Provide students with less guidance on building challenges.

Share Your Program!

Want your school to be featured in our newsletter or website? We would love to share the amazing work of your students to inspire others and grow awareness of Space Club programming!

1. Make a copy of the Media Release Form and edit as needed.
2. Send home with students for parent signature.
3. Submit media and media release forms here.



Share your love of Space Club with us!
Click to submit a testimonial or media of your program.

Connect with Us!

Connect with real-world STEM!

Share the story of real STEM professionals with your students! Cosmic Career Chats is a series of on-demand videos with real scientists, engineers, technicians, and other STEM career professionals.

Purpose of Career Chats:

- A glimpse into the everyday lives of a STEM professional
- Prospective role models from diverse backgrounds
- Connections to real-world applications through guest speakers' projects and experiences

Cosmic Career Chats typically consist of 3 parts:

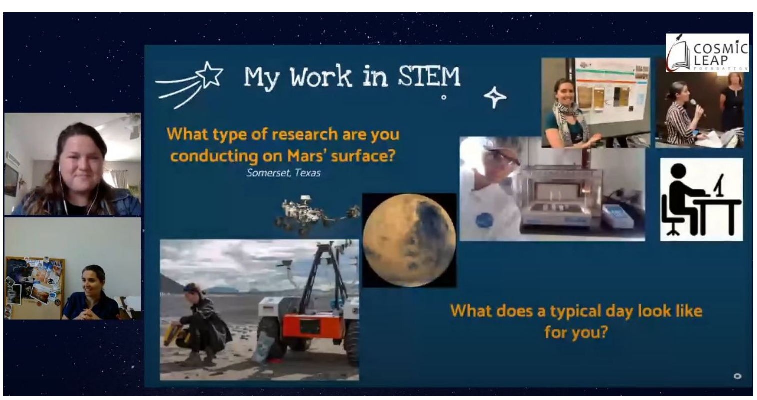
1) An introduction of the STEM professional and their educational background
2) Their "STEM Story," or a short explanation of their journey through STEM, including the joys and difficulties they endured
3) Rapid Fire Questions provided by students from all over the world!

How to Use Cosmic Career Chats:

- Watch a video related to a Space Club mission
- Assign to watch at home with reflection prompts
- Use to explain class concepts

Watch Cosmic Career Chats and submit student questions here!

For example, Chris Bigler, he mentions how he used everyday materials around his house to develop a quick-mock-up prototype for the Forward Separation Barrier on Sierra Space Company's *DreamChaser,* a perfect example of how a STEM professional develops prototypes before a team iterates and develops a product.



This episode of Cosmic Career Chats featured Dr. Marion Nachon, a planetary scientist and geologist who researches the rocks on Mars through collaborative, innovative projects with NASA and the Mars rovers!

Learn more at: www.cosmic-portal.org/chats

5: Join the Space Colony Competition

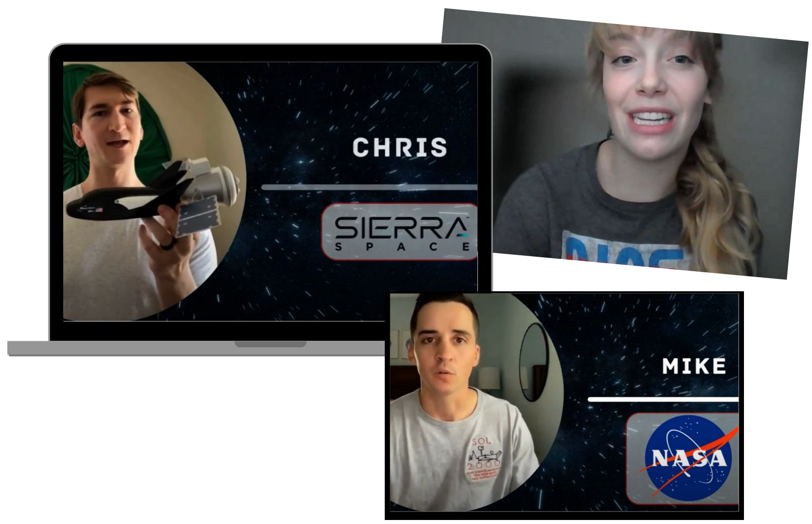
Submit your design for a colony on the Moon or Mars that can keep a crew alive and happy! The Space Colony Competition is open to any team of up to 6 elementary or middle school students. Learn about the challenges of living in space, research and design a colony, and build a 3D model using recycled materials. Then, upload a video and presentation for a chance to win prizes, get feedback from real STEM professionals, and compete with students around the world!

STEPS FOR SUCESS

1. REGISTER FOR COMPETITION
2. IDENTIFY THE PROBLEM
3. BRAINSTORM SOLUTIONS
4. DESIGN COLONY LAYOUT
5. BUILD COLONY
6. CREATE REPORT & VIDEO
7. SUBMIT

Feedback from real STEM Professionals!

Competition Divisions
Elementary: 3rd - 5th grade
Middle: 6th - 8th grade



Register at:
cosmic-portal.org/competition

Space Club

Teacher Guide

Mission to Moon

Mission to Moon Overview

Through interactive sessions, Space Club students become a team of astronauts challenged to complete missions centered around a Journey to the Moon. Each week, students will read a message or watch a video from Mission Control, who will introduce the activity and provide background context. Students will then engage in hands-on activities centered around the engineering design process.

Mission to Moon Components

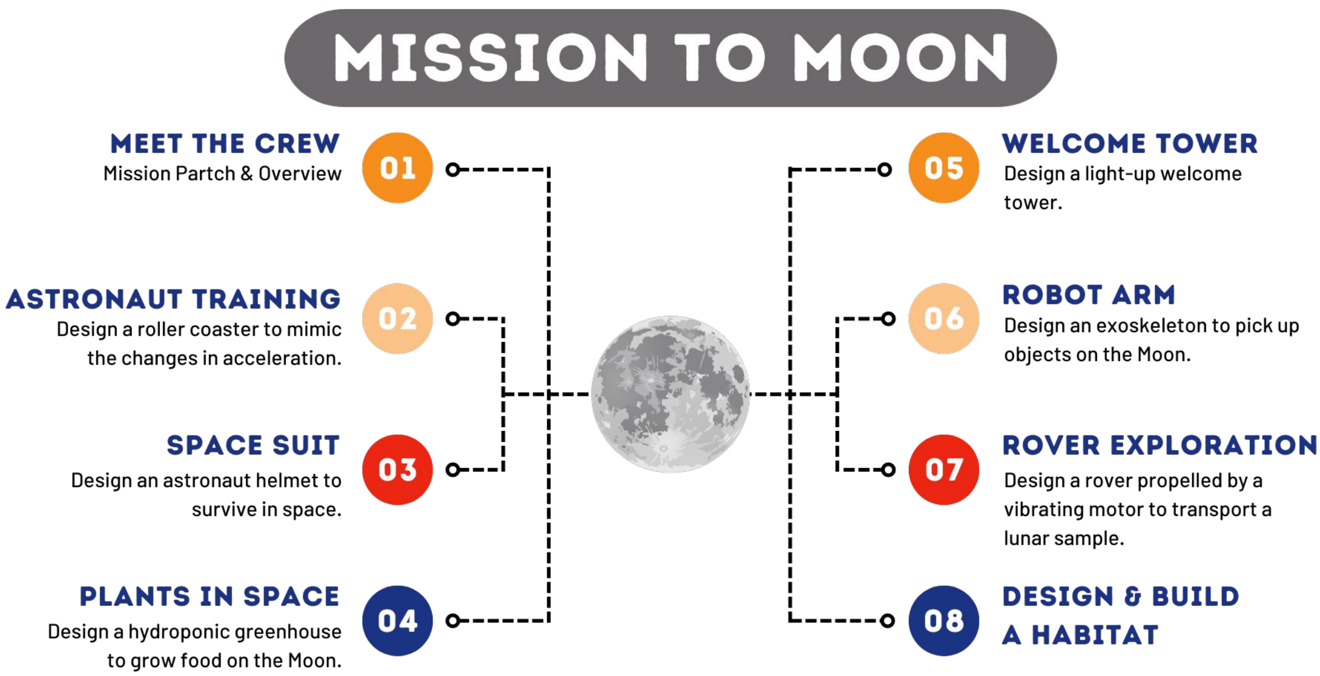
The Mission to Moon curriculum is intended to be used as a series of lessons that follow a storyline and increase in complexity. However, besides the final mission, each activity can be conducted as a stand-alone session without prior knowledge of other missions. The final Mission 8 is a culmination of learning that involves designing and building a habitat on the Moon.

Access Lesson Handouts on the [Cosmic Portal]

Mission to Moon curriculum includes both teacher guides and student mission handouts. All links are found in the Cosmic Portal.

- Teacher Guide (this packet): Lesson instructions and materials list
- Student Mission Sheets: Student companion handouts that guide students through the mission. The handouts can be printed and combined to create a student notebook. A digital journal is also available.
- Student Digital Journal: A digital notebook is available for distance learning or using with tablets in the classrooms.
- Spanish Version: A Spanish version is available for student materials.

Cosmic Portal



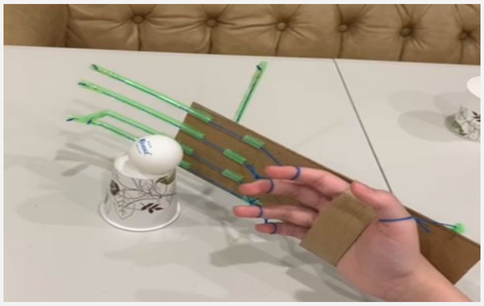
Mission to the Moon

Session Overview

Mission to Moon is a curriculum designed to implement during distance or classroom learning. From space suit design to growing plants in space, students will complete engineering design challenges centered on an epic journey to the Moon. The following missions prepare students for a capstone project of designing a habitat on the Moon!

Mission	Activity Overview	21st Century Skill
1 **Meet the Crew**	Mission Patch Sparks Activity	Teamwork
2 **Astronaut Training**	Roller Coaster Engineering Challenge	Communication
3 **Astronaut Helmet**	Astronaut Helmet Engineering Challenge	Critical Thinking
4 **Plants in Space**	Plant Device Engineering Challenge	Resilience
5 **Welcome Tower**	Welcome Tower Engineering Challenge	Initiative
6 **Moon Samples**	Robotic Arm Engineering Challenge	Leadership
7 **Rover Exploration**	Rover Engineering Challenge	Adaptability

For engineering design challenges, here is a suggested structure.



Session 1: Background, Planning, Building

1. Engage: Play mission video and review design challenge
2. Brainstorm: Gather materials and sketch design ideas
3. Build: Build initial prototype

Session 2: Review, Test, Modify, Reflect

4. Review: Play another background video and review challenge
5. Build: Complete building
6. Test & Modify: Test prototype and modify as needed (this should take the longest time!)
7. Reflection: Connect back to science concepts and discuss success and failures.

21st century skills are used throughout all engineering design challenges; however, teachers may wish to focus on a particular skill during a mission. The skill in the table above refers to the topic covered in the mission introduction video. Instructors may wish to have students discuss and reflect on a particular skill during a mission.

Standards Alignment

Mission to the Moon

Mission to Moon is an 8 unit curriculum designed for Space Club sites to implement during distance learning. From space suit design to growing plants in space, students will complete engineering design challenges centered on an epic journey to the Moon.

Mission	Next Generation Science	Science TEKS (Texas)
Practices across Missions	Engineering Practices 3-5-ETS1-1, 2, 3 MS-ETS1-1, 2, 3	Science & Engineering Practices: A, B, D, E, F, G; 2A-D, 3A-C, 4A-C
2: Roller Coaster Engineering Challenge	3-PS2-1; 3-PS2-2; 4-PS3-1; 5-PS1-3 MS-PS3-1,2,5 Potential Energy MS-PS2-1 Forces	Matter: 3.6D Forces: 3.7A, 3.7B, 3.8B, 4.7, 4.8A, 5.7A, 5.7B, 6.7A, 6.7B, 6.7C, 6.8A, 7.7A/B/C/D, 8.7A/B
3: Helmet Engineering Challenge	5-PS1-3	Matter: 3.6D
4: Plant Device Engineering Challenge	3-LS1-1; 5-PS1-3 MS-LS1-4; MS-LS1-5	Matter: 3.6D Organisms: 3.11A Earth: 5.12C
5: Welcome Tower Engineering Challenge	3-PS2-3 4-PS3-2; 4-PS3-4 5-PS1-3	Matter: 3.6D Circuits: 4.8C, 5.8A/B Forces: 3.7A, 3.7B, 3.8B, 4.7, 4.8A, 5.7A, 5.7B, 6.7A, 6.7B, 6.7C, 6.8A, 7.7A/B/C/D, 8.7A/B
6: Robotic Arm Engineering Challenge	5-PS1-3 MS-PS3-3 Energy MS-PS2-3 Motion and Stability	5.11; 4.13B Circuits: 4.8C, 5.8A/B Matter: 3.6D Forces: 3.7A, 3.7B, 3.8B, 4.7, 4.8A, 5.7A, 5.7B, 6.7A, 6.7B, 6.7C, 6.8A, 7.7A/B/C/D, 8.7A/B
7:Rover Engineering Challenge	4-ESS1-1 Earth 5-PS1-1, 3 Matter MS-PS2-2 Motion MS-PS3-3 Energy	Circuits: 5.8A/B Matter: 3.6D Forces: 3.7A, 3.7B, 3.8B, 4.7, 4.8A, 5.7A, 5.7B, 5.8B, 6.7A, 6.7B, 6.7C, 6.8A, 7.7A/B/C/D, 8.7A/B
8: Lunar Base Design (Space Colony Competition - not included in this guide)	4-PS3-4 Energy; 5-PS1-3 MS-PS3-3 Energy MS-ESS1-2 Gravity MS-ESS1-3 Scale MS-LS1-6 Photosynthesis MS-LS2-1,4,5, Resources	Matter & Energy: 3.6A/D, 4.6A, 5.6A, Earth & Space: 3.11A, 3.11B, 4.11B, 5.11 6.10A, 6.11, 7.9A, 7.9B, 8.9B, 8.10A Organisms & Environment: 4.12A, 4.12B, 5.12C, 5.13A 7.13A, 8.12A, 8.12C

Mission to Moon Supplies

Below is a list of materials needed per team to complete the Mission to Moon challenges. Many supplies can be found at your local grocery store. Actual pricing will depend on quantity and vendor. To use digital tools, students will need a mobile device, tablet, Chromebook, or computer with camera.

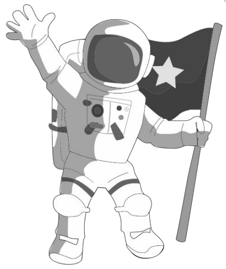
Click here to purchase these materials from Pitsco!

Material List	Qty per Student	Notes	Approx cost for 24
Printing of Handouts	1		About $175 depending on vendor and quantity.
Bag for supplies	1		
Masking Tape	1 roll	Clear tape also works	
Ruler	1		
Scissors	1		
Pencil	1		
Construction Paper	40 pages	To simplify supplies, use construction paper or copy paper for all the challenges needing paper. However, the robotic arm in Mission 5 works better with cardstock.	
Cardstock Paper	6 pages		
Ziplock Sandwich Bag	6	(Mission 3) Any resealable clear bag will work. Only 1 bag required. The other 5 are for packing materials for kits.	
Beans or Seeds	4	(Mission 3) Pinto beans plus another seed or popcorn kernel are recommended to compare results.	
Cotton Balls	4	Jumbo size works best	
5 oz Paper Cups	4		
Bendy Straws	30		
Paper Plates (7 - 9 in)	7	Exact size is not important	
Ping Pong Ball	1		
Foil	30 in x 12 in or 76 cm x 30 cm	Amount doesn't need to be exact. Use this as a minimum. Can also purchase foil sheets.	
String or twine	5 feet or 1.5 meters	This is a minimum amount for Mission 5. We like to provide students with the entire ball of string.	
Vibrating Motors	1	Make sure to test out the motors and batteries by placing a wire on each side of the coin cell battery to complete the circuit and power the motor.	$36
Coin Cell Battery (3V)	4	1 battery needed for Mission 6 rover. Additional batteries can be used in place of the solar panel in Mission 4 & 8. Please ensure coin cell batteries are handled safely. Read this.	$22
LED Lights (5 mm)	4	Voltage range should be between 2.0-2.2V	$6
			$239

Optional Materials			
Solar Panels (2V output)	1 ($6.45)	A coin cell battery can be used instead.	$143
Recycled materials		Missions can be enhanced with common recycled materials like cereal boxes, plastic containers, magazines, etc.	

Mission 1
Meet the Crew

Meet the Crew

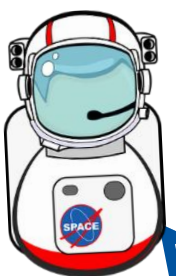


Mission Overview

1. Welcome to Space Club! Introduce the program and discuss logistics.
2. Watch the Mission Overview video or read script
3. Complete the "Mission Warm-up" box. In the future, this can be completed as students walk into the classroom.
4. Complete team challenges - many options are provided! Distance learning? Find activities here.
5. Astronaut Mental Training and Mission Patch Activity: Answer the mental challenges and mission patch activity on the student handouts. Use the teacher slides as a guide.
6. Complete the "Spark Quiz." Sparks are something you are passionate about, makes you excited, and is unique to you! We recommend instructors sharing their personal sparks with students. Learn more about sparks from the Search Institute.
7. Complete ***Sparks Mission Patch***. Students will create their personal mission patch. Watch: Our World: Mission Patches (5:22)
8. Optional: Create a class or club mission patch that can be turned into t-shirts, stickers, or badges for the entire group to have a shared identify.

Word of the Day: Teamwork
Activities center around how astronauts need to work together as a team to accomplish the mission. Everyone must participate to succeed!

STEM Career:
Astronaut



Welcome to Space Club Mission Control! Congratulations! You have been selected by NASA as the newest member of the United States astronaut class to embark on a mission to the Moon! Your team was selected from over 18,000 applicants.

Hi! I am part of Space Club Mission Control and I am your commander for this exciting journey! Some background on our mission: NASA plans to build a habitat on the Moon for humans to live and work. But first, they need to learn as much as possible about living there. First, you will complete astronaut training. Next we will launch to the moon and learn how to survive by growing our own food. We will then build a solar-powered welcome tower to help us find our way back to base when exploring the lunar surface. We will then complete a scientific expedition by collecting and transporting rock samples for further study. Finally, we will design a new base on the Moon for humans to someday live!

To get started, let me introduce your crew's first mission. At NASA, before astronauts get sent into space, they design a mission patch. Creativity is important as each of the over 150 different patches is uniquely designed to represent the team and mission.

In today's mission, your challenge is to design a mission patch that represents- YOU! We look forward to seeing your mission patch designs!

~*Space Club Mission Control*

Great videos to show:

We Are NASA (2:23 min)

Becoming a NASA Astronaut (1.5 min)

Becoming Astronauts: Are you next? (4 min)

Astronaut Mental Training Answer Key

The answers to the mental challenges are as follows:

1. (a) 43 hours. Divide distance by speed to get the time.
2. (87) Turn the page upside down to see the numbers ordered from (87) to 91. There is no "up" in space! There are currently 4,987 satellites orbiting the Earth right now (as of 2019).
3. (b) The pattern mirrors adjacent shapes but in the opposite color.

More puzzles like these can be found in Astronaut Tim Peake's book, *The Astronaut Selection Test Book: Do You Have What it Takes?*

Resources

Video Resources

Real World Connection

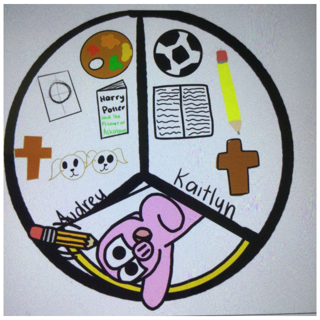
- NASA 2021: Let's Go to the Moon (3:23 min)
- We Are NASA (2:23 min)
- We Go as the Artemis Generation (1:11 min)
- Meet the Artemis Team (1:59 min)
- #AskNASA┃ What is Artemis? (2:57 min)
- Our World: Mission Patches (5:22 min)
- The Artemis Program Patch with Dee (3:44 min)

STEM Career Connection

- What Do Astronauts Do? (4:41 min)
- Meet the Artemis Astronauts
- Becoming Astronauts: Are You Next? (3:42 min)
- Why did you want to be an astronaut? (3 min)
- A day in the life of an astronaut? (9 min)

Extension Activities:

- Connect sparks to STEM careers! Read more here.
- Use sparks as icebreakers during a Zoom call including Show & Tell.
- Click here for more icebreaker activities.



Meet the Crew

Students create their own personal mission patch.

Materials
❑ Construction or Cardstock Paper
❑ Pencil
❑ Colored Pencils / Markers

Build a Mission Patch

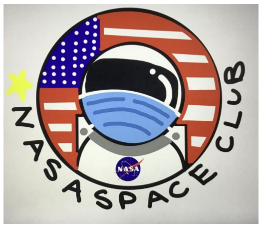
1. A spark is something you are passionate about, makes you excited, and is unique to you! Sparks can be something you like to do or an interest you have. Sparks are a great way to build relationships with students and help them feel connected to Space Club.

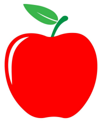
2. Ask students to think about their interests. Use the student handouts to brainstorm ideas and narrow down to <u>one</u> spark. You may need to help students get beyond the silly phase and select something they are actually passionate about.

3. Once every student has selected a spark, time to create a personal mission patch! The purpose is to have a way to display their spark and keep it as a reminder during Space Club. Teachers should also use this spark as a way to get to know students and connect lessons to personal interests.

4. The mission patch should include: student name, name of spark (i.e. “football”), and decoration to represent that spark. Students that don’t like to draw can use stickers, magazines, or other materials to add to their mission patch. You can also have students create digital artwork to print and add to their mission patch.

5. Optional: challenge your students to make the mission patch 3D by adding a pop-out component to a physical mission patch. Or a digital patch can be animated!

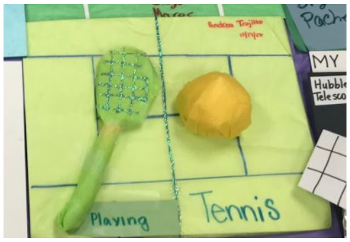


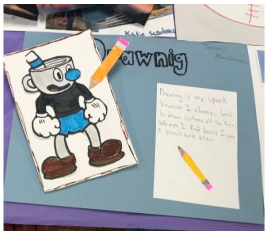


Teacher Tips: Students can save the mission patch to add to their astronaut helmet on the mission 3.

Sparks can be referenced throughout Mission to Moon. Ask students to create a digital Zoom background with their spark, share a story related to their spark, or have a show and tell day.

You may also consider making a team mission patch to represent the group as a whole.

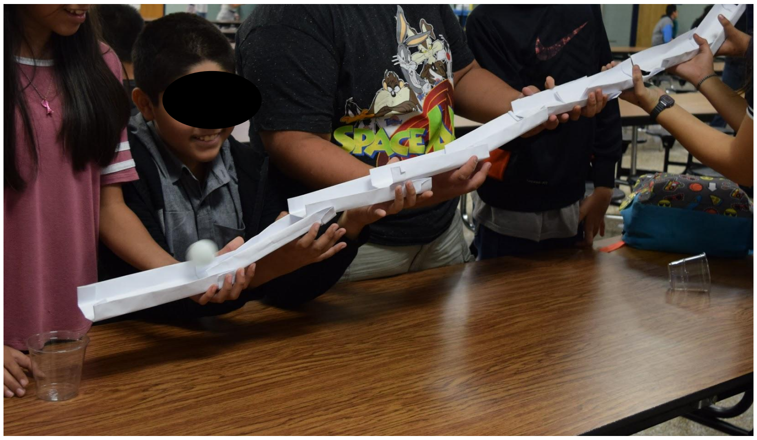




Teamwork: Pipeline Challenge

Student groups work to move a ball by creating a track as a team.

Group Size: 4 - 8 students



Prior to Activity

1. Collect materials.
2. FInd a large open space for activity.

Materials
❑ 1 page of copy paper per person
❑ 1 cup per team (9 oz recommended)
❑ 1 ping pong ball per team

Activity Instructions

1. Put students in teams of 4 - 8 students. The larger the groups the more challenging the activity.
2. Provide each team with materials listed. Make sure each person has a piece of paper.
3. Have students form a line. The person at one end of the line has the cup. Place the cup on the ground. The person at the opposite end has the ball.
4. The goal is to have the ball land in the cup without touching the ball once in motion. The paper is to be used as the track. The ball must remain in motion at all times. If the ball stops or falls off the track, start over! The ball must land inside the cup at the end of the track.
5. Once the team accomplishes the task, move the cup farther way. You can even move it across the room! Now the team will realize that they have to do a relay race. Once the ball leaves the first person's track, that person must run to the end of the line ready to catch the ball and keep it moving!
6. Hint: Start with smaller groups for younger students, but we recommend no less than 4. Older students can even go up to 10+ students! Can you get the whole class to work together?

Teamwork: Head Tower Challenge

Student partner teams work together to stack blocks on top of a plate on their head.

Group Size: 2 students

Prior to Activity

1. Collect enough blocks for each team to have 5-8 depending on how difficult you believe they would be to stack.

Materials Per Group
❑ Blocks ❑ Paper plate

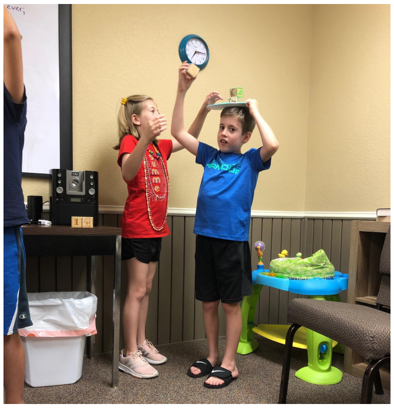
Activity Instructions

1. Students form pairs and designate one person to be the “block head” first. The block head must hold a plate on top of his/her head.

2. The partner is to hold a handful of blocks and when the teacher says “go” hands the first block to the partner. The partner’s job is to hand more blocks to the block head as they request more. They should also verbally assist the block head in positioning each block that is stacked or telling the blockhead how to balance the plate/stack of blocks.

3. Partners should be competing with other partner teams to see who can have the highest stack of blocks at the end of 1 minute. If a team builds a tower of blocks that is taller than all the other teams but falls before the timer ends, they do not win.

4. The objective of this icebreaker challenge is to facilitate good communication between partner teams. Emphasize that the partner is the eyes of the team and the blockhead is the hands so they must work together to be successful.



Teamwork: Straw Tower Engineering Challenge

Build a straw tower to hold 2 ping pong balls.

Group Size: 2 - 4 students

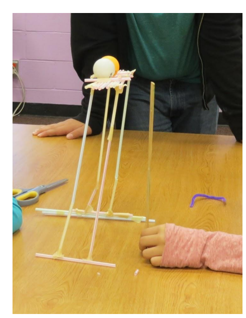
Prior to Activity

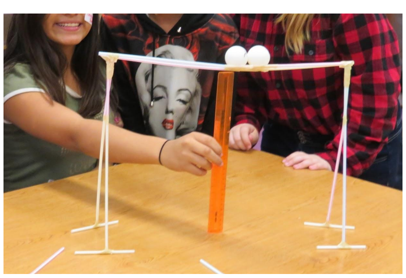
1. Review the engineering design process handout.
2. Review activity instructions and handouts.
3. Gather materials.

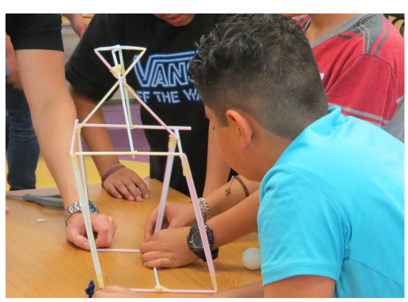
Materials per Team
❑ 20 straight straws
❑ 2 ft masking tape
❑ 2 ping pong balls
❑ Ruler

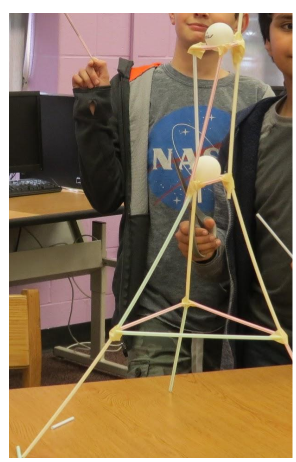
Activity Instructions

1. Introduce engineering design process using the handout provided. Explain to students that real-world engineers use this process to create engineering designs such as rockets, airplanes, skyscrapers, and computers. More great resources here and here.
2. Split students into teams of 2 - 4. Grades K - 2 work best in partners, while older teams work well in groups of up to 4. We do not recommend doing this challenge individually.
3. Explain the challenge. **The mission: Build a straw tower to hold 2 ping pong balls at least 1 foot or 30 centimeters off the ground.** The rules or constraints:
    a. Freestanding tower: no taping or securing to the ground or table.
    b. Do not tape ping pong balls to tower or together.





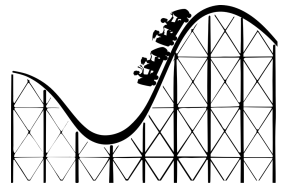




Mission 2

Astronaut Training

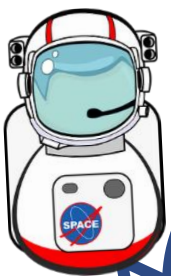
Mission Overview



1. Complete the "Mission Warm-up" box.
2. Watch the Mission Overview video or read script
3. **Science Background:** Read about the science of roller coasters and complete the potential and kinetic energy activities.
4. **Roller Coaster Challenge:** Introduce the engineering design process with the roller coaster challenge - always a student favorite! Connect to Mission to Moon with the vomit comet that uses changes in acceleration to prepare humans for space travel. How can the roller coaster cause changes in acceleration to a ping pong ball?

STEM Career:
Astronomer

Word of the Day: Communication
Ideas only come to life if you can clearly communicate them! As a team, you must be able to communicate effectively to work together and complete the mission.



Before we head to the Moon, we must first get ready for traveling in space. When NASA selects an astronaut for a space mission, he or she must undergo years of rigorous physical and mental training. One example of this training is riding an airplane that simulates weightlessness felt in space. The airplane flies in a wave pattern of steep climbs and sharp dives. As it climbs up, passengers get several seconds of weightlessness at the top. The airplane can even simulate lunar gravity. Each flight includes 40 - 60 repetitions of this change in G-forces, and 1 in 3 passengers get sick leading to the nickname of "Vomit Comet"!

While we can't send you on a Vomit Comet ride, you can experience similar sensations at an amusement park! Roller coasters cause a series of low- and high-gravity sensations that mimic the free falls and accelerations of airplanes and spacecraft. For example, as the coaster reaches the bottom of a hill or goes around a curve, you feel your body pressing into the seat. Similarly, acceleration during launch makes astronauts feel two to three times heavier than they are.

In today's mission, your challenge is to design and build a roller coaster that will cause changes in acceleration. Keep in mind that our Mission to the Moon will require you to take initiative and be bold! Don't worry about failure, that's part of the engineering design process! To succeed, you must first have the courage to try.

~Space Club Mission Control

Great videos to show:
The Vomit Comet ft. Emily Calandrelli (5:16 min)

What is Engineering? (6:20 min)

The Physics of Roller Coasters (3:38 min)

Video Resources

Real World Connection
- What zero gravity really feels like in the "vomit comet" (7:42 min)

STEM Career Connection:
- How do you become an Astronomer (8 min)
- NASA Explorers S4 E3: Training the Astronauts (6:15 min)
- #AskNASA┃ How Can I Be An Astronaut? (3:53 min)
- #BeAnAstronaut: Why Did You Want to Be an Astronaut? (3:06 min)

STEM Career Connection: Engineering
- I Am A Scientist (2:31 min)
- I Am An Engineer HD 1080p (1:37 min)
- Meet an Aerospace Engineering Student (2:10 min)

Science Connection
- How roller coasters affect your body - Brian D. Avery (5:01 min)
- Roller Coaster Forces: Explained (7:21 min)

Science Background

Science of Roller Coasters

Do you love riding on a roller coaster and feeling the heart-pounding sensation of flying out of your seat? Ever wonder how roller coasters work?

ALL ABOUT ENERGY

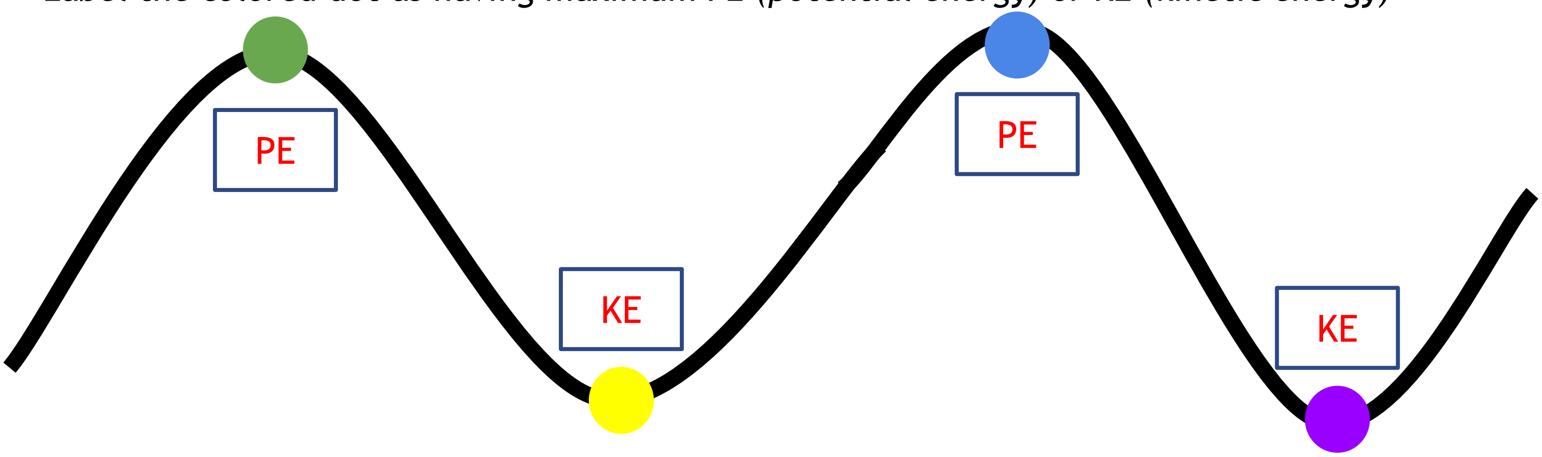
As you go up the first hill, a motorized chain pulls your cart to the top (that's the click click sound you hear at your feet). The first hill is usually the tallest and has the most **potential energy** or the amount of energy stored due to the object's height. The amount of energy stored from falling down the first hill will be enough to carry riders all the way to the end of the ride! The taller the first hill, the farther gravity can pull riders downward.
As riders scream while falling down the hill, **gravity** takes over. All the built up **potential** (stored) energy now changes to moving or **kinetic energy**. The further down the hill, the faster you go! As riders go up and down hills, the energy changes from potential to kinetic and back at each hill.

NEWTON'S FIRST LAW OF MOTION

According to Newton's First Law of Motion, an object in motion stays in motion. This should mean that the roller coaster will keep moving forward forever! However, **friction** forces slow down the cart as the wheels move over the track. **Air resistance or drag** forces caused by the cart moving through the air will also slow you down.

Potential and Kinetic Energy

Label the colored dot as having maximum PE (potential energy) or KE (kinetic energy)



Did you know a skateboarder uses gravitational potential and kinetic energy to do cool tricks?

1. **Go to:** http://phet.colorado.edu/en/simulation/energy-skate-park-basics

2. **Click the link for a skateboarder simulation showing gravitational potential and kinetic energy.**
   - Click play
   - Select Intro
   - Check bar graph
   - Place the skateboarder on the track to see how the energy changes

What is another real-world example of gravitational potential and kinetic energy?

Student answers will vary- another example besides the roller coaster and skateboarder could be bouncing a ball, rubber band, biker on a hill, object falling from above etc.

Astronaut Training

2

Students build a fun and safe roller coaster to get a ball into a cup.

Build a Roller Coaster

1. Mission: Design a safe and fun roller coaster!
2. Design constraints:
    a. Ball must stay in motion at all times
    b. Ball makes at least 1 turn.
    c. Ball lands in cup.
    d. Nothing inside cup.
3. Test: When students finish, they will test their roller coaster to make sure it meets all the design constraints. They can also measure the height, number of turns, and the time it takes the ball to reach the bottom.

Extension: Can you make the ball reach the bottom faster? Can you increase the height of the roller coaster? Can you add more turns? Read more about this challenge here.

A mental health activity to practice is "roller coaster breathing." You can find more information here or through this video.

Roller coaster math extension problems: How long does it take for the ball to travel to the bottom of the roller coaster? Can you figure out the distance the ball travels? Can you calculate the average speed of the ball?

Materials Per Student

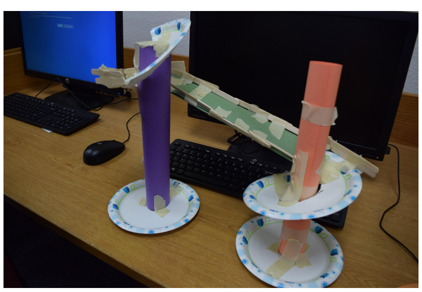
- ❏ Scissors
- ❏ Tape
- ❏ 8 Pieces of construction paper
- ❏ 4 Paper Plates
- ❏ 1 Paper cup
- ❏ 1 Ping Pong Ball
- ❏ Optional - other recycled materials

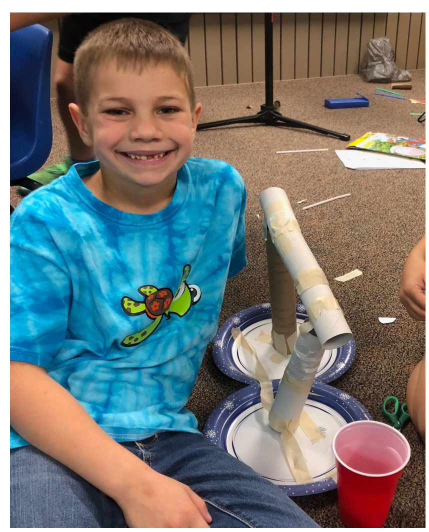
Note: no need to constrain materials on this challenge. Let the students use whatever is available (Amazon boxes, cereal boxes, etc.) to create a wild ride! But if providing a supply kit, make sure they only use those items above so they have materials for the rest of the activities!

Watch this activity in action!

Student Flipgrid Examples

Student Project Highlights





Mission 3
Astronaut Helmet

Astronaut Helmet

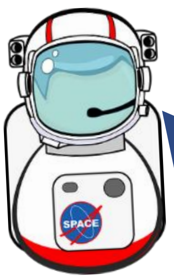
3

Mission Overview

1. Complete the "Mission Warm-up" box.
2. Watch the Mission Overview video or read script
3. **Science Background:** Learn the science behind space suit design and the parts of a helmet. Complete the activities on the page to learn more about space suits and helmets.
4. **Astronaut Helmet Challenge:** Design and build an astronaut helmet to stay protected on the Moon.

STEM Career:
Aerospace Engineer

Word of the Day: Critical Thinking
Students have the tendency to jump right into a project without thinking through the best approach.



As we prepare for launching to the Moon, we need to pack our bags. Going to the Moon is kind of like a camping trip, but your house is 239,000 miles away, and your campsite has no oxygen, food, or water...

First we need to have protective gear to survive the elements of space travel and living on the Moon. In this mission, you will learn about astronaut space suits and design your own astronaut helmet.

When astronauts go on a mission they wear a space suit to protect themselves. Astronaut suits have over 13 layers and weigh 280 pounds. Along with wearing a spacesuit, another way astronauts stay safe is through teamwork. During training, crew members learn to work together and build important team skills such as communication and collaboration. Can you think of a time you had to work as a team? What challenges did you face? Now imagine facing those same challenges during a dangerous space walk!

Good luck with your mission, and I look forward to seeing your designs! ~*Space Club Mission Control*

Great videos to show:
#AskNASA ┃ What are the Next Generation Spacesuits? (3:31 min)

It Takes Teamwork to Become an Astronaut - STEM in 30 (1:26 min)

NASA astronaut Peggy Whitson #SuitUp Video (1 min)

Video Resources

Real World Connection

- #AskNASA ┃ How Are We Going to the Moon? (2:52 min)
- #AskNASA ┃ Who Is Going with Us? (3:30 min)

STEM Career Connection

- What is Aerospace Engineering (5 min)
- NASA Explorers S4 E2: The Scientists (5:52 min)
- Women of Artemis: Meet NASA Physicist Jennifer Inman (2:59 min)
- Who Works At NASA? What It Means To Be a NASA Employee (2:55 min)
- Our World: Careers at NASA - More Than Just Astronauts! (6:05 min)

Science Connection

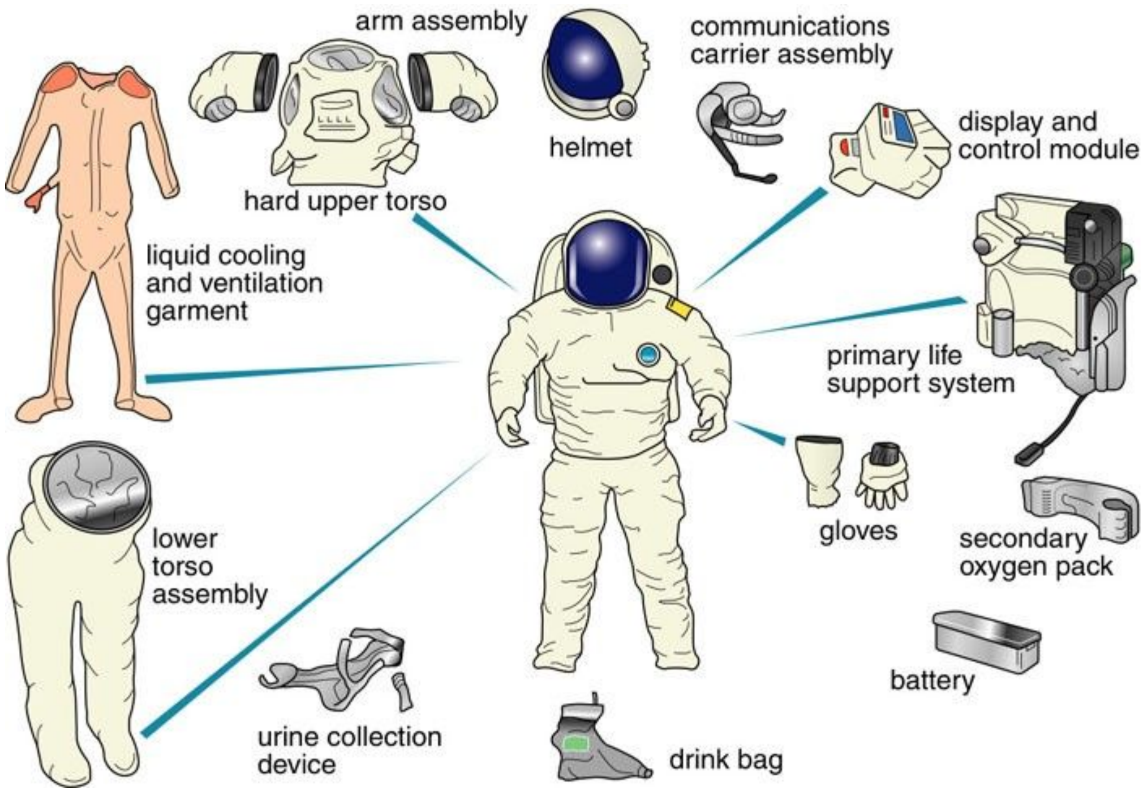
- Spacesuit | HOW TO BUILD... EVERYTHING (2:59 min)
- SpaceX spacesuits - Take a deep dive (2:19 min)

Extension Activities

- Do a spacesuit glove challenge with your students. Here are some resources from NASA and Long Island's Air & Space Museum.
- Have students do research about spacesuits and create a Flipgrid video.
- Suit Yourself Activity: Students apply linear equation concepts to evaluate the oxygen component of an astronaut's spacesuit.

Science Background

NASA designs spacesuits to keep astronauts warm, protect them from radiation, and provide oxygen for breathing. Learn more at www.nasa.gov/feature/spacewalk-spacesuit-basics



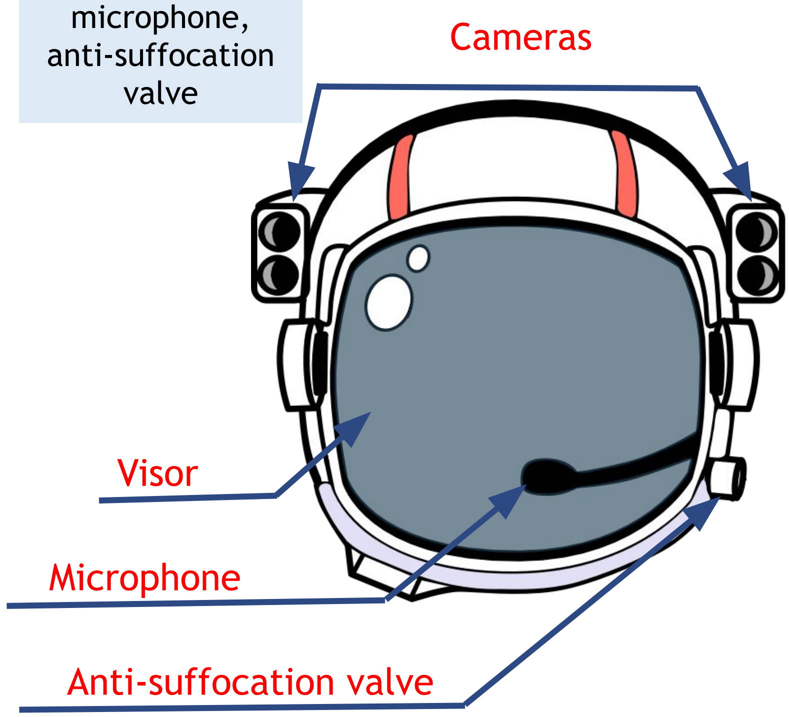
Space Suits for the Next Explorers

1. We need space suits to survive the harsh environment of living on the Moon! Watch the video to see the new NASA space suit called xEMU. https://youtu.be/vPkamuLqwM8

2. What is one thing that NASA improved in this spacesuit design?

Word Bank: cameras, visor, microphone, anti-suffocation valve

Label the parts of the helmet



Activity: Astronaut Helmet

3

Students create an astronaut helmet to stay protected on the Moon.

Build an Astronaut Helmet

1. Mission: Design and build an astronaut helmet to stay protected on the Moon.
2. Design constraints:
    a. Cover entire head
    b. Allow the astronaut to breathe and see
    c. Rest comfortably on shoulders
    d. Include a movable visor
    e. Include a communication system
3. Test: For testing, make sure your helmet follows the design constraints. The goal is for students to also be able to explain why their astronaut helmet needs all these different constraints. For example, a communication system is to talk with NASA Mission Control or other astronauts.
4. Personalize and decorate your helmet! NASA puts stripes on the outside of the astronaut suits to tell one astronaut from another. If someone were to see just your astronaut helmet, how would they know it belongs to you? Also encourage students to include their spark.

Materials Per Student

- ❑ Scissors
- ❑ Tape
- ❑ 7 Sheets of construction paper
- ❑ 1 bendy straw
- ❑ Optional: Art supplies and recycled materials such as cereal boxes, cardboard, tissue boxes, etc.

Note: materials don't need to be restricted on this one, but make sure they don't use more than those listed from their supply kits.

Watch this activity in action!
[Student Flipgrid Examples]
[Student Project Highlights]

Note: the linked activities also included an astronaut boot. The boot was removed in this updated curriculum.

Teacher Tips: Have students place all the helmets at the front of the classroom and have them guess who each helmet belongs to. This is a great icebreaker and way for students to get to know each other

For virtual learning, have students submit photos of their helmet design and over video chat have the students guess who the helmet belongs to.

Note: the instructional video also has a boot challenge. We recommend focusing on part 2 for the helmet design.

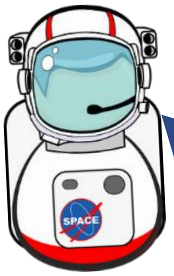
Mission 4
Plants in Space

Plants in Space

4

Mission Overview

1. Complete the "Mission Warm-up" box.
2. Watch the Mission Overview video or read script
3. **Science Background:** Learn the challenges of living in space and explore ways to grow food in order to stay alive.
4. **Plant Device Engineering Challenge:** Students will design a hydroponic greenhouse to grow plants including comparing two different seed types.



STEM Career:
Botanist

Word of the Day: Resilience
Activities emphasize the need to persevere through difficulties and be patient when waiting for success and results.

Life is good on the Moon! Well, until you run out of food. Earth has over 50,000 edible plants. Rice, maize, and wheat provide 60% of the world's food energy intake. In order to sustain human life on the Moon, we must figure out how to grow plants here!

Today, you will become botanists on a mission to design a plant growth system. Growing plants can be complicated. How will the plants get water and sunlight? What temperature and air composition is needed? This mission requires resilience to succeed. Be patient as you plan, build, and study your results! You've got this!

~Space Club Mission Control

Great videos to show:

NASA ScienceCasts: A Successful Mission Starts With Nutrition (3:52 min)

How Astronauts Grow Plants In Space (3:25 min)

NASA | Eat Like an Astronaut (12:31 min)

Video Resources

Real World Connection

- #BeAnAstronaut: How Did You Get Interested in STEM? (3:00 min)
- #AskNASA | How Do We Get New Science to the Moon? (2:53 min)
- How astronauts can get a taste of steak in space (6:15 min)
- ScienceCasts: Historic Vegetable Moment on the Space Station (3:54 min)

STEM Career Connection

- Keyanna Millinger '14: Botanist and Environmentalist (3:17 min)
- Jessica Meir, Ph.D. - From Marine Biologist to Astronaut (29:59 min)
- Space Plants - How they are adapting (4:30 min)
- Growing in Space (2:40 min)

Science Connection

- Space Plants - How Are They Adapting? (4:27 min)

Science Connection

- Vegetation Transformation: Crash Course Kids #5.2 (2:59 min)
- How Does A Seed Become A Plant? (3:45 min)
- The Martian | "Do The Math" Clip (0:56 min)

Extension Activities

- **Science Discussion:** How will your plant device meet your seed's needs to allow it to grow? Answer: The cotton ball contains the water that the seed needs to germinate. Air is sealed into the bag, providing the plant with CO2. The bag is clear so it allows the sunlight to enter and provide the plant with the energy it needs for photosynthesis.
- Complete the Food for Spaceflight activity from NASA. This lesson will help your students answer the question: What foods are best suited for spaceflight, and what makes foods suitable for spaceflight?
- Complete NASA's Lunar Plant Growth Chamber activity and watch this video from the ISS.

Science Background

Word Bank: roots, leaf, radicle, seed coat

4

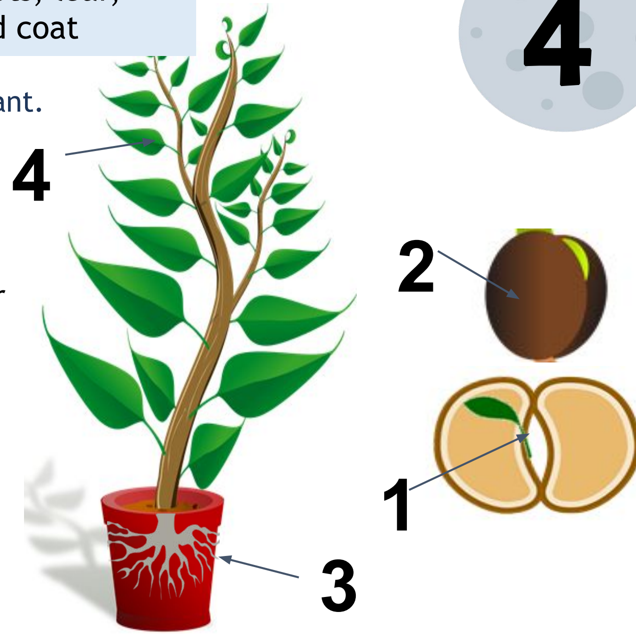
Plant Anatomy: Fill in the blanks with the name of each part of the plant.

1: The radicle ________________ is a small stem of an embryo plant.

2: The seed coat ________________ provides protection as the outer layer of a seed.

3: The roots ________________ are how plants collect water and nourishment.

4: A leaf ________________ is the main organ of photosynthesis and transpiration for the plant.

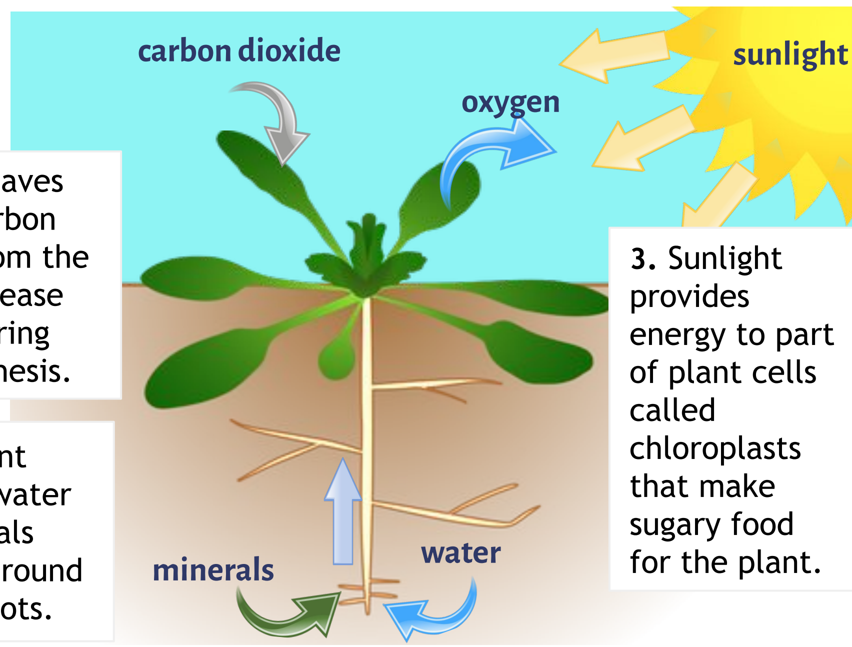


PHOTOSYNTHESIS

How green plants make their food.

What 4 things do plants need?

1. Carbon Dioxide ________
2. Water ________
3. Minerals ________
4. Sunlight ________



HYDROPONICS

Hydroponics is a method of farming that allows plants to grow without soil. NASA is testing out this method to grow plants in space. Here are some basics on hydroponics:

- Why not use soil? Soil is too heavy to transport and does not exist on the moon.
- Plants will grow with their roots exposed to the mineral water solution. All the nutrients that are in soil will instead be injected directly into water.
- The nutrients in hydroponics can be from fish waste, manure, or chemical fertilizers.
- The growth rate on a hydroponic plant is 30-50 percent faster than a soil plant grown under the same conditions. The plant also tends to produce more fruit.

Plants in Space

4

Students will build a device to hold a Mini-Greenhouse and watch their plants grow!

Build a Plant Device

Materials Per Student:
❑ Scissors ❑ Tape ❑ 1 Ziplock Bag ❑ 2 Seeds or beans ❑ 2 Cotton Balls ❑ 2 Paper Cups ❑ 6 Bendy Straws ❑ 4 Pieces of Construction Paper ❑ Optional: add reflective materials Note: constrain materials on building the device holder, otherwise it will be too easy.

1. Students will first need to build a greenhouse. Then, students will be provided an assortment of materials for the plant device holder engineering challenge.

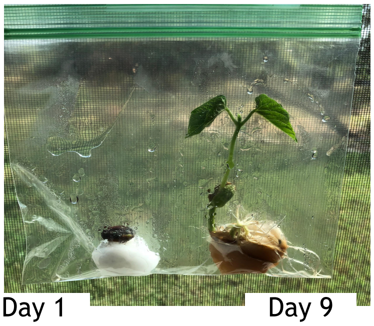
2. **Build a Greenhouse**
   a. Students will need 2 seeds. We recommend one is a Pinto bean that is soaked for at least 1 hour. The second seed can be a vegetable or flower seed or popcorn kernels.
   b. Soak 2 cotton balls in water and place in Ziplock bag.
   c. Place a seed on top of each cotton ball.
   d. Seal the bag. Do not squeeze any air out.

3. **Plant Device: After building your greenhouse, design a device to support your plant as it grows. The device must:**
   a. Allow plant to get plenty of sunlight.
   b. Hold plant bag upright.
   c. Stand up on its own without you holding it.
   d. Seeds in the bag are 6 inches (15 cm) above the ground

Bonus: How can you use reflective materials to direct more sunlight to the plants? This can be CDs, aluminum foil, etc.

4. **Test**: Students will build their plant holder device until design constraints are met. Students will then watch and observe their seeds growing and record the results. A minimum of 5 days is recommended for observation of plant growth. The student handout includes a chart to recording plant growth.

Watch this activity in action!
Student Flipgrid Examples
Student Project Highlights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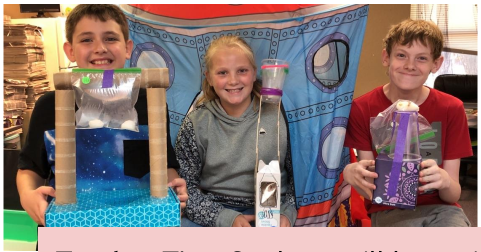


Teacher Tips: Students will be excited to watch their seeds grow! Make it into a competition to see who will grow the tallest plant. Students can share daily heights on a shared Google Doc or Slide. We also recommend having students compare seeds, and as a class, you can determine which seeds have the most successful plant growth.

Make sure to point out that no soil was needed. Plants don't need soil to grow! This is a major misconception for students.

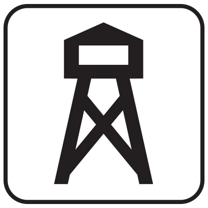
Also, providing too many materials will make it too easy to build the plant holder. Part of the challenge is struggling to use the limited supplies to make it stable and hold up the bag.

Mission 5
Welcome Tower

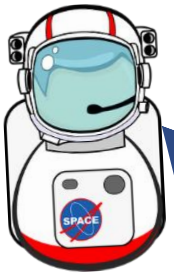
Welcome Tower

5

Mission Overview



1. Complete the "Mission Warm-up" box.
2. Watch the Mission Overview video or read script
3. **Science Background:** Explore how to power life on the Moon, different types of energy sources and how to complete a circuit.
4. **Welcome Tower Engineering Challenge:** Students will design a welcome tower that has a sign powered by an energy source and has an on/off switch.



STEM Career:
Mechanical Engineer

Word of the Day: Initiative
Have confidence in your abilities! Challenge focuses on having confidence to apply effort to the activities immediately without waiting on others to start for them or provide hints.

Welcome to the Moon! Don't waste too much time jumping around (you can jump 6 times higher than on Earth due to lower gravity!) because NASA just radioed our next mission.

Today, you will become mechanical engineers on a mission to design a welcome tower. Our tower will help us get back to base when we go out exploring. On the Moon, a day is 29.5 Earth days long. This means we will have 2 weeks of sunlight followed by 2 weeks of continuous darkness. So our tower needs to have a light!

How will we power our tower light? We need to find a source of energy that is renewable so we don't rely on bringing fuel from Earth. This mission requires initiative and confidence in your abilities. You can always ask for help when you get stuck, but never be afraid to try it yourself first!

~Space Club Mission Control

Great videos to show:

Will we ever live on the Moon? (3 min)

Exploring mechatronics and mechanical design though teamwork (3:20 min)

STEMonstrations: Solar Energy (2:40 min)

Video Resources

Real World Connection

- What if we covered the Moon in solar panels? (3:30 min)
- NASA's New Space Reactor Is Powered by Nuclear Fission (7:06 min)
- 5 Inventions Showing Us the Future of Solar Energy (10:05 min)

STEM Career Connection

- Mechanical Engineer (5:54 min)
- Meet Mechanical Engineers at Google (1:58 min)
- What is Mechanical Engineering (2 min)

Science Connection

- What is engineering: How different disciplines work together to create a vending machine (3:18 min)
- The Power of Circuits! | Technology for Kids | SciShow Kids (4:41)

Extension Activities

- Complete the Solar Oven activity. Through the construction and testing of a solar oven, students will understand the importance of solar energy to the establishment of a lunar base.
- Create a paper circuit and make a neuron star light up!

Science Background

5

In your own words, how does a circuit work?

Answers will vary - A circuit is complete path where electricity can flow. Circuits allow electricity to work like lights, and appliances. A circuit needs to have a power source such as battery, wire or some type of conductor material for the electricity to flow, and a device like a light bulb that uses the electric current

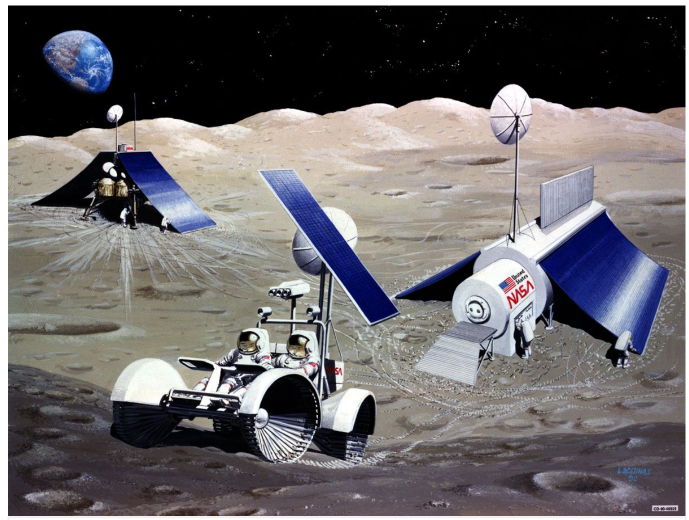
How will you power your colony?

Under each type of power source, check the box if the statement is a <u>positive feature</u>. *All the statements are true however some are positive features and some are negative features of the power source.*

Solar Panel

How does it work? Converts sunlight into electricity

- ❑ A night on the Moon is about 14 days long - a real challenge to using solar energy
- ❑✓ Moon's polar sites have longer periods of sunlight
- ❑✓ Environmentally friendly
- ❑✓ You can build multiple solar panels so one is always in daylight
- ❑✓ Moon has "peaks of eternal light" or places that almost always see sunlight.
- ❑✓ You can place solar panels in orbit and beam the power down as microwave rays

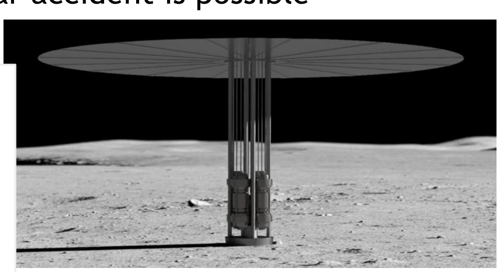


Artist depiction of a lunar base with solar panels. Credit: NASA

Nuclear Power

How does it work? Harness the energy from splitting atoms to generate electricity.

- ❑✓ Fission system is compact, reliable, safe system
- ❑✓ Does not rely on sunlight
- ❑ Technology is still under development
- ❑ Need specialized skills to fix
- ❑ Nuclear accident is possible



Kilopower mini-nuclear power system being developed by NASA.

Fuel Cell

How does it work? Combines hydrogen from a tank and oxygen from the air to produce electricity, leaving water and heat as its only byproducts.

- ❑✓ Hydrogen needed could be sourced locally using the Moon's polar water and surplus solar power.
- ❑✓ Lightweight
- ❑ Technology is still under development
- ❑ Lower power output so ideal as a backup power source

Fuel Cell Credit: Hydrogenics

Activity: Welcome Tower

5

Students will build a welcome tower that holds a welcome sign powered by an energy source.

Build a Welcome Tower

1. **Mission**: First, create a welcome sign. Then build a tower that holds and powers the light up sign.

2. Create a welcome sign from a piece of construction paper at least 2 in x 2 in or 5 cm x 5 cm. Another option is to use an index card. The sign should include the name of your lunar base.

3. **Design Constraints:**
   a. Use only provided materials (otherwise this becomes too easy)
   b. Include welcome sign with LED light
   c. Raise sign at least 1 ft or 30 cm from ground
   d. Include a switch on the ground to turn light on and off

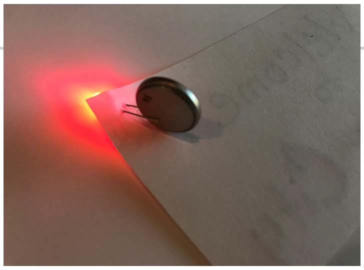
   If using a solar panel:
   e. Solar panel must have full exposure to the sun.
   f. Allow for the solar panel to face different directions based on the location of the sun.

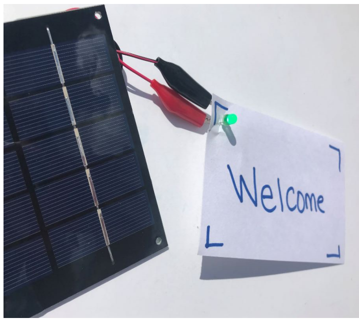
4. **Testing:**
   a. Is the sign at least 1 foot off the ground?
   b. Is the power source on the ground?
   c. Does the switch turn the light turn on and off?

If using a solar panel, students will go outside on a sunny day to test:

- Is the sign at least 1 foot off the ground?
- Is the power source on the ground?
- Does the switch turn the light turn on and off?
- Can the solar panel rotate or face more than one angle?

Materials Per Student
Only use materials provided ❑ Scissors, Tape, Ruler ❑ 5 Sheets of construction paper ❑ 1 Sheet of cardstock ❑ 2 Paper plates ❑ 12 Bendy Straws ❑ 1 Solar Panel OR Coin Cell Battery *(3V)* ❑ 1 LED Light *(2.0-2.2V)* ❑ Aluminum foil: need enough to make a conductive path from LED to bottom of tower



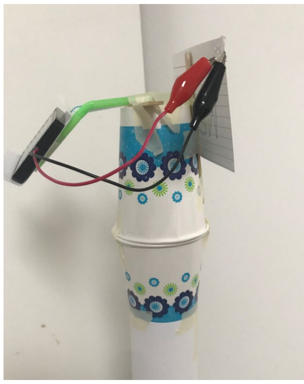


Student Flipgrid Examples | Student Project Showcase
Note: the examples linked above did not have the constraint of a switch on the ground.

Teacher Tips: The aluminum foil is used for creating a path between the LED light and power source on the ground. In the pictures, the switch is pressing the two pieces of foil together.

Struggling to build a sturdy tower? Add plastic cups to make this an easier activity.

Using a solar panel? An incandescent light bulb can be used to charge if stuck indoors.



Mission 6
Collect Moon Samples

Collect Moon Samples

6

Mission Overview

1. Complete the "Mission Warm-up" box.
2. Watch the Mission Overview video or read script
3. **Science Background:** Learn how scientists collect samples on the Moon for testing and the types of craters found there. Learn more about the parts of a hand and the science of bionic hands.
4. **Robotic Arm Engineering Challenge:** Design a robotic arm to pick up and rock samples (ping pong balls).

Word of the Day: Leadership
Be someone who can inspire and motivate others to reach a goal! Becoming and independent thinker who understands how to work as a team.

STEM Career:
Biomedical Engineer

You've probably noticed that the lunar surface is full of thousands of craters. So why are there so many craters on the moon, but we only know of 180 on Earth? Unlike Earth, the Moon has no atmosphere to protect itself from comets and asteroids. That means it has no wind, it has no weather, and certainly has no plants and nothing can remove marks on its surface once they are made. The dusty footsteps of astronauts who once walked on the Moon are still there today, and they aren't going anywhere anytime soon. Scientists also believe that some of these craters may have ice, which would be very helpful to humans living on the Moon.

Today, your mission is to collect rock samples from deep inside a crater. How will we build a robotic arm that can not only move but be strong enough to pick up an object? This mission might be difficult, so be resilient as you encounter challenges and don't be afraid to redesign your device and try again! Have fun exploring!

~Space Club Mission Control

Great videos to show:

Robotic Hand (3:38 min)

Robonaut 2 on the Space Station (1:05 min)

60 Seconds With a NASA Bioengineer: Vanessa Wyche (1:30 min)

BONES OF THE HAND (2:30 min)

Video Resources

Real World Connection

- The New Tech Heading To The ISS Will Change Human Space Exploration (7:26 min)
- Valkyrie: NASA's Superhero Robot (2:58 min)
- 8 NASA Robots That Will Study The Mysteries Of Space
- Valkyrie : NASA's Most Advanced Space Humanoid Robot (2:22 min)
- GM-NASA Space Robot Power Glove (3:25 min)
- Engineers Created A New Bionic Arm That Can Grow With You (4:29 min)
- Solving Rubik's Cube with a Robot Hand (2:50 min)

STEM Career Connection

- Biomedical Engineering student prints 3D hand (0:59 min)
- So You Want to Become a Biomedical Engineer (2:30 min)
- What does a Biomedical Engineer Do? (1:30 min)

Extension Activities

- Create a robotic hand as an advanced grabber and have students calculate the ratio of each straw to the finger's length.
- Have students research the "Twin Study" and how space affects the human body. Then have them create a Flipgrid video of their findings.

YOUR HANDS

Whenever you throw a ball, write a letter, or eat a bowl of cereal, you are using the bones in your hand. Your wrist has 8 bones that make up the carpus region. The center of your hand is made of five separate bones, which are part of the metacarpus region. Each finger on your hand has three bones, except for your thumb, which has two. The bones of your four finger are attached with joints that can only curl inward. The thumb can rotate because of a joint called the carpometacarpal joint.

Bionic Hand

Alt-Bionics developed the Genesis Hand, an affordable prosthetic for patients with below elbow amputations. The Genesis Hand uses electromyography. Whenever you decide to move any part of your body, your brain sends electrical signals to the necessary muscle groups. These signals can be used to determine the intended motion a user is trying to make and translate it into the mechanical motion of the hand.

All About Craters

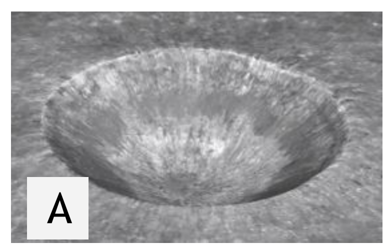
In this mission, you will use a robot hand to gather a rock from a crater. Can you figure out the type of crater in each picture? Read the descriptions and classify each photo as a simple or complex crater.

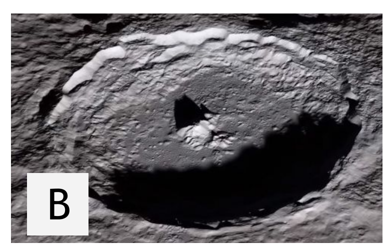
SIMPLE CRATERS
- Relatively small
- Smooth bowl shape

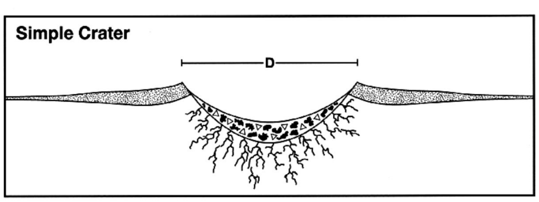
Simple Craters: B, C

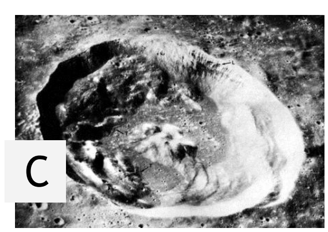
COMPLEX CRATERS
- Relatively large
- Shallower depth compared to diameter
- Contains a central peak or peak ring

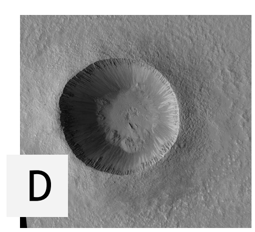
Complex Craters: A, D

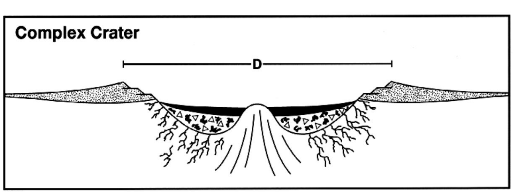












The lunar surface is full of craters because the thin atmosphere provides no protection from asteroids. Moon craters are typically much wider than those on Earth because of the lower gravity (⅙ of Earth).

Activity: Robot Arm

6

First, build a robot hand. Then, build a robot arm to pick up a rock sample.

Build a Robot Arm

1. Students will need to build a robot hand. Then students will use the remaining materials for the robot arm.

2. **Build a Robot Hand**: Have students follow instructions in video on how to build the robotic hand.

   a. Cut out an outline of your hand using the cardstock or cardboard.

   b. Cut each straw into 3 pieces and tape along fingers. They will first cut the straw in half. Then take one of the halves and cut it in half again, giving them 3 pieces.

   c. Thread string through the straws to move fingers.

3. **Robot Arm: After building their robot hand, design a robot arm that can pick up a ping pong ball.**

   a. 5 Movable fingers

   b. Robot arm must extend at least 6 inches or 15 cm beyond the length of your own hand

   c. Picks up a ping pong ball

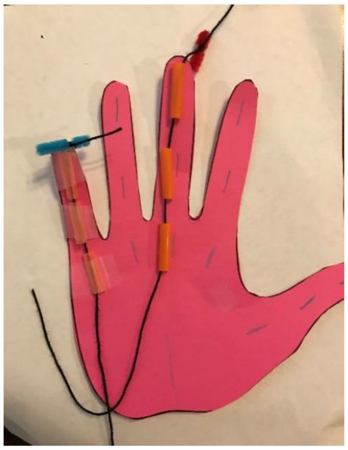
4. Test: Students will test the device by trying to pick a ping pong ball using only their robot arm. If they succeed, encourage them to pick up other heavier objects to see if their robot arm is strong enough.

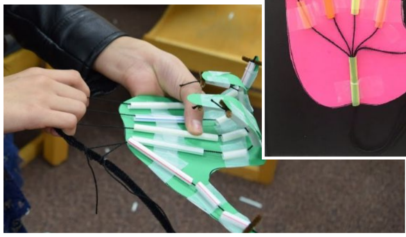
Materials Per Student
❑ Scissors, Tape
❑ Pencil or Marker
❑ 7 Straws
❑ 5, 12 inch (30.48 cm) pieces of string
❑ 3 Sheets of cardstock ***(for robot hand)***
❑ Ping pong ball or similar object
❑ 5 Sheets of construction paper
❑ Recycled materials, such as cardboard
Note: the hand should be made of cardstock or cardboard to be sturdy enough to work!

Teacher Tips: Many teachers find this to be the most challenging activity. The robot hand is very much a step-by-step activity in the video, but the actual construction can be frustrating for younger students. Talk about persistence in keeping with the design and show some examples for motivation!

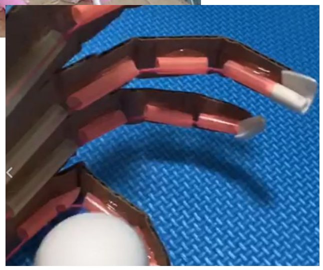
We highly recommend trying this one first before doing with students. Also, this activity will take longer than the others so plan accordingly. Building the robotic hand takes 45 min.

Older students can make their own variations of the hand using different lengths of straw and string.





One challenging part of the build is keeping the string on the finger. Notice in these pictures how one has tape at the end and other has the string tied to a small piece of straw.

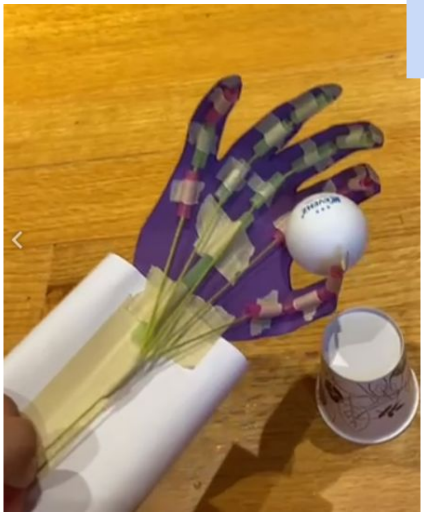


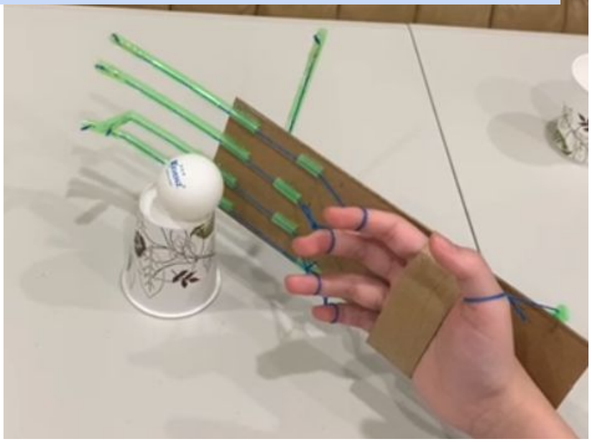
Activity: Robot Arm

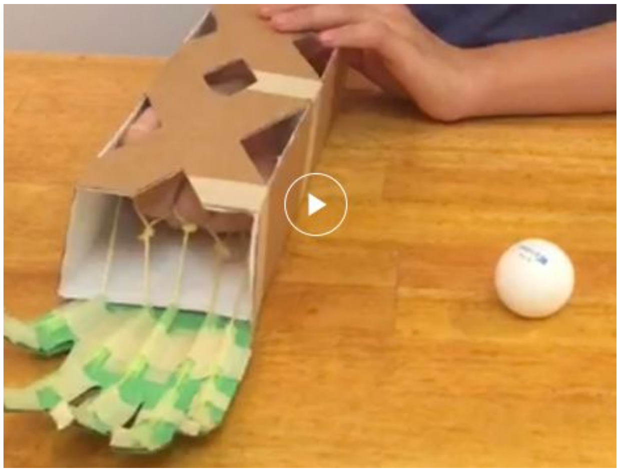
6

Teacher Tips: After making the hand, students will need to figure out a way to attach to their arm and create a grabber. If students struggle with creating the robot arm, make sure to emphasize the they are building an arm to extend their cutout robot hand past their own hand. I also recommend having videos and photos ready to show students that are struggling to visualize this challenge.

Watch this activity in action!
Student Flipgrid Examples
Student Showcase





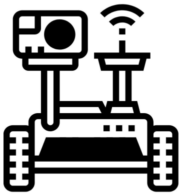


Mission 7
Rover Exploration

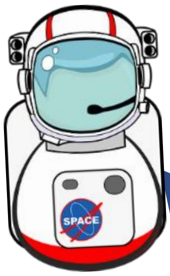
Rover Exploration

7

Mission Overview



1. Complete the "Mission Warm-up" box.
2. Watch the Mission Overview video or read script
3. **Science Background:** Learn about rovers on the Moon. Practice identifying conductive materials and difference between open and closed circuits.
4. **Rover Engineering Challenge:** Design a rover to transport the sample back to base for testing. Students will design a "rover" to carry a rock sample (ping pong ball).



STEM Career:
Electrical Engineer

Word of the Day: Adaptability
Being able to adjust to different conditions. It is important to practice adaptability when you have failures and challenges song the way!

Great job collecting the rock samples from the crater! Now we need to transport them back to base for testing.

For today's mission you will be transporting the rock samples you collected in your last mission back to your base. However, these rocks are too heavy to carry. You will become electrical engineers on a mission to design a rover to transport our samples. A rover is a type of robot that travels on the surface of another planet like the Moon.

NASA has been sending rovers to space since 2003 to conduct preliminary research of planets and send information back to Earth for humans to study. This helps humans to be prepared for what they might encounter. For the Artemis mission, NASA will be sending the VIPER rover in 2022 and will go to the South Pole of the Moon to get a close-up view of the location and concentration of water ice that could eventually be harvested to sustain human exploration on the Moon.

How will you power your rover? How will it transport the samples? Be warned...this rover might not behave the way you want! You will need to be adaptable by being resourceful and overcoming unexpected challenges.

Best of luck getting those precious rock samples back to base! ~*Space Club Mission Control*

Great videos to show:

Design of Lunar Rover was mostly guesswork (2 min)

Introduction to Electricity- video for kids (5 min)

Mission: Solar System - Sandeep Yayathi, Robotics Engineer (4 min)

Video Resources

Real World Connection

- #AskNASA | Why Are We Going to the Moon? (3:36 min)
- NASA Moon Rover Books Ride to the Moon (1:57 min)
- Tri-ATHLETE (2:30 min)
- Awesome Robots Inspired by Nature (5 min)
- BB-8 visits the robots of NASA (3:30 min)
- Life at the Lab: Soft Robots (1:55 min)
- Boston Dynamics' amazing robots Atlas and Handle (7:18 min)

STEM Career Connection

- Career Spotlight: Robotics Engineer (2 min)
- James Fraction, Electrical Engineer (3 min)
- What is electronic and electrical engineering (2 min)

Science Connection

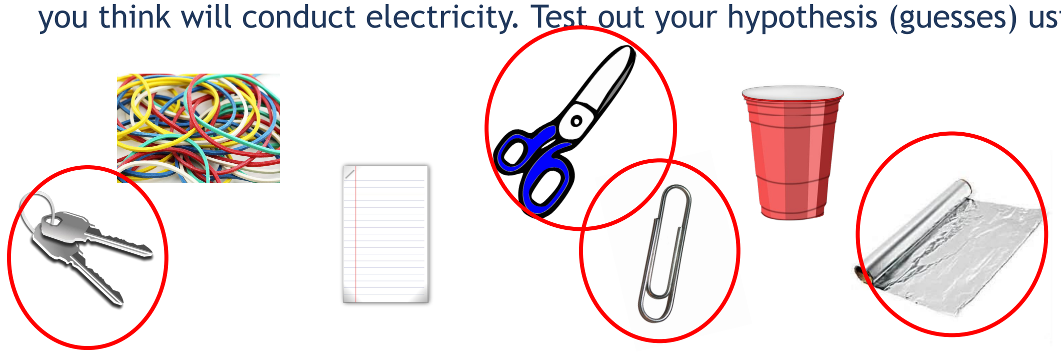
- What is electricity? (2:33 min)
- The Power of Circuits (5 min)
- The Power of Circuits! | Technology for Kids | SciShow Kids (4:41)

Extension Activities

- Have students explore open and closed circuits by creating Light up Constellations

Science Background

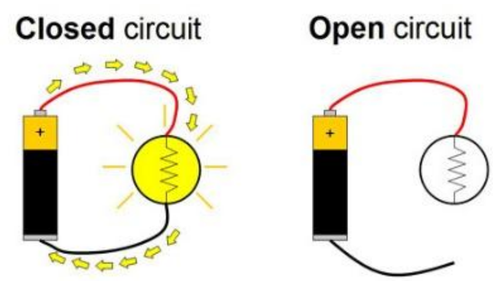
Time for a science experiment! Our rover will require **conductive** materials. These are materials that will allow electricity to pass through them. Circle the objects below that you think will conduct electricity. Test out your hypothesis (guesses) using an energy stick.



What other conductive materials can you find? List them below!
Answers will vary

Use the word bank to complete the sentences below.

1. Electricity is the ___flow___ of electrons.
2. A circuit is a ___path___ through which electricity can flow.
3. A **closed** circuit is a ___complete___ circuit that allows for the electricity to flow from one end to the other without interruption.
4. An **open** circuit is an ___incomplete___ circuit that does NOT allow the electricity to flow from one end to the other.

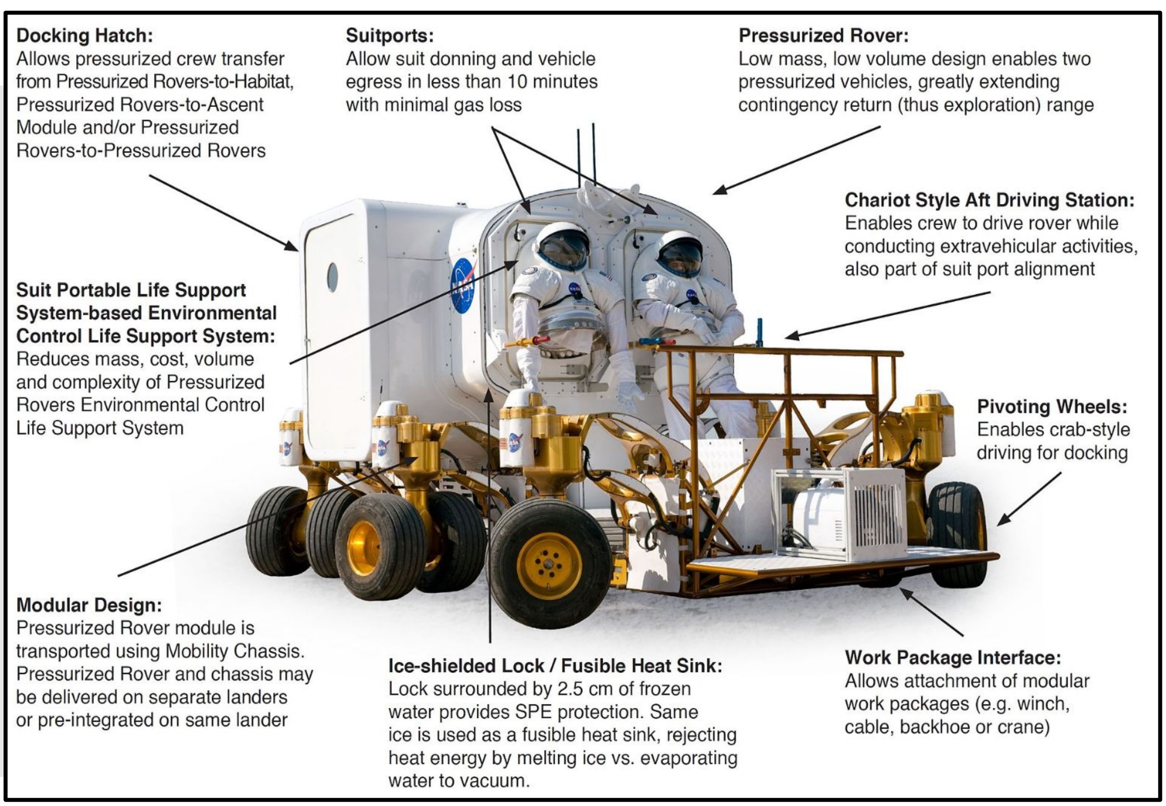


Word Bank:
Complete, incomplete, flow, power, path

Lunar Rover

NASA is looking to upgrade previous lunar rovers to support the new Artemis mission to send humans back to the Moon. One example is the Space Exploration Vehicle (SEV) shown to the right.

The SEV is the size of a small pickup truck and can house two astronauts for up to two weeks.



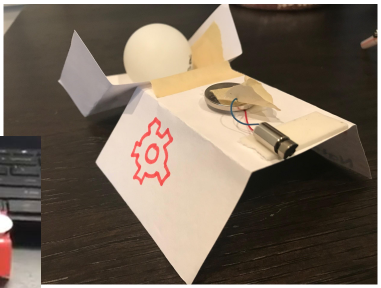
Activity: Rover Challenge

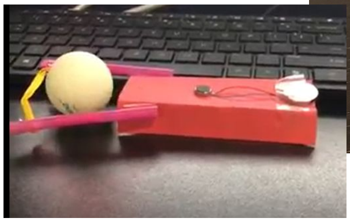
7

Students build a rover to carry a ping pong ball.

Build a Rover

Watch this activity in action!
[Student Examples]
[Student Showcase]





1. Mission: Design a rover that can carry a rock sample (ping pong ball). Note that this is not a real robotic device as there is no way to program the robot to respond to commands. Students control the "rover" by modifying the design.

2. Design constraints:

    a. Move at least 1 ping pong ball a distance of 1 foot or 30 cm

    b. Use the vibrating motor to propel the rover forward

    c. The rover may move freely or along a track

3. Test: This activity requires continual testing. We recommend using the ping pong ball from the start to allow students to continually refine their designs. Keeping the rover moving in a straight path is a real challenge. Providing a track such as a row of books or a ruler to guide the rover will make this an easier activity. Or challenge students to make their own track.

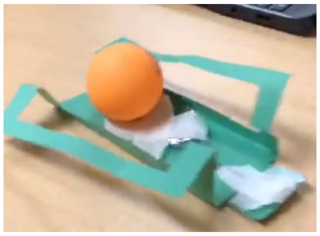
Materials Per Student
Note: not all materials need to be used.
❑ Scissors, Tape & Ruler
❑ 1 Coin cell battery
❑ 1 Vibrating motor
❑ 2 Bendy straws
❑ 1 Ping Pong Ball
❑ 1 Piece of construction paper
❑ 1 Piece of cardstock paper

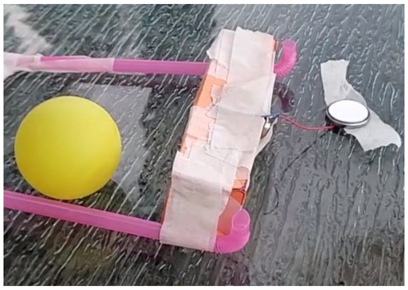
Teacher Tips: If students use the cardstock and are struggling, advise them to only use 1/4th of the sheet because it can be heavy and slow the rover down. The rover needs to be very *light* to work!

Note that some pictures show a paper cup. This was removed as it made the challenge to easy! But you may wish to add back in if students are struggling.

Motor

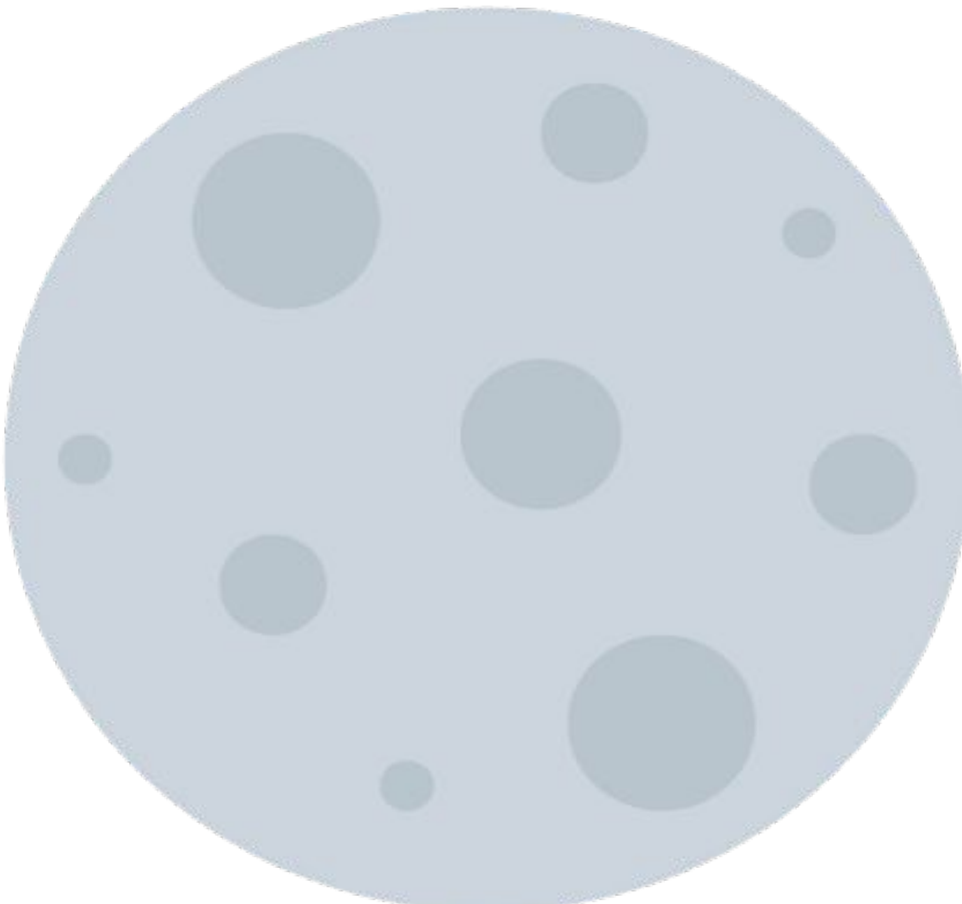
Battery





Mission 8

Mission Success



Mission Success

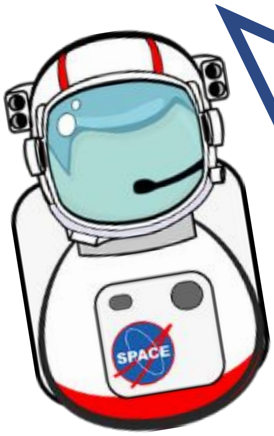
Mission Overview

Mission 8 is participating in the Space Colony Competition! However, not all programs have the time to dive into this longer project. To wrap-up Space Club's Mission to Moon:

1. Reflect on your mission: *Which was your favorite? What is something you learned about engineering or space exploration?*

2. Celebrate by providing each student a certificate of completion and maybe a small prize or snacks! Or bring in a STEM professional guest speaker for students to learn about their STEM story and career pathway as well as share their own projects during Mission to the Moon.

3. For ongoing exploration after Space Club, encourage students to visit NASA's website, download a stargazing app, or watch past Cosmic Career Chats. Student handouts are available to guide them through these activities. These are excellent options for extending learning in the classroom or as at-home assignments. All of these resources can be accessed even after Space Club ends, providing students with continued opportunities to explore space.



Congratulations on completing your mission to the Moon! The time has come for us to head back to Earth. Don't forget to bring all your samples. NASA is waiting for us back in Houston to complete a mission debrief. They will also analyze our samples from the Moon. I wonder what they will discover?

I am so proud of our team. We learned how to think like a scientist. We learned how to solve problems like an engineer. What an amazing adventure! Where should we travel next?

~Space Club Mission Control

Take Space Club to the new level by joining the Space Colony Competition! Learn more at:
cosmic-portal.org/competition

SPACE COLONY COMPETITION

Activity: NASA Resources

Students explore NASA websites to learn about the latest in space exploration.

Materials
❑ Paper & pencil
❑ Tablets or computer

Instructions

1. Explain to students that they will be exploring NASA's website to discover new space-related information.
2. Distribute the student handouts with the provided website links and instructions.
3. Briefly go over some of the featured NASA resources to spark interest.
4. Encourage them to visit all the linked pages, but to spend extra time on the one that interests them the most. Remind students they will need to write or draw something they learned during their exploration.

Website Exploration

5. Allow students time to independently explore NASA's website.
6. Walk around the room to assist with any questions or provide support as needed. Encourage students to take notes or make sketches as they explore.

Reflection Activity

7. Have students write a brief paragraph or create a drawing to illustrate something new they learned. This could be a fact, concept, or image that stood out to them during their exploration.
8. Invite students to share what they learned with the class. Facilitate a brief class discussion about the discoveries made, encouraging students to ask questions and engage with their peers' findings.

NASA Student Resources:

- NASA's Kids Club: www.nasa.gov/learning-resources/nasa-kids-club/
- First Women Graphic Novel: www.nasa.gov/calliefirst
- NASA's Kid Science https://science.nasa.gov/kids
- Surprisingly STEM https://plus.nasa.gov/series/surprisingly-stem/
- STEMonstrations https://plus.nasa.gov/series/stemonstrations/
- NASA's Picture Dictionary https://www.nasa.gov/learning-resources/nasas-picture-dictionary/
- NASA SpacePlace https://spaceplace.nasa.gov/en/menu/educators/mars/

Activity: Cosmic Career Chats

Students learn about the experiences of real STEM professionals.

Materials
❑ Paper & pencil
❑ Tablets or computer

Instructions

1. Explain the purpose of Cosmic Career Chats: to provide insight into the lives and careers of STEM professionals. Highlight that they will hear relatable stories and see diverse role models.
2. Pre-select or allow your students to explore the Cosmic Career Chat Library. View the Cosmic Career Chat
3. Discuss the STEM professional's background and key takeaways from their "STEM Story."
4. Ask students how the speaker's journey relates to what they're learning.

Extension:

5. Encourage students to explore how the guest's work applies to real-world problems.
6. Assign videos for out-of-class viewing with their families!

Access Career Chat Library

Some of our STEM professionals:

- **Nick Bittner,** Manufacturing Instructor, Engineering student, farmer, and researcher
- **Sarah Tyk,** a technician at a biotech company who has a background in astronomy and geoscience
- **Valerie Avila**, a rocket scientist, from Southwest Research Institute
- **Hannah Gard,** a broadcast meteorologist
- Marion Nachon a geologist and planetary scientist
- **Chris Bigler,** a structural engineer at Sierra Space in Colorado

Learn more about Cosmic Career chats:

Cosmic Portal

COSMIC CAREER CHATS!

Activity: Explore the Universe

Students use an app to explore planets, stars, and satellites in the night sky.

Materials
❑ Paper & pencil
❑ Tablets or phones

Instructions

1. Provide students with tablets or allow them to use cell phones with the SkyView app. The free version works great.
2. Provide students with handouts to guide exploration in the app.
3. This app can be used indoors, but encourage students to use it at night with their family to identify all the stars in the night sky! We also love hosting a Family Star Party and inviting local astronomers with telescopes.