EDUCATOR'S GUIDE

DEFINITION STUDIOS K2 STUDIOS

SPACE

THE NEW FRONTIER

Dear Educators,

Welcome to *Space: The New Frontier*! The five hands-on activities in this Educators Guide are designed for teachers, community group leaders and museum educators who work with elementary to middle school-aged students. Grade level suggestions are included but we encourage you to adapt any of the activities for your individual students. Activities address the following questions and can be used before or after the film:

1. Why are wheels so amazing?
2. What's the difference between a rocket and a plane?
3. Can you build a space station? How can people survive in space?
4. What makes something stay in orbit?
5. How does gravity work?

The activities link your experience with *Space: The New Frontier* to your classroom science curriculum and the Next Generation Science Standards. See the chart on the following page for details about specific standards. Activities are written with a casual style, addressing students directly, requiring only supplies that are easy and inexpensive to obtain. Each activity requires about 45 minutes of class time.

Activities Include:

- A Student Page with a challenge, list of supplies, steps to do the activity and open-ended inquiry questions. Please note that most questions do not have right or wrong answers. They are for exploration. Your content questions will be answered on:
- A Teacher Page with background information, book recommendations and recent updates from space.

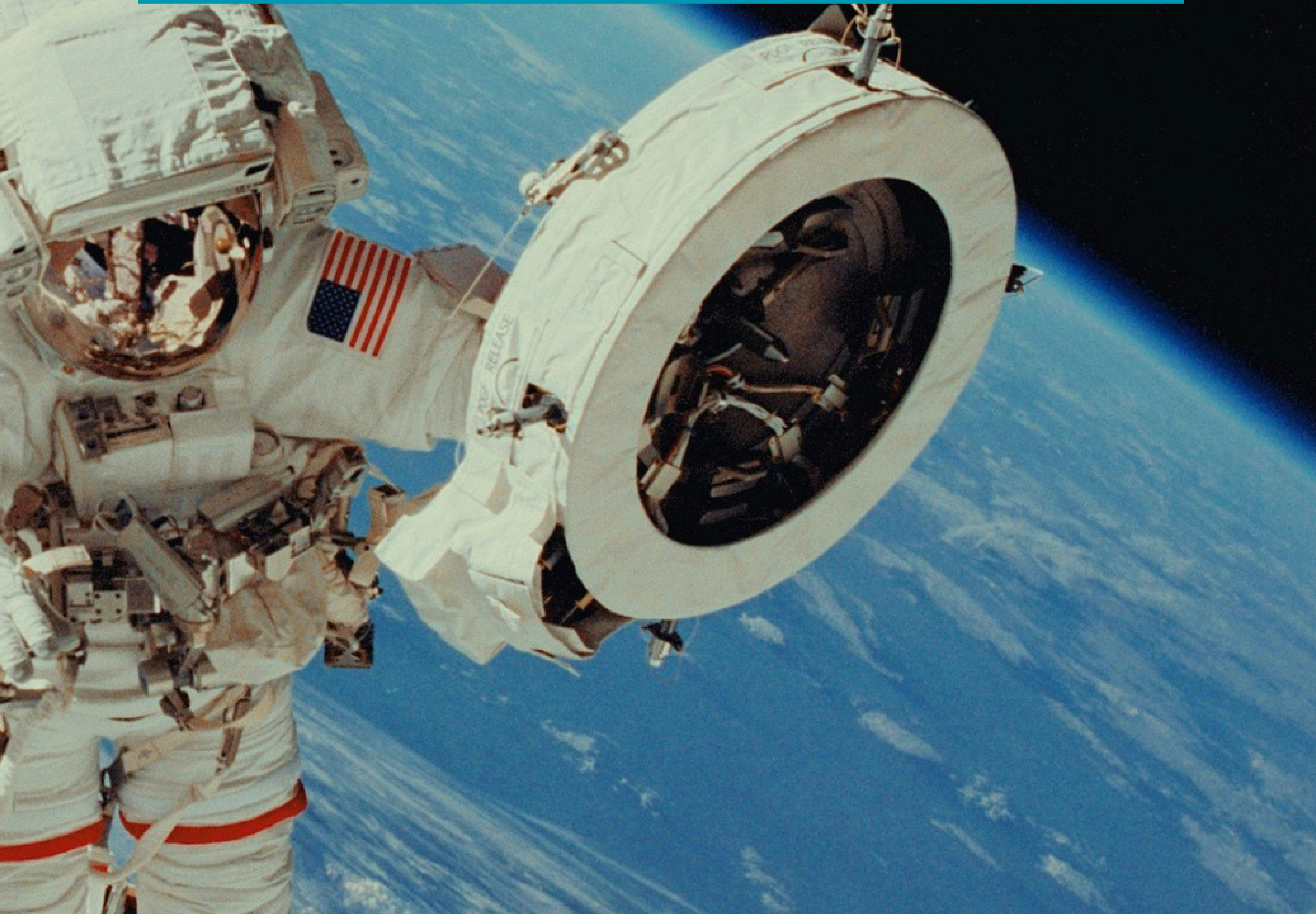
We have also included the "Can You Find These in the Film?" activity for the day of your visit, a brief overview of the film, and additional resources at the end of the guide.

When you complete the "How do you build a space station?" activity, please send a photo of your model and explanation of the modules you've included to info@growinggreat.org and we'll send you a copy of the book *Space on Earth: How Thinking Like an Astronaut Can Help Save the Planet* by Dave Williams and Linda Pruessen. Let us know if you'd like more hands-on STEM activities like the ones in this guide and we'll send you new ones every month.

Enjoy your travels in space!

K2 Studios and GrowingGreat
guide by Meghan Nealon & Jennifer Jovanovic

Content Table



N E X T G E N E R A T I O N S C I E N C E S T A N D A R D S

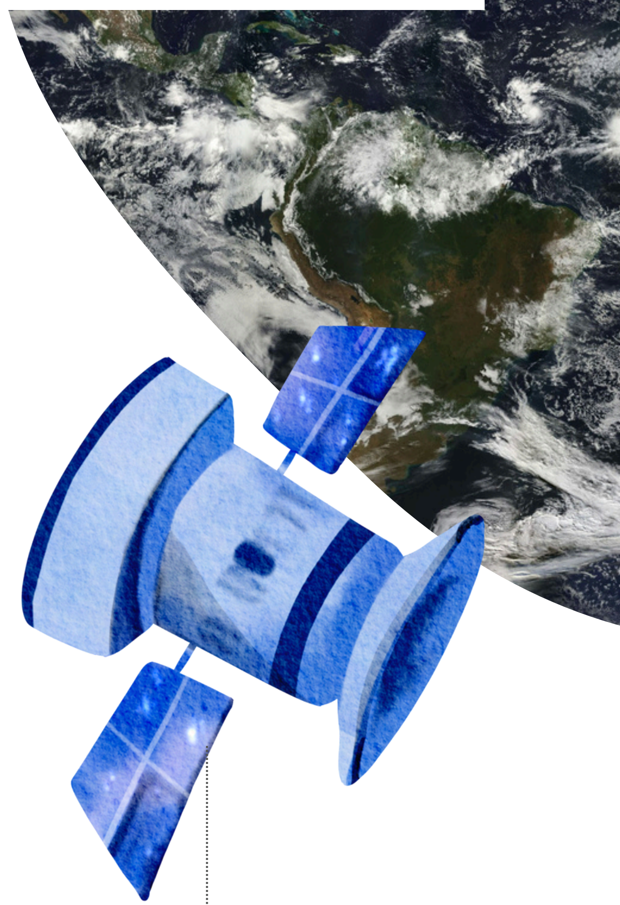
in *Space*: *The New Frontier* and hands-on activities in this guide

2-PS1-3	Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.
2-ESS1-1	Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
K-2-ETS1-1	Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2-ETS1-2	Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.
4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down.
5-ESS2-1	Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
3-5-ETS-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3-5-ETS-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

An Overview of

SPACE: THE NEW FRONTIER

The Next Space Age is Now



An entire generation came of age with the indescribable awe of landing on the Moon — and the ensuing Golden Age of Space has changed our world forever for the better. More than 50 years later, what is the next step for humankind? A second golden age of space has quietly dawned on us, with new hope for humanity as a spacefaring species.

In the quest to make human spaceflight accessible within in a decade, not a century, and ultimately affordable to ordinary citizens, leading innovators, entrepreneurs, engineers and daredevils are locked in a race into the unknown. From self-assembling habitats, commercial space stations, launching rockets without fuel to building the Lunar Gateway to deep space, history is in the making as we speak.

Space: The New Frontier captures a time as epic as the Giant Screen, and as real as our present moment. Come aboard: life on Earth or in space will not be the same again.

ACKNOWLEDGEMENTS

Space: The New Frontier is produced by Definition Studios Australia, and distributed by K2 Studios in IMAX®/Giant Screen and other specialty theaters located in science centers, museums, and other cultural destinations and attractions worldwide.

The *Space: The New Frontier* Educators Guide is written by Meghan Nealon and Jennifer Jovanovic at GrowingGreat, www.growinggreat.org.

Special thanks to Clark Planetarium, Salt Lake City, Utah, USA, for their review and feedback.

Graphic design by Mia Villalonga.

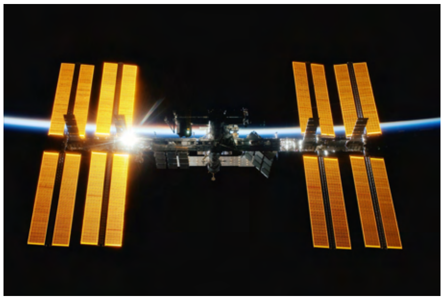
Learn more about *Space: The New Frontier*, a giant screen format film at www.spacethenewfrontier.com.

Image Sources: Aurelia Institute, Blue Origin, Definition Studios and K2 Studios, NASA, Unsplash, Voyager Space

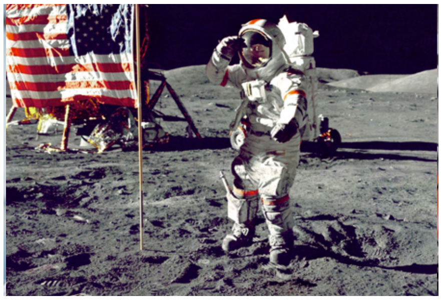
S P A C E : T H E N E W F R O N T I E R

Can You Find These in the Film?

Spin Launch's suborbital accelerator



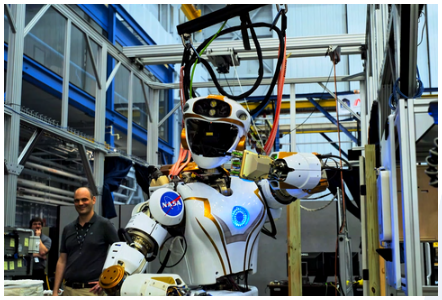
The ISS



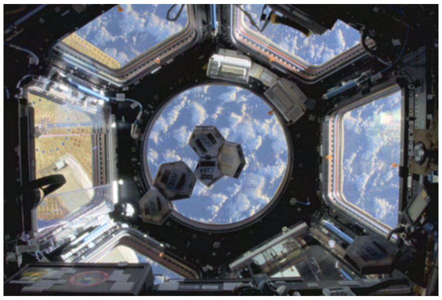
Astronaut Neil Armstrong, the first man to walk on the moon in 1969

Apollo 17 astronaut Gene Cernan

President Richard Nixon welcomes the quarantined Apollo 11



Valkyrie robot



Self-assembling Tesseract tiles

Astronaut step on the moon.

NASA's Neutral Buoyancy Lab pool

GRADES 2-5

ACTIVITY 1

How do you move a big, heavy rocket on the ground?

Challenge

Use wheels to move something really heavy across the floor.

You will need

Pencils, heavy brick or block, cans, Styrofoam trays, something round you can trace to make wheels, marker, toothpicks to use as axles, scissors, straws and cans.

ACTIVITY 1

How many pencils does it take to get a heavy brick to roll? How many wheels and axles does it take to make a truck that can transport a giant rocket? If you can answer one question, you'll be pretty close to understanding the other.

1. One at a time, put pencils underneath the brick until you have enough to make the brick roll easily.

2. Try the same experiment with cans instead of pencils. How does the difference in size between the pencils and the cans affect the movement of the brick?

3. Go on a wheel and axle hunt. Here are a couple of examples to get you started – a doorknob, a toy car, a large truck. A wheel rotates around an axle.

4. Based on your research, design a model of a truck that can drive a rocket down the street like the one in *Space: The New Frontier*. We suggest cutting Styrofoam trays into the shapes you need, but feel free to choose your own materials. What would happen if your wheels were square?

What do you think?

- When you watch vehicles ride by, how many wheels do you see on each one?
- Why do some vehicles have more wheels than others?
- What would happen if you put a heavy rocket on a bicycle? Why?
- How do things move differently on small wheels or large wheels?

Tips for teachers

What's Going On? Two of the biggest challenges in moving a rocket on the ground are controlling rolling resistance and avoiding going up and down hills. Rolling resistance is the energy that is lost from the tires as they experience friction and gravity while driving down the road. A rocket has so much mass and is so heavy that it builds up a tremendous amount of momentum when going downhill, which makes it very difficult to stop. Momentum = mass x velocity. Nobody likes a runaway rocket. If you put wheels and axles on a vehicle, each wheel only touches the ground at one spot while it's turning, so it creates less friction to slow you down. Imagine trying to drag a rocket down the street. That would never work. The more wheels and axles you have, the more you distribute the weight. In the activity, if you used more pencils, the weight of the brick was spread out, so it was easier to move. Larger wheels require more energy to get moving but they are better at reducing friction than small wheels, so once you are moving, they go faster.

In 2023, NASA's Crawler-transporter 2 (CT-2), seen in *Space: The New Frontier*, received a certificate from Guinness World Records as the heaviest self-powered machine. The CT-2 uses tracks instead of wheels and can transport 18 million pounds. Breanne Rohloff, the youngest and only female driver of CT-2, offers some steering tips in this article ("Driving the world's largest vehicle will test your nerves and skills" *Commercial Carrier Journal*, Mar. 9, 2022).

Out-of-this-World Books

How It's Built: Rocket by Elise Wallace. Children's Press, 2022. (Recommended for grades K-3)

The Astronaut's Guide to Leaving the Planet: Everything You Need to Know, from Training to Re-entry by Terry Virts. Workman Publishing Company, 2023. (Recommended for grades 4-6)

Standards Covered in this Activity

K-2-ETS1-1, K-2-ETS1-2, 3-PS2-1, 3-PS2-2, 3-5-ETS1-1, 3-5-ETS-2, 3-5-ETS-3

News from Space

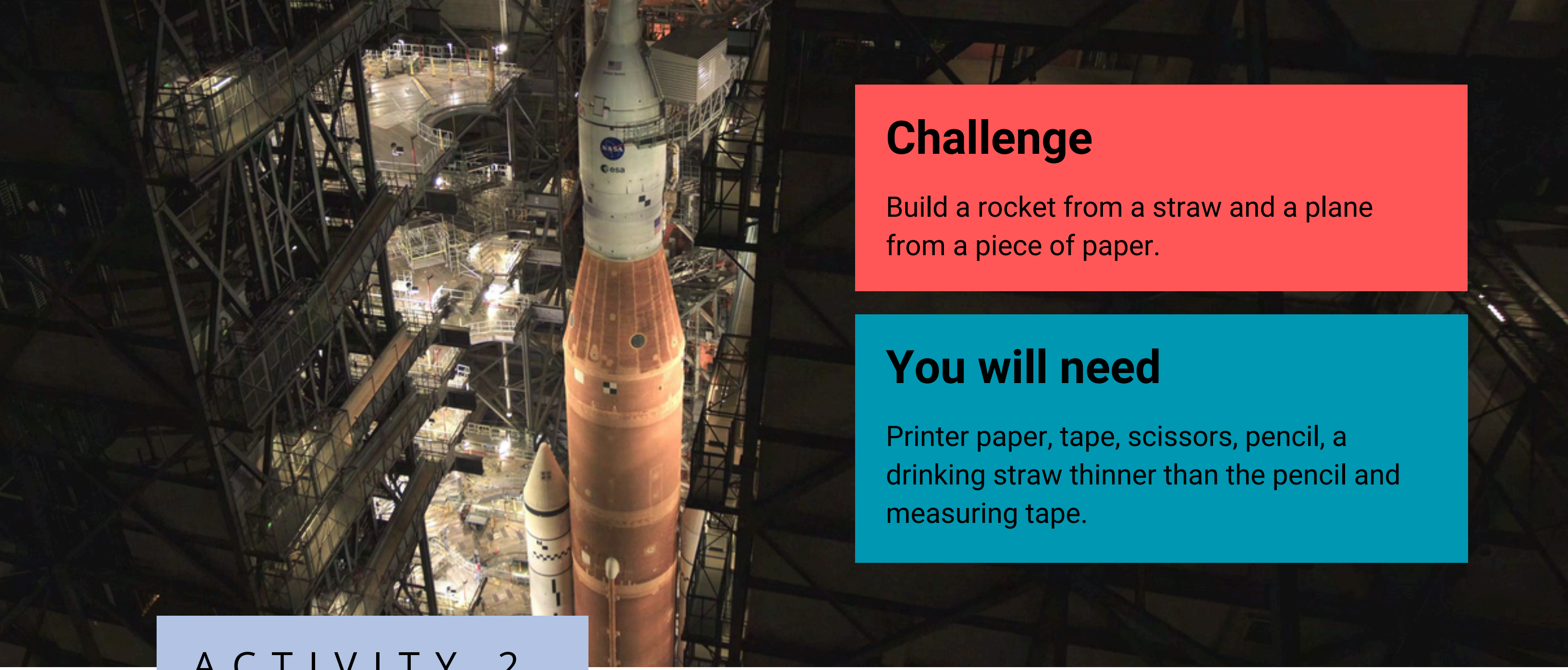
Oops. Odysseus tipped over. Odie, as he has been nicknamed, is a solar-powered robotic moon lander built by Intuitive Machines. Odie landed on the moon on February 22, 2024. One of his six landing legs might have snagged on something. We don't have all the details yet. Now that Odie is on his side, his solar panels aren't working as well, but as of February 29, he was still sending pictures. Take a look at the shapes and sizes of the wheels on Curiosity (the Mars Rover) and Odie.

What are the advantages of wheels or legs for a rover? Because the gravity on the moon is only 1/6th of earth's gravitational pull, things tend to tip over more easily. As a former NASA engineer, Philip Metzger, explains: it is very difficult to push over the refrigerator in your kitchen. "It's so heavy that a slight push is not going to push it over," but if you try to push over a piece of Styrofoam in the shape of a refrigerator (which mimics a fridge's weight in lunar gravity), a very light push will knock it over.

GRADES 2-5

ACTIVITY 2

Ready, Set, Launch!



Challenge

Build a rocket from a straw and a plane from a piece of paper.

You will need

Printer paper, tape, scissors, pencil, a drinking straw thinner than the pencil and measuring tape.

ACTIVITY 2

1. Wrap a piece of paper around the pencil and tape it to make a cylinder like the one in the illustration. Remove the paper from the pencil. This is the body of your rocket.

2. Fold the end of the cylinder to a point and tape it to make the rocket's nose.

3. Mark the "launch point" where you're standing, put the straw inside the rocket, aim it carefully and blow!

4. Observe the flight path when you send it across the room or straight up into the air. Measure how far it travels.

5. Cut additional pieces of paper to make fins and wings and tape them to the sides of the rocket. Relaunch using the straw. Notice how adding the fins and wings changed the flight path of your rocket. Did it travel farther this time?

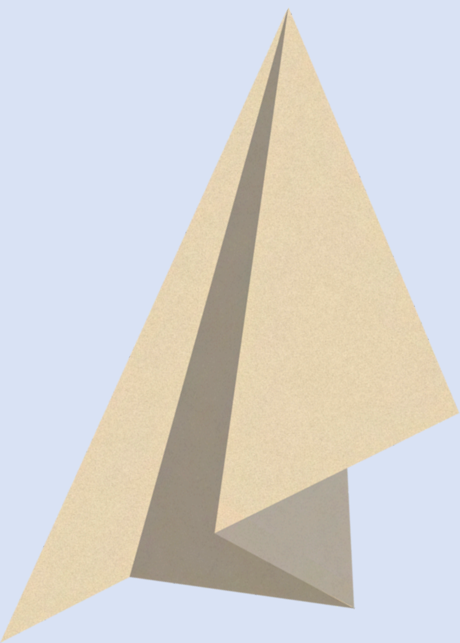
6. Fold a piece of paper into an airplane. There's a sample on this page, but you can design it however you like. Stand at the same launch point and release. Measure how far the plane travels.

7. Adjust the shapes of your rocket and plane and launch them again. How does your flight path change if you flatten the tip of your rocket's nose or cut the edges of your airplane's wings to be rounded? What changes help them fly farther?

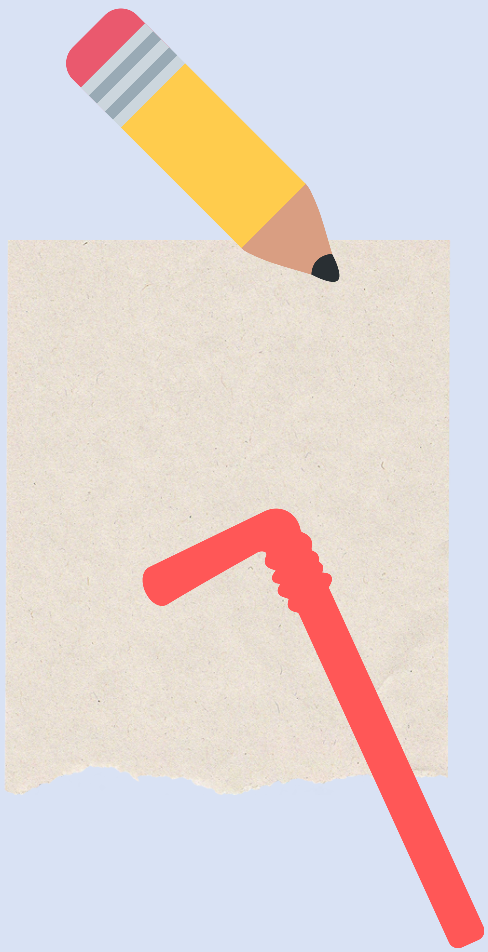
What do you think?

- What are the differences between the way a rocket and an airplane fly?
- What parts of your rocket and airplane designs help them fly through the air? Why?
- Is there a way to change the thrust power (the way the rocket flies) to send it farther? How?
- What if you try a thicker straw or different kind of paper? Does that make a difference?
- If you were to improve your designs, what would you change? What would you keep the same? Why?

Building a Plane



Building a Rocket



Tips for teachers

What's Going On?

WEIGHT is the force generated by Earth's gravity that pulls a rocket down to Earth. Gravity also generates your own body weight and keeps your feet on the ground. The pressure from the air you blow into the straw provides enough force to overcome the weight and send it into the air. Then gravity overcomes that force and brings your rocket back to Earth.

THRUST pushes a rocket up into the atmosphere. Your straw rocket works the same way as full-sized rockets. When you blow air into the straw, the air cannot escape the sealed paper. The force of the air is then exerted as THRUST which pushes the rocket into the air. Real rocket fuel creates that same effect with a controlled chemical explosion.

DRAG is the force that holds the rocket back when it is accelerating forward. It is generated by the difference in speed between the solid rocket body and the fluid air it moves through. A rocket nose cone's pointed shape helps to cut through and push the air out of way and direct the air down the curved sides of the rocket, reducing friction and drag.

LIFT is the force that holds planes in the air. The force of lift is generated by the difference in speed between the aircraft and the air. Your paper airplane gets lift from its wings. The pressure on the top of the wing is less than on the bottom, pushing the plane up. On a rocket, lift is exerted on the side because the rocket is launched vertically.

STABILITY means that the rocket follows a smooth path of flight. If it wobbles, the ride will be rough and extra fuel will be used to get back on track. If the rocket tumbles, it will likely be destroyed. In your paper rocket, the fins provide stability.

Out-of-this-World Books

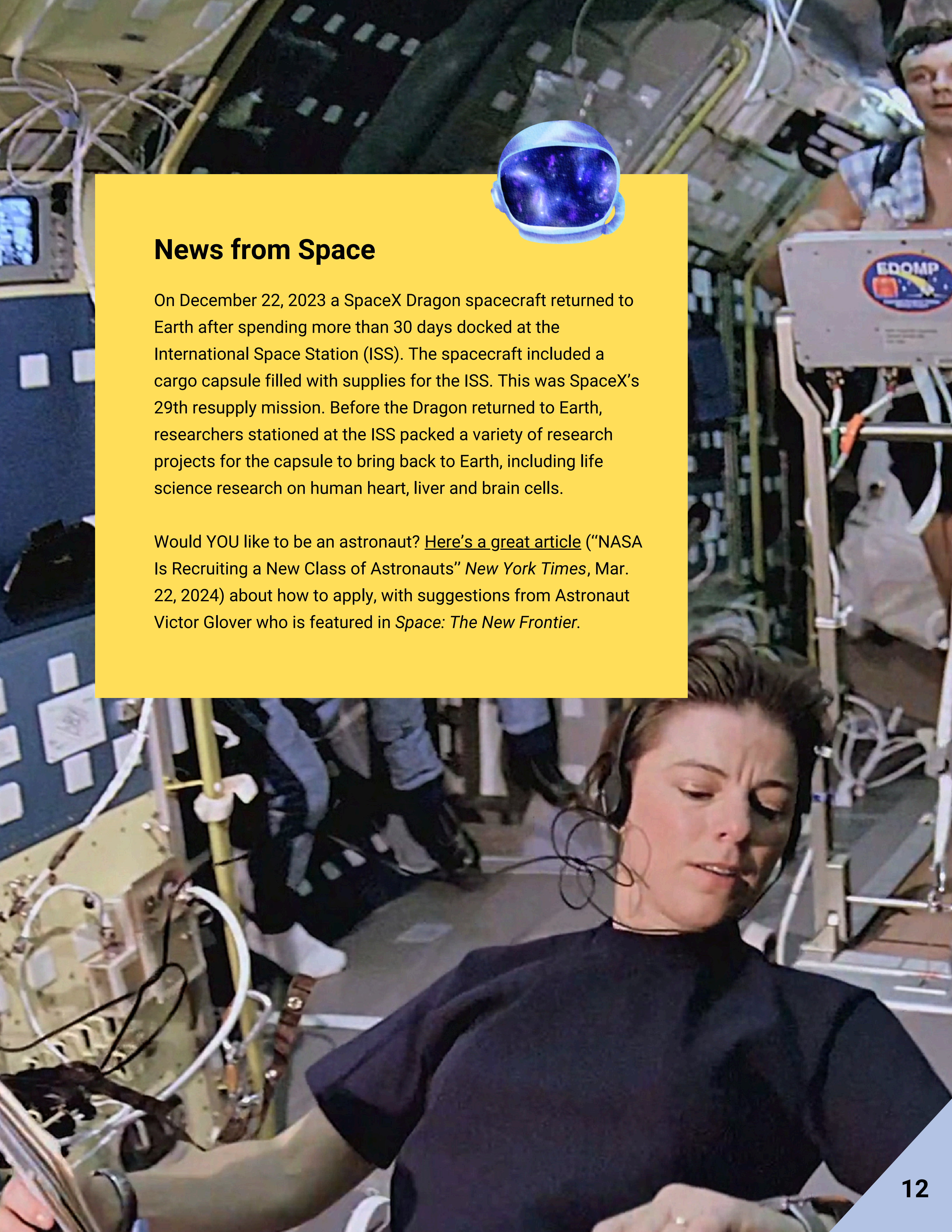
Interested in learning more about invisible forces in our world? Check out these exciting reads!

Forces: Physical Science for Kids by Andi Diehn. Nomad Press, 2018. (Grades K-3)

I can be a rocket scientist by Anna Claybourne. Dover Publications, 2019. (Grades 3-6)

Standards Covered in this Activity

K-2-ETS1-1, K-2-ETS1-2, 3-PS2-1, 3-PS2-2, 4-PS3-2, 4-ESS3-1, 5-PS2-1, 3-5-ETS1-1, 3-5-ETS-2, 3-5-ETS-3



News from Space

On December 22, 2023 a SpaceX Dragon spacecraft returned to Earth after spending more than 30 days docked at the International Space Station (ISS). The spacecraft included a cargo capsule filled with supplies for the ISS. This was SpaceX's 29th resupply mission. Before the Dragon returned to Earth, researchers stationed at the ISS packed a variety of research projects for the capsule to bring back to Earth, including life science research on human heart, liver and brain cells.

Would YOU like to be an astronaut? Here's a great article ("NASA Is Recruiting a New Class of Astronauts" *New York Times*, Mar. 22, 2024) about how to apply, with suggestions from Astronaut Victor Glover who is featured in *Space: The New Frontier*.

GRADES 2-5

ACTIVITY 3

How do you build a space station?

Challenge

Design the environmentally-friendly space station hotel of the future.

You will need

Plastic interlocking bricks, magnetic tiles or other building materials (bottle caps, wooden blocks, recycled water bottles, tape), the ISS drawing on the next page, your imagination, paper and markers.

ACTIVITY 3

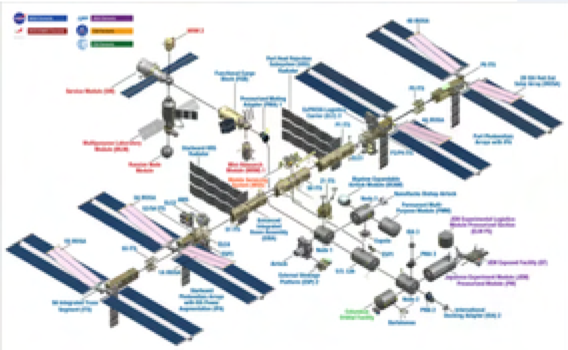
1. The International Space Station (ISS) is put together from many smaller modules, brought to space at different times. Components include docking stations, solar panels, a robot arm, laboratories and much more.

2. Soon, more than just astronauts will be visiting. YOU may be able to visit space and even stay in a space hotel! How would you keep that hotel up and running but also friendly to the environment, without constant visits to bring food and other supplies?

3. Use the paper and markers to create a design for your own space station hotel. What types of modules would you want to include? Why?

4. Use the building materials to build a model based on your design.

5. When you complete this activity, please send a photo of your model and explanation of the components you've included to info@growinggreat.org and we'll send you a copy of *Space on Earth: How Thinking Like an Astronaut Can Help Save the Planet* by Dave Williams and Linda Pruessen. (limit one book per classroom)



International Space Station Facts and Figures

International Space Station Facts An international partnership of five space agencies from 15 countries operates the International Space Station. Learn more

NASA / May 23, 2023

More to Explore: How can people survive in space? (grades 4-8)

1. Imagine that you are an engineer focusing on the hazards astronauts face when they leave the safety of Earth's atmosphere. Their lives depend on you! How will you design elements of the ISS to protect them?

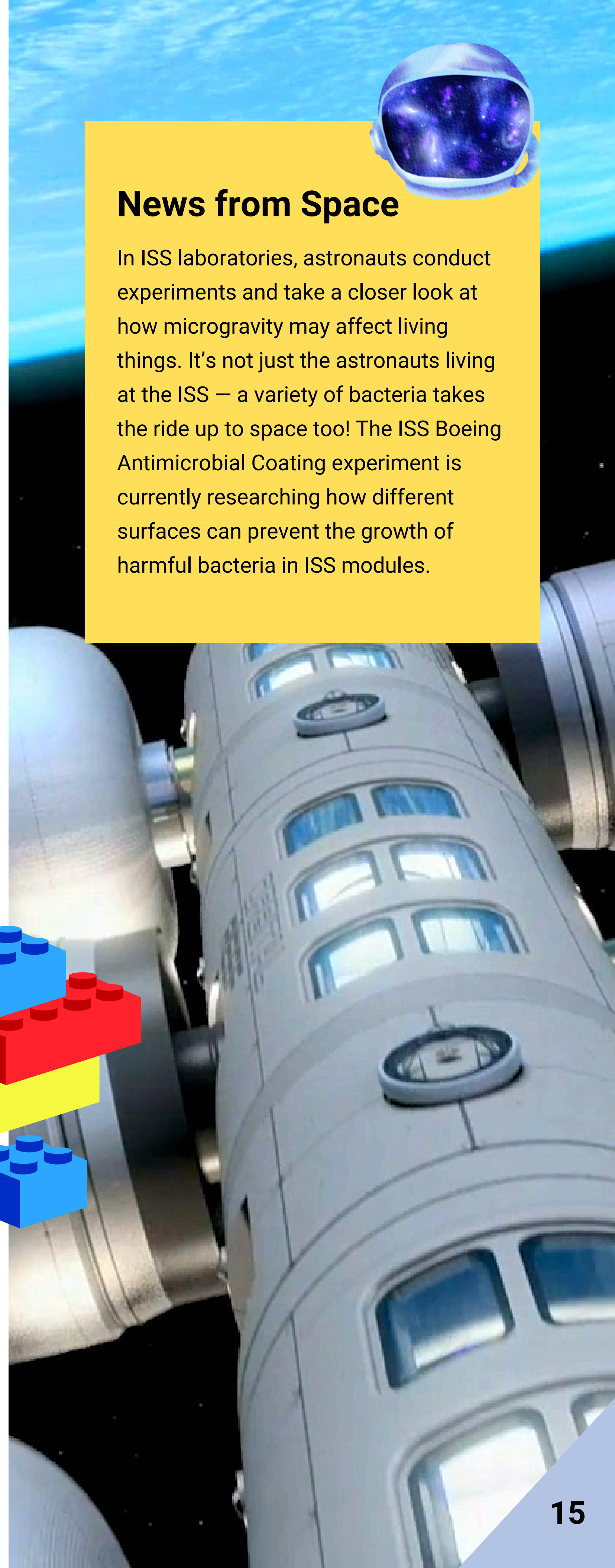
2. Choose one of the following hazards: lack of air, micrometeoroids, radiation, extreme temperatures and microgravity.

3. Draw a design of the protective system you would create for the ISS. Label the most significant parts.

4. Write a paragraph to NASA describing the hazard, how your system protects astronauts from it and how you plan to test your system on Earth prior to sending it to the ISS.

What do you think?

- If you were going to live at the ISS for a long time, what would you bring with you? Why?
- If you could invent an improvement for your ISS design, something that's never been done before, what would that be? Why?
- If assembling a full-size ISS was your job, how would you do it?



News from Space

In ISS laboratories, astronauts conduct experiments and take a closer look at how microgravity may affect living things. It's not just the astronauts living at the ISS — a variety of bacteria takes the ride up to space too! The ISS Boeing Antimicrobial Coating experiment is currently researching how different surfaces can prevent the growth of harmful bacteria in ISS modules.

Tips for teachers

The ISS helps protect astronauts from five major hazards faced by people who travel in space.

Lack of Air. The human body has developed within Earth's atmosphere and cannot survive without it. However, air does not exist in space. Without ISS modules that are filled with pressurized, breathable air, astronauts would suffocate.

Micrometeoroids. Micrometeoroids are tiny bits of comets, asteroids, dust, and, sometimes, leftover junk from previous missions, all of which travel through space at very high velocities. Strong spacecraft hulls and tough spacesuits protect against deadly micrometeoroids.

Radiation. Space contains many sources of radiation, including the Sun. Some radiation can kill cells in the human body. On Earth, the atmosphere blocks most harmful radiation, but in space, where there is no atmosphere, spacecraft and spacesuits must provide protection.

Extreme Temperatures. Space is a vacuum; it has no temperature and no air. In space, heat cannot travel through the air like it does on Earth. When the astronauts are working outside the ISS, heating and cooling systems in their space suits protect them from, for example, bare metal that has been in the sunlight at 260°C or in the shade at -100°C.

Microgravity. Space is a microgravity environment, not zero gravity, because it is filled with mass such as planets, moons, astronauts and space capsules. The human body builds bone and muscle strength that overcomes some of the force of gravity on Earth. Because astronauts do not have to overcome gravity in space, their muscles do not have to work very hard. Exercise machines help prevent bone and muscle loss. Check out an astronaut's workout here ("Why Do Astronauts Exercise At Least Two Hours a Day in Space - ISS Science" Smithsonian National Air and Space Museum Youtube channel, Nov. 21, 2017).

Out-of-this-World Books

Feel like an astronaut with these super cool science reads!

A Trip into Space: An Adventure to the International Space Station by Lori Haskins Houran. Albert Whitman & Company, 2019. (Grades K-3)

Path to the Stars: My Journey from Girl Scout to Rocket Scientist by Sylvia Acevedo Tyson. Clarion Books, 2020. (Grades 4-6)

Standards Covered in this Activity

2-PS1-3, K-2-ETS1-2, 3-LS4-3, 4-ESS3-2, 5-ESS2-1, 5-PS2-1, 3-5-ETS1-1, 3-5-ETS-2

GRADES 2-5

ACTIVITY 4

How does the International Space Station stay in orbit?

Challenge

Create a model to experiment with how orbit works.

You will need

Scissors, hole punch, string, marble or tiny toy car.

ACTIVITY 4

1. Punch three holes evenly around the edge of the paper plate.

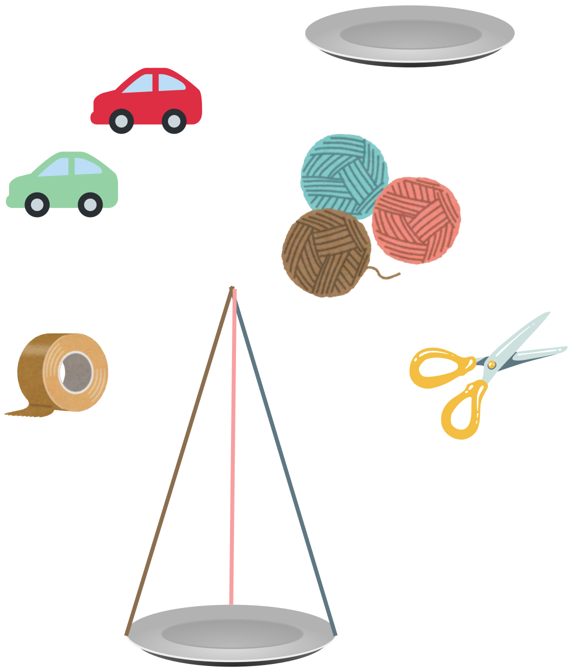
2. Cut three strings of different length and tie one string to each hole in the edge of the paper plate.

3. Tie the ends of the three strings together, so that you can hold them at the top and spin the plate around in a full circle.

4. Arrange the string to create a design that keeps the plate as steady as you can while you spin it.

5. Place the car (or marble) in the center of the plate.

6. Spin the plate and try to keep the car on the tray as you spin!



What do you think?

- How can you keep the car from falling off the plate while you spin?
- What happens if you let go of the strings while you're spinning the tray?
- How many revolutions (full circles) can you achieve without your car falling out of orbit (off the plate)?
- What does the orbit look like if you put different objects on the plate instead of the car?
- If you could make a change to your design, what change would you make? Why? Test your idea and see what happens.

Tips for teachers

Anything that is in orbit is held there by gravity. The ISS is held in place by the Earth's gravity. The Earth and other planets are held in orbit by the Sun's gravity. When you spin the tray in a circle, the tray is held in its orbit by the string. If you stop pulling on the string, the tray takes off in a straight line. The force you apply to the tray through the string is called centripetal force. When the ISS is in orbit around the Earth, it is the Earth's gravity that exerts a centripetal force on it that prevents it from flying off into space. The Earth's gravity pulls on the International Space Station (ISS) like you pull on the string to keep the tray traveling in circular motion.

An orbit is a regular, repeating path that one object takes around another one. Without gravity, an object orbiting the Earth would go off into space along a straight line. With gravity, the orbiting object is pulled back towards Earth. These opposite forces create a constant state of tug-of-war. The motion of an object and the force of gravity have to be balanced in order for an orbit to happen. If the momentum is too small, the object will be pulled down and will likely crash into the Earth. If the momentum is too great, the object will speed past and not enter orbit at all. The ISS orbits about 250 miles above Earth and has an orbital velocity of 5 miles per second.

Out-of-this-World Books

Fly into orbit with these space-tastic reads!

One Step Further: My Story of Math, the Moon, and a Lifelong Mission by Katherine Johnson. National Geographic Kids, 2021. (Grades K-2)

Astrophysics for Young People in a Hurry by Neil deGrasse Tyson. Norton Young Readers, 2019. (Grades 3-6)

Standards Covered in this Activity

K-2-ETS1-1, K-2-ETS1-2, 3-PS2-1, 3-PS2-2, 5-PS2-1, 5-ESS2-1, 3-5-ETS-3

News from Space

Since the year 2000, astronauts have carried out research and made upgrades to keep the ISS running. While not all the ISS technology is out of date, Phil McAlister, director of the Commercial Space Division of NASA, compares the ISS to a car bought in 1999, saying that “maintenance is becoming more difficult.” As NASA looks towards the next stage of space travel and exploration, it plans to crash the ISS into the ocean at the end of 2030. The ISS will be replaced by a new space station built by a private company, specifically Axiom Space, Voyager Space, or Blue Origin.

GRADES 2-5

ACTIVITY 5

What would it feel like to live on the International Space Station?

ACTIVITY 5

Challenge

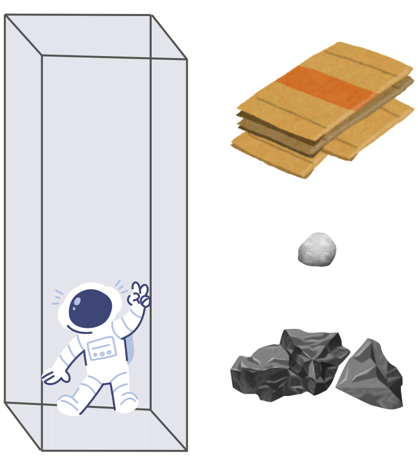
Figure out how microgravity and gravity affect objects differently.

You will need

Shoebox, markers, paper, cardboard, scissors, small action figure, rock and pebble.

1. Study the photo of NASA Flight Engineer Loral O'Hara on the ISS. Look for all the clues to tell it is a microgravity environment. How do you know she's not in a lab on Earth?

2. Using the shoebox and other supplies, create a model of the ISS environment. Be sure to design your shoebox vertically, so that it is tall and not wide.



3. Place the action figure astronaut in the box. Since you're on Earth, they just sit on the bottom of the box.

4. Hold the box so that the open side faces you and you can watch the astronaut. What happens to the astronaut when you jump?

5. What happens when you try the same thing with the rock and then with the pebble?

What do you think?

- What happened to the action figure when you jumped? Why?
- How did the rock and pebble react to you jumping? Why?
- How do you think living in microgravity would change your daily routine (getting dressed, eating breakfast, going to school, playing sports, reading and writing)?

Tips for teachers

When we talk about weightlessness, what we really mean is microgravity. It's the free-fall feeling you get when you begin to speed down the hill on the roller coaster and it's what astronauts experience on the International Space Station. In this activity, you (and the action figure in your shoebox) are in free fall after you jump into the air and are just starting to return to the ground, so, for a moment, the action figure – and even the rock – is floating. It's not surprising that NASA does a lot of testing and training for its missions underwater which helps approximate weightlessness. In *Space: The New Frontier,* Astronaut Victor Glover is training at NASA's Neutral Buoyancy Lab. Spacewalks are dangerous and so astronauts like Glover use this enormous swimming pool to build muscle memory and practice making decisions under pressure.

Gravity is a property of mass; however, the force of each object's gravity depends on its amount of mass. The less mass an object has, the weaker the effect of its gravity. Space is a microgravity environment, not zero gravity, because it is filled with mass such as planets, moons, astronauts and space capsules.

Out-of-this-World Books

Be inspired to aim for the stars with these great reads!

Luna Muna by Kellie Gerardi. Dragonfruit, 2022. (Grades K-3)

From Farmworker to Astronaut / De Campesino a Astronauta: My Path to the Stars / Mi viaje a las estrellas by José M. Hernández. Piñata Books, 2019. (Grades 4-6)

Standards Covered in this Activity

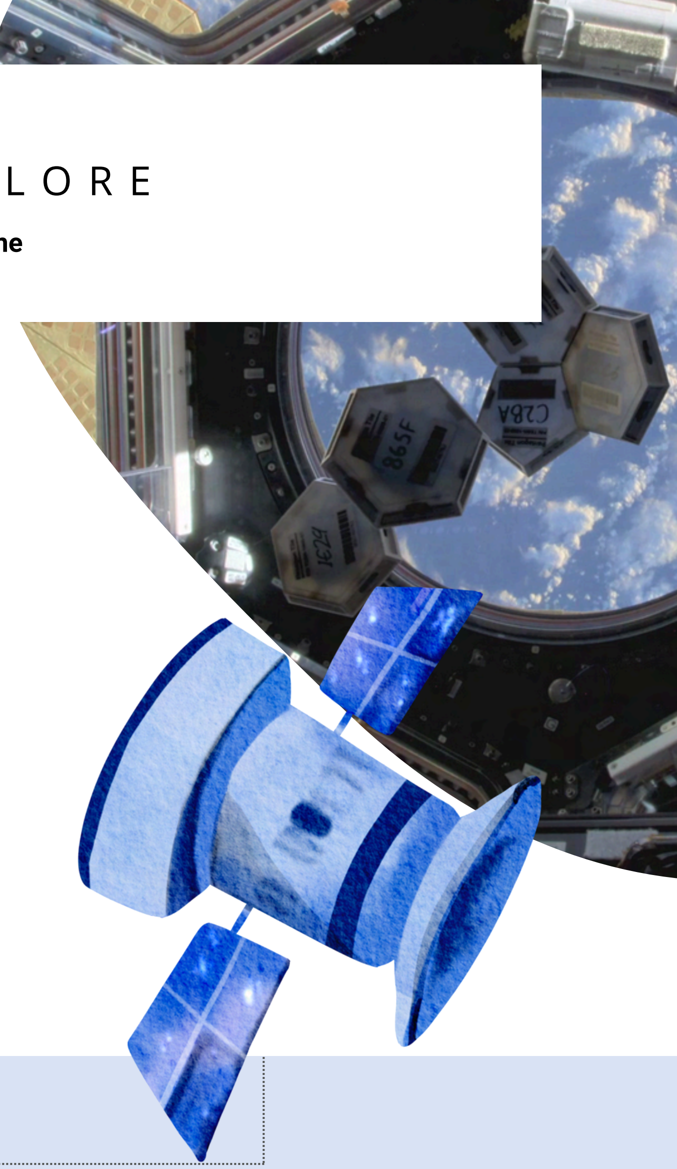
2-PS1-3, 2-ESS1-1, K-2-ETS1-2, 3-PS2-1, 3-PS2-2, 3-LS4-3, 5-PS2-1, 5-ESS2-1, 3-5-ETS-3

News from Space

On February 22, 2024, Intuitive Machines' Odysseus lander’s first successful lunar landing marked the first touchdown by a U.S.-built spacecraft since the Apollo 17 mission in 1972 and the first ever by a privately-built spacecraft. Odysseus is not carrying any astronauts, but is rather controlled remotely by engineers on Earth. Since landing, the Odysseus has transmitted two photos, one as it approached its landing site and one close-up image of the moon’s surface. According to Intuitive Machines "flight controllers intend to collect data until the lander's solar panels are no longer exposed to light.“ The data, which includes measures of space weather interactions and the Moon’s surface, will be used to help plan for future lunar landings in this unexplored area of the Moon. Once Odysseus no longer has light exposure, the robotic lander won’t be able to harness solar energy and will freeze. Odysseus sets the stage for a new era of private space exploration, not only in the United States, but across the globe.

MORE TO EXPLORE

Ideas for School and Home



If you loved *Space: The New Frontier*, you'll love visiting a retired space shuttle.

Shuttle Atlantis – Kennedy Space Center Visitor Complex
Shuttle Discovery – Steven F. Udvar-Hazy Center
Shuttle Endeavour – California Science Center
Shuttle Enterprise – Intrepid Sea, Air & Space Museum

Visit astc.org or childrensmuseums.org to find other museums, planetariums and space exhibits near you.

Interested in deepening your understanding of the science behind the activities in this guide? Check out these resources!

Why are wheels and axles so important, even in space travel?
https://www.nasa.gov/wp-content/uploads/2023/03/simple-machines-classroom-connection-508.pdf

Could you really go to Mars and back some day?
https://www.nasa.gov/humans-in-space/humans-to-mars/

How do you build a space station?
https://www.nasa.gov/international-space-station/

https://www.space.com/16748-international-space-station.html#:~:text=The%20International%20Space%20Station%20was,launched%20on%20single%2Duse%20rockets.

How does the International Space Station stay in orbit?
https://science.nasa.gov/learn/basics-of-space-flight/chapter3-3/#:~:text=The%20orbit%20of%20every%20planet,major%20axis%20of%20its%20orbit.

How is microgravity in space different from gravity on Earth?
https://www.nasa.gov/learning-resources/for-kids-and-students/what-is-microgravity-grades-k-4/

https://www.nasa.gov/centers-and-facilities/glenn/what-is-microgravity/

How can people survive in space?
https://www.nasa.gov/humans-in-space/living-in-space/

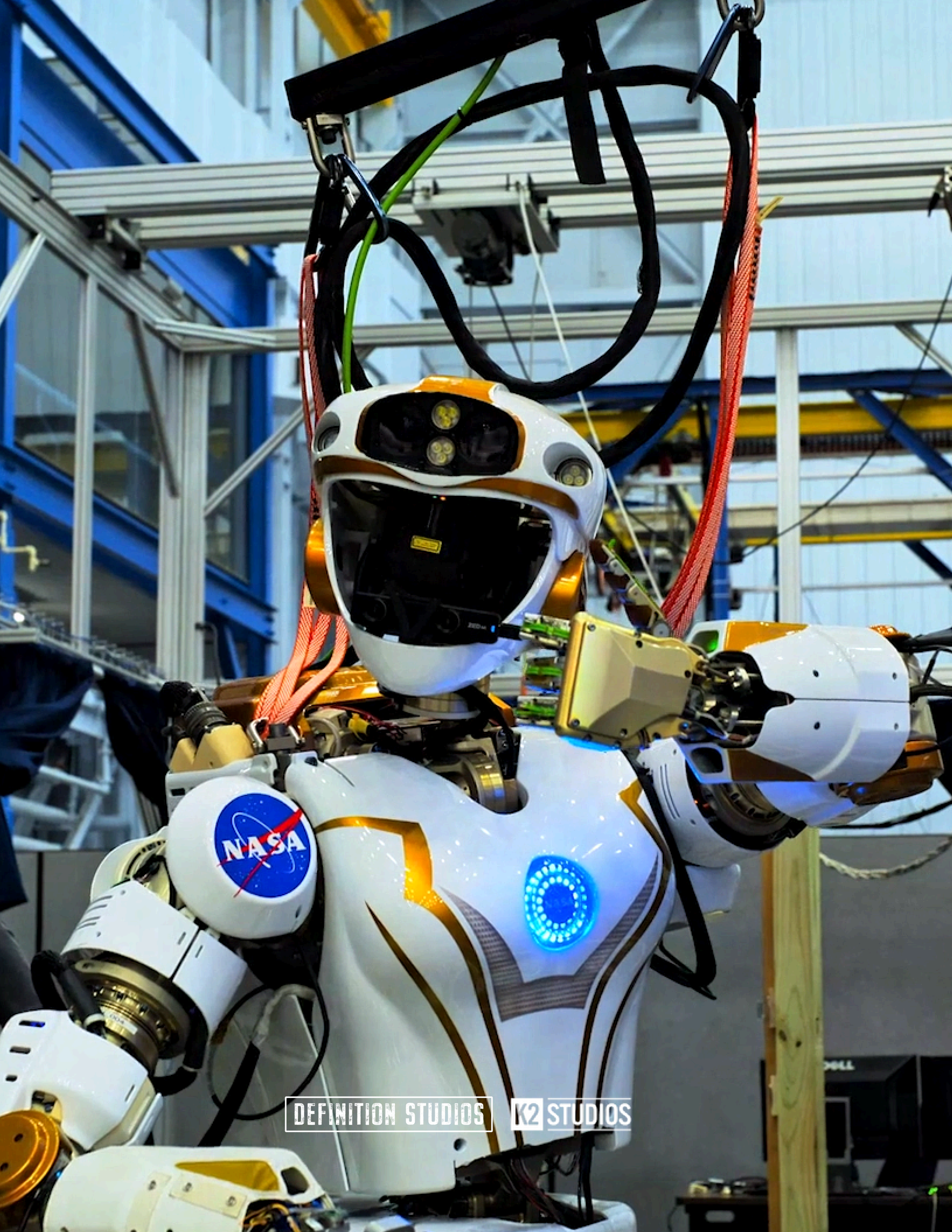
https://www.nasa.gov/missions/station/so-you-want-to-be-a-space-farmer/

https://www.nasa.gov/humans-in-space/the-human-body-in-space/

Have some more fun with these extension activities!

- Spot the International Space Station as it passes over Earth! https://spotthestation.nasa.gov
- Join the GrowingGreat Pen Pal Club and receive hands-on STEM activities every month that you can do at home with friends and family. Email info@growinggreat.org to sign up!
- Read the fictional story of Callie, the first woman and person of color on the Moon. The 40-page comic book highlights NASA technologies for exploring the Moon. https://www.nasa.gov/calliefirst/
- Even the closest exoplanets are too far away to visit. But what if they weren't? Take a trip outside our solar system with guided tours in English and Spanish. https://exoplanets.nasa.gov/alien-worlds/exoplanet-travel-bureau/
- NASA technology is all around you. Discover which technologies originally used for space missions are now making life better on Earth. https://homeandcity.nasa.gov

- This series of visualizations shows how some of the key indicators of climate change have changed in Earth's recent history. https://climate.nasa.gov/interactives/climate-time-machine/
- Online portals that allow you to visualize, explore, and analyze the surfaces of other worlds using real data returned from a growing fleet of spacecraft. https://trek.nasa.gov/#
- Check out the NASA Kids Club here: https://www.nasa.gov/learning-resources/nasa-kids-club/
- Play fun games, do hands-on activities, watch videos and read about space and earth! https://spaceplace.nasa.gov
- Check out fun games and activities and learn more about our changing planet! https://climatekids.nasa.gov
- Activities for kids (grades K-4), adults and the whole family! https://www.nasa.gov/learning-resources/for-students-grades-k-4/
- Activities for kids (grades 5-8), adults and the whole family! https://www.nasa.gov/learning-resources/for-students-grades-5-8/
- From Earth to Space – it’s all connected! https://ca.pbslearningmedia.org/subjects/science/earth-and-space-science/?gad_source=1&gclid=Cj0KCQiA84CvBhCaARIsAMkAvkIF3cB37q4RbmBT5eesgf3x73FoN8yUIlBEwW7IFHM2W3vckl8YW4YaAlKZEALw_wcB&rank_by=recency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K2 STUDIOS