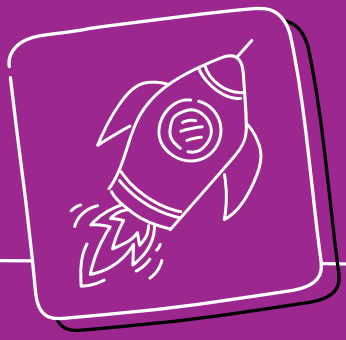

Space

educator guide

ARTEMIS

WELCOME TO THE SPACE Educator Guide!

In this Educator Guide, you'll find Grade Banded Learning Standards aligning to each of the activities. You will also find a QR Code linking you to COSI Connects, an online universe of science through videos, activities and so much more! COSI Connects also includes a section called Community Connects, a digital hub for online and in-person resources from museums, cultural institutions, and other nonprofits.

For additional resources, including book recommendations, and video instructions for completing each of the activities inside your box be sure to check out cosi.org/connects/kits/.

For questions regarding the content inside this educator guide, please email sciencequestions@cosi.org.

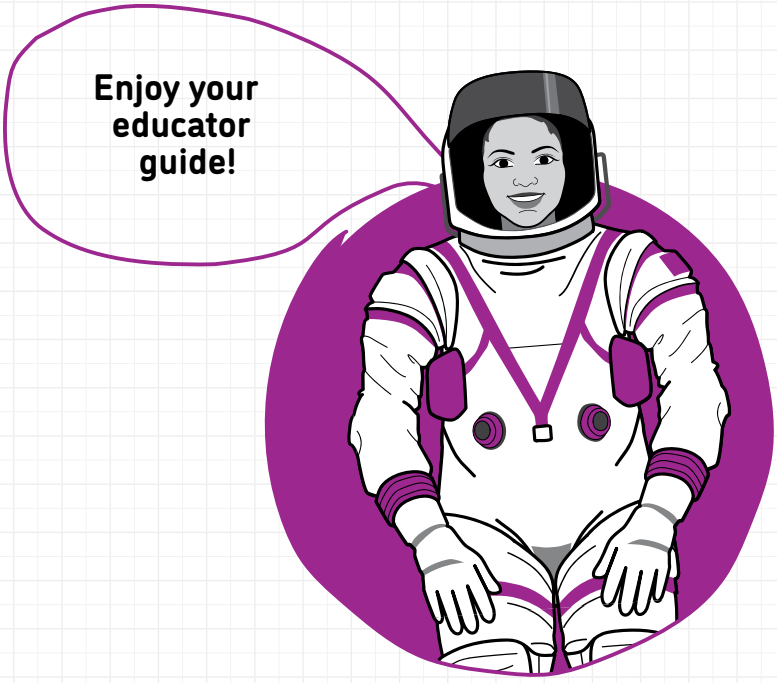

Table of Contents

Dear Educators, Parents, and Caregivers:

We know education is important now more than ever, and COSI stands ready to be your partner with this COSI Connects Kit. Together, we will engage, inspire, and transform our students and youth in science, technology, engineering, art, and math (STEAM) at school and at home. These activities correlate directly to Ohio's Learning Standards - the key learning goals that schools and educators use.

This box is full of experiences designed to engage K-8 learners; it is especially recommended for grades 3-7. As you look through the Activity Guide, you will find step-by-step instructions, interactive questions that will promote critical thinking, and explanations of the science behind each activity. If you want to dig deeper into science, additional experiences are available through our free Connects digital platform. In this Educator Guide, you will find the Ohio Learning Standards and Next Generation Science Standards that correspond to each of the activities in this box. You will also find critical thinking questions and extensions that work well with different grade levels at home and in the classroom.

If you have any questions about the content of this guide, please email **ScienceQuestions@cosi.org**.

Space Kit: https://cosi.org/connects/kits/space-kit.php

Resources: https://cosi.org/connects/kits/space-kit-resources.php

Connects: www.cosi.org/connects

Facilitating STEAM Learning with Kits

Kits Overview

COSI Connects Kits contain carefully designed hands-on STEAM activities that support fun, engaging learning about a topic or theme. Each box comes with:

- **Supplies**: Materials for activities are in the box
- **Activity book:** This guide provides directions for setting up and completing activities, explains relevant STEAM content knowledge and skills, and offers discussion prompts to deepen the learning experience
- **Instructional videos:** Each kit has a QR code linking you to short videos demonstrating how to complete different steps of the activities. If you cannot scan the QR code, you can find the videos online at cosi.org/spacekitvideos.

Goals for Using Kits

At COSI, we know science is everywhere and for everyone. To reinforce this message, we've designed our kits to do so much more than just teach STEAM content knowledge. Every kit, regardless of the content or topic, also provides important non-content learning opportunities such as:

- Engaging with STEAM in fun, inspiring, and creative ways
- Making sense of scientific observations
- Seeing oneself as a capable, welcome, and valued STEAM community member
- Practicing a growth mindset by valuing effort and learning over ease and knowing
- Bonding with peers, family, and educators over shared experiences and excitement

Techniques for Facilitating COSI Connects Kits

Decades of research show that learning is rarely as straightforward as receiving information. This is especially true when the goal is to *understand* and *apply* information, not simply recognize and repeat it. Learning and understanding requires the student to make sense of the information for themselves: Have they heard anything like that before? Does it make sense? Does it support or contradict something they already know? Is it useful or interesting enough to warrant the effort to learn and remember it?

When helping your learners accomplish the goals of using a COSI Connects kit, you'll want to

ask more questions than you answer (unless they're practical or logistical questions about the directions).

Why? For a few reasons:

1) If learners have a question in mind before doing an activity, or before doing a step of the activity, they'll be primed to notice information that is useful for sense-making or question-asking.
2) This technique helps you model the process of science for your learners. Instead of assuming what they do or don't know and thus what you need to tell them, you are being curious, collecting data (their knowledge and ideas) and interpreting those data to decide how to most effectively help them.
3) This invites critical thinking: you can follow most questions with things like, "Why do you think that?" or "What did you observe during your activity that makes you think that?"
4) It shows your learners that you are interested in their experiences, and that you find them valuable and interesting to know.
5) If something isn't working, it can help you troubleshoot the issue: Did they skip a step? Use a different material? Was the reaction really fast or really subtle and they missed it?

Make sure you ask your questions with curiosity and openness: you are asking the question because you want to learn your learners' answers, not because you will try to change their minds (even if you do want to!). This will help them feel more comfortable sharing, which will deepen and sustain their conversations and learning.

Technique	Examples of Effective Questions
Model the scientific method before, during & after Model the scientific method before, during & after Scientists work together to collect information (evidence) they can use to answer questions about how things work, why things happen, or even if/when things *will* happen! They collect this evidence by learning from their peers, making observations, and conducting experiments. Additionally, scientists are never "done" learning: experiments often leave scientists with more questions than answers, which is exciting!	· What questions could we answer by doing this activity? · What information could we collect to answer that question? What changes or results could we look for? · What do you think will happen? Why? · What information or knowledge did you use to come up with your answer? · What new questions do you have? What about those questions is interesting to you? How would you collect evidence to answer your questions?
Focus on ideas rather than terminology If a learner is having a hard time with a particular word or phrase (pronouncing, understanding – anything!), help them find other words to use instead. It's more important for learners to learn by making sense of ideas and practicing skills than it is for them to use terminology correctly.	· What are other words that mean the same thing? · How would you explain it to a younger sibling? · Can you act out the word, or draw the word? · Is there a similar word that means something different, and that's making this feel confusing? · How can you remember the information/skill even if you forget the specific word(s)?

Help learners see themselves as scientists by challenging negative misconceptions Importantly, "science" is a *process*, not a product - science is not simply a collection of information or facts. Science is a process of asking questions, making observations to collect information, and thinking carefully to make sense of the information. The goal of science is not to "prove" that a certain idea is "right," or to get "the correct result" from doing an experiment. If an experiment produces an outcome that suggests a scientist's idea was wrong, that's great because there is something new to be learned! A "good" scientist is not somebody who is already very smart, works all by themselves without any help, and never makes mistakes. A "good" scientist is curious, collaborative, and learns from their mistakes.	· What does the word "science" mean to you? · Do you think science is interesting? Fun? Exciting? Scary? Boring? Why? · How do we use science to learn about things? · How does science help us understand things? · How do you use science to understand things? · What does the word "scientist" mean to you? · What does a scientist do? · What makes somebody a "good scientist" or "good at science"? · Do you think you can be a scientist? · How are you like a scientist every day? · What attributes make you a good scientist? · Why do you think it's more important for a scientist to learn from mistakes than to never make mistakes? · Have you ever made a mistake that helped you learn something really useful?
Invite sense-making and peer discussion It's great for learners to have questions because that means they're curious, and they have the opportunity to learn something new! Ask your learners to share what kit activity information and experiences they're curious or confused about and want to understand better. Ask other learners in your group to share how they figured something out. This is especially helpful when you have learners who want to work more quickly than others: capitalize on their energy and help them engage more deeply!	· Was any part of the kit activity surprising, strange, or even counterintuitive to what you expected? · Why do you think that was surprising/strange/counterintuitive – what made you think that something else would happen? · Did any part of the kit activity not make sense? · Did you see or try anything in the kit activity that helped something make sense? · Do you have any other information or experiences from before the kit activity that helped something make sense?
Explore real-world connections Learners are more likely to value the effort required to learn or complete a task if they believe the results will provide something useful and relevant. Personal connections can also help learners see themselves as capable STEAM community members and practitioners.	· Is this something you've ever wondered about? · Would a friend or family member find this interesting? · How could you use something you learned from this activity in your own life? · How could you use something you learned from this activity to help someone else?
Reflect on progress and experiences At the end of each activity, or even after a step within an activity, ask your learners questions that help them see things like: · They learned a new fact or skill · They had a fun/cool/interesting experience · They overcame an obstacle and achieved success · They are scientists and they're doing science · They changed their mind with new information · They turned a "mistake" into a learning opportunity · They wondered new and interesting questions	· What is the most interesting thing you learned? · Was anything confusing at first, but now you understand it better? · Was anything frustrating at first, but it helped you learn something? · Why was it confusing at first? How did you get to understand it better? · What is something you learned that you want to tell a friend or family member? · What is something you learned that you want to use in your everyday life?

Kit Accessibility Tips

This is an additional resource to support the success of learners. Below are tips and tools from COSI's accessibility experts that can be used when adapting for learners.

Fine Motor Adaptations

- Get creative! When completing a movement required activity, think of different ways to accomplish it, like moving an object by attaching it to a wheelchair.
- If an object is too small to handle, swap for similar but larger objects, like switching a bouncy ball for a basketball. You can also attach the smaller object to a larger one to make it easier to hold.
- Use hand over hand to support students when completing fine motor tasks.
- For the writing portions, provide notepaper to give extra space for writing.

Blind and Low Vision Adaptations

- Use puffy paint on the activity book images to create additional tactile images.
- Use manipulatives (objects) for students to touch when explaining how something works to help students process what is happening.
- Use the camera on a phone or tablet to magnify the words and images in the activity book.

Deaf Adaptations

- Utilize COSI's demonstration videos with closed captioning when completing an activity.
- Visually demonstrate the activity steps.

Cognitive Adaptations

- Break the activity into smaller steps to make processing easier.
- For harder to understand concepts use manipulatives (objects) to explain or relate to a practical process.
- Model the steps for the child to follow and complete at the same time.
- Ask leading questions to help students problem solve. For example: "How could you change the shape of the wings to make it fly better?"

Speech Adaptations

- Have students present in alternate ways, like with drawings or by demonstrating what they did.

Standards Alignment and Extension Questions

The following pages will include Ohio Learning Standards and Next Generation Science Standards that are aligned with each activity in the kit. In addition to these standards, you will find extension questions to scale up or scale down the content of each activity according to your students' abilities or grade level. These extension questions are arranged in grade level bands of Kindergarten – Second Grade, Third – Fifth Grade, and Sixth – Eighth Grade. Each set of these questions are also aligned with both Ohio Learning Standards and Next Generation Science Standards.

Throughout the kit activities, your students will find opportunities to write down their scientific findings and connect to digital learning resources through COSI Connects. This will allow them to fulfill the Ohio English Language Arts, Technology, and Digital Literacy Learning standards listed below.

Kindergarten – 2nd Grade

- K-2.ICT.3.b.: Use visuals found in digital learning tools and resources to clarify and add to knowledge.
- W.K.2: Use a combination of drawing, dictating, and writing to compose informative/ explanatory texts that name what is being written about and supply some information about the topic.
- W.1.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- W.2.8: Recall information from experiences or gather information from provided sources to answer a question.
- K-2.ST.2.a.: Communicate and collaborate using several digital methods.

Third Grade – Fifth Grade

- 3-5.ICT.1.a.: With guidance, identify and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.
- W.3-5.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
- 3-5.ICT.4.d.: Produce and publish information appropriate for a target audience using digital learning tools and resources.

Sixth Grade – Eighth Grade

- 6-8.ICT.4.b.: Select and use a variety of media formats to communicate information to a target audience.

COSIconnects learning lunchbox

Space

ACTIVITY 1: Become an Engineer

Engineers and scientists work at NASA to build rockets that travel to outer space.

Ohio Learning Standards

K – 2nd Grade Technology K-2.DT.3.a.: Describe how different technologies are used in various fields.

3rd – 5th Grade Technology 3-5.DT.1.b.: Give examples of how requirements for a product can limit the design possibilities for that product.

2nd Grade Science 2.PS.1: Forces change the motion of an object.

5th Grade Science 5.PS.1: The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

8th Grade Science 8.PS.1: Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields.

8th Grade Science 8.PS.2: Forces can act to change the motion of objects.

Next Generation Science Standards

K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull

K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

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.

GRADES K–2

Extended Learning Questions:

1) What do you think an engineer does?
2) A payload on a rocket is something it is carrying. What can you think of that a rocket might be carrying?
3) Hold one end of the string up high and launch your balloon rocket. Now, hold it down low and launch your balloon rocket. Does the rocket launch differently? How?
4) Try attaching the payload to a different part of your rocket. How does this change the way it launches? Does one placement work better than the other?

Ohio Learning Standards:

2nd Grade Social Studies 3: Science and technology have changed daily life.

1st Grade ELA RI.1.4: Ask and answer questions to help determine or clarify the meaning of words and phrases in a text.

Next Generation Science Standards:

K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

COSIconnects learning lunchbox

Space

ACTIVITY 1: Become an Engineer

Engineers and scientists work at NASA to build rockets that travel to outer space.

GRADES 3–5

Extended Learning Questions:

1) How could you change the design of your rocket to make it launch faster? Try it out! Maybe you want to try a few changes to see which works best. Share what changes you made with someone else. Explain what worked and what didn't.
2) What design changes could you make to your balloon rocket to make it launch more slowly?
3) Compare your balloon rocket to a rocket that launches into space. What is similar? What is different? What do engineers need to think about when building a rocket that will launch into space?

Ohio Learning Standards:

3rd – 5th Grade Technology 3-5. DT.2.b.: Plan and implement a design process: identify a problem, think about ways to solve the problem, develop possible solutions, test and evaluate solution(s), present a possible solution, and redesign to improve the solution.

3rd – 5th Grade Technology 3-5.DT.1.a:. Demonstrate how applying human knowledge using tools and machines extends human capabilities to meet our needs and wants.

Next Generation Science Standards:

3-5-ETS1-3: 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.

GRADES 6–8

Extended Learning Questions:

1) Perform three launch trials of your rocket with a payload. Measure the distance your rocket travels on the string for each trial and write it down. Then, calculate the average distance traveled by adding those three numbers together and dividing by 3.
2) Change the location of the payload on your balloon rocket. Perform three launch trials with this new design. Measure the distance your rocket travels on the string for each trial. Calculate the average distance traveled by adding those three numbers together and dividing by 3. Compare this number to the average distance traveled with the original payload placement. Which position of a payload launched the rocket further? Why do you think that is?
3) Make a timeline from the years 1958-1976. On one side of the timeline, write down a few events from NASA missions to the moon. On the other side of the timeline, write down a few events that happened in U.S. history. What connections do you think there are between the NASA missions and key events in US history?

Ohio Learning Standards:

6th Grade Math 6.SP.5 Summarize numerical data sets in relation to their context.

6th – 8th Grade Technology 6-8. DT.2.a: Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution.

6th Grade Social Studies 1: Multiple tier timelines can be used to show relationships among events and places.

6th Grade ELA RI.6.1: Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Next Generation Science Standards:

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

Join us at our Community Learning Table: "Community Connects"

The Community Connects section of this digital hub brings together educational resources from museums, cultural institutions, and other nonprofits in your community to extend your learning

cosi.org/connects

COSI Center of Science and Industry

COSIconnects learning lunchbox

Space

ACTIVITY 2 : Go to Space

The Space Launch System, or SLS, will carry the Orion Spacecraft to the Moon. Today, use your engineering expertise to make a new rocket to launch you into space!

Ohio Learning Standards

2nd Grade Science 2.PS.1: Forces change the motion of an object.

4th Grade Science 4.PS.2: Energy can be transferred from one location to another or can be transformed from one form to another.

5th Grade Science 5.PS.1: The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

6th Grade Science 6.PS.3: There are two categories of energy: kinetic and potential.

7th Grade Science 7.PS.3: Energy can be transformed or transferred but is never lost.

8th Grade Science 8.PS.2: Forces can act to change the motion of objects.

Next Generation Science Standards

K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull.

K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

GRADES K–2

Extended Learning Questions:

1) With an adult's help, find three pictures of different rockets. What looks the same about them? What looks different?
2) Try launching the rocket a few times. The first time, fill the canister half full of water and drop half of an antacid tablet in. The second time, fill the canister half full of water and drop in a whole antacid tablet. Which makes your rocket launch faster? Which makes your rocket fly higher? What are other things could you change?
3) Attach an object to your rocket. What is different about your rocket now? Launch it again. Did this change the way your rocket launched? How?

Ohio Learning Standards:

Kindergarten Mathematics
K.MD.2: Directly compare two objects with a measurable attribute in common to see which object has "more of" or "less of" the attribute, and describe the difference.

2nd Grade Science 2.PS.1: Forces change the motion of an object.

Next Generation Science Standards:

K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

COSIconnects learning lunchbox

Space

ACTIVITY 2 : Go to Space

The Space Launch System, or SLS, will carry the Orion Spacecraft to the Moon. Today, use your engineering expertise to make a new rocket to launch you into space!

GRADES 3–5

Extended Learning Questions:

1) Think about your balloon rocket launches in Activity 1. Compare that to your film canister rocket launch. How do you think adding a payload would affect the launch of the film canister rocket? Optional: try it out!
2) On September 12, 1992, Dr. Mae Jemison became the first African American woman to go to space. Look online to find an article or video written or made by Dr. Jemison about going into space. This is called a firsthand account. What was her experience like?
3) Find a video or article about Dr. Jemison's trip to space that was written by someone who wasn't there. What did you learn? How was it different from the firsthand account?

Ohio Learning Standards:

4th Grade Social Studies 2: Primary and secondary sources can be used to create historical narratives.

4th Grade ELA RI.4.6: Compare and contrast a firsthand and secondhand account of the same event or topic; describe the differences in perspective and the information provided.

4th Grade ELA W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

Next Generation Science Standards:

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.

GRADES 6–8

Extended Learning Questions:

1) Is antacid dissolving in water an example of a physical or chemical reaction? How do you know?
2) A dissolution happens when a solute dissolves into a solvent. Are all dissolutions examples of chemical reactions? Why or why not? (Hint: Think about the dissolution of salt in water)
3) How did the energy of the chemical reaction transfer in this experiment? How do you know?

Ohio Learning Standards:

6th Grade Science 6.PS.2: Changes of state are explained by a model of matter composed of particles that are in motion.

7th Grade Science 7.PS.2: Matter can be separated or changed, but in a closed system, the number and types of atoms remains constant.

7th Grade Science 7.PS.3: Energy can be transformed or transferred but is never lost.

Next Generation Science Standards:

MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

Join us at our Community Learning Table: "Community Connects"

The Community Connects section of this digital hub brings together educational resources from museums, cultural institutions, and other nonprofits in your community to extend your learning

cosi.org/connects

COSI Center of Science and Industry

COSIconnects learning lunchbox

Space

ACTIVITY 3 : Build a Moon Base

Your rocket has blasted into space and landed safely on the moon. Now it is time to use some creativity and what you know about the engineering design process to build your own moon base.

Ohio Learning Standards

K – 2nd Grade Technology K-2.DT.2.b.: Demonstrate the ability to follow a simple design process: identify a problem, think about ways to solve the problem, develop possible solutions, and share and evaluate solutions with others.

3rd – 5th Grade Technology 3-5.DT.2.b.: Plan and implement a design process: identify a problem, think about ways to solve the problem, develop possible solutions, test and evaluate solution(s), present a possible solution, and redesign to improve the solution.

6th – 8th Grade Technology 6-8.DT.2.d.: Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems.

Next Generation Science Standards

K-2-ETS1-2: Engineering Design - 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.

GRADES K–2

Extended Learning Questions:

1) What shapes did you create in your moon base? Can you use the playdough or the toothpicks to make another shape?
2) Make a circle out of playdough and toothpicks. Put it somewhere in your moon base. Where did you choose to put it? Why?
3) Pretend you are taking a trip to the moon! What will you bring with you?
4) Going to the moon would be an adventure. Have you ever been somewhere that felt like an adventure? Maybe it was a long trip or a walk at the park. Who went with you? What was your favorite thing about it?

Ohio Learning Standards:

Kindergarten Mathematics K.G.5: Model shapes in the world by building shapes from components, e.g., sticks and clay balls, and drawing shapes.

1st Grade ELA SL.1.4: Describe people, places, things, and events with relevant details, expressing ideas and feelings clearly.

Next Generation Science Standards:

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.

COSIconnects learning lunchbox

Space

ACTIVITY 3 : Build a Moon Base

Your rocket has blasted into space and landed safely on the moon. Now it is time to use some creativity and what you know about the engineering design process to build your own moon base.

GRADES 3–5

Extended Learning Questions:

1) Measure the length, width, and height of your moon base and write the measurements down. Draw a diagram, or picture, of your moon base. Show the measurements on that picture.
2) Find a triangle where the sides are all the same length. How do you know they're the same length? This type of triangle is called equilateral. Do you see any triangles whose sides have different lengths?
3) Imagine that more astronauts will be coming to your moon base. You need to add another room for them. Where would you put this room? How will you decide how big to make it? Can you make it without getting new play-dough or toothpicks?

Ohio Learning Standards:

5th Grade Mathematics
5.G.3: Identify and describe commonalities and differences between types of triangles based on angle measures (equiangular, right, acute, and obtuse triangles) and side lengths (isosceles, equilateral, and scalene triangles).

Next Generation Science Standards:

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.

GRADES 6–8

Extended Learning Questions:

1) What was the biggest challenge when you were building your moon base? How did you go about solving this problem?
2) The Moon's environment is different from Earth's environment. For example, there is no air on the moon and the force of gravity is not as strong. What other things are different on the Moon than they are on Earth? How do you think engineers plan and test for the Moon's environment when they're designing a moon base?
3) Measure the length, width, and height of your moon base and write the measurements down. Draw a diagram, or picture, of your moon base. Show the measurements on that picture. The volume of a cube is length times width times height. How would you estimate the volume of your moon base? Talk through it with a partner.
4) Imagine that you will be living on your moon base with three other astronauts. Write a narrative on how you would live in your moon base. What do you do in each of the rooms you created? Where do you spend most of your days? Be creative!

Ohio Learning Standards:

7th Grade Mathematics
7.G.6: Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

7th Grade ELA W.7.3: Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.

Next Generation Science Standards:

MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Join us at our Community Learning Table: "Community Connects"

The Community Connects section of this digital hub brings together educational resources from museums, cultural institutions, and other nonprofits in your community to extend your learning

cosi.org/connects

COSI Center of Science and Industry

Space

ACTIVITY 4 : Impact Craters

Astronauts go into space to collect scientific data, and today you will do just that! Have you ever noticed craters on photos of the moon? In this activity, you and your team of astronauts will collect scientific data on impact craters.

Ohio Learning Standards

2nd Grade Mathematics 2.MD.1: Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

3rd Grade Mathematics 3.MD.4: Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch.

5th Grade Science 5.ESS.1: The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.

7th Grade Mathematics 7.G.4: Work with circles.

Next Generation Science Standards

MS-ESS1-2: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

GRADES K–2

Extended Learning Questions:

1) Put your meteoroid objects in order from largest to smallest. Which is the largest? Which is the smallest?
2) Look at your three meteoroids. Which made the largest crater? Which made the smallest crater? Why do you think that is?
3) Put on shoes or boots and go somewhere where you can make a footprint (in sand, dirt, or mud). First, take slow, careful steps. Look at your footprints. What do you notice? Now, run as fast as you can to make more footprints. Do your running footprints look different? Why do you think that is?

Ohio Learning Standards:

Kindergarten Science K.PS.1: Objects and materials can be sorted and described by their properties.

Kindergarten Mathematics K.MD.2: Directly compare two objects with a measurable attribute in common to see which object has "more of" or "less of" the attribute, and describe the difference.

Next Generation Science Standards:

2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

COSIconnects learning lunchbox

Space

ACTIVITY 4 : Impact Craters

Astronauts go into space to collect scientific data, and today you will do just that! Have you ever noticed craters on photos of the moon? In this activity, you and your team of astronauts will collect scientific data on impact craters.

GRADES 3–5

Extended Learning Questions:

1) With an adult's help, find a picture of a crater on Earth and a picture of a crater on the moon. Compare the pictures: what is similar? What is different? Why do you think there is a difference between how craters look on Earth and how they look on the moon?
2) Over time, the Earth's surface changes due to weathering. That means that water, ice, wind, animals, and vegetation change the Earth's surface. Imagine a meteoroid hits the Earth and leaves a crater in its surface. How might weathering affect that crater?
3) With an adult's help, look online to learn how meteors have impacted life on Earth in the past. Write one paragraph about what you learned. Did anything surprise you?

Ohio Learning Standards:

4th Grade Science 4.ESS.2: The surface of Earth changes due to weathering.

4th Grade English Language Arts W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

Next Generation Science Standards:

4-ESS2-1: Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

GRADES 6–8

Extended Learning Questions:

1) Using the diameter you measured, calculate the radius, circumference, and area of one of your craters.
2) Something that is falling toward the ground has kinetic energy (energy of motion). What happens when a meteorite hits the ground? If the meteorite stops moving, where do you think that energy goes? How is it transferred?
3) Gravity is an attractive force between two objects. Think about a meteoroid traveling through space. Does it experience gravity? When, and how? When might it experience stronger or weaker gravitational pull?

Ohio Learning Standards:

6th Grade Science 6.PS.3: There are two categories of energy: kinetic and potential.

7th Grade Math 7.G.4. Work with circles.

7th Grade Science 7.PS.3: Energy can be transformed or transferred but is never lost.

8th Grade Science 8.PS.2: Forces can act to change the motion of objects.

Next Generation Science Standards:

MS-PS3-5: Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

MS-PS2-4: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Join us at our Community Learning Table: "Community Connects"

The Community Connects section of this digital hub brings together educational resources from museums, cultural institutions, and other nonprofits in your community to extend your learning

cosi.org/connects

COSI Center of Science and Industry

COSIconnects learning lunchbox

Space

ACTIVITY 5: Make a Parachute

Now that you have collected data on the moon, it is time for you and your team to get back into your space capsule and return to Earth. One very important safety feature for astronauts returning to Earth is a parachute. Use your engineering skills one last time to design the perfect parachute!

Ohio Learning Standards

K – 2nd Grade Technology K-2.DT.2.b: Demonstrate the ability to follow a simple design process: identify a problem, think about ways to solve the problem, develop possible solutions, and share and evaluate solutions with others.

3rd – 5th Grade Technology 3-5.DT.2.b: Plan and implement a design process: identify a problem, think about ways to solve the problem, develop possible solutions, test and evaluate solution(s), present a possible solution, and redesign to improve the solution.

2nd Grade Science 2.ESS.1: The atmosphere is primarily made up of air.

6th Grade Science 6.PS.4: An object's motion can be described by its speed and the direction in which it is moving.

Next Generation Science Standards

5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.

MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

3-5-ETS1-3: 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.

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

GRADES K–2

Extended Learning Questions:

1) Jump up three times in three different ways. Can you make a really small jump? Can you make a really big jump? Gravity will always make you come back down to the Earth!
2) Make one parachute with a coffee filter and another with tissue paper. Drop both parachutes from the same height. Does one work better? Why do you think that is?
3) What would happen if a parachute had a hole in it? Make one parachute without a hole, and another with a hole. Drop both parachutes from the same height. What do you notice?
4) Attach a different object to your parachute. Drop it again. Does this object change the way the parachute moves?
5) Tell a story about the parachute you made. What was the most fun about making the parachute? What was something that was hard?

Ohio Learning Standards:

1st Grade ELA RI.1.1: Ask and answer questions about key details in a text.

2nd Grade Science 2.PS.1: Forces change the motion of an object.

2nd Grade ELA SL.2.4: Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent sentences.

Next Generation Science Standards:

K-2-ETS1-3: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Space

ACTIVITY 5: Make a Parachute

Now that you have collected data on the moon, it is time for you and your team to get back into your space capsule and return to Earth. One very important safety feature for astronauts returning to Earth is a parachute. Use your engineering skills one last time to design the perfect parachute!

GRADES 3–5

Extended Learning Questions:

1) When a parachute is falling toward the Earth, drag slows it down. Gravity pulls it toward the Earth. Explain in your own words: How do drag and gravity work together to make parachutes function?
2) What would happen if a parachute had a hole in it? Make one parachute without a hole, and another with a hole. Drop both parachutes from the same height. What do you notice?
3) What changes could you make to the parachute to increase the drag? Is there any way to completely stop the parachute from falling? Why or why not?

Ohio Learning Standards:

5th Grade ELA L.5.4: Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 5 reading and content, choosing flexibly from a range of strategies.

5th Grade Science 5.PS.1: The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

Next Generation Science Standards:

3-PS2-1: Plan and construct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.

GRADES 6–8

Extended Learning Questions:

1) How do you think space programs identify where a capsule will land on Earth? Are there any ethical considerations that need to be made about where it lands?
2) Attach a heavier object to your parachute and perform a drop test. Observe any changes in how your parachute moves. What design changes could you make to account for the weight of the new object?
3) Design a new parachute to accommodate the heavier object. Once you have a final design, perform three drop tests and document the distance traveled (d) and time (t) for each test. Find the average speed for each test using the equation: speed=distance/time, or speed = d/t.

Ohio Learning Standards:

6th - 8th Grade Technology 6-8.ST.1.d.: Analyze an environmental concern and investigate technology solutions to that problem.

6th – 8th Grade Technology 6-8.DT.2.a.: Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution.

Next Generation Science Standards:

MS-PS2-2: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Join us at our Community Learning Table: "Community Connects"

The Community Connects section of this digital hub brings together educational resources from museums, cultural institutions, and other nonprofits in your community to extend your learning

cosi.org/connects

COSI Center of Science and Industry

Glossary:

Astronaut – A person who flies on a NASA spacecraft and is launched into Earth's orbit or beyond.

Comet – A ball of frozen gases, rock, and dust that orbits the Sun or other stars.

Crater – A bowl-shaped depression in the surface of a moon or planet.

Impact craters – Bowl-shaped depressions that are made when rocks from space hit a planet or a moon.

Diameter – The distance of a straight line from one side of a circle to the other that crosses through the center.

Gravity – An invisible force that pulls objects toward one another.

Meteor – A rock from outer space that enters Earth's atmosphere.

Meteorite – A rock from outer space that reaches the ground on Earth.

Meteoroid – Small pieces of rock-like debris flying through outer space.

Parachute – An umbrella-shaped piece of fabric that slows down a person or an object for a safe landing.

Payload – The stuff carried by a vehicle.