

Dear Educator,

You may have told your students that they have the potential to reach the stars, but now, they can actually prepare to make that trip when they visit Kennedy Space Center's new hands-on Astronaut Training Experience® (ATX) and Mars Base 1 (MB1) programs. There, they can train to be an astronaut and learn what it will take to sustain human life on the red planet.

The STEM activities in this free guide created by the curriculum experts at Young Minds Inspired (YMI) are designed to equip students for the exciting future that awaits us in space. Aligned with Next Generation Science Standards, the activities are designed to seamlessly integrate with and enhance your science curriculum, giving students a foundation for exploring the real-world issues related to space travel that they can only experience in person at Kennedy Space Center in Florida.

The ATX and MB1 adventures at Kennedy Space Center provide visitors age 10 and older with a unique experience involving the most immersive simulators and virtual reality challenges available on this planet. Both adventures use authentic NASA science, and the data that visitors develop is even used by NASA for research!

So join the journey at the gateway to NASA's bold future by sharing this program with other teachers in your school. Please comment online at ymiclassroom.com/feedback-atx to let us know your thoughts on this program. We look forward to hearing from you.

Sincerely,



Dr. Dominic Kinsley
Editor in Chief
Young Minds Inspired



Questions? Contact YMI toll-free at 1-800-859-8005 or by email at feedback@ymiclassroom.com.



TARGET AUDIENCE

Students in grades 4-6 and their families.

OBJECTIVES

- Stimulate student interest in science and space exploration.
- Promote interest in the ATX and Mars Base 1 experiences at Kennedy Space Center.
- Integrate STEM-based activities into real-world experiences that lay the groundwork for students' lives and career interests.

PROGRAM COMPONENTS

- This two-page teacher's guide.
- Two reproducible activity sheets and a take-home parent letter.
- Dedicated microsite at ymiclassroom.com/atx with standards alignment and links to free NASA resources.

HOW TO USE THIS PROGRAM

Download and photocopy this teacher's guide and the two activity sheets, and have students share the take-home letter with their families. Prepare the materials for each activity in advance.

ACTIVITY 1

ATX: TRAIN LIKE AN ASTRONAUT.

Materials needed: Pencils, activity sheets, and scissors. Per group of 3-4 students: 20 craft sticks, five marbles, one straw, three feet of string, one hot-glue gun, and glue.

Ask students to volunteer what they might know about Newton's three Laws of Motion. Do they know that, in addition to affecting how things move on Earth, Newton's Laws also affect how things move in outer space? Depending on students' prior knowledge, review Newton's Laws in class (taken from www.grc.nasa.gov/www/k-12/UEET/StudentSite/dynamicsoflight.html#lawofmotion):

1. If an object is not moving, it will not start moving by itself. If an object is moving, it will not stop or change direction unless something pushes it.
2. Objects will move farther and faster when they are pushed harder.
3. When an object is pushed in one direction, there is always a resistance of the same size in the opposite direction.

Explain that, on Earth, it is easy to see how these Laws affect our everyday lives. Ask students to share examples of each Law. Students might say that a skateboard doesn't start moving until you push off (Law 1), a sled will go faster and faster when someone is pushing it (Law 2), and a diving board will spring back up when you jump off it (Law 3).

Now ask students if anyone knows the name of a force that can start an object moving. Give them a hint by forming a ramp with a cardboard and a few books and placing a marble at the top. Ask students what will happen before you let the marble go. How many students knew that it was gravity that caused the marble's movement?

Gravity is an important part of Newton's Laws. On Earth, gravity exerts an enormous force. Above Earth, however, it does not. (Earth's gravity weakens the further you get from the center.) So, although Newton's Laws follow the same rules on Earth as they do in space, in space they act a bit differently.

To demonstrate this, show students the video of an early spacewalk at <https://kcts9.pbslearningmedia.org/resource/phy03.sci.phys.mfw.asrnt/newtons-third-law-of-motion-astronauts-in-outer-space/#.WmvybDdG3IU>, then discuss the problems the astronauts encountered when trying to move and perform tasks. Which of Newton's Laws seemed to cause the most problems? (Newton's Third Law)

Now ask students to brainstorm ways to help these early astronauts. Students might suggest modified tools that can be used with one hand while the astronauts brace themselves with their other hand. Or astronauts might use a "seat belt" or other brace to hold themselves in place. Explain that, today, astronauts on the International Space Station use "restraining loops".

Now distribute the activity sheets and materials needed. Tell students that they will work in small groups using the instructions on the sheet to build a machine called a Newton's Cradle, a classic illustration of Newton's three Laws of Motion. First show them this video to get an idea of what they are going to build: <https://www.youtube.com/watch?v=0LnbyjOyEQ8>. Then tell them that they can actually experience Newton's Laws up close and personal on the microgravity trainer that is part of the ATX experience at the Kennedy Space Center!

ACTIVITY 2

MARS BASE 1: ADAPT AND SURVIVE.

Materials needed: Pencils and activity sheets. Per group of 3-4 students: scissors, two 2-liter soda bottles (empty and washed), duct tape, 6-inch piece of heavy cotton string, 1 liter of naturally sourced water (from a pond, lake, spring, or rain barrel), 2-3 cups of potting soil, and one or two small plants (with roots attached).

Prepare the bottles in advance, including punching or drilling a hole through the lower bottle cap. To do this, cut the bottles as shown in the diagram on the activity sheet, but do not attach the pieces until students have added the water and soil.

Introduce the idea that if humans eventually live on Mars, they will need nutrition from plants grown in biomes. Ask students to share what they already know or may remember about biomes, including how biomes support life on Earth. Then ask them to share some details about the biome in which they live, including specific plants and how those plants help humans survive. Point out that all biomes are part of Earth's biosphere.

Challenge students to share what they know about Mars. Does Mars have a biosphere? Although Mars has a thin atmosphere, it does not appear that the planet has a biosphere with any biomes that can support life. Ask students to brainstorm what this might mean for NASA's plans to put humans on Mars.

Show students the video at <http://channel.nationalgeographic.com/mars/videos/growing-food-on-mars/>, then point out that while plants are a vital part of a biome, the soil on Mars is not conducive for plant growth—at least, not the kinds of plants humans need to survive.

Distribute the activity sheets, and challenge students to imagine that they are NASA scientists charged with designing a botany lab on Mars—one that will keep plants alive in a closed environment and protect them from the temperature extremes found there. Students will first design a miniature version of their Mars botany lab by working in small groups to follow the directions on the sheet, then they will record how long the plants stay alive while experimenting with ways to protect them from hot and cold temperatures.

PARENT TAKE-HOME LETTER

Distribute copies of the letter for students to give to their parents or guardians so that they are aware of the unique opportunity for their children to experience hands-on what it's like to train like an astronaut preparing to live on Mars, only available at Kennedy Space Center's Astronaut Training Experience and Mars Base 1 programs.



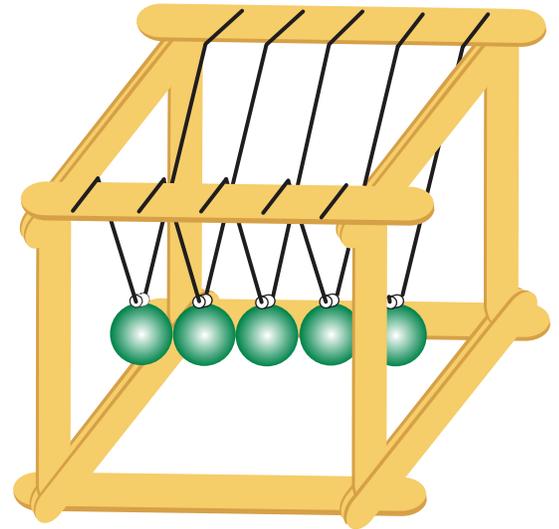
ATX: TRAIN LIKE AN ASTRONAUT.



ATX® is the all-new Astronaut Training Experience® at Kennedy Space Center. When you sign up for ATX, you learn how to live and work in space, using immersive simulators and virtual reality technology. You'll be part of a crew that blasts off to explore Mars, and even get to experience a spacewalk in a microgravity simulator.

At ATX, you'll also learn the importance of Newton's three Laws of Motion. It is these laws that drive rocket propulsion and enable astronauts to move effectively in space. To get ready for ATX, work with a small group of classmates to build a machine that demonstrates Newton's Laws of Motion—a Newton Cradle!

1. Cut your straw into five pieces small enough to fit on top of the marble. You will thread your string through the straw.
2. Use the hot glue to secure the pieces of straw to the top of each marble and let dry.
3. Build your frame using the craft sticks and hot glue. Think about the video you saw and check out this example at right.
4. Once the frame is dry, thread your string through the straws and attach the marbles to the frame. **Tip:** Make sure the marbles are touching when they are at rest!
5. Put your machine into action!



Now answer these questions:

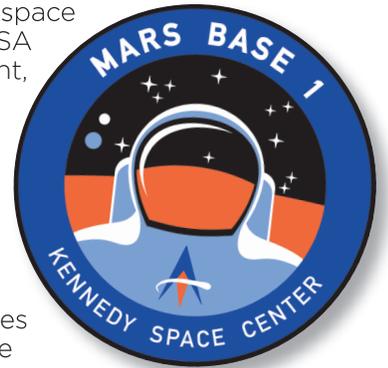
1. How does your cradle demonstrate Newton's Laws of Motion? _____
2. What was the most difficult part about building the cradle? _____
3. How can you improve your design? _____



Take your learning one step further and enjoy the adventure of a lifetime! Nowhere else on Earth can you experience astronaut training but at Kennedy Space Center. In the all-new Astronaut Training Experience (ATX), you can train to live and work in the Martian environment through exciting and immersive simulation technology. Join the crew as you complete a mission simulation including launching, landing, and walking on Mars, and experience a spacewalk in a microgravity simulator. For details, visit [KennedySpaceCenter.com/atx](https://www.kennedyspacecenter.com/atx)

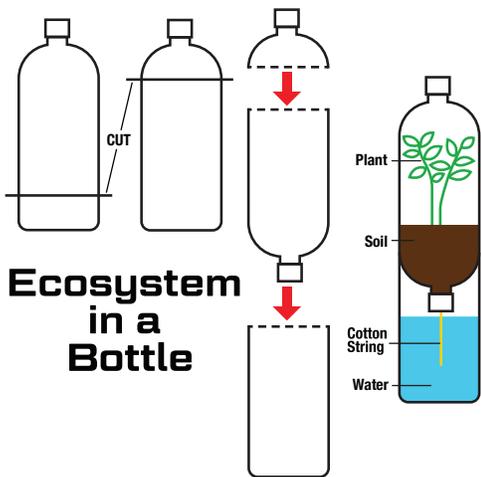
MARS BASE 1: ADAPT AND SURVIVE.

Mars Base 1 is Kennedy Space Center’s new hands-on adventure for next-generation space explorers. When you sign up for Mars Base 1, you’re part of a team managing the NASA Base Operations Center on Mars. You’ll face the challenges of the Martian environment, program robots to optimize solar energy, and grow plants in the Botany Lab to provide real data for NASA research.



Get ready for Mars Base 1 by working with a small group of classmates to create a prototype botany lab—in a bottle! Follow these instructions and the diagram below:

1. Fill the bottom part of your botany lab (the bottle without the lid) about halfway full of the water your teacher will give you.
2. Thread the string through a hole in the cap of the other bottle. Leave about 2 inches of string sticking out inside the bottle. The other 4 inches will dangle down into the water.
3. Turn the bottle with the string upside-down and fit it into the bottom part of your lab, as shown in the diagram, so that the string is in the water. Use tape to secure the two pieces together.
4. Fill the top part of your bottle lab with about 3 inches of potting soil.
5. Plant your plants in the soil.
6. Use tape to secure the bottle top you cut off to the top part of your lab.



Now answer these questions:

1. How long do you think the plants will survive? _____

Why? _____

2. Place your botany bottle lab in a sunny place. Observe your plants once a week and record your observations below:

Week 1 _____

Week 2 _____

Week 3 _____

Mars has extreme hot and cold temperatures. How do you think NASA scientists will protect their Botany Lab from those temperatures? Try your own experiment. Work as a team to design and create a way to protect your plants from cold, then place your botany bottle in a freezer for a few hours to see if your design worked. Next, design and create a way to protect your botany bottle from heat, and place it under a heat lamp for a few hours. Record your results on the back of this sheet.



Continue your adventure! Travel to Mars to live and work for the day at Kennedy Space Center’s Mars Base 1. Set in a landscape of the future, Rookie Astronaut teams have the unique opportunity to manage the Base Operations Center on Mars, grow and harvest plants in the Botany Lab, program robots to optimize solar energy, and adapt to the challenges of living in the Martian environment! For details, visit KennedySpaceCenter.com/atx

Dear Parents and Guardians,

You want the world for your child—but what if you could give him or her a once-in-a-lifetime learning experience that is out of this world? Now you can. Your child can enjoy a unique, exhilarating, hands-on adventure with the new Astronaut Training Experience® (ATX) and Mars Base 1 (MB1) programs at Kennedy Space Center in Florida.



This exciting educational opportunity makes what students have learned in their classroom science and STEM lessons come alive as they practice the skills astronauts need to travel and work in space, or spend a day managing operations at a base on Mars while providing real data for NASA research. It's an investment in your child's future and an adventure that could very well ignite a lifelong passion for science, setting your child on course to a real career option.

ATX and MB1 are only two attractions in the galaxy of fun and learning your family can explore at Kennedy Space Center. Get an up-close look at the spacecraft that took us to new frontiers and learn more about the story of our country's history of space exploration.

It's an experience that can be found nowhere else in the world, and one that your family will treasure for the rest of their lives.

For more information, visit [KennedySpaceCenter.com/atx](https://www.kennedyspacecenter.com/atx)

