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. At a point in their lives where they are thinking about their futures, this just might direct them to an interest in space and/or an ultimate career goal involving the sciences.

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 7-12 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 items to build simple and compound machines, e.g., scissors, box cutters, cardboard, spools, wooden skewers, craft sticks, hot-glue guns, glue, string, levers, nails, screws, hammers, wheels, wooden blocks, craft sticks, small buckets or cups, linking building blocks such as Legos or K'NEX. If you have access to a 3-D printer, have students create their designs on the printer and put them together to form their machines!

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, as follows:

1. Every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force.
2. Force is equal to change in momentum (mass x velocity) per change in time. For a constant mass, force equals mass times acceleration. (F=ma)
3. For every action (force) in nature, there is an equal and opposite reaction.

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).

Ask students to watch as you demonstrate one of Newton's Laws. Line up four marbles on a flat surface. Then, roll a fifth marble so that it hits the first marble in line. Have students describe what happened, and which Laws were demonstrated (the first and third). How would the demonstration change if you placed the marbles on a ramp? (Both gravity—a force—and Newton's second Law would apply.)

Remind students that a ramp (inclined plane) is an example of a simple machine, and that there are many simple and compound machines that work according to Newton's Laws. Prompt students to name some (simple: lever, pulley, inclined plane, wedge, screw, wheel and axle; compound: wheelbarrow, crane, scissors, seesaw, bike, and anything else that combines two or more simple machines).

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 farther 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)

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 use the engineering design process to work in small groups and build a simple or compound machine that will illustrate one or all of Newton's three Laws of Motion.

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).

The above materials are the minimum needed to build a basic bottle biome. If you have other materials such as aquarium gravel or glass jars, feel free to include them and encourage students to be creative. You may also choose to let students add living organisms such as pill bugs, worms, or garden/land snails.

Introduce the idea that if humans eventually live on Mars, they will need sustainable 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. Therefore, scientists will have to create a botany lab on Mars to grow plants.

Ask students to brainstorm what living and nonliving things could be part of a Mars botany lab, as well as what challenges scientists on Mars would need to overcome. Write student responses on the board. Now distribute the activity sheets. Acting in the role of 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 planet's temperature extremes—students will first work in small groups to envision and create their own miniature version of a "bottle botany lab", using their choice of the materials listed above. Then they will record how long the plants stay alive while experimenting with ways to protect them from hot and cold temperatures.

Note: Middle school students might need a model to help them build their labs. Consider doing a Google image search of "bottle biomes" and projecting the results on a screen. This should give them guidance without step-by-step instructions, as planning and building their own projects is an important part of the STEM process.

Students of all ages can then follow-up by designing a logo for their botany lab and giving an oral presentation that includes support for how their lab would be a vital part of a Mars colony.

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.

ACTIVITY 1

Reproducible Master

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 create a simple or compound machine that demonstrates Newton's Laws of Motion. Follow the engineering design process to create your plan, using the chart at right.

Now, answer these questions:

1. Describe your machine. _____

_____

2. Which Law(s) of Motion does it demonstrate?

_____

3. What improvements did you make to your machine?

_____

4. How could your machine help astronauts do their work in space or on Mars?

_____

_____

Name

_____

Stem Challenge

_____

Ask

_____

Imagine

_____

_____

Plan

_____

_____

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Create

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_____

Improve

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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**

ACTIVITY 2

Reproducible Master

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. Use your choice of the materials provided to build a self-sustaining biome. Draw a sketch of your design in the space at right, then trade ideas with your classmates and build your botany lab. Test your design by placing your prototype in a sunny location. Then answer the questions below:

1. Why did you choose your design?_____

_____

2. How will it work? _____

_____

3. What was the most difficult part of your design to implement?

_____

4. How did you solve that problem? _____

_____

5. Observe your plants once a week, for several weeks, 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 develop a way to protect your plants from cold, then place your prototype botany lab in a freezer for a few hours to see if your design worked. Next, develop a way to protect your botany bottle from heat, and place it under a heat lamp for a few hours. Record your results.

Cold _____

Heat _____

Now design a logo for your botany lab and give an oral presentation that includes information on how your lab would be a vital part of a Mars colony. Sketch your logo 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**