

NASA STEM Challenge Fact Sheet

Partners for 21st Century Learning

The U.S. Department of Education's (ED's) 21st Century Community Learning Centers (21st CCLC) program is partnering with other federal agencies to bring exciting content and experiences in science, technology, engineering and math (STEM) to students in some of the nation's highest-need communities. The programs, which take place during out-of-school time, currently benefit underserved students in almost 80 21st CCLC sites in 10 states nationwide.

Since 2013, ED has collaborated with NASA to give student teams the opportunity to tackle real-world engineering design challenges and to interact directly with NASA scientists and engineers.

About ED's 21st CCLC Program

ED's 21st CCLC program supports the creation of community learning centers that provide academic enrichment opportunities during non-school hours for children, particularly those who attend high-poverty and low-performing schools. These 21st CCLCs help students meet state and local standards in core academic subjects, such as reading and math, and offer enrichment activities that complement schools' regular academic programs.

ED-NASA Partnership

The ED-NASA collaboration provides students with the opportunity to solve challenges currently being addressed by NASA scientists and engineers. Throughout the program, 21st CCLC staff and students interact directly with NASA scientists and engineers, learning firsthand about engineering design and practices.

NASA STEM Challenge

In 2013, 20 21st CCLC sites across three states participated in one of three engineering design challenges from NASA. In 2015, almost 80 21st CCLC sites across 10 states are participating, and students in these sites can choose from six challenges. The NASA STEM Challenges are based on real mission data and experiences that occur during human and robotic exploration of the solar system, and they are designed for students in grades 5-8.

Throughout the eight-week challenges, as students participate in interactive web sessions with NASA scientists and engineers, they get feedback as they develop their engineering designs and learn firsthand about STEM careers. At the culmination of the program, student teams create and submit brief videos showcasing the solutions they have developed in response to the challenges. ED leaders, as well as NASA scientists and engineers, will review the student videos, and some will be highlighted in a culminating live Web event.

The challenges, which were developed as part of NASA's Summer of Innovation program, provide participating sites with an educator guide, introductory videos, and resources to help educators conduct the challenges and engage the students.

- **Challenge 1: Parachuting Onto Mars.** The challenge objective is to build a device to slow the descent of a spacecraft or probe, while protecting its cargo for a successful landing. The device must be designed, built, and tested using only the materials and template provided. The drag device must have at least five separate angled edges and should protect the weighted cargo bay when dropped from a height of at least 2 meters. In developing their solutions, students learn about design, surface area, mass and descent time. For the final product, student teams create a video featuring the process they used to design the device.
- **Challenge 2: Spaced Out Sports.** The challenge objective is to design a sports game, using Newton's Laws of Motion, that could be used by astronauts on the International Space Station. The activity should be entertaining and something that might also be included in the astronauts' physical fitness program. Students work as a team to design and build a game that astronauts could play in a microgravity environment. It must be played within a 5- to 10-minute timeframe, with clear rules for scoring and determining winners. The focus of the game is a projectile that is launched toward a goal positioned at least two meters away. Development of the game provides students with an opportunity to learn about and apply Newton's Laws of Motion. For the final product, student teams create a video explaining the process followed to develop the game.
- **Challenge 3: Radiation Shield.** The challenge objective is to design and build a radiation shield that can absorb or reflect as much visible and ultraviolet light as possible. The shield will also be subjected to tests for flexibility, ballistic impact and load bearing; and if it survives, it must be immersed in water for 10 seconds, followed by a repeat of all tests. Through the process of designing their shields, students learn about the space environment, material properties and protective technologies. For the final product, student teams create a video explaining the process they followed to solve the problem of protecting astronauts from space radiation.
- **Challenge 4: Why Pressure Suits?** The challenge objective is to design a pressure suit or spacesuit that will protect a high-altitude pilot or astronaut from the low-pressure environment of a near-vacuum or vacuum environment. The pressure suit must completely surround the pilot or astronaut to provide protection to the human body, and it must be constructed of materials that are not affected by the vacuum environment. During this challenge, students learn about pressure, temperature and density and how they vary with altitude. For the final product, student teams create a video about the process they followed to design the pressure suit or spacesuit.
- **Challenge 5: Packing Up for the Moon.** The challenge objective is to design and develop a plant growth chamber that would be used by astronauts to grow vegetables on the moon. Students work in a team to design and build a plant growth chamber with a growing area of 1 square meter. The model must show how the plant growth chamber

opens from its delivery configuration to its growing configuration once it is on the surface of the moon. It must be a separate, independent structure from the lunar station; however, placement and access to the chamber must make it possible for astronauts to tend to and harvest crops without venturing onto the lunar surface. The chamber must have systems that provide light, temperature control, water, nutrient delivery and power. In designing the chamber, students learn about design criteria and constraints and about how the earth's and moon's environments differ from each other. For the final product, student teams create a video featuring the process they followed to design the plant growth chamber.

- **Challenge 6: Design a Crew Exploration Vehicle.** The objective is to design and construct a Crew Exploration Vehicle (CEV), which must carry two toy astronauts as passengers. The CEV must fit inside designated size and weight constraints and carry two astronauts measuring 2 centimeters in length. Student teams design and build secure seats for the astronauts without gluing or taping them in place. The astronauts must stay in their seats during drop tests and be able to enter and exit the CEV through a designed hatch. In developing CEVs, students learn about the design process, troubleshooting, invention and innovation. For the final product, student teams create a video describing the design and testing they completed to arrive at their solutions for a CEV.