National Aeronautics and
Space Administration

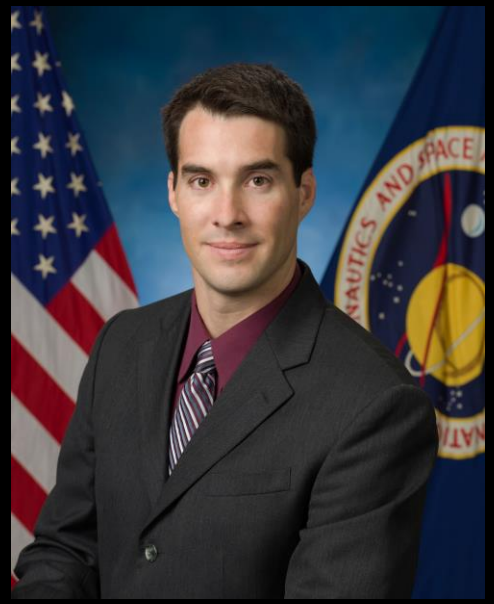
INSPIRE - ENGAGE - EDUCATE - EMPLOY
The Next Generation of Explorers

Celebrating Station Science

STEM on Station
February 4, 2021
Scott Black & Krystal Winters

20 Years on the International Space Station

Presenters



Scott Black
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Today's Agenda

- ✓ Twenty Years on the International Space Station by the Numbers.
- ✓ Educator Resources from STEM on Station.
- ✓ Celebrating Station Science Series
- ✓ Activity – STEMontration: Exercise.
- ✓ Celebrating Station Science: Experiments.
- ✓ Questions-and-Answers.

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The International Space Station by the Numbers

Celebrating 20 Years of Continuous Human Presence

Nov. 2, 2020

Marking 20 Years of Continuous Human Presence on the

International Space Station

Deep Space Exploration | Commercial Space Market | Global Partnership | Space Laboratory

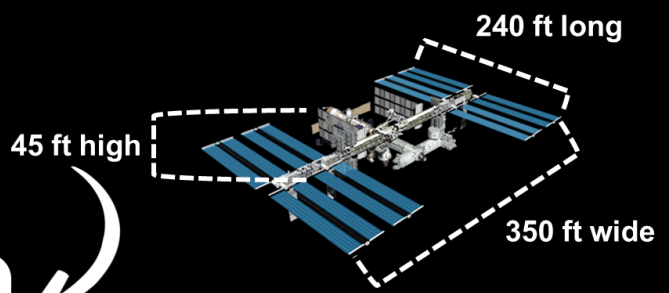
A truly global endeavor, the unique microgravity laboratory has hosted **242** people from **19** countries, nearly **3,000** experiments from over **4,000** researchers in **108** countries, and a variety of international and commercial spacecraft.

The International Space Station is the blueprint for American leadership in global cooperation, enabling a U.S.-led multinational partnership to advance shared goals in space exploration and remains the sole space-based proving ground and **stepping stone** for NASA's **Artemis** program.

nasa.gov/station | #SpaceStation20th

Space Station: Facts and Figures

The Space Station was built on orbit over 41 assembly flights between 1998 and 2011. There have been 215+ successful launches to station to date to deliver crew, supplies and science.



Powered by 262,400 solar cells housed in 38,400 square feet of solar arrays.

Internal volume of 32,333 cubic feet – about the size of a 6 bedroom house.

Travels approximately 250 miles above Earth at 17,500mph.

Orbits the earth 16 times per day. Orbital path overs 90% of Earth's population.

Humans in Space: Facts and Figures

More than 239 different people from 19+ countries have visited the Space Station. 100,000 people at more than 500 facilities in 37 states and 16 countries cooperate on space station operations.

Built to house a crew of 3 to 9 people.

NASA astronaut Christina Koch broke the record for longest continuous spaceflight by a woman, returning to Earth in February 2020 after 328 days in space!

225+ spacewalks for space station construction, maintenance and upgrades conducted since December 1998.

About 63,000 meals eaten on station since the first Expedition in 2000

Space Station Mission

- ✓ Build international and commercial human exploration partnerships
- ✓ Enable long-duration human spaceflight beyond low-Earth orbit
- ✓ Return benefits to humanity through basic and applied research
- ✓ Facilitate the development of a commercial market in low-Earth orbit

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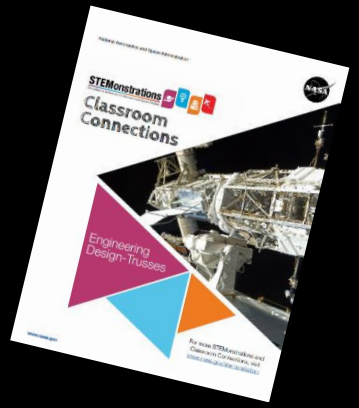
Educator Resources from STEM on Station

STEM on Station Resources

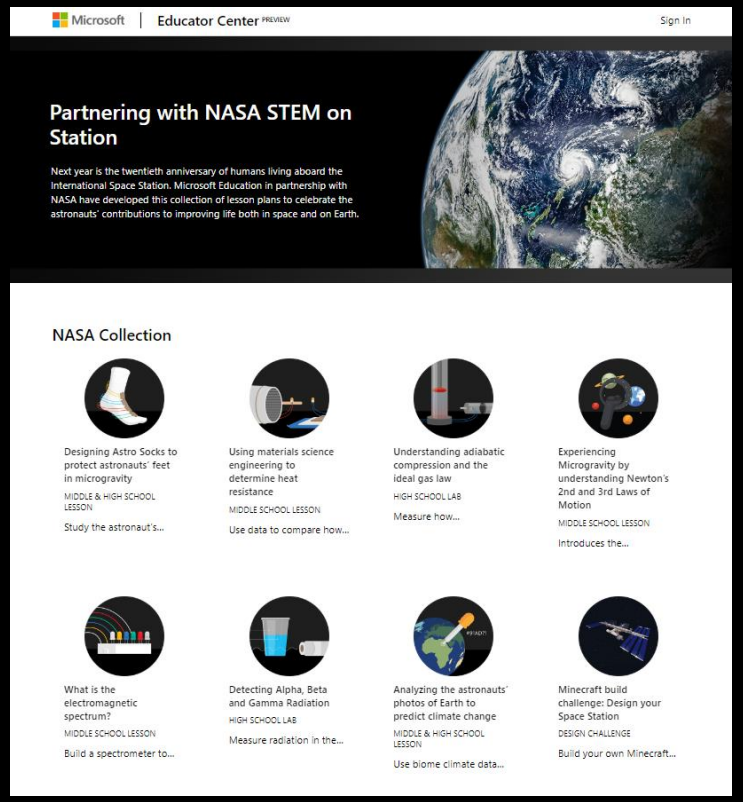
STEMonstrations



In-flight Education Downlinks

STEM on Station Resources

Microsoft Hacking STEM

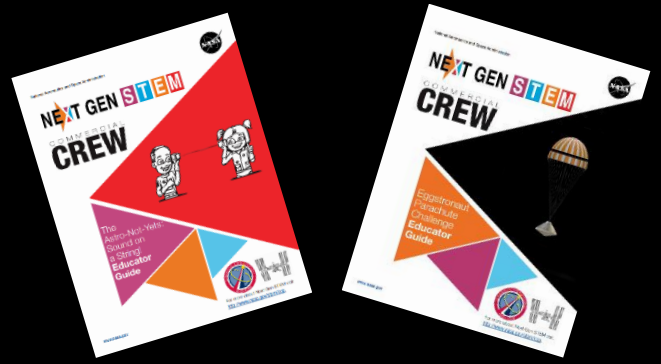


Expeditionary Skills for Life

STEM on Station Resources

Commercial Crew Program

Commercial Crew
STEM Mission Kit



Celebrating Station Science

Get Involved with Station

Visit the STEM on Station website for lesson plans, videos, news updates + out-of-this-world opportunities!

www.nasa.gov/stemonstation

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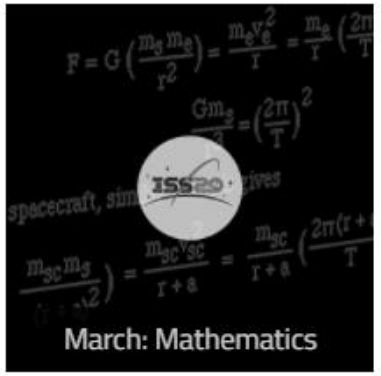
Celebrating Station Science

Celebrating Station Science

- Yearlong celebration of science on the International Space Station for a K-12 STEM education audience.
- Updated throughout the 2020-2021 school year.
- Resources grouped into monthly themes.

Celebrating Station Science: Monthly Themes

Explore through a variety of theme-based resources.



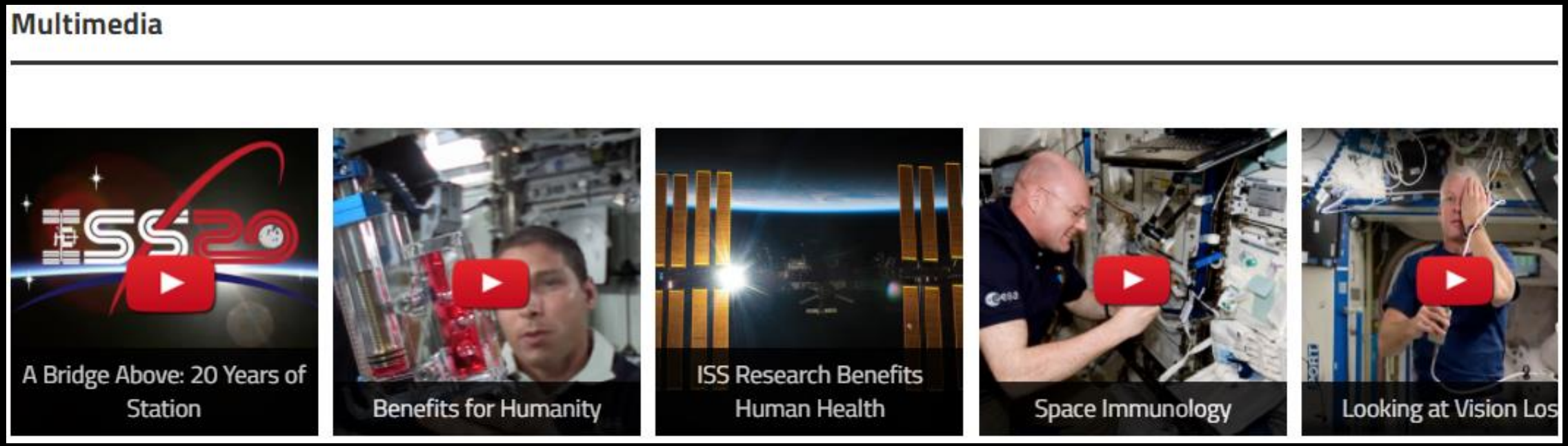
Celebrating Station Science: Lesson Plans

Celebrating Station Science: Computer Science

Follow Us

Lesson Plans

Celebrating Station Science: Multimedia



ScienceCasts Discussion

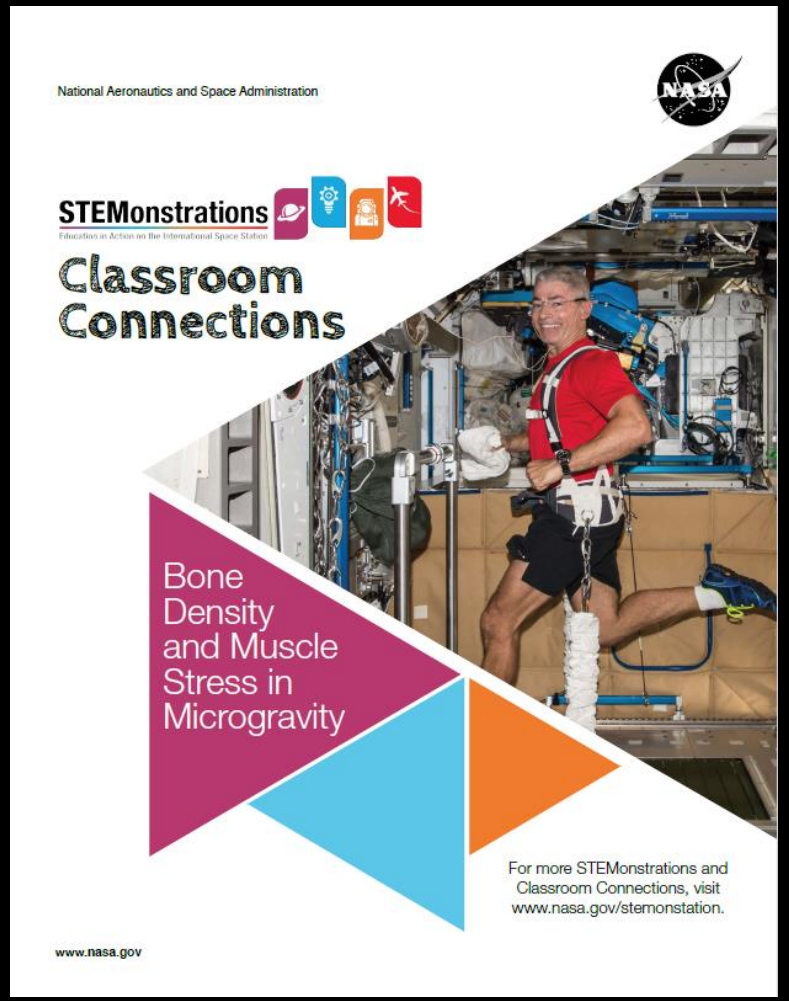
- What would students learn about plants and plant growth from the video?
- What would students learn about the nature of science and scientific method from the video?
- How can you incorporate ScienceCasts into classroom lessons/activities?

Activity: Exercise STEMonstration

Osteoporosis Discussion

- Who is impacted by osteoporosis?
- What causes osteoporosis?

STEMonstration: Exercise



Grade Level: 4-8

Time Required: 60 minutes

Next Generation Science Standards:

- **4-LS1-1.** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- **MS-LS1-1.** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
- **MS-LS1-3.** Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

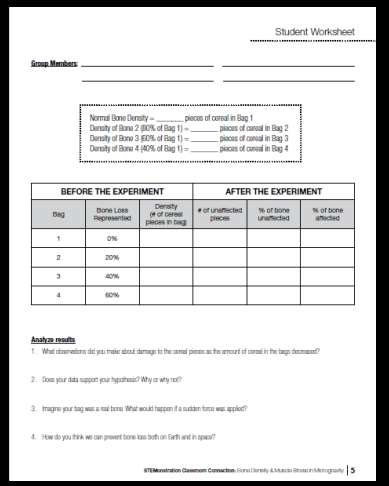
Objective:

- Identify the effects of decreased bone mass
- Describe why healthy bones are important in space and on Earth.

Activity Directions

You will need:

- ✓ 4 sealable snack-size plastic baggies
- ✓ Corn puff cereal
- ✓ Heavy text book (or other heavy, durable, flat object)
- ✓ Exercise STEMonstration Classroom Connection



Student Worksheet

Group Members: _____ _____

_____ _____

Normal Bone Density = _____ pieces of cereal in Bag 1
Density of Bone 2 (80% of Bag 1) = _____ pieces of cereal in Bag 2
Density of Bone 3 (60% of Bag 1) = _____ pieces of cereal in Bag 3
Density of Bone 4 (40% of Bag 1) = _____ pieces of cereal in Bag 4

	BEFORE THE EXPERIMENT		AFTER THE EXPERIMENT		
Bag	Bone Loss Represented	Density (# of cereal pieces in bag)	# of unaffected pieces	% of bone unaffected	% of bone affected
1	0%				
2	20%				
3	40%				
4	60%				

Analyze results

1. What observations did you make about damage to the cereal pieces as the amount of cereal in the bags decreased?
2. Does your data support your hypothesis? Why or why not?
3. Imagine your bag was a real bone. What would happen if a sudden force was applied?
4. How do you think we can prevent bone loss both on Earth and in space?

STEMonstration Classroom Connection- Bone Density & Muscle Stress in Microgravity | 5

Directions:

1. Completely fill bag 1 with cereal and close it. Only fill with complete, unbroken pieces. Count and record the number of cereal pieces placed into the bag. (Tip: Count as you place cereal in the bag)
2. Fill bag 2 with 80% of the cereal as bag 1. Record the number of pieces.
3. Fill bag 3 with 60% of the cereal as bag 1. Record the number of pieces.
4. Fill bag 4 with 40% of the cereal as bag 1. Record the number of pieces.
5. Place heavy textbook on top of bag 1, push down with a hard force for 10 seconds. Repeat for bags 2-4.
6. Count and record the number of undamaged cereal in each bag. Calculate the percentage of each bag not damaged by the force.

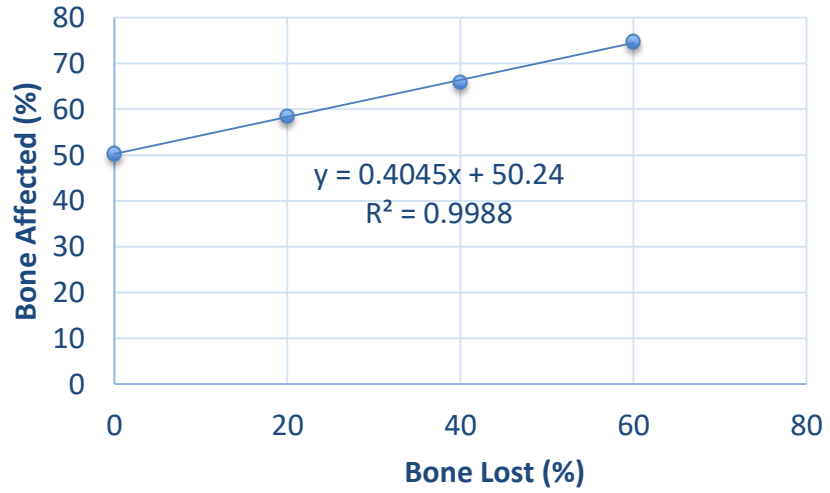
Filled Bags

Bag 1	Bag 2	Bag 3	Bag 4
0% bone loss	20% bone loss	40% bone loss	60% bone loss
308 pieces	246 pieces	185 pieces	123 pieces

Count and Record Undamaged Cereal

Example Results

BEFORE THE EXPERIMENT			AFTER THE EXPERIMENT		
Bag	Bone Loss Represented	Density (# of cereal pieces in bag)	# of unaffected pieces	% of bone unaffected	% of bone affected
1	0%	308	153	49.7	50.3
2	20%	246	102	41.5	58.5
3	40%	185	63	34.1	65.9
4	60%	123	31	25.2	74.8



Activity Discussion

1. What observations did you make about damage to the cereal pieces as the amount of cereal in the bags decreased?

2. Does your data support your hypothesis? Why or why not?

3. Imagine your bag was a real bone. What would happen if a sudden force was applied?

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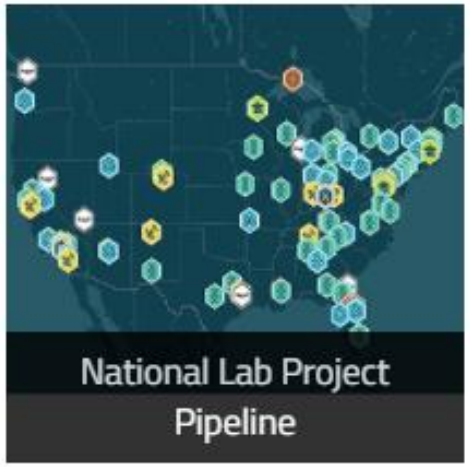
Celebrating Station Science: Experiments

Celebrating Station Science: Experiments

Space Station Experiments


National Lab Project Pipeline


Materials International Space Station Experiment


Combustion Integrated Rack (CIR)


Fluids Integrated Rack (FIR)


Microgravity Science Glovebox

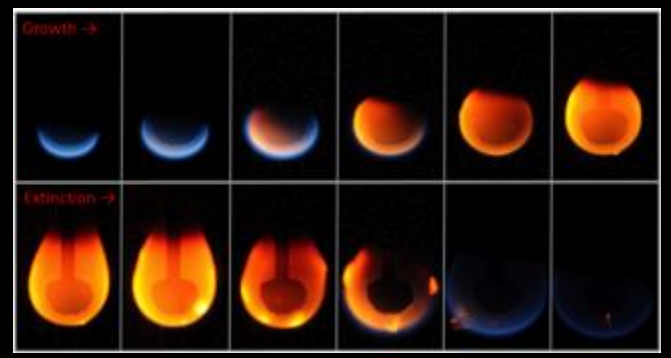
Experiment Investigation

Directions:

1. Read about an experiment found on Celebrating Station Science.
2. Identify the NGSS (or state standards) involved with the experiment.
3. In the chat, write the classroom lesson you could incorporate the experiment into, and how you would incorporate it in the lesson.

Example:

- **Experiment:** Spacecraft Materials Microgravity Research on Flammability (SMµRF) from the SoFIE series of experiments.
- **NGSS:** HS-PS1-5
- **Class Lesson/Unit:** Chemical Reactions—Oxidation-Reduction
- **How to integrate:** SMµRF identifies differences in flammability of materials in microgravity and on Earth, findings will help understand material flammability and thermal energy transfer and better understand what compounds will have oxidation-reduction reactions.

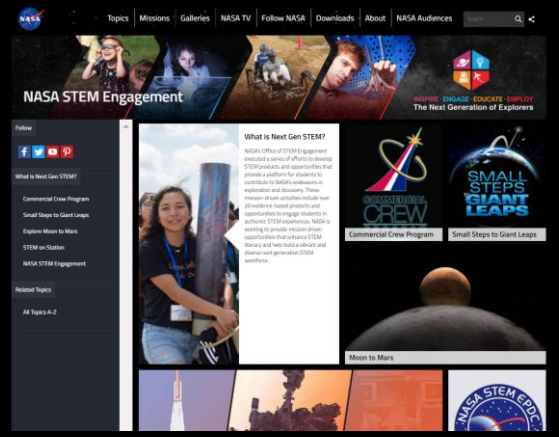


Additional Resources

NASA Express

nasa.gov/stem/express

Next Generation STEM



nasa.gov/stem/nextgenstem

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Celebrating Station Science

How will you celebrate station science in your classroom?

Questions?