VCU School of Education Partners with NASA to Connect & Engage Students with NASA’s Missions though Performance Based Learning & Engineering Design Challenges!

The Center for Innovation in STEM Education (CISTEME) hosted a virtual teacher workshop for Richmond area middle school districts in collaboration with NASA Langley Research Center and the NASA Wallops Space Flight Facility this past summer. The first phase of this two-part experience provided an engaging virtual teacher professional learning experience August 28-30.

Approximately 27 middle school teachers and specialists from Colonial Heights, Petersburg, Henrico County and Richmond City participated in the offering. Dr. Al Byers, who leads CISTEME, worked closely with the following district science and STEM leads across the four school systems to ensure the experience met each district’s unique needs, and was grade-appropriate and standards-aligned using the compelling context of NASA missions to facilitate deeper understanding of STEM science and engineering content and practices:

- Dr. Decardra Jackson, STEM coordinator, Petersburg City Public Schools
- Dr. Joe Douglas, instructional specialist, Colonial Heights Public Schools
- Dr. Eric Rhodes and Dr. Rachael Toy, Henrico County Public Schools
- Josh Bearman, science instruction specialist, Richmond City Public Schools

Dr. Byers shared his enthusiasm, saying: “We are excited for CISTEME to help provide this high impact experience in cooperation with our local school districts. Virginia is the only state in the U.S. besides California that has not one but two NASA centers, and the only other state besides Florida that launches payloads directly into orbit, resuppling the International Space Station from Wallops Space Flight Facility. It’s imperative for us to draw upon NASA’s authentic STEM content as an inspiring context for STEM learning across our region!”

Part of this experience made teachers aware of the many internships for teachers and students that are also available at both NASA Langley and NASA Wallops.
Extensive planning with the district coordinators and specialists occurred with insight and expertise from NASA that included the following individuals:

- **NASA Langley Research Center:** Office of STEM Engagement
  - Dr. Kimberly Brush, director
  - Dr. Anne Weiss, education specialist

- **NASA Wallops Flight Facility:** Education Directorate
  - Dr. Joyce Winterton, senior advisor for education and leadership development
  - Patricia Benner, education specialist
  - Victoria Danna, education support specialist

Across the three days, NASA’s Artemis Program provided a compelling backdrop for hands-on learning at a distance with the sixth grade teachers. Artemis will land the first woman and next man on the moon by 2024, using innovative technologies to explore more of the lunar surface than ever before. There has never been a better time to inspire students to be the next generation of engineers, scientists and explorers! The workshop shared the latest developments of the Artemis mission with respect to the design challenges assigned to each NASA location, in addition to discussing the Commercial Crew Program, and the Global Learning and Observations to Benefit the Environment (GLOBE) citizen science program.

Dr. Brush elaborated on the importance of the Artemis Program.

“The Artemis Program is providing career opportunities in all areas of STEM, requiring creative and innovative people to fill new roles – some of which do not even exist yet. Teachers who are informed on NASA’s work are our greatest allies in inspiring the students, who will become the workforce of the future. We are grateful for this opportunity to bring NASA subject matter experts, videos and classroom activities to teachers who are so excited to share NASA’s work with their students,” Brush said.

Teachers learned how to access and leverage NASA engineering design challenges and performance-based learning projects that addressed many sixth grade components of the Virginia Standards of Learning from biology, geology, environmental science and physics. Teachers working virtually learned first-hand from NASA scientists and engineers and participated in hands-on activities they could replicate for their students, including 2-liter rockets and engineering design challenges for life support systems that will soon be on the moon!

Dr. Winterton shared feedback from the teachers.

“The teachers reported that they will use the NASA information in their classes and that it will add a ‘real-world’ connection to their lessons. Middle school teachers are so important in helping students understand that STEM careers can be exciting and rewarding. It was a privilege for NASA to work with such dedicated educators,” Winterton said.

CISTEME worked with their partner at the Science Museum of Virginia (SMV), Timshel Purdum, director of playful learning and inquiry. A virtual earth-moon and solar system tour by Justin Bartel, SMV’s immersive experience manager and astronomer provided an online planetarium experience that may also be delivered to schools directly if desired.

At the end of the three-day workshop, Wallops Flight Facility’s Benner awarded NASA professional development certificates documenting the teachers’ contact hours for their effort. Educators report that they are already using instructional strategies learned this summer with their students while teaching virtually, posting videos of their experiences! The group hopes for a follow-up onsite experience before the school year is out. Stay tuned for more on this front as it launches.

Many teachers provided wonderful feedback such as:

- Great job! Very informative! I can’t wait to attend more NASA workshops for educators!
o Everything provided was very useful. Time flew by. Loved the videos that added excitement and just learning about what NASA is doing...I feel I can explain more to my students about what is going on in space exploration and get them excited!

o Loved it. Each day was better than the day before. Helpful workshop. You also modeled how to do virtual lessons and get students involved.

o This was great. It was content rich and I have a better understanding of the "How" and where we are going in the future. Thank you for the insight into how the Research and Pioneering Facility works. I hope to inspire my students to work at NASA in the future.

o My key take-away is how to incorporate the ENTIRE Engineering process in our Science Standards. These presentations encouraged soft skills as team--work, collaboration, creativity and to dream about the future. I got an idea of the work ethics and guiding principles of NASA's workspace (i.e. perseverance, failing forward, improve designs and keep trying). I'll also take away all the resources available to enhance and bring imagery, movement and activities to my instruction.

o Great organization and use of time! It honestly has been the most rewarding and useful PD I have had this summer.

URL SHARED BY Joanna Minott, Earth Science Teacher, Huguenot High School, Richmond City Public Schools (rocket from student at home with parents): https://drive.google.com/file/d/1--eijoBJK4d3eiie61sd2UgiYkPDW7Jz/view

NASA Langley Research Center History, Artemis and STEM Careers: DR. Kimberly Brush
NASA Langley Content Research Discussion: Mars Helicopter Rover: Anne Weiss
NASA Langley Discussion: Culturally Responsive Teaching: Anne Weiss

Culturally Responsive Teaching (CRT)

"...a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural references [that they would be familiar with] to impart knowledge, skills, and attitudes." (Gladson-Billings, 1995)

Culturally responsive teaching (CRT) activities integrate cultural contexts, art, and STEM content (an Engineer 2020 skill).
The Artemis Program

Artemis is the twin sister of Apollo and goddess of the Moon in Greek mythology. Now, she personifies our path to the Moon as the name of NASA’s program to return astronauts to the lunar surface by 2024.

When they land, Artemis astronauts will step foot where no human has ever been before: the Moon’s South Pole.

With the horizon goal of sending humans to Mars, Artemis begins the next era of exploration.

Artemis Phase 1: To The Lunar Surface by 2024

Artemis I: First human to orbit the Moon in the 21st century
Artemis II: First human spacecraft to the Moon in the 21st century
Artemis III: First human landing on the Moon
Artemis IV: First crewed mission to the Moon
Artemis V: First crewed mission to Gateway and lunar surface

Commercial Lunar Payload Services
 - CLPS: deliver science and technology payloads
 - Early Moon Missions:
 - Remove debris from lunar surface
 - First scientific landing on non-rotated human landing

Large-Gauge Cargo Landers
 - Increased capabilities for science and technology payloads

Humans at the Moon - 21st Century
First crew leverages infrastructure defined by previous missions

Lunar South Pole Target Site

2020

2024
NASA Jessica Taylor: GLOBE hands-on investigations for students

GLOBE Students Do Science

SOL: Investigate and Understand

- "Investigate" - scientific methodology and implies systematic use of inquiry skills (observing, communicating, measuring, predicting, experimentation, evaluating data…)
- "Understand" - knowledge application, include the ability to recognize, explain, apply, analyze, make judgements, etc.
Original Challenge

Hurricane Dorian hit the Bahamas and eastern United States (Virginia) September 2019, resulting in catastrophic damage. There was little way of getting food and supplies to affected residents. In this activity, you are challenged to design, build and test a propulsion system and Food Transportation Device (FTD) that can safely deliver food to affected areas during future natural disasters. The food needs to arrive intact and fresh.

Alternate Challenge

The entire community of New Rochelle, New York, was shut down in early March 2020 in an attempt to contain the spread of Covid-19. Within a one-mile radius, no one could leave their home during a two-week span for food or supplies. In this activity, you are challenged to design, build and test a propulsion system and Food Transportation Device (FTD) that can safely deliver food to affected areas during future public health crises. The food needs to arrive intact and fresh.
Materials

- Each team will receive:
  - 2 sheets of 8 ½ x 11 cardstock
  - 3 sheets of paper
  - 10 rubber bands
  - 1 plastic grocery bag
  - 4 cotton balls
  - 1 rubber cork
  - 4 straws
  - 2 pipe cleaners
  - 1 sheet of gift tissue paper
  - 1 box of raisins

Alternate Activity: Straw Rockets

https://www.jpl.nasa.gov/edu/learn/project/make-a-straw-rocket/

- Uses paper cutout, tape, scissors, straw, pencil and tape measure
- Rocket is launched by blowing on straw
- Students are challenged to change one variable at a time (e.g., type of paper used, tail fin size, etc.) and observe what that does to the rocket's flight path and length
NASA Langley: STEM Resources: Anne Weiss

www.nasa.gov/stem/nextgenstem/moon_to_mars/mars2020stemtoolkit

Available June 29, 2020
Virtual Hands-On Engineering Design Activity with Teachers: Anne Weiss
Can you balance the Orion AA-2 Launch Abort Vehicle (LAV) mass properties?

**Step 1:** Collect your right hardware pieces to make your AA-2 Launch Abort Vehicle (LAV).
- (1) pipe cleaner = AA-2 Crew Module (CM) Rollup
- (1) popsicle stick = Launch Abort System (LAS)
- (1) paper clips = ballast blocks

**Step 2:** Integrate the CM to the LAS.
Place the stick towards the center of the pipe cleaner and wrap around the stick.

**Step 3:** Complete your LAV assembly.
- (1) popsicle stick = Crew Module (CM)
- (1) pipe cleaner = Launch Abort System (LAS)

**Step 4:** Conduct 6 mass properties test of your LAV.
Try to balance your LAV (placed on your finger or a post). Talk with a friend about what you observe.

**Step 5:** How do you balance your LAV?
- Place post or finger here to try to balance.

**Step 6:** Analyze your results.
Talk with a friend about what you observed.

**Solution Explanation:**
Mass properties are mass, center of gravity (or location of mass), and inertia. The Center of Gravity (COG) of the LAV is high, so the CM and LAV is harder to balance because the COG is higher. When you add the ballast blocks, the mass and location of mass of the system changes, moving the COG to a point that is easier to balance!

**Importance of Mass Properties:**
In this example, when the ballast blocks are added to the right location, the LAV rocket will be balanced, stable, controllable, and fly in the direction you want it to go when it launches!

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**NASA Ascent Abort-2 (AA-2) Instructional Activity**
Typical Campaign Schedule

Nov-Feb
Antarctic Campaign

March-May
New Zealand

June-July
Sweden or Palestine, TX

Aug-Oct
Ft Sumner, NM

Alice Springs and Tibooburra, Australia
Lunar Base Challenge

Presented By: Victoria Danna
Education Program Support Specialist
Suborbital and Special Orbital Projects Directorate
Wallops Flight Facility

Closing Discussion

- What other online tools could you utilize to make this activity work in a virtual environment?
- What additional tools and/or resources would you need to conduct this activity?
- How can you see yourself using this activity in your classroom?

https://padlet.com/vdanna2003/p3i6u4mc05y3d