Kids and STEM: A Match Made for the Heavens

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By Mike Jones

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Every now and then a movie comes along that can be enjoyed by parents as well as the munchkins. Remember the first *Muppet Movie*? It was a delight for both kids — who ever saw a frog riding a bicycle? — and their parents (the surprising cast, the terrible puns, and silly jokes such as a huge fork in the road). Disney excels in this genre. *Frozen* dazzled all age groups with great characters, stunning music, and an unexpectedly subtle plot. *Mary Poppins* is still a foot-tapping, knee-slapping supercalifragilistic-delicacy, six decades after its release.

Happiness-wise, museums and airports usually don't have the same effect. Museums can be boring, stale, and lifeless warehouses, with artifacts displayed behind glass, arranged by experts eager to prove they're the smartest people in the room. Similarly, airports are surrounded by barbed wire and stern signs. Pretty far removed from the "happiest place on earth."

But my sister, who is almost as wise as my mostly-sainted bride, insisted during a recent visit we turn off the telly, put down our phones, and get off our butts. She orchestrated a visit to the Virginia Air & Space Science Center in Hampton, Virginia. In retrospect, it was a great suggestion.

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If you're coming by car, the Center is just about three hours south of Washington or just a short skedaddle down I-64 east of Richmond. In our case, we left the Cessna at the lively Williamsburg airport (KJGG) which is just about the closest G.A. airport to Hampton unless you want to mess with the crowded airspace around Newport News and Virginia Beach. Easy-peasy, travel-wise.

The Center is a glistening and futuristic brick and steel structure plopped down right in the center of Hampton. I was tickled to learn the facility also serves as the visitor center for the near-by Langley Air Force Base and NASA's Langley Research Center which is based at Langley. Parking is abundant and inexpensive, so you won't wear out your Birkenstocks hiking from some distant concrete mausoleum. Everything is super-modern: soaring ceilings, huge windows, sparkling clean lavatories, a nice snack bar and lots of places to sit and just look. I'm good at looking.

Looking Up

As large as the building is, there are only two dozen or so airplanes on display, and most of them hang from the ceiling. There's a Spitfire high in the sky, diminutive against the more modern jets. A burly F-4 hangs at eye-level on the second floor, teeth bared, missiles loaded. (I was coaching a group of kids to lean *way, way, way* over the balcony railing to see the gauges in the cockpit, but we were really trying to see if we could give their teacher a coronary.) The knobby F-4 contrasts with a slick F-18 in glossy black livery, while a slender, hungry-looking F-16 floats high above both. A sleek, elegant sailplane floats near the expansive front windows, while a Wright Flyer hangs nose-to-tail to a bright yellow Stearman biplane.

There's a fascinating backstory to many of the airplanes on display. They're not the usual museum pieces, collected from bone yards and resuscitated by volunteers, hammered together with hundreds of parts that never actually flew on that particular bird. No, siree. Many of these birds were actual NASA

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The main hall at the Virginia Center is crammed with airplanes spanning more than a century of flight. Most of the planes are suspended from the ceiling, and include an F-4, an F-16 and an F-18. Most of the planes on display were flown in test and development work at Langley, just a few miles down the road.

airplanes. They were flown by test pilots at Langley, people far braver than I, developing, testing and perfecting the newest technologies of their time.

That's why the diminutive Harrier jump jet, which should feature Marine markings, is blazoned with the uncharacteristic logo of the Langley Research Center. The F-18 wasn't part of a carrier wing but instead flew under the NASA icon, which also explains the snappy paint job. I'm not sure about the G.A. airplanes on display but even the oldest jet in the room has a NASA logo stamped on the tail.

The F-18 offers obvious evidence of the modifications NASA made to the airplane; visible at the stern between the twin tails. First, there is a large white box with two black holes at the very rear of the plane. This is a spin-recovery

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drag chute, to be deployed if the airplane gets into an unrecoverable spin. Adjacent to that device, on both sides are actuators and levers which push large paddles straight into the 22,000 pounds of exhaust pouring out of the back of two burly General Electric F414 engines. These paddles are the prototypes of a "thrust-vectoring flight control" capability which is now a standard feature on many high-performance fighters such as the F-22 and the Sukhoi Su-30. (Oddly, the even-newer F-35 does not use thrust vectoring, but that's another story for another day.)

This highly modified F-18 was used by NASA in the development of thrust vectoring technology, which increases the agility of an airplane. The early thrust-vectoring equipment can be seen at the back of the aircraft.

To the Moon

One of the greatest joys of the Museum is the actual Apollo 12 capsule, charred from re-entry, back from the Moon. This was only the second mission to touch the Moon, so everything was still very experimental. Launched on November 14, 1969 it was hugely successful, even though it was struck by lightning twice during take-off. The crew was Commander Charles "Pete" Conrad, Lunar Module Pilot Alan Bean, and Command Module Pilot Richard Gordon. Conrad and Bean were on the Moon for 31 hours and performed two moonwalks which stretched over seven hours.

What did they do for 31 hours? The astronauts deployed a host of scientific experiments, including the first seismometer on the Moon. This

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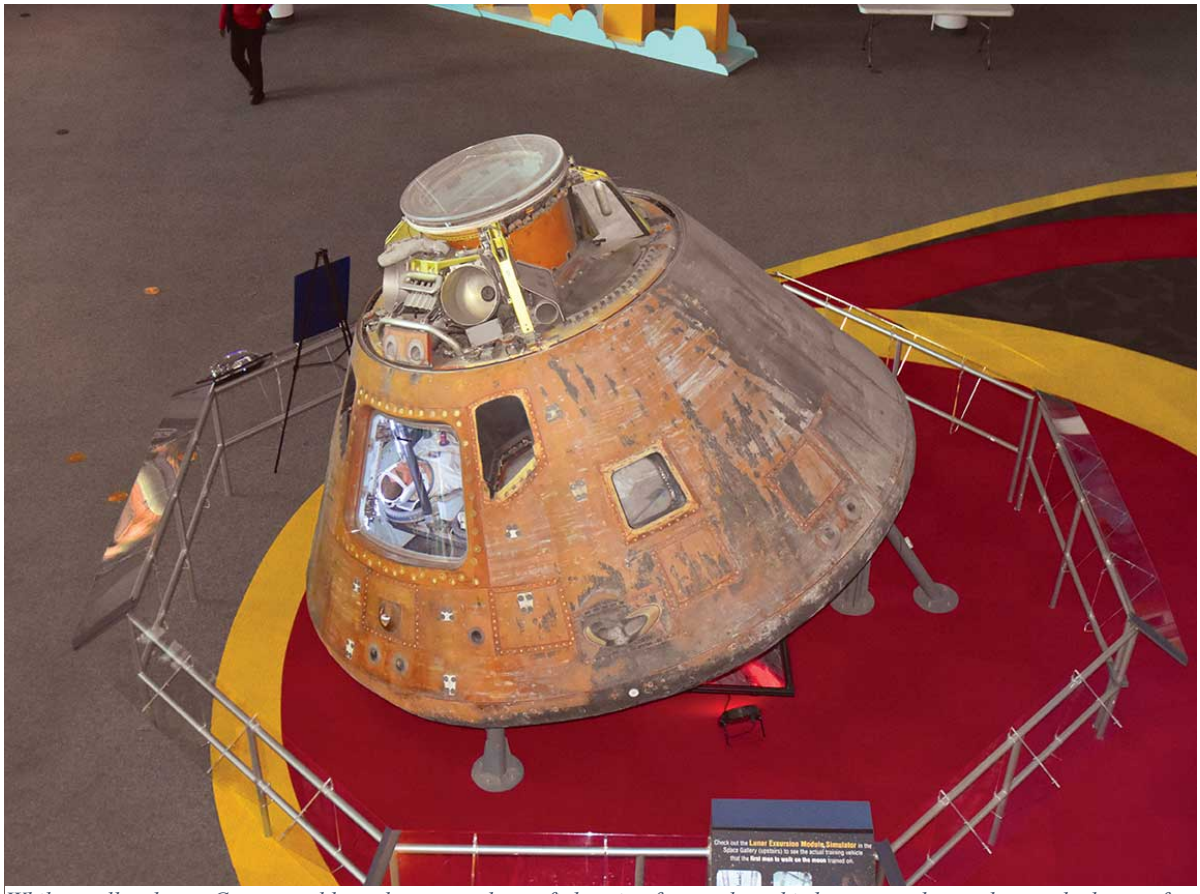
device detected moonquakes which helped scientists model the interior structure of the Moon. Other devices measured the solar wind and the Moon's tenuous atmosphere (until I got to this Center, I didn't know the Moon had any atmosphere at all!). All in all, Apollo 12 spent 3.7 days orbiting the moon, circled the Moon 45 times, and returned 75 pounds of lunar rocks to labs on Earth. The capsule brought the crew safely back on November 24, 1969.

I remember the Apollo launches and watched every one of them on television. These were the biggest machines ever thrown into space, weighing 6.5 million pounds at launch. Almost the entire system was expended on each mission: 99.96% of the Saturn rocket was burned, jettisoned, or abandoned during the mission. As such, the capsule —the only surviving portion of that massive system — is a national treasure; 3,700 pounds of history as precious



While smaller than a Cessna and less glamorous than a fighter jet, for ten days this heat-seared capsule was the home of three brave men who traveled to the Moon, set up scientific tests and brought back 75 pounds of Moon rocks. To my eyes, it seems amazingly primitive and crowded, but it was state-of-the-art in 1969.

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and unique as the Wright Flyer or George Washington's wooden teeth. It is the real deal, and walking around it is almost a spiritual experience.

In Apollo-speak, the capsule was the "command module" and featured more than 350 toggle switches, rotary switches, pushbuttons, thumbwheels, and circuit breakers, along with another 150 or so lights, displays and meters, according to Apollo expert Mark Shulman. My overwhelming impression of the capsule is its diminutive size and crowded conditions. The three crewmen were packed shoulder-to-shoulder like sardines and lay on their backs looking skyward during launch. Imagine living, eating, working, and defecating in a phone booth for ten days. Then add two of your closest friends to the party. There was no privacy, little hygiene, lots of bad smells, and extraordinary courage.

The docents at the Virginia Center are plentiful and knowledgeable. Here, George Allison (on the right) chats with the author and explains details of the Apollo 12 capsule and the mission it flew. Allison worked at NASA for his entire career, so he is accurate and comprehensive as well as engaging.

I had the distinct pleasure of chatting with docent George Allison and tapping his wealth of knowledge about the Apollo program. Lean by nature and grey by years, Allison is an engineer who enjoyed his entire career with NASA. He quietly related meeting many of the astronauts and told stories of chatting with them in cafeterias and elevators. He knows every feature of the capsule and can describe the function of every box and bulge. For example, the entire

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Apollo computer system had far less computing power than the digital magic embedded in your cell phone today.

"Hidden Figures" was a very successful film based on the story of three black female mathematicians: Katherine Goble Johnson, Dorothy Vaughan, and Mary Jackson. They all worked at NASA during the Space Race. In the days when computers were vacuum-tube monsters and workplaces were often segregated by race and gender, these erudite ladies worked as lowly "human computers", performing by hand the complex computations used in planning the first missions into space. At the Virginia Center, they are honored with a number of displays and photographs, which must be particularly inspiring to the young girls who come to see and learn.

On the mezzanine of the Center, above the Apollo capsule, is an engineering mock-up of the larger Orion capsule which will carry four people to the moon later this decade. This mock-up lacks the flight controls the final capsule will have but hints at the improvements sixty years of engineering and modern electronics will offer to our next batch of lunar explorers. But it's still going to be crowded, and I didn't see any place for the porta-potty.

Fun for the Kids

Walking out of the main hall with planes hanging over my head, I discovered the learning centers at the Museum. This is a set of large, colorful spaces designed to encourage reading, learning and experimenting with things that fly. Older kids run through the halls beneath the Wright brother's biplane while the youngest ones play with model airplanes on soft rubber padding. The more adventurous ones climb a wacky illuminated sculpture which spirals up

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almost to the mezzanine. A few large glass boxes enclose fragile models of aircraft carriers laden with their air wings. I can imagine school bus loads of kids visiting this space, frenzied teachers tracking their hyper-excited charges as they see the displays and watch professional-grade video displays. There's even an iMax theater, bringing the miracle of space flight to the kids in awesome super-high resolution.

In a few years, NASA will begin flying the new Orion capsule, which is expected to take the next group of explorers back to the Moon. It's much larger than the Apollo capsule and will feature enormous upgrades in electronics, sensors, communications and performance, but still won't offer any privacy. Or a bathroom.

I was a surprised by three discoveries. First, the prices: tickets for two, including the IMAX movie, were about $50, although there were numerous discounts for different categories of visitors. The alert reader will recall a few months ago I visited the U.S. Air Force Museum with acres of buildings and airplanes, and admission was free. I guess the defense budget operates in a different universe than the State of Virginia.

The second surprise was the small number of aircraft on display. Having been to the Smithsonian, and the USAF Museum in Dayton, and probably a dozen other museums, it was slightly disappointing to see so few airplanes. But this museum isn't focused on presenting a comprehensive display of flight, as does the Smithsonian, nor is it focused just on the early days of aviation, like the EAA Museum at Oshkosh, nor is it determined to preserve airplanes in

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flight-worthy condition like the Mid America Flight Museum in Mount Pleasant, Texas. This Virginia museum is focused on speaking about aviation to kids.

The curators and educators at the Virginia Center are remarkably creative, and here are two great examples. First, there is a row of brass plaques featuring hand imprints of many early astronauts. These are mounted relatively low on the wall, and I saw dozens of children putting their hands into the molds. Additionally, there is a brightly colored climbing tower in the middle of the museum which enticed kids to climb as high as they dared. They were laughing, and yelling to each other, and just having fun. The signal was clear: science and fun can go together. That's a great message to spread.

Which was the third surprise: there was a herd of bright yellow school busses out front, and kids were everywhere. Most impressively, they were interested and engaged. The learning centers are so bright, so colorful, and offer such interesting hands-on experiences that most of the kids were totally enthralled with the experience. Plus — which pleased me mightily — the docents and presenters were not stinting on the science or "dumbing it down." While speaking in the vernacular appropriate for the age of the kids in their groups, the teachers I saw were making a valiant effort to link the science of aviation to the lessons of their school: math, computing, engineering, and other technologies of all types. They were talking about thrust from the engines, lift from the wings and drag from the

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shapes. They were pointing out the fabric wings of the Wright Flyer and the ergonomics of flying in a prone position. And they were doing it with fun, and smiles on everybody's faces.

I have heard it said that the first person who will walk on Mars is in elementary school in America right now. That kid might have been in the Center with me that day: eyes wide open, hearing for the first time about the science and risks and adventure and beauty of flight. That visit to the Virginia Air & Space Museum might just be the ticket that makes that child say, I want to fly; I want to be an astronaut; I'm going to study hard and go to the Moon or even to Mars.

To which I say, well done, State of Virginia. You've created a premier aviation museum in Hampton, which is a worthwhile accomplishment in its own right. But even more, by deploying all of the tools of modern museum wizardry, you've been able to make science, technology, engineering and math into a playful experience for both the kids and the parents. To my mind, that's aiming for the stars.

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About the Author

Dr. Mike Jones is a 4,000 hour general aviation pilot and a retired businessman. He has served on his local airport authority for the better part of a decade. His recently-completed doctoral degree was a statistical comparison of the organizational traits found at great airports. He's always accessible at PilotMike2012@gmail.com.

Judy Norton is an award-winning nature photographer based in the Tidewater region of Virginia. My sincere thanks to her for joining me on this expedition, and for her skill behind the viewfinder.

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