Overview Round Table Education Proto Task Force Report

By Mark Wagner, Susan Ip-Jewel, Liam Kennedy, Chris Kent, Daniel Klopp, Ron Rosano, Sanjoy Som, and Elizabeth Wallace

Abstract

This paper describes the convening of the first Education Proto Task Force as an early trial effort of the newly launched Human Space Program, a 501c3 nonprofit organization inspired by the foundational work of Frank White. The initial conclusions and recommendations of the proto task force, along with related resources, are shared here. They are focused on three research questions: How can terrestrial educators use space exploration and development to inspire students on Earth? How would education change if it took place away from the Earth? And what might be the potential advantages of establishing a university on the Moon? This report is limited by the scale of the "prototype" task force initiative, but it is hoped that this contribution to the literature will be valuable to space educators, academics, and enthusiasts around the world.

Introduction

The publication of Frank White's *The Overview Effect* in 1987 first introduced the idea of the Human Space Program, a thousand-year central project focused on human migration into space.[1] Later, in *The Cosma Hypothesis,* White suggested sixteen task forces charged with tackling key issues arising out of human expansion into the solar system.[2] These task forces focused on issues such as governance, ethics, psychology, religion, and more, including education.

In 2020, at the start of the COVID-19 pandemic, White began hosting a weekly Overview Roundtable for members of the space community interested in ideas such as the Overview Effect and the Human Space Program. In summer 2021, a first attempt was made to convene proto task forces organized around a select few of the sixteen issues identified in *The Cosma Hypothesis*. The proto task force was thus convened on May 26, 2021, as part of the Overview Roundtable. The initial charge for the education task force was articulated as follows:

> **Proto-Task Force Number 3: Education**
> **Charge:** The HSP Education Proto-Task Force will consider the educational opportunities that human migration into the solar system will offer us. It will also ask how educational institutions might contribute to HSP.

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[1] Frank White, *The Overview Effect: Space Exploration and Human Evolution, 4th ed.* (Denver: Multiverse Publishing, 2021).

[2] Frank White, *The Cosma Hypothesis: Implications of The Overview Effect,* (Denver: Multiverse Publishing, 2019).

> The Proto-Task Force will begin its work by considering how the educational community is using space-based information and teaching about space exploration and development. The Proto-Task Force will consider questions such as these in its deliberations:
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> - How would education change if it took place away from the Earth?
> - There is serious discussion of establishing a university on the moon.
> - How might terrestrial educators become involved in such a venture? Should they?
> - How can terrestrial educators use space exploration and development to inspire students on Earth?
> - The Proto-Task force should answer all of these questions and any others regarding basic educational questions that members consider relevant.
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> The Proto-Task Force will conclude its work within four months and submit the framework it has developed to the Overview Round Table for inclusion in the Blueprint for Exploring and Developing the Solar System.[3]

The present authors then began meeting as a group on a weekly or biweekly basis in addition to the weekly Overview Roundtable meetings. On June 2, the charge above was summarized as seven potential research questions, and on June 10, the group voted to focus on the following three questions:

- How can terrestrial educators use space exploration and development to inspire students on Earth?
- How would education change if it took place away from the Earth? (Consider Mars, the Moon, and orbital habitats.)
- What might be the potential advantages of establishing a university on the moon?

At subsequent meetings, the group addressed each of these questions separately. Notes were taken at each session, and the findings below were synthesized from these notes. Additional meetings were allocated to focus on sharing space education projects already being pursued by each of the proto task force members. A summary of these projects is also included below. The final regular meeting of the education proto task force was on September 16, and the group's findings were presented to the Overview Roundtable on September 22, 2021.

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[3] MaryLiz Bender, "Join a Proto-Task Force," overviewnetwork.mn.co/posts/join-a-proto-task-force.

This article thus represents the expertise of the education proto task force members, including the eight present authors and a number of other contributors recognized in the notes. However, this article is limited by the scale of the "prototype" task force initiative. The group met for only four months. No thorough review of literature was conducted. Nor was any comprehensive review of existing space education resources. Also, no original research was conducted, other than the ethnography represented by the meeting notes synthesized into the final presentation and into this paper. With these caveats in mind, the conclusions and recommendations of the education proto task force are shared below.

Question 1: How Can Terrestrial Educators Use Space Exploration and Development to Inspire Students on Earth?

Terrestrial educators at all levels can use existing space exploration initiatives and current events from the space industry to inspire students on Earth. With some customization for student interests, this can be true at all levels: primary, secondary, higher education, and "pre-K to grey" lifelong learning initiatives. Government space agencies like NASA provide a variety of educational resources,[4] internships,[5] and other opportunities.[6] ESA is another example, with many globally available resources appropriate for various ages.[7] Commercial space companies also provide educational materials and opportunities (often via nonprofits), including Blue Origin's Club for the Future[8] and Virgin Galactic's Galactic Unite.[9] Independent nonprofit organizations offering space education experiences also include programs like the US Space & Rocket Center (home of Space Camp),[10] the Challenger Centers,[11] and the Boy Scouts of America (with a space exploration merit badge).[12] Some magnet schools use aerospace as a theme to attract students, like the Academy of Aerospace and Engineering in Connecticut[13] or the program at Sally Ride Elementary School in Florida.[14]

Students anywhere can also be directly connected to astronauts in space—or to engineers, scientists, and other experts on the ground. Similarly, these can be government

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[4] NASA, "NASA Stem Engagement," www.nasa.gov/education/materials/.

[5] NASA, "NASA Internships and Fellowships," www.nasa.gov/stem-ed-resources/nasa-internships-and-fellowships.html.

[6] NASA, "Human Research Programs," www.nasa.gov/hrp/education.

[7] European Space Agency, "Education," www.esa.int/Education.

[8] Blue Origin, "Club for the Future," www.clubforfuture.org/.

[9] Virgin Galactic, "Galactic Unite," www.galacticunite.com/.

[10] US Space and Rocket Center, "Education Foundation," rocketcenterfoundation.org/.

[11] Challenger Center, "Home," www.challenger.org/.

[12] Boy Scouts of America, "Space Exploration," Merit Badge Series, filestore.scouting.org/filestore/Merit_Badge_ReqandRes/Space_Exploration.pdf.

[13] Academy of Aerospace and Engineering, "Home," aaen.crecschools.org/.

[14] Sally Ride Elementary School, "Aviation & Aerospace Magnet Program, sallyridees.ocps.net/academics/aviation___aerospace_magnet_program.

representatives or employees of private companies. In addition, connections can be either live (synchronous) or recorded (asynchronous). Examples include NASA's in-flight downlinks,[15] Galactic Unite Spacechats,[16] ISS Above,[17] and mentorship programs like the Astronaut Scholarship Foundation.[18] Some individual astronauts, like France's Thomas Pesquet, put significant effort into connecting with schools.[19] There are also dedicated individual space educators who work directly with schools and students, like Janet Ivey[20] and Holly Melear.[21]

Asynchronous media, particularly video, can also be inspirational to students. Production and distribution can be small-scale (in the case of social media influencers or science communicators like Astroathens[22]) or large-scale, well-funded mass media (like Kurzgesagt,[23] Cosmos,[24] or Countdown to Inspiration4[25]). In different ways, these approaches might inspire significant shifts in student mindsets about space … through personal connections or through moving media productions of professional quality. Younger students may be more motivated by connecting with (or watching) younger hosts on newer platforms, such as YouTube, Instagram, or TikTok. Astronaut Abbey[26] or Alyssa Carson[27] may be good examples.

Interactive games and simulations, such as Kerbal Space Program,[28] may be another way to engage students. The best video games accomplish what teachers often find difficult in a classroom context—challenging students without frustrating them, while teaching critical thinking, nonlinear systems, and soft skills (such as collaboration, leadership, or resilience). Virtual reality, such as the ISS tour on Oculus,[29] may be increasingly accessible and effective as well. Whatever the medium, a focus on storytelling

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15 NASA, "STEM on Station: In-Flight Education Downlinks," www.nasa.gov/audience/foreducators/stem-on-station/downlinks.html.

16 Galactic Unite, "Spacechats," www.galacticunite.com/spacechats.

17 ISS-Above, "Home," www.issabove.com/.

18 Astronaut Scholarship Foundation, "Mentorship," astronautscholarship.org/mentorprogram.html.

19 France 24, "Meet the 'Blobs', French Astronaut Thomas Pesquet's Unusual Space Companions," www.france24.com/en/france/20210422-meet-the-blobs-french-astronaut-thomas-pesquet-s-unusual-space-companions.

20 Janet's Planet, "Home," www.janetsplanet.com/.

21 SteamSpace, "Who are We?" steam-space.org/our-team/.

22 AstroAthens, "Home," astroathens.com/.

23 Kursgesagt, "In a Nutshell," kurzgesagt.org/.

24 National Geographic, "Cosmos: Possible Words," www.nationalgeographic.com/tv/shows/cosmos-possible-worlds.

25 Netflix, "Countdown: Inspiration4 Mission to Space," www.netflix.com/title/81441273.

26 Astronaut Abby, "Home," www.astronautabby.com/.

27 Alyssa Carlson, "About," nasablueberry.com/about/.

28 Kerbal Space Program, "Home," www.kerbalspaceprogram.com/.

29 Metaquest, "International Space Station Tour," www.oculus.com/experiences/rift/1834223926601207/.

and on the emotional experience of viewers, players, or participants will be important. In short, this approach might be considered "edutainment for experiential learning."

However, most of these methods might work best for students who are already interested in space, or in the hands of teachers already interested in space. The question of how to scale space education programs beyond space enthusiasts is more challenging and may require new legislation, new curricula, and new professional development … not to mention the additional budget necessary to support these elements. Unfortunately, in the wake of COVID-19, schools' capacity to take on new programs is also limited: most school faculty and communities are still overwhelmed. Perhaps the time is right, though, to begin mobilizing toward universal adoption of a space education (and space philosophy) curriculum similar to the information and communications technology (ICT) curriculum in Australia[30] or the Next Generation Science Standards (NGSS) in the United States.[31]

That said, bottom-up models focused on student agency and empowered teachers might help to disrupt current models of one-size-fits-all top-down education. Such efforts might happen via curricula promoted directly to teachers (perhaps from traditional providers such as Pearson or Houghton-Mifflin), or even animated shows for an audience of students. If cartoons can be used to sell toys, perhaps they can also promote an interest in space exploration. Existing channels might also be used to reach families directly, including city recreation departments, community centers (like YMCA or Boys and Girls Clubs), or local summer camps. Community maker spaces might also offer programs and projects focused on space sciences, with kids creating model rockets—or their own small satellites. Perhaps an all-new Space Scouts or Space Rangers organization might be created for this purpose as well. (Dream Up is an existing organization that might already be filling a similar role.)

Whatever the level, channel, or scale of the space education model, efforts to inspire students will also need to combat and counteract frequent misinformation about space in the mainstream press and in other entertainment media. It may be that a rich array of grassroots and mass-media efforts creating ripples of change among different demographics can combine organically to create a rising tide of inspiration among educators and students around the world.

Question 2: How Would Education Change if it Took Place Away from the Earth?

It may be that the first schools in space will be on the Moon as part of an early lunar settlement. The physical danger of the environment will necessitate a significant focus on safety training and survival in any education program. In addition to updated versions of

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[30] Australian Curriculum, "Information and Communication Technology (ICT) Capability (Version 8.4)," www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/information-and-communication-technology-ict-capability/.

[31] "Next Generation Science Standards," www.nextgenscience.org/.

traditional fire drills, schools will also have to plan for decompression drills, how to get into space suits rapidly, and how to deal with dust or other contaminants. In addition, students will need to learn how to be safe and healthy in low gravity, in a vacuum, and when exposed to solar radiation. Until there are longer-duration studies on the Moon, we simply do not know the biological consequences of growing up there.

There may be psychological challenges for students on the Moon as well, and educators will need to address them. It is unknown how students (and adults) might handle the stress of the life-threatening environment, or of staying inside almost all the time with artificial day and night (due to the long twenty-eight-day solar cycle on the Moon). The schedule might also be demanding, if the children, like their parents, carry a workload similar to that on the International Space Station; if a third of their time is consumed with maintenance and their scientific work is tightly scheduled, the entire settlement's activities, including the school schedule, might be planned minute by minute, leaving little time for inquiry, exploration, and play. This might also put significant strain on family life, with parents having little time to focus on their children. However, there is no reason students could not be involved in maintenance of the school (and settlement), like Japanese students serving as their own custodians or Montessori students caring for their own learning spaces. Students could also be involved in the agricultural production of the settlement, being truly integrated into their communities in ways that have been largely lost to American children in the last century. These pursuits might also provide a degree of practical and character education, and they might help students to gain a greater appreciation for their home and for the food they produce.

Another kind of psychological challenge might be children wondering why they are living on the Moon, or resenting their parents for bringing them there (or having them there). There may also be issues with friends and relatives on Earth losing interest (or not caring anymore) when lunar residents are too far away ever to visit face to face … and are living very different life experiences. Language and culture may diverge rapidly due to the remote nature of the community and the dramatically different environment. To protect against this, the lunar school might be careful to teach human origins on Earth and the interdependence of the Earth and the Moon.

That said, teachers could take advantage of the unique learning opportunities on the Moon. For instance, there are many opportunities to learn about the geology and early formation of the Earth-Moon system and the solar system from the regolith, craters, and lava tubes nearby. Learning geology could be very hands on, authentic, and fun. Similarly, students could be directly involved in any science conducted at the settlement or elsewhere on the Moon; if there are telescopes or observatories, students could learn astronomy as well as how to program the devices and maintain the facilities. (Perhaps accommodating research requests from Earth or connecting with terrestrial schools could even be an income stream for the school, or at least a public relations priority.)

Physical education on the Moon could be even more important, as fitness might be *required* to make up for the negative effects of low gravity. Physical education might also be unique. Lower gravity (and the vacuum if outside) might make unique sports possible. The possibility of Moon boarding on the regolith of steep crater walls has also been suggested, though the safety of space suits in a fall might be a serious problem to overcome. In any case, it might be that students on the Moon would have a significant advantage (due to their comfort in one sixth gravity) in contests with visiting children from Earth. On the other hand, students from Earth would likely be much stronger.

In general, the curriculum could incorporate modern best practices that would also be beneficial to pioneering people who have migrated to a challenging environment: collaborative inquiry-driven project-based learning with multidisciplinary challenges requiring synthesis and including meaningful ethical dilemmas. Educational technology could be put to good use, with students coding all manner of equipment, using 3D printing (perhaps with regolith-derived filament), and creating drones or robots to use outside. What students are unable to experience on the Moon, they might be able to learn using virtual reality.

Living elsewhere in the cis-lunar system, in space stations or large O'Neill-style orbital habitats, would offer different challenges and opportunities. Training in micro-G survival and operations would be required, but it would offer opportunities to go outside and take advantage of the microgravity as well (for additive manufacturing projects, perhaps).[32]

QUESTION 3: What Might Be the Potential Advantages of Establishing a University on the Moon?

The basic idea of an international university on the Moon has been around for decades, with a group focused on founding the *Lunar Institute of Technology* staking claim in 1996 to the eastern edge of Copernicus as the site for its future campus.[33] The University of Michigan claimed in 2002 to be the first university with a campus on the Moon, on account of the astronauts of Apollo XV, who were all alumni of the school, having planted the university flag on the Moon.[34] In 2012, Frank White wrote a blog posted titled "A University on the Moon? Talk About Higher Education."[35] Inspired by many who came before him, he suggested that "colleges and universities ought to be making much more of the advantages that a space-based perspective would offer them," including, of course,

[32] The proto task force has not yet considered the implications of education taking place in locations further away from Earth, such as Mars or the asteroid belt. However, a paper on that subject (as well as several papers on a Moon-based school) can be accessed at t.ly/eduspace.

[33] Lunar Institute of Technology, "Lunar School," www.ibiblio.org/lunar/school/.

[34] Yuta Sasaki, James J. Duderstadt, and Shoichiro Toyoda, "Higher Education in the New Century: Themes, Challenges, and Opportunities," Keynote lecture given at the University of Michigan, June 22, 2002, deepblue.lib.umich.edu/bitstream/handle/2027.42/88791/2002_JAPAN_Revised2.pdf?sequence=1.

[35] Frank White, "A University on the Moon? Talk About Higher Education!" Overview Effect Blog, February 6, 2012, overvieweffect3.blogspot.com/2012/02/university-on-moon-talk-about-higher.html?m=0.

the Overview Effect. He imagined a *Lunar University* offering a broad liberal arts curriculum, with a focus on international relations—while the Earth hangs in the sky above them.

Some tangential work is under way today. For example, one group has founded an Earth-based *Mars University* to engage in research related to settling the red planet.[36] Another group representing the self-proclaimed space nation of Asgardia is planning an *Academy* meant to serve its citizens around the world (and one day in space), while a number of new institutions of higher learning are focused on space education and the space industry, including the *International Space University* in France and *Kepler Space Institute* in Florida. MMAARS also has a long-range plan to establish a unique accredited degree program. For our purposes, though, White's 2012 article serves as inspiration for exploring the potential benefits of establishing a physical university on the Moon.

Before more concrete discussion could proceed, a number of questions came up, mostly related to the potential scale of the *Lunar University*. How large a settlement would be established on the Moon? What would the population be? How large would the potential student body be? How big might the physical campus be? Most of these questions are unanswerable hypotheticals at this point, but for the remainder of this thought experiment, it was clear that the group was presuming that a university would have a large enough student body to warrant multiple structures, though there could be anywhere from a few dozen students to the thousands you might expect at a major terrestrial campus.

Some thought was given to facilities and learning spaces. In general, the campus structures would require shielding from the vacuum and radiation of space, likely necessitating underground habitats, though even inflatable buildings would be possible with adequate shielding. Lower gravity would suggest higher ceilings, no need for stairs, and the potential for interesting poles, slides, or simple ladders between levels. It is inspiring to imagine what university architecture might look like in a lunar environment, with classic elements of columns and domes integrated into a modern lunar habitat. Classic landscaping is an important element of university campuses on Earth, and green spaces could be included on the Moon as well, with possibilities including greenhouse gardens or hydroponic green walls in shared spaces (in addition to potted plants throughout). Perhaps there would also be a large structure to serve as a gym, for fitness or even collegiate sports. Some unique sports might be possible in the low-gravity environment, especially if the space were large enough—or if there were a safe way to engage in sports outside. Even Moonboarding on the regolith of steep crater walls would

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[36] Kolemann Lutz, Bruce Mackenzie, and Raissa Camelo, "Mars University: Education to Lead the Settlement and Exploration of Mars," Paper given at the 50th International Conference on Environmental Systems, Lisbon, July 12-15, 2021, www.researchgate.net/profile/Kolemann-Lutz/publication/353417008_Mars_University_Education_to_Lead_the_Settlement_and_Exploration_of_Mars/links/60fafa94169a1a0103b1d9d4/Mars-University-Education-to-Lead-the-Settlement-and-Exploration-of-Mars.pdf.

be a possibility, perhaps with a university skip patrol, if safety concerns were sufficiently addressed.

If general education courses are offered, there would be no reason not to take advantage of the remote learning resources available from Earth. The real academic strength in a *Lunar University*, though, would be in taking advantage of the unique location and context. Graduate research could focus on space science, particularly astronomy, lunar geology, and research focused on exposure to vacuum or low gravity (in biology or materials science, for instance). Experiments could be operated around the Moon (shielded from Earthlight and radio for instance) and operate in service of projects on Earth, potentially providing a stream of income for the university. Manufacturing processes that take advantage of a vacuum or low gravity might be particularly fruitful as well. In fact, a business school might make sense on the Moon, with significant potential for developing intellectual property (IP) derived from original research. A university endowment might be established with funding from lucrative monetization of IP in the space industry and elsewhere on Earth. A graduate program that serves as an incubator for entrepreneurs and lunar startups might be particularly successful under these conditions.

The humanities might also be supported for the *Lunar University*, and this might also be fruitful. Poets, authors, and other artists could create with a unique perspective on the Earth, on humanity, and on the universe as a whole. O'Neill's vision for a university town experience in the deep-space habitats he designed might be possible on the Moon as well. A small settlement might offer an experience similar to a small college town, and the inhabitants might enjoy a true research community, full of opportunities for synergy and cross-pollenization of ideas. Imagine conversations and entertainment at the coffee house in the Lunar University settlement!

It would also be possible for the community to be very cosmopolitan, with representatives from cultures all around the world. With English likely to be the primary language of instruction (due to its dominance in science and aerospace), one might also expect to hear many other languages, at least from other spacefaring countries, including Russian of course, Japanese, Chinese, and a variety of European languages in addition to French (which is already used at ISU and may be a requirement for Canadians). Dual immersion programs might be offered by the university, and there may even be a multilingual requirement for study there (though this may limit the number of specialists who have access to the school). In any case, the *Lunar University* should be an inclusive and international campus representative of many human cultures and academic traditions.[37]

[37] See also the Moon Village School papers at docs.google.com/document/d/e/2PACX-1vT3L18RuCCSqeoIzeZ865uVSse0uaz_0xMe0t9tO3SCzeR_0bdSa-GvDrzrTd2Vn_fIeog5wLmrRxCo/pub for additional thoughts. The focus is on a small K-12 school serving a hypothetical settlement of 125 residents at the south pole of the Moon, but many of the issues discussed would apply to a *Lunar University* as well.

Task Force Member Projects

Galactic Unite Spacechats

Spacechats are virtual field trips, providing online interactive experiences and bringing space directly into the classroom. During a Galactic Unite Spacechat, every student has the opportunity to talk directly with a future astronaut and with a diverse range of staff from Virgin Galactic. Coordinated by future astronaut Ron Rosano, these virtual experiences create an opportunity for our team and future astronauts to communicate directly with students—encouraging them to follow their dreams and focus their efforts on things that they love doing (www.galacticunite.com/spacechats).

ARES Learning

ARES Learning is a secondary school focused on helping students to develop the skill sets and mindsets of a space explorer … even if their own career might be in another field here on Earth. ARES Learning is project-based, research-driven, and space-focused. Through an individualized blended learning program paired with hands-on inquiry, students gain experience in the explorer's mindset, design methodology, Moonshot thinking, collaborative problem solving, and self-reflection (www.areslearning.com).

MMAARS

MMAARS is a vanguard in commercial analog astronautics for human space exploration, training next-gen professionals to acquire practical hands-on skills and knowledge to enter the new space era. The MMAARS Virtual Academy Analog Astronautics Program offers multi-level curriculum training, where each level consists of a twelve-day analog astronautics interactive program (www.mmaars.com).

SRGSMART Schools

SRG is reverse engineering the future with innovation schools based on an Earth Farms and Space Science curriculum. These self-sufficient schools teach, feed, and equip local students in the developing world with zero tuition. We also do fun citizen science online. Supporting and inspiring new generations of innovators is how we will engineer a better tomorrow. The SMART School Site Plan (Modular Campus Model—V7-9) is a template plan for self-sufficient innovation schools we can build anywhere there is no winter. At SMART schools students do media, art, and research projects in teams (srgsmart.org/high-res-images).

ISS Above

ISS Above is a fun and educational device that connects people to the International Space Station, and specifically to the humans on board. Our mission is to bring this magnificent human scientific achievement into homes, schools, and offices and to inspire awe in the beauty and fragility of the planet we call home. ISS Above is a single-board computer that calculates where the International Space Station is at all times. Hooked up to a TV, it displays screens with information that shows you where the ISS is and when you can see it in your skies (www.issabove.com).

Ad Astra Academy

Ad Astra Academy is a unique education, outreach, and development project that brings the excitement of exploration to students in some of the most underserved regions of the world. Curiosity is one of the most essential of human traits—a constant need to understand the world around us through uncertain tinkering and wandering journeys. We exploit this hard-wired trait to promote self-directed and inquiry-based learning, tapping into students' natural curiosity to recalibrate their relationship with the unknown and to unlock their boundless potential (www.adastra.world).

Conclusion

This paper represents the work of the authors and other contributors, all members of the Overview Roundtable convened by Frank White and the Human Space Program, over the course of four months in mid-2021. It is the hope of the authors that these conclusions, recommendations, and resources may be helpful to the future education task force when the Human Space Program, now a 501c3 nonprofit organization focused on sustainable stewardship of the solar ecosystem,[38] is fully funded and mobilized. In the meantime, it is also hoped that this contribution to the literature of space philosophy will be valuable to space educators, academics, and enthusiasts around the world.

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Editors' Notes: This is the second of two articles in this issue reporting the findings of an Overview Roundtable Proto Task Force. Here, the Task Force on Education provides some insight into the process and shares conclusions relating to key questions such as how terrestrial educators can use space exploration to inspire students on Earth, and how education might change if it took place away from Earth. While the featured article about the challenges of educating students on Mars focused on a single planet, this report focuses mostly on the Moon as an example scenario, considering issues of higher education as well. Today's space educators will find a number of useful projects and resources cited here. ***Gordon Arthur and Mark Wagner.***

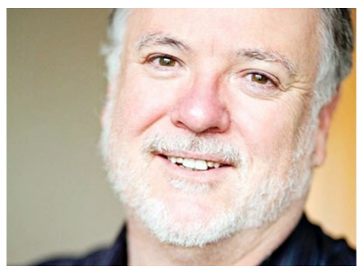
[38] The Human Space Program, "The Human Space Program," humanspaceprogram.org.

About the Authors

Mark Wagner serves as President of the Space Prize Foundation, a non-profit organization focused on promoting STEM education and increasing the representation of women in aerospace careers. He also teaches the Space Education graduate certificate program at Kepler Space Institute and is the Associate Editor of the *Journal of Space Philosophy*. In addition, he is the founder of ARES Learning, a vision for schools that prepare students with the skill sets and mindsets they will need to be successful in the growing space economy—and in humanity's rapidly approaching multi-planet future. Mark has a PhD in Educational Technology and a master's degree in Cross-Cultural Education. He also holds graduate certificates in Space Education and Space Philosophy. He is the author of More Now: A Message from The Future for The Educators of Today (2018) and a forthcoming book about Space Education, which explores both current opportunities on Earth, and the possibilities for teaching students on the Moon, on Mars, and in deep space habitats. Outside his work, Mark loves playing hockey, practicing martial arts, and obsessing over his '62 beetle, which now runs on an electric motor and Tesla batteries. He is a certified health coach and biohacking enthusiast, who also enjoys songwriting, spending time in nature, and exploring the world with his friends and family.

Susan Ip-Jewell, DCEG, DOD, is a Space Medicine Clinical Scientist, Analog Astronaut, Exponential Technologist, and Entrepreneur. She is an official Space Coach for AFWERK, empowered by the US Space Force and Air Force. She has received two knighthoods as Dame from the Royal Crown of the Kingdom of Montenegro and Dame Commander in the Order of the Eagle from Kingdom of Georgia, Royal House of Georgia. She is a member of the Board of Governors for Life Sciences and Bioengineering Branch of the Aerospace Medical Association. She is Vice President of Space Renaissance International.

Her research focuses on analog astronautics, space medicine, med tech, human factors, and exponential technologies. She is the CEO of the Mars-Moon Astronautics Academy & Research Sciences (MMAARS), training analog astronauts and building the Mars-Moon Settlement Analog Training Settlement in the Mojave Desert, California. She is CEO of AvatarMEDIC, Inc., which aims to disrupt and democratize healthcare access by converging XR/AR/AI, haptics, robotics and drones. A veteran analog astronaut and commander of multiple analog astronaut missions, she pioneered the first Martian station-to-station simulation training and MMAARS Space Medics training programs. She has commanded missions from low- to high-fidelity locations in Nepal, Antarctica, Africa, and America's Mars-Moon Analog Astronaut Exploration Expeditions project. She trained at the National Institutes of Health (NIH), National Cancer Institute (NCI) in clinical research medicine, drug discovery and molecular therapeutics. She is a graduate of the International Space University and the recipient of a Google Scholarship to attend Singularity University's (GSP15). She founded the Clinic, LLC, an integrated wellness and telemedicine center in Los Angeles, California.



Liam Kennedy is CEO of ImageBEAM Inc. ImageBEAM has been producing livestreaming events for its clients since 2003. Clients include the Planetary Society. One of the largest live streaming events was the Transit of Venus from Mt. Wilson streamed using NASA's contract with Akamia, which reached over 600,000 viewers worldwide. Liam is considered an expert in the livestreaming field and has provided consulting support to many other organizations.

Liam is the inventor of ISS-Above, a single board computer device (a Raspberry Pi) that presents a rich set of live information about the ISS including live video views of the earth. This device has been shipped to more than 3,500 locations around the world including private homes, schools, science centers, and every NASA center nationwide (NASA does not endorse ISS-Above).

Throughout a career in programming and live video streaming/video production, Liam has been passionate about astronomy and the perspective it gives humankind on our place in the Universe and how beautiful and fragile our Earth is. Previously President of the Orange County Astronomers, a Griffith Observatory Planetarium Lecturer, and a NASA/JPL Solar System Ambassador, today Liam focuses on bringing the ISS into people's daily lives through public outreach, deployment of the ISS-Above into homes, schools, and public spaces, and spearheading projects to enhance our view of space exploration and of ourselves.

Chris Kent is an educator and business professional focused on innovation. His personal mission is building schools in the developing world that create opportunities for students with little. He and his team teach advanced agronomy, commerce, design, food, robotics, systems, and space: Earth Farms & Space Science. Through this dual-focus STEAM (Science, Technology, Engineering, Art, Math) program they find bright stars—the future innovators that humanity needs.

Dan Klopp is a business leader with an extensive background in technology and strategic marketing. Dan holds a BS in Physics (with minors in Chemistry and Mathematics) from Millersville State University, along with an MBA from Duke University's Fuqua School of Business. Additionally, he has done postgraduate work in marketing theory at the University of Pennsylvania's Wharton School of Business. Dan has worked in marketing, product development, and business leadership positions for Hewlett Packard, W. L. Gore and Associates, and Thermo Fisher Scientific. He has also served as an adjunct professor of business and marketing for several universities. Dan is currently working for ILC Dover in its Space Systems Division. Dan resides with his wife in Milton, DE.

Ron Rosano has been pursuing his passion for inspiring students about space travel for over twenty-five years, as an informal astronomy and spaceflight educator with several different programs. He will be flying into space with Virgin Galactic and into the stratosphere with Space Perspective and World View. He is the organizer of Galactic Unite Spacechats (live Q&A video calls), connecting Virgin Galactic staff and astronauts with (as of March 2022) over twelve thousand students from over two hundred schools and thirteen different countries. Since 2008, he has conducted more than seventy events as a NASA Solar System Ambassador, giving presentations on Mars rovers, the James Webb Space Telescope, the Apollo Moon landings, commercial space flight, and more. He has closely followed NASA and other space missions ever since the Apollo lunar flights, and he is thankful to be credited for his work on NASA's Apollo Lunar Surface Journal. He has been active in public telescope viewing with the San Francisco Amateur Astronomers. He serves on the Advisory Council of the Astronomical Society of the Pacific, the Board of Advisors of Human Space Program, and the Board of Directors of the Nepal Youth Foundation.

Sanjoy Som is an astrobiologist, who broadly investigates how the rock record can preserve properties of an ancient atmosphere, and how the rocks can create or contribute to an atmosphere; a discipline he likes to call *Atmospheric Geology*. Atmospheric gases and/or gases released in water-rock reactions are fundamental in metabolic processes, and so he enjoys thinking about the role life has in modulating the concentration of gases (atmospheric or not), and how the concentration of those gases modulates biological lifestyle (survival, maintenance, growth). As examples, he investigates how ancient raindrop craters can record atmospheric density, how gas bubbles trapped as amygdales in ancient lava flows can record atmospheric pressure, and how channel morphology can be an indicator of flow sustainability (the latter in the context of Mars). He is also very interested in the topographic evolution of Mars. At Ames, he focuses on the latter part of this interest: how rocks can create or contribute to an atmosphere. Specifically, he is investigating the connection between geology, geochemistry, and microbiology in serpentinizing systems through a combination of field, laboratory, and theoretical studies. Deep-sea exploration has been a growing interest of his, overprinted on the space exploration passion that has fueled his career. To that end, he has been involved with research cruises onboard the R/V Atlantis, and has explored the sea floor both robotically (ROV Jason), and physically (DSV Alvin).

Elizabeth Wallace is a proven, creative leader in both the travel and event production industries. She has twenty-nine years' experience of facilitating international travel documents for corporate travelers, and nine years' experience in educational event production, including festivals and planetarium shows. Her goal is to help international travelers to cross borders through expert visa and passport processing. Her current businesses are aimed at helping people to get beyond borders, that is, through finding their place in the universe through arts-integrated astronomy programs and space tourism.