



Upcoming Local Events

Look for announcements for Honors and Awards Banquet and Annual Technical Symposium in the Fall.

Upcoming National Events

Nov. 16-18, 2020

ASCEND

LasVegas/Online

[Event Link](#)

Jun. 15-19, 2020

AVIATION Forum

Virtual Event

[Event Link](#)

Note from the Editor

We've all had an eventful start of 2020. I wish everyone good health and successful adjustments to our new environment. As section leadership, we are adjusting as well and working to make your membership work for you. We still held the annual Student Essay Contest. Read about the contest and the essays from winners Lucas Anderson (8th Grade) and Colin Hicks (7th Grade). The Wyoming Science Fair was another success with fellow AIAA volunteers judging and awarding our annual prize. The Honors and Awards Committee is planning an alternate format for the banquet this year. Please watch for an announcement! Annual Technical Symposium at CU Boulder last Fall was the largest ATS so far in our history. Planning for ATS 2020 is continuing as the committee navigates the current uncertainty with large gatherings.

Our Membership Committee provides information in this newsletter about our growth. It is important that we continue to grow. Volunteers have many opportunities to further our Aerospace Industry through Policy, Education, Communication, and as a resource to local community events. Please consider contacting any of our newly elected council members or committee members to find out more at our website (aiaa-rm.org/).

Adrian Nagle

RMS, Newsletter Editor

Ball Aerospace

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Section Officers

Elected

Section Chairman	Dr. Merri Sanchez
Vice Chair	Tracy Copp
Secretary	Kevin Mortensen
Treasurer	Dr. Taylor Lilly
Vice Chairman – North CO	John Marcantonio
Vice Chairman – South CO	Dr. Todd Nathaniel
Vice Chairman – MT	Erik Eliassen
Vice Chairman – WY	Mark Kettles

Committees

Fellow-At-Large	Gene Dionne
Member-At-Large	Pamela Burke
Education and STEM	John Marcantonio
Honors and Awards	Stacey DeFore
Membership	Marshall Lee
Newsletter Editor	Adrian Nagle
Public Policy	Tracy Copp
Programs	Chris Zeller
Technical Committee Liaison	John Reed
Webmaster	John Grace
Young Professionals	Alexandra Dukes

We Need You! If you are interested in increasing your participation in AIAA Rocky Mountain Section, we need your help with positions in any of the committees. If you have an interest, please contact: Kevin Mortensen – kevin.mortensen@baesystems.com

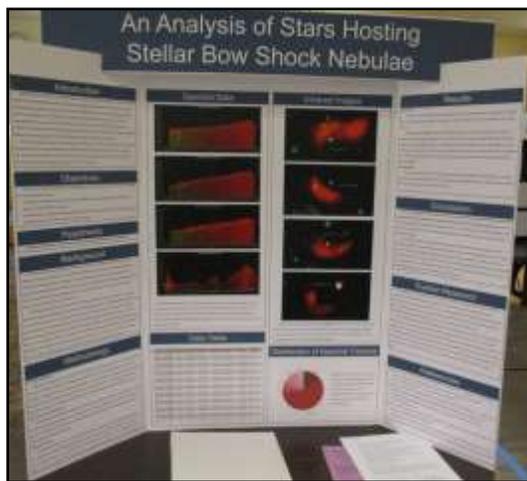
New Space Force calling Colorado Springs home under congressional deal: A new neighbor in Colorado Springs? The Gazette in Colorado Springs reports our country's first new armed service since the Air Force was created in 1947, United State Space Force, will call Colorado Springs home. The article reveals congress passed a spending bill that provides \$322 million for construction on local bases. Some troops who are part of the Air Force Space Command at Peterson AFB, Schriever, AFB, and Buckley AFB will be part of the USSF. It is expected the USSF will have 15,000 troops. Read more at [The Gazette; Space Force](#).

AIAA RMS Awards Prizes at the Wyoming State Science Fair

Mark Kettles, *Dish Network*

The Wyoming State Science Fair was held 1-3 March at the University of Wyoming in Laramie. AIAA RMS sponsored prizes for the best individual projects related to aerospace. Volunteer judges included Michael Stoellinger (Associate Professor of Mechanical Engineering), Adrun James (Graduate Student), Jorden Schulte (Graduate Student), and Sue Janssen (AIAA RMS Educational Outreach). Judges pre-

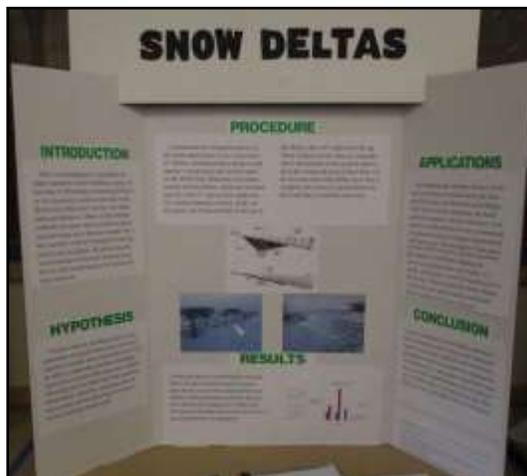
viewed the projects and then interviewed the students on 2 March. Dr. Stoellinger presented the awards on 3 March. The prizes include a certificate, an Arduino kit, and a one-year student membership to AIAA.



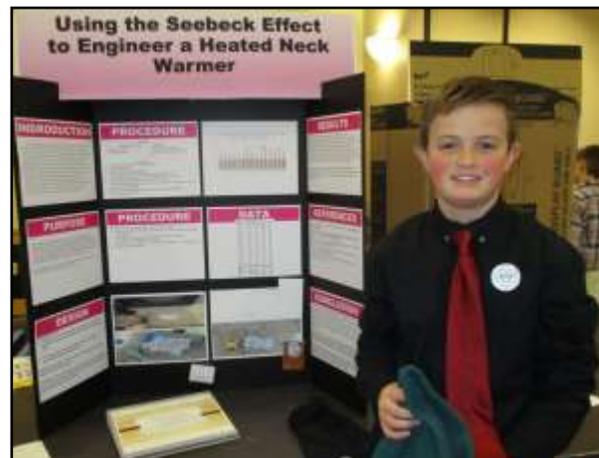
First Place, Senior Division: "An Analysis of Stars Hosting Stellar Bow Shock Nebulae" by Sam Norcross; Kelly Walsh High School



First Place, Junior Division: "Need a Brake?" by Elyn Bowers; Pinedale Middle School



Second Place, Senior Division: "Snow Deltas" by Thaddaeus Christensen; Homeschool



Second Place, Junior Division; "Using the Seebeck Effect to Engineer a Heated Neck Warmer" by Ashton Bennett, Big Piney Middle School

2020 AIAA RMS Honors & Awards Call for Nominations

Stacey DeFore, Honors and Awards Chair

The Rocky Mountain Section would like to recognize AIAA members' achievements and service to the aeronautics, astronautics, and aerospace industry. The AIAA-Rocky Mountain Section awards program is intended to honor outstanding engineers and educators, to celebrate the contributions of our AIAA members.

The following Professional Engineer of the Year, Young Professional Engineer of the Year and Educator of the Year awards provide a forum to recognize our deserving colleagues.

- Professional Engineer of the Year
- Young Professional Engineer of the Year (35 years and under)
- Educator of the Year-Collegiate Level
- Educator of the Year- K-12 Level
- Young Professional Public Service of the Year (35 years and under)
- Professional Public Service Awardee of the Year

The online nomination form contains criteria and required information for each award. Please provide the required information completely and concisely. There is a one-page limit for all nomination justifications with character restriction enabled on the online form. Note, it is a requirement that nominees be an AIAA member to be nominated in all categories excluding the new Public Service Award. The Public Service Award is a new category this year and is intended to acknowledge outstanding public service contributions to our aerospace community.

If you wish to confirm a nominee's member status before submitting the nomination package, please contact the awards committee chair at stacey.defore@teledyne.com.

The deadline for submissions is 11:59 p.m. on Sunday, May 31, 2020. You will receive an auto-generated reply confirming your nomination submission. Early submissions are appreciated by the Awards Committee. A panel will be selected to evaluate the nominations and identify the outstanding nominee in each award category. The panel con-



sists of members of AIAA with an objective to identify the outstanding nominee in each award category. Deliberations are private and decisions are final.

Please submit nominations online and direct questions to Stacey DeFore, AIAA-RM 2019-2020 Honors and Awards Chair: stacey.defore@teledyne.com

Additionally, the AIAA Rocky Mountain Section is seeking members to be part of the Engineer of the Year and Educator of the Year awards selection committee. Committee members will be required to review the award submittals and support a committee nomination selection meeting at the beginning of April to select a winner in each category.

Due to COVID-19 state orders governing gatherings, the Honors and Awards recognition event details will be confirmed at a later date.

If interested in volunteering as part of the awards committee, please contact the awards committee chair at stacey.defore@teledyne.com.

Nomination Form:

<https://coloradospace.wufoo.com/forms/z155h1km16kxm60>

Deadline:

Sunday, May 31, 2020 at 11:59pm

University of Colorado, Colorado Springs Chapter Student Club Activities Update

Dr. Lynnane George, Advisor, and Lisa Adele, Secretary, UCCS AIAA Student Club

The University of Colorado at Colorado Springs AIAA student club experienced an eventful 2019-2020 academic year. The club was started in Fall 2018 with only four students and grew over the next two years to over 63 members. AIAA events allow students to network and socialize with others in their field as well as provide professional development and outreach opportunities. Club members participated in many activities this past year, including industry site tours, hosted several distinguished speakers, volunteered in the community, and competed in the AIAA Space Systems Design Competition.



New UCCS AIAA Student Club Logo

There were several notable events that happened in the Fall. In October 2019, the UCCS AIAA student club sponsored a meeting before astronaut Scott Kelly's talk that attracted students, faculty, and industry visitors. The club also enjoyed field trips and presentations by many speakers, including Captain Chris Box of the Air Force Research Laboratory Space Vehicles Directorate and Retired Navy Captain and UCCS Vice Chancellor Chuck Litchfield. Club members volunteered at the Cool Science Festival in

October, which introduces youth to concepts in science. Several students presented at the AIAA Annual Technical Symposium in Boulder in November, and a group of students visited the Colorado School of Mines in Golden to tour their Asteroid Mining labs and attend an AIAA monthly meeting. Club members also toured the United

Launch Alliance facility in Centennial, CO to learn about launch vehicles.

The club also achieved a significant milestone at UCCS in December – we received formal club recognition. This means we can reach more aspiring engineering students who have a passion for aerospace. The club also introduced an official

club logo, voted on by student members.

The UCCS Section also had an exciting and fun Spring term. The semester kickoff meeting was held on Thursday 30 January 2020 featuring Lockheed Martin's Carolyn Overmyer, who spoke about her experience as the Orion Service Module Integrated Product Team Manager for the Artemis 1 and 2 Missions. She also gave students advice about how to prepare for a career in the aerospace industry.

The club also sponsored many activities during Engineering Week in February, with events ranging from the club hosting a distinguished visitor, astronaut Mark Lee, to recruiting and community outreach activities. Team members also formed a Lunar Base Design Team to design a fully functional moon base camp for NASA's 1st long duration Lunar expedition mission. They entered their final design into the AIAA Space Systems Design competition in May.

Unfortunately, campus closed in March and all club activities were cancelled for the remainder of the term. However, the UCCS AIAA student club has many events



Spring Kickoff Meeting

and activities already planned for Fall 2020 and we look forward to another successful school year! Please contact club advisor Dr. Lynnane George, lgeorge2@uccs.edu for more information.

Engineering Week Activities—February 2020

- Monday February 17: Hidden Figures Panel and Movie Showing and Women in STEM Panel 5:00 – 8:15 PM
- Wednesday February 19: AIAA Engineering Recruiting Table (10:30am-3pm)
- Wednesday February 19: Wildflower Elementary 4th grade Outreach & STEM Program (11am—1pm)
- Thursday February 20: Hidden Figures Movie Showing at Centennial 192 (5pm-7:15pm)



Student Chapter Meeting with Speaker Astronaut Mark Lee from Engineering Week 2020



Wildflower Elementary Fourth Grade Outreach and STEM Program from Engineering Week 2020



Rocky Mountain Membership Continues to Grow

Marshall Lee, AIAA RMS Membership Outreach Director

I want to thank you for your continued membership and support of our Rocky Mountain Section. With your help, we have reached a total membership of nearly 1,500 strong as of February 2020. Our numbers were around 1,200 in 2016 at this time, so we continue to expand as a “Very Large” AIAA section.

You would guess that our count at 1,443 today is down due to the new world of COVID-19. However, the drop in numbers is typical at the end of the school year for Student Members. Professional and Educator Associates are the same level as in February, with Students accounting for the drop from 329 to 274.

Why has our section continued to grow? I can point to a few factors that have possibly influenced the rise. The growth of the aerospace business in general is a large contributor. Our industry is a buzz with new energy – commercial or new space interest, landing on the moon by 2024, and Colorado as the largest space economy per capita in the U.S.

Another reason is RMS has seen growth with our Young Professional participation as more and more new grads join the aerospace workforce. Geek nights, happy hours, and movie showings are all bringing our YPs together.

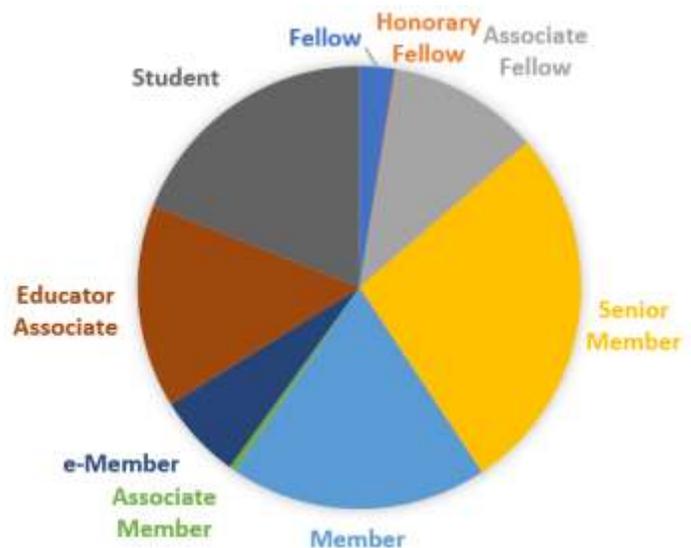
Also, AIAA National instituted an introductory program call e-Membership to provide an easy way to join by offering a 1-year free membership to new participants to try it risk-free.

And finally, RMS began collaborative corporate events to get the word out about the importance of career advancement through joining a professional association. This program year, we participated in events where members spoke about their personal involvement with our organization and what it did to enhance their lives. We celebrated the launch of the GPS III satellite at Lockheed Martin, sat in on a panel discussion about state and local policy at ULA, and discussed what it means to participate as a volunteer in an industry association defining the aerospace profession at Ball Aerospace.

Even in these extenuating circumstances we now live in, your AIAA Rocky Mountain Section will strive to connect members as we rollout new programs and virtual events starting this fall.

Again, we appreciate your support and participation for this past program year. We look forward to making 2020-2021 better yet.

Member Level	Count
Fellow	37
Honorary Fellow	2
Associate Fellow	158
Senior Member	390
Member	271
Associate Member	7
e-Member	90
Educator Associate	214
Student	274
Total	1443



Colorado Aerospace Day at the Capitol

Christine Pumford, Ball Aerospace

This year's Colorado Aerospace Day at the Capitol took place March 10, 2020. This is an exciting event in which members of Colorado's booming aerospace industry fill the Capitol to network and discuss with Colorado legislators the state of the industry and how they can support aerospace within the state. The Rocky Mountain Section represented AIAA at this event and the members in attendance were able to talk to numerous industry members, legislators, staffers, and students about AIAA.

With Colorado's ranking as the number one state in the nation for per capita private aerospace employment, Colorado legislators are excited about aerospace and engaged in learning more about it. This year was an especially momentous Colorado Aerospace Day at the Capitol as the Colorado Senate passed a bill making that day, March 10th, Colorado Aerospace Day.

The day began with breakfast and a welcome from the President of the Colorado Senate, Leroy Garcia. Garcia welcomed the members of industry and expressed his pride in the Colorado Aerospace workforce. After Garcia's welcome, attendees visited the House and Senate. During the Senate visit, attendees witnessed the Senate vote in that session to make March 10th Colorado Aerospace Day and introduce a bill declaring Colorado to be the most fitting permanent location for the United States Space Command. Later in the day, Governor

Jared Polis addressed the attendees and spoke about the growing aerospace industrial base in the state. The day concluded with an aerospace panel and reception at the Governor's mansion a few blocks down from the Capitol.

Throughout the day and these events, attendees were able to visit the AIAA booth and discuss what we do and the current AIAA policy initiatives. Attendees were excited to hear about the different ways in which AIAA connects the aerospace community and what we are doing to engage STEM students.



Four New AIAA Fellows in the Rocky Mountain Section

Gene Dionne, Rocky Mountain Section Council

The American Institute of Aeronautics and Astronautics (AIAA) has selected its Class of 2020 AIAA Fellows and Honorary Fellows. The induction ceremony for the new Fellows and Honorary Fellows will take place at the AIAA Fellows Dinner (hopefully) to be held on July 16, 2020 at the Hilton Crystal City, VA. They will also be recognized the following night at the AIAA Aerospace Spotlight Awards Gala at the Ronald Reagan Building and International Trade Center in Washington, D.C. “The 2020 Class of AIAA Honorary Fellows and Fellows have earned the respect and gratitude of the aerospace community for their dedication, creativity and contribution to better understanding our world in terms of its limits and how we can push past those boundaries,” said John Langford, AIAA president. They are the best minds in the industry. I congratulate them on this career accomplishment.”

The four new Fellows from the Rocky Mountain Section are the following.

Salvatore “Tory” Bruno is the President and CEO of United Launch Alliance in Centennial, CO. His citation reads: *“For visionary leadership as a senior aerospace executive and rocket scientist with an enduring passion for space and its potential for humanity.”* For more than 30 years, Tory has made major contributions to the aerospace industry as a true “rocket scientist”, leading more than 15 different civil and defense programs at Lockheed Missiles and Space, Lockheed Martin Space and now at ULA. Tory has been in his current position since 2014 overseeing 53 successful Atlas and Delta launches (with no failures!) as well as the development of the company’s new Vulcan Centaur rocket. Before that, he was the VP and General Manager of Lockheed Martin’s Strategic and Missile Defense Programs for seven years, leading a large business unit producing ballistic missiles and ballistic missile defense systems. Preceding that role, he was the President, Strategic Missile Programs where he led U.S. Navy and Air Force strategic missile systems development and field support of the D5 Trident II, Fleet Ballistic Missile and submarine launched IRBM. Leading up to that, he was the VP and PM for the THAAD Missile Defense Interceptor where he oversaw the development,

manufacturing and deployment of that very successful operational system. He is active in many professional associations and is often a keynote speaker at RMS technical conferences and at AIAA national conferences. He’s also a very strong and active supporter of STEM education initiatives. His undergraduate degree was from Cal Poly University in Mechanical Engineering and has attended the Senior Executives in National and International Security Program at the Kennedy School of Government at Harvard University.

Dr. Michael Gazarik is at Ball Aerospace and Technologies in Boulder and Broomfield where he is the Vice President of Engineering. His citation reads: *“For his advancement of and advocacy for technological and organizational innovation, enabling the long-term success of the aerospace and defense industry.”* In his current position, Mike leads overall strategic and operational leadership of the engineering organization as well as manufacturing and test operations, supply chain management, facilities, independent research and development and intellectual property. He has over 25 years of experience in the design, development and deployment of spaceflight systems. Prior to joining Ball in 2015, he was at NASA for eleven years in senior engineering leadership positions at the Langley Research Center and then NASA Headquarters where he was the driving force behind establishing NASA’s Space Technology Mission Directorate. This important initiative significantly increased NASA’s investment in the technologies needed for future space missions. He serves on the engineering department advisory boards of three universities and has been an organizer and speaker at many AIAA section and national technical conferences. He currently is the general chair for the AIAA SciTech Executive Steering Committee and is also actively involved as a member of AIAA’s Corporate Membership Committee where he is shaping the society’s governance and growing membership initiatives. His undergraduate degree in Electrical Engineering was from the University of Pittsburgh, his graduate degree in EE was from Georgia Institute of Technology as was his PhD in EE with a specialty in Systems and Controls.

Mr. Stanley “Scott” Gustafson is the Lockheed Martin Space Vice President responsible for the company’s centers of excellence (COE) in the Denver area and in Sunnyvale, CA. His citation reads: *“For sustained technical and program management excellence enabling the delivery of critically important national security space capabilities.”* In his current position, he leads the design, production and delivery of space products including optical payloads, RF and radar payloads/products and spacecraft buses. Previous to this position he was the Mission Success VP where he led independent assessments of the performance integrity of LM Space products. Prior to joining LM in 2018, Scott spent 31 years at the Aerospace Corporation, a DoD Federally Funded R&D Center (FFRDC) in Los Angeles. While there, he had a wide range of responsibilities including: General Manager of MILSATCOM programs where he led systems engineering support to the Air Force and Navy procurement organizations and before that he was the GM and Principal Director of Overhead Persistent Infra-Red (OPIR) programs where he supported the Air Force’s Space Based IR System (SBIRS) and Defense Support Program space segments. Prior to that, he had several Principal Director positions supporting the Air Force’s Space Radar Program, Development Planning Directorate and many years supporting the MILSATCOM programs. He is active in professional associations such as AIAA and is currently the elected Chair of the AFCEA/IEEE MILCOM Board. He serves as the LM executive liaison with CU Boulder and is on the Dean of Engineering Advisory Council. His undergraduate degree in Chemical Engineering was from Purdue University, his graduate degree in Chemical Engineering was from Stanford University and he also attended Senior Executives in National and International Security Program at the Kennedy School of Government at Harvard University.

Dr. David Klaus is a Professor of Aerospace Engineering at the University of Colorado at Boulder. His citation reads: *“For exceptional personal contributions to human spaceflight operations and pioneering space biology research, as well as for being a professor inspiring generations of aerospace engineers in bioastronautics education.”* He is a tenured professor at CU where he has been since 2002, teaching undergraduate and graduate students, and conducting

research in bioastronautics. He established and leads a special academic graduate program in bioastronautics addressing all facets of human spaceflight. Prof. Klaus has won multiple awards from CU for teaching excellence and mentoring of students, plus he was recognized with the Educator of the Year award in 2004 from the Rocky Mountain Section and he also was awarded the AIAA national Distinguished Service Award as Chair of the Life Sciences and Systems Technical Committee in 2009. Before entering the academic world, he was an Extra Vehicular Activity (EVA) mission operations and space suit test analysis contract engineer at Johnson Space Center as well as certified launch control engineer on the shuttle program in the mid 80’s. Prof. Klaus has published over 120 refereed journal articles, book chapters and conference papers. He is very active in AIAA and has been the



2019 AIAA Fellows and Honorary Fellows

Chairperson of the Life Sciences and Systems Technical Committee. He established, and is the Executive Director, of the FAA’s Center of Excellence for Commercial Space Transportation leading the efforts of 10 universities supporting the FAA in advancing commercial spaceflight. Prof. Klaus earned his undergraduate degree in Mechanical Engineering from West Virginia University, his graduate degree in Aerospace Engineering Sciences was from the University of Colorado as was his PhD in Aerospace Sciences. He was awarded a Fulbright Scholarship to attend the University of Bonn (Germany) for postdoc work in Microbiology.

Congratulations to all for this achievement!

Election Results for 2020-2021 Council Positions

Thank you for voting for the 2020-2021 AIAA-RMS Council Officer positions. The Election's Tellers Committee confirmed the vote count and the following are the 2020-2021 AIAA Rocky Mountain Section Council Officers. They will begin their term June 1st.

Chair: Stacey DeFore

Vice Chair: Alexandra Dukes

Secretary: Kathleen Pirazzi

Treasurer: Dr. Taylor Lilly

Communications Director: Sally Hanley

Engagement & Outreach Director: Chris Zeller

Membership Outreach Director: Marshall Lee

The Future of Space — Student Essay Contest

AIAA RMS Educational Outreach sponsored a contest to encourage middle school students to consider the future of space in the next 50 years. Seventh and eighth grade students from Colorado, Wyoming and Montana were invited to submit an original essay to answer the questions: ***“How advanced can you envision space technology and exploration through the next 50 years? What do we need to do now to achieve that?”***

The announcement was sent to RMS members with a request to forward the flyer to middle school students and educators. Nine 7th graders and sixteen 8th graders submitted essay. For the first time we had entries from Montana!

Fifteen AIAA RMS members reviewed the entries and selected the winning essays: David Amato, Michael Anderson, Eric Bjork, Lauren Daniels, Mike Dickey, Sally Hanley, John Kettling, David Loomis, Jane Mattson, Barrett McCann, Clark Mikkelsen, Chris Rouw, Jennifer Rozek, Barb Sande, and Katie Vanhemert. Criteria included originality of ideas presented, soundness of logic used to develop ideas, realism of ideas presented, and quality of composition,

clarity of expression and grammar and spelling.

Judges enjoyed the experience:

“This was fun! - Eric and David

“What a great contest!” – Jennifer

“These essays were a pleasure to read.” – Lauren

“It's so great to hear about their ideas for the future.” – Sally

“... after doing a whole box full of technical reading and studying all week, this little essay was very smooth, soothing, slightly philosophical, and rather eye opening.” – John

“Very interesting and some of the students were quite innovative.” - David

The winning authors were presented with a certificate and a monetary award. All authors received a small package of AIAA “schwag” including stickers, pencils, and silicone bracelets. The first place essays have been sent to the national level contest.

Enjoy reading the top essays on the following pages!

First Place, 8th Grade Essay—Lucas Anderson

Teacher: Tyler Fox

School: Eagleview Middle School, Colorado Springs, CO

It is no secret that our species has always been keen to explore anything undiscovered, and what we thought impossible one decade was the basis for our dreams in the next. And at this point, what grounds do we have to expect that to change? Since the earliest rockets were created, people imagined using them to travel to the moon, and when our species accomplished that, people imagined going to the stars. The more important question is not about if we will ever visit other planets, exoplanets, or even further destinations, but about how we will overcome the necessary difficulties and how difficult will they be to overcome. There are already plans in place by many of the major space organizations, and NASA is no exception. According to one article, “Unlike the way the space program started, NASA will not be racing a competitor. Rather, we will build upon the community of industrial, international, and academic partnerships forged for the space station” (“60 Years”). So it seems that we are going to have a far more cooperative future than our past, which will surely lead to more accomplishments. According to the article, “It’s Official. Humans Are Going to Mars. NASA Has Unveiled Their Mission,” NASA already has a plan to get humans to Mars in the next couple of decades, but they aren’t the only ones with that goal (Lant). SpaceX, for example, has been making strides toward Mars and, as stated above, will likely work with NASA and other companies to make sure they succeed. For example, the article, “NASA Teams with SpaceX, Blue Origin and More to Boost Moon Exploration Tech” discusses the organizations working on the steps leading up to this goal. The author states, “SpaceX will also work with NASA’s Kennedy Space Center in Florida on how best to land Starship on the moon” (Wall). So human exploration seems to have a bright future, mostly focused on getting to Mars.

But what about exploration in the absence of humans? We’ve already sent probes out to the distant solar system and beyond, so what’s next? In the very near future, our focus seems to be going inward rather than outward; we’ve launched the Parker Solar Probe, which will, as the name suggests, be sent toward the sun. However, we do still have longer-term goals, such as the Europa Clipper, which will allow us to gather information on Jupiter’s icy moon of the same name. But this project, unlike the solar probe, is still in its early stages (“Europa Clipper”). However, it will likely be a major focus for the next few decades. Another piece of technology that will impact our understanding of space is the James Webb Space Telescope (which will hopefully launch sometime within the next 50 years). This long-anticipated satellite will be an improved alternative to the Hubble telescope. It should allow us to get better images, and therefore understanding, of the universe in which we live. This will likely consume much of NASA’s attention with all of the useful information it can give us. According to a NASA article, “Webb will solve mysteries of our solar system, look beyond to distant worlds around other stars, and probe the mystifying structures and origins of our universe” (“60 Years”). So in short, the future of both manned and unmanned space travel seems relatively diverse and full of possibility.

Space could also be used to improve the lives of humans on Earth; many problems such as shortages of resources could be solved by traveling to other celestial bodies. Mining asteroids and other objects has been proposed before, but is this plausible, and is there anything valuable to be found? According to one

article, “Though most [asteroids] are hunks of rock or ice, some are replete with iron, platinum, gold, and other precious minerals” (Perry). While most likely not unattainable, the prospect of extracting resources from outer space does bring in some new challenges. We would need to improve our propulsion capabilities and develop excavation equipment that functions properly in the harsh environment of space. Technologies such as ionic thrusters, which exist but are still not practical, mainly due to their small size and thrust. These would need to be improved upon and scaled up to be fit for a mineral-harvesting craft. Other propulsion methods and energy sources may prove to be promising contributors to this goal. This equipment would have to handle extreme temperatures and temperature fluctuations and be able to work in a vacuum. This equipment would have to be designed for use in microgravity, and be unaffected by the heightened radiation levels present in that environment. We will need to make transporting large amounts of material more efficient, as many candidates for mining are all the way in the asteroid belt, or farther. Transportation may benefit from reducing the amount of unwanted material being transported; minerals are generally not found in a pure state, so technology should be developed that will allow ore to be refined on the asteroid or planet, if possible. Asteroid mining could prove to be very profitable, making it a great motivation to explore further.

Another point to consider is non-material resources; there’s quite a bit more than rock, metal, ice, and gas in our solar system. Energy is just as valuable as any of those, and it may be easier to acquire. For example, a solar panel orbiting the sun could be more efficient due to the lack of an atmosphere and the clouds that come with it. Transportation will likely not be a great issue; electricity can be transferred with the use of electromagnetic waves (Kingatua). Capitalism will most likely be one of the strongest driving forces behind progress in space.

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First Place, 7th Grade Essay—Colin Hicks

Teacher: Rachelle Morris

School: East Middle School, Great Fall, MT

To answer the questions, “How advanced can you envision space technology and exploration through the next 50 years?” and, “What do we need to do now to achieve that?” I opted to look into how space exploration and technology has developed in the past 50 years and what our predictions are for later missions to hypothesize how they will happen in the next 50 years. To make things a little easier, I chose NASA for my information and research because NASA is the leading organization in this subject. Now, let us start by talking about how space exploration has developed since the '60s.

First off, since the '60s man has landed on the moon, launched the largest telescope into space that is still in use to this day and constructed the International Space station. July 20, 1969, we first landed on the moon with 600 million watching as Neil Armstrong planted that American flag. This was a major milestone in the space community. It also paved the way for many more space missions to come. About 30 years later we were able to launch the International Space Station on November 20, 1998, which was a huge deal because it was the start of the continuous presence of people in the space station. April 24, 1990, the Hubble Space Telescope was launched into orbit along with five other astronauts. It made many discoveries such as discovering some of Pluto's moons, finding the age of the universe, and discovering many exoplanets. Now, all of these things we have accomplished within the past 50 years. These will help me later hypothesize how we will grow in our journey of space exploration. But first I will be talking about speculations on what we might accomplish within the next 50 years.

There is a mission that NASA announced to be the start of colonization on the moon. They named it Artemis in tribute to the Apollo missions. NASA, in their article about the Artemis mission simply said, “to prepare for Mars”. They also mentioned in that same article that this endeavor is going to take place in the years 2024 and 2028. Now, in my opinion, I do not think that this is feasible considering that they have only been working on this operation since 2017 which may seem like a long time but they have so many things that they have to make this mission to work. In 2021, we are scheduled to launch the James Webb Space Telescope. It will be replacing the Hubble space telescope and will be far better than the Hubble Telescope. It is predicted that this telescope will be able to see planets and stars born, it has a large shield-like object to protect it from external temperatures, and it may be able to find new exoplanets and use a tool called a spectroscope to study these new exoplanets. Now I have mentioned all this because using the information I can predict what might happen in the next 50 years and with that said I can go on to the next paragraph.

With all of this information, I can make a pretty solid prediction of what might happen within the next 50 years of space exploration. If we are going to mars, the moon, and sending out a new telescope to explore space within the next couple decades then within a half a century we are most likely going to start exploring the planets of our solar system more. We sent a rover named Pathfinder in 1997 for the first time onto Mars. Now if we keep advancing at the same rate as we have been I think we could send a rover to Jupiter or one of its moons within the next 30 years. Now my reasoning behind this has to do with how long it took us to send the first rover to Mars, roughly 30 years from the moon landing to the Pathfinder. Now if we get to Mars on the scheduled time in 2025 then we can use that as our ‘modern moon landing’ and add another

rough 30 years to estimate that we might send a rover that will land on Jupiter or one of its moons. Now this estimate could be off because we have advanced so much so quickly that it may only be something like 20 years in our future. Using the same reasoning and if we keep advancing at the same rate then we might send a rover to Saturn towards the end of our 50-year limit. Aside from rovers, NASA will launch the Deep Space Gateway that will further develop the Artemis mission. Now after reading NASA's article on the Deep Space Gateway I concluded that it won't just help further Artemis but will also help us create better exploration spaceships because in the article it says, "...Building the deep space gateway will allow engineers to develop new skills and test new technologies that have evolved since the assembly of the International Space Station." This got me thinking that we can create better spaceships to explore our solar system and even others, but that would be long term and not just 50 years.

The next 50 years of space exploration are bound to be full of discoveries and technologies that will better our world. Answering the question of how we will advance, I think we will send rovers to both Jupiter and Saturn. We might also create better exploration spaceships. All of these can be possible if we keep advancing in this field of technology. I have created these conclusions using many different articles from NASA and my thinking skills. Overall, I think that we will advance indefinitely.

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