

Launching Dreams: The Long-term Impact of SAREX and ARISS on Student Achievement

Presented by

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Abstract

At the beginning of the 21st century, NASA described its educational mission a objective in terms of “inspiring the next generation of explorers . . . as only NASA can.” Thanks to the dedication of the amateur radio community, over 300 successful school contacts have taken place through Amateur Radio on the International Space Station (ARISS), with a future schedule set to average one contact per week. Prior to ARISS, well over 200 school-to-shuttle contacts were accomplished via Shuttle Amateur Radio Experiment (SAREX). Each event was filled with eager students, proud parents and teachers, and excited members of the media who could not help but be caught up in the thrill of it all! But, what happened *after* the last student squeezed in a question before the orbiter or ISS moved out of the “footprint” . . . *after* the glow of that “fifteen minutes of fame” had dimmed. . . *after* the return to homework, tests, football practice, and music lessons? The question remains: Has indeed this “next generation of explorers” been inspired? Has the SAREX/ARISS experience actually made a positive difference in students’ lives?

NASA’s new approach to education acknowledges that inspiration provides the base, but it must lead to engagement, followed by education, and finally employment. In this “case study” paper, a veteran teacher will trace the nearly two-decade history of her students’ involvement with SAREX/ARISS from their middle school days to their current careers. She will follow their paths to illustrate how their involvement in these programs at a young age contributed to the inspiration that – as NASA’s current approach to education emphasizes – has continued to engage them in science and technology throughout their lives.

About the Author

Patricia Palazzolo is a grade 7 – 12 Gifted Coordinator in the Upper St. Clair (PA) School District, but is probably best known as "Pennsylvania Teacher-in-Space." In 1985, she was named Pennsylvania finalist for what was to become the ill-fated Challenger mission. In that role, she has addressed over 50,000 Americans and conducted teacher workshops from Colorado to New Brunswick. Her students have sent sea-monkeys and Chia Pet seeds into orbit with John Glenn, spoken with cosmonaut Sergei Krikalev while he circled the Earth as the first Russian on the American space shuttle, and contacted astronaut Mike Fincke on the International Space Station via amateur radio. Pat was the 2002 recipient of the Anne Morrow Lindbergh K-12 Aerospace Educator A

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1 Introduction

NA1SS, this is WB4GCS on Primary. . .

NA1SS, this WB4GCS on Primary. . .

Nothing but static.

NA1SS, this is WB4GCS on Secondary. . .

Uh oh! At that, my heart nearly stopped! Secondary. . . and still no response? What was wrong? The huge room was filled with students, family members, teachers, and members of the media . . . and all eyes were glued to the wall-sized tracking screen. We could see that the International Space Station was in the “footprint” over Pittsburgh, yet we heard nothing. Would the months of preparation leading up to this moment end in disappointment?

Once again, the calm voice of our amateur radio “wizard,” Jim Sanford:

NA1SS, this is WB4GCS on Primary. . .weak but readable. . .

And then we **all** heard it!

WB4GCS, this is the International Space Station, NA1SS. Your signal is getting stronger.

The collective breath released by all, and the brightness of the grins on every face, seemed powerful enough to blast us all into orbit without a shuttle! The excited students began their Q & A with Expedition 9 astronaut Mike Fincke. . . but, in fact, the opportunity for this exchange had its beginnings fifteen years earlier with an entirely different group of eager middle-schoolers.

2 Orbiting the Turnpike

Back in 1985, over 11,000 teachers completed lengthy applications in hopes of becoming NASA’s first “Teacher-in-Space.” After a long and grueling selection process, two teachers were chosen to represent each state and US territory. I was thrilled to be selected as one of the two Pennsylvania representatives. I was assigned to the same training group as New Hampshire teacher Christa McAuliffe; after Christa’s eventual selection as America’s Teacher-in-Space, I was both pleased and honored that NASA appointed the remaining state finalists “Space Ambassadors” and assigned us the task of promoting aerospace education in our home states. In the months leading up to the Challenger launch I, like the rest of the Teacher-in-Space finalists, received requests to drive ever farther to conduct school assemblies, run

teacher workshops, and give speeches. The public was definitely caught up in the dream.

The nightmare came that January.

3—2—1—Liftoff! I watched Challenger rise, brighter than the sun, into that clear blue sky and heard the voice of the Public Affairs Officer come over the loudspeakers at the viewing site: *Obviously a major malfunction. . .the vehicle has exploded.*

I returned to Pennsylvania to find a blur of phone calls, cameras in my face and questions -- questions as to possible damage to children's psyches, questions as to whether the Teacher-in-Space Project had been nothing more than a public relations stunt, and questions as to whether we should be spending any money at all on the space program. What I did *not* return to find was any lack of the ability of space exploration to continue to inspire students and teachers.

And so it was on a warm spring day in 1989 that I received a phone call out of the blue from Mary Ellen Chuss-Mirro, a dynamic teacher in the small Sacred Heart School in the small town of Bath on the opposite side of Pennsylvania. She had read that I was "NASA Space Ambassador" to the state and wondered if I had any ideas for "experiments" her middle school students could conduct to keep them busy so they would not "drive her husband crazy" while he drove them around the Bethlehem Raceway on a two-hour "mission" in the van that they had converted into a "space shuttle." I came up with several suggestions and, intrigued, called her back several weeks later to find out if the mission had been a success. Delighted with the outcome and bubbling with enthusiasm, she said her only concern was that she did not know how she would "top it" the following year.

"I do," I said, "Come on a mission across the entire state! My students will serve as Mission Control for your orbiter!"

The detailed planning would have made NASA proud. . . police escorts set up along the way, stops arranged at various venues on the route (including a special welcome by the Governor in Harrisburg), experiments designed, a special "rover" built to be used to explore "Planet Pittsburgh" upon the crew's arrival, and computer tracking programs written by my students so they would be able to provide hourly reports to our entire student body about the location, speed, fuel consumption rate, and likely "landing" time of the "orbiter," known as *Missioner II*.

A real coup on our part, or so we thought, was having secured the use of a cell phones for the duration of the mission across the Commonwealth. At that time, very few "average people" had ever used, let alone owned, a cell phone. We were grateful to the company that donated the equipment and usage time of this "new-fangled" high-tech device that would help our Mission Control stay in touch with the van-turned-shuttle.

After a year of preparation, *Missioner II* blasted off on April 30, 1990 and began its five-day journey across Pennsylvania . . .and for much of the mission, the "new-fangled" high tech device known as a cell phone was useless. Fortunately, a couple of local hams, Seth Ward KC3YE (SK) and his son Glenn N3EKW, graciously volunteered to serve as our "back-up" communications system.

Not only was their ability to communicate with the van-turned-shuttle instrumental to the mission's success, it provided excitement and a genuine "Mission Control" feel

to our site. The students loved seeing the radio equipment and hearing the details of the orbiter's progress across the state over the speakers. As the "shuttle" drew closer and closer to Pittsburgh, we began to hear other hams talking about it over the radio.

Did you just see that? Is that a space shuttle on the Turnpike?

On "final approach," I was a bit concerned about *Missioner II*'s clearance coming through one of Pittsburgh's famous tunnels. After hearing our ham radio volunteers discussing our tunnel situation, a ham listening in from a station in a rival school district could not contain his curiosity. He called to ask us just *what* we were trying to bring in through the tunnel. He had assumed it was some kind of big truck . . . until he heard the words "wingspan" and "tail height." Our students got a good laugh when they heard him joke, "That's Upper St. Clair for you . . . always having to show off!"



The excellent work of our amateur radio volunteers saved the day. Our eighth grade Mission Control team was able to track the shuttle to a perfect landing at our front entrance. The entire school stood outside to cheer her arrival. She was indeed an amazing sight moving down the street with a motorcycle police escort, firing 40,000 cubic feet of non-toxic smoke out of the main engines! (Yes, the firing of the main engines should not happen during a landing, but middle schoolers who have been meticulously tracking an unseen object for almost a week want to see smoke and hear noise at the end.) *Missioner II* impressed even former astronaut Joe Allen, who was kind enough to join us for the event. (My "Mission Control" students had met him when they won a trip to the Hubble launch for their design of a shuttle

experiment about soap bubble kinetics in microgravity.) He grinned, patted her wing, and called her a “really slick vehicle.”

The help we received from ham radio volunteers in tracking the van-turned-shuttle led to my “next generation” of students tracking the **real** thing just four years later.

3 From Mars to the Stars

During the same period I was working with the teacher in Bath on plans for *Missioner II's* journey across the Commonwealth, I was contacted by visionary community members from a town much closer to Pittsburgh – Mars (yes, Mars!) Mars is about a 45-minute drive north of Pittsburgh, but at that time, was rather rural in nature. The members of the Mars Area Foundation for Education Enrichment (MAFEE) contributed funds to provide special educational and cultural experiences to help their students realize that they were part of the world.

So, what special experience did the students seek? They wrote to then-Soviet leader Mikhail Gorbachev to inquire, “Wouldn’t you like the Russians to be the first to visit Mars – Pennsylvania, that is!” Never believing that they would actually receive a response, they were stunned by the arrival of a brief telex stating only that “Cosmonaut Hero Sergei Krikalev will visit the children of Mars in three weeks.”

The students then wrote to NASA and said, “You’re not going to let the Russians beat us to Mars, are you?” And so it was that Astronaut Mario Runco, Jr. joined Cosmonaut Sergei Krikalev for the first US-Soviet mission to Mars (Pennsylvania!)

And so it was, too, that I was called upon to serve as a true “Space Ambassador” . . . especially when Sergei arrived alone, had no return ticket on Aeroflot, we had no translator available, and the nation he came from was still known as the USSR. Everyone was so grateful to have him as a guest for an entire week, but so nervous about making mistakes. We need not have been concerned. From making school visits to attending Pittsburgh Pirate games to serving as the grand marshal of a community parade, Sergei charmed us all.

Therefore, everyone took interest in his next mission to Mir. He was, after all, “our” cosmonaut. It was May of 1991 -- one year after our special shuttle-van-across-Pennsylvania event. My students who had, as eighth graders, served as Mission Control were now nearing the end of their first year of high school. They had all maintained their interest in science and technology, taking high-level courses and volunteering at the science center. By this time, encouraged by our amateur radio volunteers, I had earned my own ham license.

Yes, in May of 1991, the students were excited to know someone on Mir, but that excitement turned to worry when the Soviet Union disintegrated and stories of Sergei Krikalev being “stranded” in space made headlines. I was able to see him at the Association of Space Explorers Conference in Washington DC in the summer of 1992, not long after he had finally returned to Earth as “the last Soviet citizen” . . . and the first thing he said to me was “Mars. . .the children?” He had realized that the students he had met during his visit might indeed have been concerned about his welfare. He smiled when I gave him a chocolate space shuttle made by a

Pittsburgh-area candy company to take back to his little girl. I assumed that our paths would never cross again.

It was the following summer that an amazing set of circumstances came together: I learned about the opportunity for students to speak with astronauts aboard the space shuttle through a program called SAREX, I now knew some wonderful people in the amateur radio community who might be willing to help, and I found out that the first Russian ever to fly on the American space shuttle was to be, of all people, Sergei Krikalev. Best of all, despite an incredibly tight schedule, Sergei's mission, STS-60, was to be a SAREX mission. There was just enough time to get an application in! There would be no guarantee that my proposal would be accepted, let alone assigned STS-60, but it was worth a try. For equipment and technical support, I turned to the North Hills and Butler Area Radio Clubs. I then approached the Mars Area School District with an offer I hoped they could not refuse: I would do all the work in writing the proposal, finding the volunteers, and planning the event -- if they would allow me to propose a joint effort between my school district and theirs. . . with half the question askers coming from my district . . . yet set everything up in Mars. (My own district never did quite understand why I based the event in Mars, rather than my own school. I explained to them that part of the SAREX application required explaining how one would attract the media. How could anyone resist headlines proclaiming that the shuttle had contacted "life on Mars," not to mention the fact that the first Russian to fly on the shuttle had already visited that town?)

The students who had tracked the shuttle-van as eighth graders were now high school seniors. I turned to them to design a method of engaging the "new generation" of middle schoolers in SAREX. How could they develop a fair method of selecting the few students who would actually have an opportunity to ask a question? Letters would be sent home to every middle school child in the district. On the *outside* of an envelope, interested students would write the question they would most like to ask an astronaut on orbit. All identifying information, as well as a signed permission slip, would be sealed *inside* the envelope. My team of former students would go through all the questions and pick the best ones. Only then would the envelopes be opened and the identities of the question writers revealed.

I submitted our SAREX proposal . . . and waited.

When our proposal was accepted as one only five sites in the world to be scheduled for a SAREX contact with STS-60, there was joy in both school districts. With the help of some local hams, I began a series of assemblies to excite and inform all the students in both areas about amateur radio and space exploration. In the meantime, my team of twelfth graders took their assignment of question selection very seriously. They wanted to be sure to come up with the most important, most interesting, most diverse combination of questions possible. It was their way of passing their torch to this next generation of students.

When the envelopes were opened, we were pleased to find that the "official question askers" included an equal mix of boys and girls. All were excited about the upcoming opportunity. Fourteen students – half from Upper St. Clair and half from Mars, all from grade levels 5 through 8 – began to prepare for the big day that would come in February, 1994.

The morning of the contact day was electric. It seemed as if every newspaper and television reporter in Western Pennsylvania had descended on Mars Middle School.

The “SAREX kids,” sporting sweatshirts with a huge STS-60 logo on the front, proudly posed before a large banner that said “From Mars to the Stars.” In between interviews, they practiced reading their questions so as to be prepared when it was their turn to hold the mike. The school’s main office had been set up like Mission Control and overflow crowds were able to watch the event from the cafeteria and gym on closed circuit television. Back in Upper St. Clair, the school was open for the public to come in to watch the event unfold on a viewing screen set up in the auditorium. As the time for contact approached, a call from NASA informed us to which crew member the students would be speaking. “Looks like it’s going to be Sergei,” said the voice. He could hear the cheer that erupted from the crowd. “I guess they’re happy,” he laughed.

We all watched the tracking program and saw the shuttle come into the footprint. Nothing. No response to our control operator’s call. Tense silence as the shuttle moved away from the footprint. Finally, the voice from NASA told us that “something had come up” with the deployment of the Wake Shield Facility and that, essentially, Sergei “didn’t have his ears on.” I was proud of the students’ response. They smiled bravely and told the media it was still exciting just to hear the radio attempts. I knew they were disappointed, but part of their preparation had been to learn that SAREX was considered **secondary** to other shuttle experiments and operations, and that a school would only have one opportunity for contact no matter what interfered. . . including other things that might “come up” on the shuttle. However, as we stood there, we heard the voice from NASA say, “Sergei would like to try again on the next pass, if you don’t mind missing 90 more minutes of school.” This time the cheer was even louder. The contact with Mars was being made via telebridge, so we were actually receiving the signal by bridge to a ham operator based in Australia and could thus wait for the shuttle’s next pass.

The hour-and-a-half zipped by. Soon we heard our control operator calling the shuttle once again. . .and once again, there was no response. Wait. . . was that something? Perhaps. . .lots of static. . .no. . . the shuttle was out of range. The disappointment was palpable this time. (We later learned that the experts had a theory that the problem had something to do with a huge aurora.) Still, the students exhibited great dignity and maturity as they spoke of how it had been a “great learning experience.”

At eleven o’clock that night, my phone rang. It was my SAREX mentor wanting to know if we would like to give it an unprecedented third try in about fifteen hours!

I began frantically calling fourteen families at midnight, trying to make arrangements for everyone to return to Mars in the morning. I made calls to the media, the volunteers, and to our dear control operator who lived almost two hours away. Everyone was willing to return.

In the morning, we woke up to an ice storm! The Mars District was closed, and my own had a two-hour delay. I kept in mind the poster I had hanging in my classroom: “You never fail unless you stop trying.” There was no huge audience this time, but the amazing principal in Mars was able to get the Mars SAREX students in via police escort, our amazing control operator took a day off from work and braved the two-hour icy drive to set up the radio, and even a limited number of media returned. Unfortunately, there was no way to get my own SAREX students safely to Mars. The roads were just too bad. Then, I had an idea. I called the Johnson Space Center and asked if my kids could be patched in via speaker phone. At first, they did not

like the plan, believing it would be too difficult to have first a student from Mars ask a question, followed by one from Upper St. Clair. The delay would be too great and it would be too confusing. I asked them to just please let us try. After testing the acoustics from various points in the classroom, Houston said the sound was the best when the speaker phone was placed on a chair near my desk.

As the shuttle approached the footprint (which we could not see because the equipment was in Mars), my students – on their knees – gathered around the chair, waiting for their turns to scream their questions into the speakerphone. Their parents formed a ring around them. There was no media. We waited tensely.

Then we heard the response for which we had been hoping:

This is U5MIR.

It was Sergei! This was followed by the first question, posed by one of the “Martians.” My student shouted her question into the phone as soon as Sergei had completed his answer. The back-and-forth system was working well . . . until my school began dismissing buses early due to the increasingly bad weather. *Bus 43. . . Bus 71. . .* came over the PA system. The people in Houston informed us that they were hearing our bus announcements and threatened to cut us off. At that, some parents grabbed mousepads to tape over the speakers in the room while others raced to the main office to ask the principal to cut the announcements. The student questions continued successfully. At one point, a woman took Sergei’s place in answering. It was difficult for him to make out children’s voices, in English, over a less-than-ideal sound system. However, having the opportunity to speak with both Cosmonaut Sergei Krikalev and Astronaut Jan Davis on the first Russian-American shuttle flight was indeed very memorable! It was also a very special example of adults modeling persistence and teamwork for students. From the ham volunteers to the school administrators to the astronauts themselves, it was obvious that the willingness to be flexible and work hard could make important dreams come true!

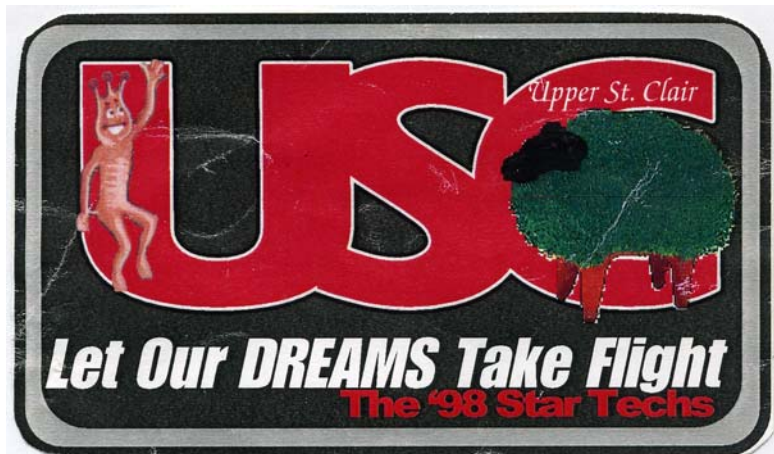
4 The Next Generation: John Glenn, Sea-Monkeys, and Ch-ch-chia!

My special group of seniors felt good about having played a role in exposing my new generation of students to the wonders of science and technology. They headed off to college. . . Francesca to Georgetown with hopes of medical school. . . Noah to Notre Dame with plans for medical research. . . Kevin to USC for computer engineering. . . Amy to Cornell to study planetary science and earth systems. . . Joe off to Villanova for chemistry. . . Mike on to Michigan as a physics major. . . and others off to similar pursuits. As they departed, they kidded me: They had tracked a shuttle mock-up on the Turnpike. My next group of students had communicated with the genuine orbiter. What was to follow? Would my next students get to go into orbit themselves?

Not exactly. . . but thanks to the continued efforts of this “first generation” of students, my new group did get to send a “little piece of Upper St. Clair” into orbit. Over my many years of teaching, I have witnessed the imagination, learning, and accomplishments of my former students ripple out to touch others in wider and

wider circles, like the rings of water from the proverbial pebble tossed in a pond. Amy continued following her passion for space science through college. At one point, while attending one of the very selective summer NASA Academies, she became friends with a grad student who had designed a ratchetless ratchet wrench that was going to be flown as a shuttle experiment. He had just a tiny bit of space remaining in his container and was musing about “some teacher” perhaps being able to have kids think of what to do with that space. Amy immediately responded, “I know just the teacher! I know just the kids!”

I received a phone call from her the very last week of school and was told that we had one week to try to design an experiment for that small bit of “leftover space”. . . and that experiment had to meet all NASA’s requirements or we would lose the opportunity. In short, my students had to operate as real scientists. My middle school students at first had difficulty understanding that the experiment would be loaded into the shuttle during the summer and sit there for at least two months. . . so, no, they could not send up anything that was alive. . .and our allotted space was just a few test tubes. They finally hit upon the idea of sending Sea-Monkey (brine shrimp) eggs, since they would be able to “bring them to life” after their time in space. But they also wanted to send some flora along with their fauna. Suddenly, one of the students started singing the “Chia Pet” jingle: *Ch-ch-chia. . .Ch-ch-chia!* Why not? One never seems to see them for sale except at holiday time, so they must store well. The experiment design began in earnest, with the students working through much of the summer to meet NASA’s standards. Most memorable was the day they were actually able to load their experiment into the special container NASA had sent us, and to place the mission patch they had designed themselves on that container. The patch depicted both a Sea-Monkey logo and Chia-pet sheep, as well as the students’ own motto: *Let Our DREAMS Take Flight. . .* with “DREAMS” standing for “**D**oing **R**eal **E**xperiments **A**dds **M**eaning to **S**cience.”



Throughout the design process, the students had known only that their experiment would fly on “a” mission. It turned out to be “**the**” mission of 1998: STS-95 -- 77-year-old John Glenn’s return to space. That being the case, my little team received far more than their “fifteen minutes” of media attention. Nevertheless, the stars in their eyes were not so bright as to dim their excitement at viewing the launch and feeling humbled to realize that something they had put together was indeed being

carried into orbit. And for Amy, now starting her Masters in Science, Technology, and Public Policy at George Washington University, it was another ripple in the pond. The students involved in this project began high school on fire and took advantage of every science and engineering opportunity throughout the next four years. When they were high school seniors, they finally had the opportunity to meet John Glenn and his wife Annie in person during the couples' visit to Pittsburgh. The Glenns generously spent half an hour with us privately. As I watched these students speaking to Colonel Glenn, I realized that their resumes now included Governor's School for the Sciences, several national awards for science and engineering projects, important summer internships, Eagle Scouts, and even the collection and refurbishment of thirty discarded wheelchairs that were then sent to poor hospitals in Vietnam. They had all been awarded scholarships to top universities – with one even having been already accepted for a full ride to medical school – and they had not yet officially graduated from high school!

5 The Adventure Continues: From SAREX to ARISS

Early in 2004, yet another opportunity presented itself.

I had a voicemail message at school asking me to call NASA . . . something about being a “crew pick” for an ARISS contact. What did that mean?

As it turned out, Pittsburgh astronaut Mike Fincke was going to be the Science Officer for Expedition 9 on the International Space Station. . . and he had selected my school with which to do an ARISS contact! I was thrilled, yet confused. I had never met Mike Fincke and he had never attended Upper St. Clair Schools. How did I get to be his “crew pick?” Why wasn't he going to do an ARISS with his own school? Was this a prank?

I soon learned that it was a genuine opportunity! Col. Fincke had promised an Upper St. Clair grad working in life sciences/countermeasures at the Johnson Space Center that, if he ever had the chance to go into space, he would do a school contact with the school of her choice. When his flight assignment came, he remained true to his promise and she, of course, selected her alma mater for contact. Although this particular young woman, Lesley Lee, had graduated before I began teaching in the district, she was aware of the kinds of special projects my students and the supportive community had been able to “pull off” over the years. This project would definitely require skill to be successful because, unlike the SAREX which had been difficult enough to accomplish in Mars, this would **not** be a telebridge. This was to be a “direct.” Add to that the Upper St. Clair landscape, where every building was built into a hillside, and my concerns over finding a way to set up an antenna to clear both buildings and trees grew serious. For that matter, where could I even find someone with the right antenna? Where could I find someone who could set up the correct equipment?

I turned to my local amateur radio club -- WASH, the Wireless Association of South Hills who, in turn, engaged the cooperation of WACOM, Washington Area Communications. Their energy, passion, commitment, and expertise were boundless . . . even as the contact date kept slipping and everyone had to keep changing their vacation dates. They took over everything having to do with the set-

up, from stringing wire through the school roof to splashy camera and sound set-ups to T-shirts! All I had to do was deal with the students.

This time, instead of middle school, I wanted to involve a range of ages. The students selected to ask questions represented each grade level from fourth through twelfth. I named them the “ARISS Ambassadors,” and informed them that part of their job would be to act as my liaisons to each of their respective classes. I would call upon them to keep their classmates updated on information related to space, science, and technology throughout their years in the Upper St. Clair School system. It would also be my hope that, as they graduated and moved on to college and careers, they would continue the ripple-in-the-pond effect of contributing to others. . .including offering any learning opportunities possible to the “next generation” of students who would follow them.

. . . This is the International Space Station, NA1SS. Your signal is getting stronger. . .

Jim Sanford, WB4GCS, turns the microphone over to ninth-grader J.T. Gralka, who asks the first question, while Kevin Smith, N3HKQ, prepares the next student to quickly take his turn. I stand off-stage to guide each student who has asked a question safely clear of the next child leaving the platform. They are starry-eyed from the experience and I know that their minds are no longer connected to their body movements. I do not want to see a domino-style pileup of my ARISS Ambassadors! I, too, am dizzy with excitement and grateful that someone is recording Mike Fincke’s answers. I vaguely realize that he is responding in ways that range from humorous to poetic, but I cannot get my mind to register anything beyond, “The kids are talking to an astronaut on the ISS! It’s really happening!” I become aware that the students have had the same experience when reporters begin to ask them what they think of the answers to their questions. I almost laugh when I see the puzzled look in their eyes as they suddenly realize that they can’t remember what Mike just told them. It is fine. The details will return to our brains later. For now, it is enough just to bask in the glow of a successful ARISS and thank all those who have made it possible, just as we did over a decade ago after our SAREX with STS-60. A random thought passes through my mind. . . After beginning with a contact date of “anywhere between May and September,” and through numerous “slips” of the “official date” once we had been given one, we have finally made successful contact on this date. . . August 27. . . today is Sergei Krikalev’s, U5MIR’s, birthday.

6 The “Next Generation of Explorers”: NASA’s Goal of Engagement, Education, and Employment

NASA’s new educational mission has set goals that move beyond simply “inspiring” children to consider careers in science and technology. It is important for students to seek strong educational foundations in these fields as a means of retaining an interested, well-trained work force, as well as to engage the public in a “vision” that supports science, technology, and space exploration. Various reports of the monumental numbers of students, teachers, and the general public who have

witnessed, heard, or read about SAREX and ARISS contacts have been issued over the years. I know that after a SAREX or ARISS contact, I have had to send the ARRL reports of “my numbers” in terms of live audience, those watching from satellite locations, teachers who may have been in-serviced, newspaper article readership, and even numbers who may have viewed a news story about it on television. Those statistics reveal the tremendous outreach of SAREX/ARISS. . . and no one can watch the faces of those viewing students talking via amateur radio to an astronaut and doubt the “inspiration factor,” even for those who are simply “audience members.”

However, it is vital that we consider the long-term **impact** of that inspiration. The students who were actually selected to ask a question, or in some cases, to help set up the equipment, are significantly smaller in number than those reported as “audience members.” Yet, if the inspiration of that hands-on experience at a crucial age can inspire these children to pursue educations and enter careers at the passionate and “high quality” level which I have witnessed among my own former students, then the positive impact of SAREX and ARISS goes far beyond any numbers found in reports. All of my students who have participated in SAREX/ARISS -- or as the original “Mission Control” team tracking *Missioner II* across Pennsylvania – have gone on to phenomenal accomplishments and careers that contribute much to society. Almost all have opted for careers in science, technology, or science-related fields (such as MBAs working for technology firms or patent lawyers). There are many medical doctors and information technology specialists. One is now an amazing calculus teacher whose classroom is next door to mine! Therefore, I will highlight just a few examples from each of my “generations of explorers.” They now range in age from twelve-year-olds to professionals in their early thirties.

7 The “First Generation”: *Missioner II* Mission Control Team

- **Noah Gray** – went on to Notre Dame and then finished a PhD in neuroscience at the Mayo Clinic, where he investigated vesicle trafficking and endocytosis before joining the Cold Spring Harbor Laboratory; he later conducted research at the Janelia Farm Research Campus (Howard Hughes Medical Institute) which is the world-class center known for bringing together the best scientists from many disciplines to collaborate on small teams to try to solve some of the world’s most challenging problems; currently assistant editor of *Nature Neuroscience*, the top journal in its field
- **Joseph Pickel** –completed a BS in chemistry at Villanova, followed by a PhD in polymer chemistry at University of Akron; currently a polymer chemist at the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory in Tennessee; the center is the first of five nanoscience research centers funded by the US Department of Energy; Joe’s research group is dedicated to “making polymers behave the way we want them to” so that they can be useful in fuel cells, making lighter and stronger cars, biomaterials, and more. . .and, in Joe’s words, “I’m loving it!”; has also had to

become an expert glassblower, since polymer chemists often have to make the supplies they need for their experiments



Joe Pickel's passion for science did not end in middle school. Today he is Dr. Joseph Pickel, a polymer chemist at the Oak Ridge National Laboratory. (KnoxNews)

- **Michael Weinberger** – finished his BS in physics at Michigan and a PhD in experimental particle physics at Cornell; currently working for Texas A&M University on the CDF experiment at Fermilab in Chicago, and the CMS experiment located outside Geneva, Switzerland; in his most recent note to me, Mike said, "I am in the middle of working right now and am actually underground in France working on electronics for the CMS particle detector as I type this."
- **Amy (Snyder) Kaminski** – studied planetary science and Earth systems at Cornell, where she also added a minor in science journalism after having attended a shuttle launch with me with a press pass; became editor of Cornell's "Science and Technology Journal"; received a Masters in Science, Technology, and Public Policy at George Washington University, specializing in Space Policy, while also authoring a book with "space law expert," John Logsdon; has published many articles on astronomy, as well as articles on space tourism; is often a featured presenter at the very NASA Academies she attended as an undergraduate; did an internship with the Rand Corporation, then worked with the FAA Commercial Space Division as the "Office Lead" on both Space Tourism and Space Debris; on the Board of

Women in Aerospace and is featured in a book about 100 powerful woman in the space industry, aimed at middle school girls; currently Space Programs Examiner for the Office of Management and Budget



Amy (Snyder) Kaminski participating in a NASA Academy as a college student. Today Amy is Space Programs Examiner for the White House.



While in college, Amy alerted a "second generation" of middle schoolers about an exciting opportunity to develop and fly an experiment on the shuttle.

8 The “Second Generation”: SAREX and Sea-Monkeys



Students eager to see their experiment launch with John Glenn in 1998. Megen Vo is standing on the left, teacher Pat Palazzolo on the right. Sitting left to right are students Matt Muffly, Karl Zelik, Dan Zelik, and Dan Doan.

- **Megen Vo** – was featured in the Nickelodeon program *Figure It Out!* Panel had to try to figure out what was so special about the “pets” Megen had brought to the studio in Orlando (flying them in all the way from Pittsburgh) – of course, they were our actual sea-monkeys that had been to space with John Glenn back when they were just eggs; Megen is currently in medical school at Case-Western University
- **Matthew Muffly** – accepted into the Pennsylvania Governor’s School for Health Care during high school (a highly selective summer program); has been a research assistant for a hand surgeon throughout college and has had an article published in the *Journal of Hand Surgery*; is about to start medical school
- **Daniel Doan** – became concerned about problems faced by hospitals in Vietnam which do not have enough wheelchairs for their patients; for his Eagle Scout project, he rounded up broken and discarded wheelchairs from area hospitals, took classes in how to repair them, and single-handedly refurbished thirty wheelchairs in his family’s garage; faced with the problem of delivering them to Vietnamese hospitals, he was able to get the World Vision organization to send them; was granted a full scholarship to

undergraduate studies *and* medical school by the University of Pittsburgh while still a high school senior; currently in medical school

- **Karl Zelik** –completed a BS in biomedical engineering at Washington University in St. Louis; spent undergrad summers working with mechanical hearts in Pittsburgh; this past year he worked developing bionic prosthetics at St. Jude Hospital ; currently working on his Masters in mechanical engineering at Michigan
- **Daniel Zelik** – received a full scholarship from Iowa to work on his Bachelors in industrial engineering, with a minor in psychology; as his co-op program, he spent months at a time working with NASA at the Johnson Space Center; currently working on his PhD in human factors engineering at Ohio State

9 The “Third Generation”: The ARISS Ambassadors



Sarah Perrone and Matt Boyas with their award-winning Exploravision project.

- **Matthew Boyas** – on the Future Problem Solving Team that qualified to represent Pennsylvania at the International Future Problem Solving Finals, where the team finished Fourth in the world; three Honorable Mentions from Toshiba for papers submitted for the Exploravision Contest; in January, one of those papers will be featured in a textbook called *Nanotechnology 101* (Greenwood Publishing group); has served well as an ARISS Ambassador,

including assisting me in running science events for my middle school students; currently a high school junior

- **Benjamin Burns** – perfect SAT scores, but equally strong in civic responsibility; was on the First Place Design, Engineering, & Fabrication team in high school; nationally ranked as a math student; currently an undergraduate at Harvard studying engineering and physics and also working in the Harvard Observatory

10 Conclusion

After more than two decades and well over 500 successful school contacts, have SAREX and ARISS served to “inspire the next generation of explorers. . .as only NASA can?” Reports that count the numbers of people “exposed” through these events to science and technology – and, more specifically, to both amateur radio and to NASA – reveal sky-high numbers. But in this paper – a longitudinal “case study” of one teacher’s lengthy involvement with these activities over the course of her career – I have sought to provide specific follow-ups of the students most deeply involved at the time. SAREX and ARISS inspire engagement, education, and employment through

- providing “hands-on” learning
- making real-world connections among disciplines
- requiring problem-solving while under the pressure of deadlines
- demanding excellent communication skills
- illustrating the importance of technology and the joy that sharing one’s skills can give to others
- allowing adults to model the power of passion, partnership, and persistence



Ham volunteers make Upper St. Clair’s ARISS a success!



Back on Earth, astronaut Mike Fincke greets teacher Pat Palazzolo and two of the ARISS Ambassadors with whom he had spoken while on orbit.

My former students continue to work in exciting high-tech fields, and continue their willingness to help my “current generation” of students. Recently, I emailed a number of my old students requesting their help with an educational proposal for a shuttle downlink. The response was immediate and overwhelmingly positive. Mike Weinberger emailed me from underground in France, writing “I hope I am not too late to help with this project. I would love to help out the current students.” From Tennessee, Joe Pickel wrote “I would LOVE to take part in this project. . .please tell me what you need and I will help out.” Last spring, a team of my high school students made the national finals of an academic competition, for which they traveled to Washington DC. The highlight of the trip was a tour of the White House that Amy Kaminski was able to arrange for them.; more impressive than the tour, in their minds, however, was the fact that it was the “legendary Amy” herself who was accompanying them as they walked through the White House. Amy’s willingness to “scramble” on last-minute notice to allow my students to participate in the tour. . . as well as Mike’s and Joe’s willingness to fit us into their hectic schedule. . .have roots, I am certain, that go back to the amateur radio and other volunteers who gave of their time and expertise when these students were so young.

I am but one teacher who is very proud and humbled by the accomplishments of her SAREX and ARISS students over the years . . . and especially proud of the lives they have touched and their willingness to “give back.” Is there a long-term impact of SAREX and ARISS on student achievement? I am but one teacher . . . There were well over 200 SAREX school contacts, and there have already been over 300 ARISS school contacts. . . just do the math.