

Avicenna Academy

Science Community Collaboration

Implementation Plan for Student Spaceflight Experiments Program (SSEP)

Mission 1 to the International Space Station

<http://ssep.ncesse.org>

Avicenna Academy Science Community Collaboration (AASCC)

Community Members:

Avicenna Academy (Lead School); Crown Point, Indiana (www.avicennaacademy.org)

Forest Ridge Academy; Schererville, Indiana (www.fra.edu)

Highland Christian School; Highland, Indiana (www.highlandchristian.org)

LaLumiere School; South Bend, Indiana (www.lalumiere.org)

Proposed SSEP Community Program Director/ Co-Directors:

Ms. Amanda Arceo, M.S., M.Ed., Principal Director

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Science Chair, LaLumiere School

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1. Community Overview

1.1. Introduction

Avicenna Academy created a science community collaboration last year to pool students for participation in the National Center for Earth and Space Science Education (NCESSE)'s STEM initiative called the Student Spaceflight Experiments Program (SSEP). Our science community collaboration, Avicenna Academy Science Community Collaboration (AASCC), participated in SSEP STS-135 during the spring semester of the 2010-2011 school year. We are herein proposing to extend our involvement in SSEP by participating in SSEP Mission 1 to the International Space Station (ISS) during the 2011-12 academic year.

1.2. Community Partners

Avicenna Academy, AASCC's lead school, is a small, co-educational, private, accredited school providing services to students in preschool through grade seven. We are located in the Northwest corner of Indiana in an area known simply as "the region". This largely industrial region is considered an extension of the Chicago metropolitan area. We are also located approximately 130 miles from Indianapolis, our state capital.

In an attempt to make SSEP a larger community effort, Avicenna Academy has invited all students in the larger faith-based community to participate with us. In addition, this year we are collaborating with Forest Ridge Academy in

Avicenna Academy

Science Community Collaboration

Schererville, Indiana, Highland Christian School in Highland, Indiana and LaLumiere School in South Bend. Our collaboration's population is approximately 1,000 grade K-12 students.

The SSEP flight experiment design competition will be open to our nearly 500 grade 5-12 students. Our expectation is that at least 400 will be formally engaged in flight experiment design. The entire population of 1,000 grade K-12 students will participate in the broader SSEP community engagement programming, *e.g.*, the mission patch design competition. We are committing at least nine science teachers and several adult volunteers to work with the students as they navigate SSEP.

1.3. Demographic Information

The current community demographic is approximately 66% Caucasian, 18% Arab, 8% African American and 8% Mixed or undeclared. Several of AASCC's student participants exhibited sufficient financial need to qualify and receive financial aid to attend their private schools.

2. STEM Education Strategic Need and SSEP Connections

2.1. Continued STEM Education Need

The ability to think critically and solve problems is necessary to be competitive in today and tomorrow's job market. Education in the 21st century is marked by a unique challenge to not only build a foundation of knowledge but to expand that knowledge by fine-tuning skills that can be utilized in the global community. Technology is no longer a separate aspect of the modern job market; it is pervasive throughout every field. Proficient use of technology should no longer be the end-goal in today's classrooms, rather technological proficiency must be used as a stepping-stone to innovation, further invention, application and ultimately solutions to real-world problems. The methods used to present information and programs adopted to cultivate problem-solving ability and critical thinking skills need to be fresh, student-centered and have a real application in today's world if they are going to be effective.

SSEP's experimental design competition requires students to utilize information they've gained in the classroom and expand upon it by further research and investigation. Throughout SSEP, interest level and therefore student investment is high because this program is a student-driven program where students are able to pursue a topic that is of interest to them. There is a clear connection between the investigative skills that are fine-tuned through scientific exploration and problem-solving ability. With the job market's transition from national to international playing fields, problem-solving ability and critical thinking skills are the tools our students will need to get a job in competitive fields. Additionally, in order to find solutions to the increasingly complex problems that the world faces such as resource scarcity, global warming, and epidemic disease, tomorrow's world leaders, scientists and engineers will need to possess the very skills that SSEP develops and hones in students today.

Members of AASCC typically have high scores on standardized tests such as IOWA and ISTEP+ and it is our continued priority to foster an ongoing love for science in our student community by further developing strong, inquiry-based science programs. The schools within our community support STEM education through various programs such as Science Olympiad, Math Bowl, Science Club, Rocketry, and Action Science Activities. Additionally, the schools host their own annual science fair and encourage student participation at the regional level. Field trips to the Museum of Science and Industry, local zoos, health clubs, Indiana Dunes and the Kennedy Space Center, to name a few, add support to our STEM programs. Additionally, Forest Ridge Academy has provided opportunities for its students to attend Space Camp.

In addition to aiding students in building skills that are crucial, SSEP provides opportunity for the adult leaders to continue their education in STEM fields and to gain additional skills in technology and within laboratory settings. Many

Avicenna Academy

Science Community Collaboration

studies have shown that teacher familiarity and comfort with technology translates to more effective use of technology within the classroom and ultimately more effective teaching. Each school member of our community has expressed a desire to increase teacher comfort in STEM fields and through the collaborative nature of SSEP, we will no doubt be expanding our proficiency as educators in these areas.

2.2. Previous SSEP Participation (Laying the Foundation)

Our previous SSEP experience on the final flight of Space Shuttle Atlantis (STS-135) yielded results far surpassing the already-great expectations I had for the program. These include:

- 98 students grades 4-12 were fully engaged in flight experiment design, with 13 flight experiment proposals submitted by students teams
- 9 flight experiment proposals were formally accepted for review by the Step 1 Review Board:
 - All Mixed Up: The Effect of Microgravity on the Interaction of *Paramecium bursaria* and *Paramecium caudatum* in a Mixed Culture, using Yeast and Bacteria as a Food Source
 - Brine Shrimp in Microgravity
 - Chive Seed Germination in Microgravity
 - Coagulation in Microgravity
 - Food Preservation in Microgravity
 - Fruit Flies in Microgravity
 - Lactobacillus forming Bio-films in Microgravity
 - Reproduction of Yeast in Microgravity
 - The Struggle for Existence in Microgravity (Based on Gause's 1932 Experiment): The Effect of Microgravity on the Population Growth of *Saccharomyces cerevisiae* and *Schizosaccharomyces pombe* in a Mixed Culture
- Our selected flight experiment flew on STS-135:

Title: *All Mixed Up: The Effect of Microgravity on the Interaction of Paramecium bursaria and Paramecium caudatum in a Mixed Culture, using Yeast and Bacteria as a Food Source*

Grades 4-6, Avicenna Academy (Principal Investigators and Co-Investigators); Grades 4-12, Life Learning Cooperative (Collaborators)

Co-Principal Investigators: Heba Abuzer and Jenna Rifai

Co-Investigators: Amalia Hosken, Maria Khan, Ameer Rifai, Sarah Suleiman, Sabriya Umrani, and Ayesha Zubair

Collaborators: Basil Bryson, Zoe Bryson, Gabriel Carpenter, Haley Crane, Trevor Crane, Connor Cunningham, Nicole Cunningham, Shepherd Cunningham, Rowan Everett, Christopher Martin, Erica Martin Eli Morey, Isaac Morey, Jude Morey, Sam Morey, Louie Morris, Ridge Pershing, Andy Phipps, Tressia Phipps, Josh Porch, Tonia Shirey, Jana Smith, Luke Smith, Randy Smith, Alexis Stephens, Anja Stephens, Jesse Stephens, Cameron Troy, Jennifer Viera, David Walker, and Taylor Wright

Avicenna Academy

Science Community Collaboration

Teacher Facilitator: Amanda Arceo, M.S., M.Ed., Principal

Experiment Summary: This experiment will be testing the effect of microgravity on the interaction of two types of paramecia: *P. bursaria* and *P. caudatum*, using yeast and bacteria as a food source. In the 1930s, a scientist named Georgyi Gause did a study on the same interaction. Gause discovered that on Earth, with gravity, both species survived. That was not the case when he tested two different species of paramecia together: *P. aurelia* and *P. caudatum*. Gause found out that the reason that both species survived is because they ate different food. Even though *P. bursaria* and *P. caudatum* both eat yeast and bacteria, when they are grown together in gravity, they chose to eat only one. *P. bursaria* ate yeast cells that were in the bottom of the test tube and *P. caudatum* ate bacteria that were floating higher up in the test tube. Both species were able to live because they did not live in the same niche, or area eating the same food supply.

Results Summary: Students found, upon analyzing flight samples, that the paramecium did not maintain their physical integrity. Specifically, the students were able to identify the presence of ruptured membranes and organelles but as there were zero whole paramecium left, we could not determine what effect flight had on the interaction between the two species. Students hypothesized that the movement and jostling associated with shipping and flight likely contributed to the ruptured cell membranes. Preliminary ground experiments were run prior to the flight and we are awaiting the results of our final ground experiments. Those will be analyzed on Friday, September 9th as all the students will have returned from summer break.

- 270 K-Twelfth Grade students were engaged in the mission patch design competition, and 6 Mission patches were submitted.
- Students have exhibited an increase in self-motivation in the field of science. This may be due in large part to the student-centered, student-led nature of the program.
- Students have demonstrated an increase in confidence in all academic areas.
- The community aspect of this program led to our students not only interacting with other students within AASCC, but also within the greater science community of North America. The students were able to interact with professional scientists throughout the program from conceptual guidance during preliminary stages to instructional lessons in equipment utilization during final stages of sample preparation. This interaction has taught them the importance of being clear and concise in their communication and most importantly that their voice, their questions, their experiences matter to adults.
- Participating students have become more efficient in research and each student (100%) participating in AASCC's SSEP that took the ISTEP+ science test scored a pass+, the highest possible score on that assessment, which was given toward the end of the semester of student involvement in SSEP STS-135. That fact alone is indicative of the great potential for increased science knowledge and skill imbued throughout SSEP.
- Avicenna Academy's Science Community Collaboration's participation in SSEP has garnered quite a bit of attention and media coverage:
 - Indiana Space Grant Consortium
 - <https://engineering.purdue.edu/INSGC/GeneralPublic/AvicennaSSEP>

Avicenna Academy

Science Community Collaboration

- NASA
 - <http://www.nasa.gov/audience/foreducators/crown-point-ind.html>
- WishTV
 - <http://www.wishtv.com/dpp/news/national/final-shuttle-launch-continues-indiana-nasa-connection>
- WNDU
 - http://www.wndu.com/indiana/headlines/Indiana_schools_experiment_will_be_aboard_shuttle_125204024.html
- Council of Islamic Organizations of Greater Chicago
 - http://www.ciogc.org/_newsletter/JULY-2011/eNEWS-JULY-15-2011.html
- NWI Times
 - http://www.nwitimes.com/news/local/lake/crown-point/article_6868cd19-9f74-59b5-8e98-c0f28bbb5d67.html
- Journal Gazette
 - <http://journalgazette.com/article/20110708/NEWS07/110709609>

Motivation is at the forefront as we continue to guide our students throughout their educational journey. Psychology has been studying the ins and outs of motivation and how to increase motivation, specifically internal-motivation of students as internal-motivation is shown to have a high correlation of a positive nature with success later in life. We fully realized the extent of the success in motivating our students when we stood in KARS Park, near the launch site at Kennedy Space Center this past July, just moments after Atlantis took off with AASCC's STS-135 experiment, when one of our communities participating students, a sixth grader, turned to me and asked when we were going to begin researching for our next experimental design competition. Within minutes she had three of her SSEP participants excitedly talking about different ideas for experiments completely unlike the one they had just designed. Amusingly enough, I was unaware at the time that there would be the potential for our community to participate in SSEP a second time.

3. SSEP Mission 1 to the International Space Station (ISS) – Proposed Scope and Implementation

3.1. Introduction

Despite SSEP requiring a substantial time (and emotional!) commitment and overhaul of how we currently do things in most American classrooms, the overwhelming benefits of participation speak for themselves. SSEP was life changing for AASCC's students. It presented us with an amazing opportunity to transition from theoretical knowledge, learned in class to practical knowledge and application. That alone contributed to the increase in interest and motivation. Our students were presented with obstacles nearly every step of the way in their research and experimental design and instead of tossing in the towel, the students persevered, altered their approach and forged ahead; not only did they gain an abundance of knowledge and laboratory skill, they gained indelible characteristics which their parents have expressed they have since exhibited in other areas of life.

3.2. New Goals

Our goals for our continued participation in SSEP are as follows:

- 1) Increase the level of academic independence/curiosity exhibited by students at younger ages in the field of science
- 2) Expand the previous participants' knowledge base by encouraging topics unrelated to their last experiment
- 3) Increase communication skills by having previous participants act as peer-group advisors
- 4) Maintain pass and pass+ scores on ISTEP+ science exam
- 5) Improve the quality of scientific writing

Avicenna Academy

Science Community Collaboration

6) Increase participation across the community. Across the community partnership proposed for SSEP Mission 1 to ISS, we expect:

- the total number of students formally engaged in flight experiment design will be 400, representing a four –fold increase over SSEP on STS-135
- at least 40 flight experiment proposals from student teams, representing a 3-fold increase on SSEP on STS-135
- the total number of students formally engaged in the mission patch design competition to be 600 reflecting over a two-fold increase over SSEP on STS-135

3.3. Achieving Goals through Strategic Planning

Using our previous experience with SSEP as a gauge for creating goals and determining potential for success, I know that the competitive nature of the SSEP design competition automatically encourages independence and self-motivated curiosity within a group. As director, my objective to expand upon the knowledge base that the students gained through this past semester's participation in SSEP can be easily obtained by encouraging the students to research new topics that they did not previously explore. Having former primary investigators serve as peer-group advisors while encouraging former co-investigators to take the driver's seat will increase communication within and amongst groups as students work to lead each other through this program. The excitement that was created during SSEP STS-135 is still very much alive and will have a catalytic effect on excitement for the participation in SSEP Mission 1 ISS. Maintaining pass and pass+ scores on the ISTEP+ science exam is important as it is, unfortunately, how most of the public grades our schools. That said, our students gained much more knowledge from SSEP participation than the state standards require for students of their grade level, which was evident in their test scores.

As our previous SSEP experience proved to be invaluable, the administration has made alterations to Avicenna Academy's programs and curriculum to not only accommodate future SSEP participation but to encourage continued success and growth through participation in SSEP. Specifically, we have adopted a school-wide emphasis on writing skills. While we have always prided ourselves on being thorough in our academic programming, I realized in reading and editing the students' proposals that there is still a great deal of progress to be made in writing. Students of all ages at Avicenna Academy are engaging in more creative writing, more guided writing and more scientific writing. Our third and fourth grades, in fact, have not only woven more scientific writing into the curriculum, but we have altered the curriculum and tweaked methodologies and expected student products because of SSEP.

Our third and fourth graders are now called "pre-SSEPs" and they will be designing experiments in small groups under the guidance of their science teacher throughout the year. Their first science lesson pertains to gravity and its effect on the planet and then microgravity is introduced for the first time. Previous SSEP participants have created a presentation that will soon be delivered to the third, fourth and fifth grade students introducing them to SSEP by sharing their experience in their own words. Teachers throughout our school have showed a renewed interest in science and this year our school has increased the number of teacher participants by 300%, more evidence of the impact SSEP has on a community.

Not only has SSEP motivated our science community collaboration, but we have motivated many of the professional scientists who have aided the students on their SSEP journey. We created and continue to nurture relationships with professors in universities across North America. Some of the scientists served as selection panelists while others served as local mentors to the students. One of the scientists, a biologist from Nova Scotia, has continued to provide valuable tips for students despite his failing health. Several other scientists expressed that while their time is limited due to their

Avicenna Academy

Science Community Collaboration

own time-sensitive, grant-funded work they were happy to help us as we engaged students in real-science. A University of Notre Dame professor who originally volunteered his laboratory for our sample preparation has committed to coming to our school to help any of our grades with science laboratories, whether or not related to SSEP. In addition, he has extended summer laboratory opportunities for our students as they transition from middle school to high school students. His work in rare and neglected diseases has already inspired one of our SSEP participants who now expresses an interest in pursuing medical microbiological research. These relationships that we have established will support our students as they progress in skill, interest and school itself.

As the director of AASCC's last experience with SSEP, I can say without a doubt that SSEP is changing the face of STEM education. I am committed to not only paving the road to success for and with our students, but I am committed to spreading the word about SSEP. If implemented properly, it's a nearly limitless (in potential, not experimental parameters!) program that can inspire today's students to become tomorrow's critical thinking scientists. I thank you for your consideration. If you have any questions, please do not hesitate to contact me at ms.arceo.avicenna@gmail.com or on my mobile at (808) 292-7030.

4. Budget

4.1. Request

We are requesting: \$19,950 in order to provide this opportunity in our community. The cost covers the basic cost of participation with SSEP.

4.2. Matching Funds

We are committing significant staff time to this effort, corresponding to a total of \$32,760.00. Details are provided in the Table below.

Role	Number of Staff	Hours	Rate	Subtotal
SSEP Community Program Lead Director	1	60 – planning	\$45/ hour	\$2,700.00
SSEP Community Program Lead Director	1	80 – classroom instruction	\$45/hour	\$3,600.00
SSEP Community Program Co-Directors	3	40-planning/each	\$38/hour	\$4,560.00
SSEP Community Program Co-Directors	3	100-classroom instruction/each	\$38/hour	\$11,400.00
Teachers	9	40/each	\$25/hour	\$9,000.00
Administrators	3	25	\$20/hour	\$1,500.00
Total				\$32,760.00

Total Contribution from Avicenna Academy Science Community Collaboration.....\$32,760.00