

## **Mobile Aerospace Education Lab (m-AEL): A NASA Supported K-12 "Roadshow-In-A-Box" Initiative to Advance Aviation/Aerospace Education in Underserved Counties**

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# **Mobile Aerospace Education Lab (m-AEL): A NASA Supported K-12 “Roadshow-In-A-Box” Initiative to Advance Aviation/Aerospace Education in Underserved Counties**

## **Abstract**

The Work in Progress (WIP) paper discusses an aerospace-themed STEM learning lab initiative to expand science, technology, engineering, and mathematics (STEM) literacy in underserved counties in the region surrounding Elizabeth City State University (ECSU). The rural counties served by ECSU has long suffered the effects of poverty and has lacked the opportunities for most students to encounter the 21<sup>st</sup> century workplace that is readily accessible in more urban areas of the state. However, with recent growth in the aviation and aerospace industry in the region, there now exists the potential to link K-12 education to the aerospace industry. This initiative adopts Roadshow-in-a-Box model, extends laboratory resources and is an important step towards expanding STEM literacy and career exposure for students from the most economically distressed region in the State. The initiative is expected to serve over 200 schools, located within the twenty-one (21) counties surrounding ECSU, over a period of three years. This highly interactive learning lab on wheels provides students with hands-on activities, laboratory equipment, simulations, information, and rich digital media content to develop awareness and increase interest in STEM, especially aviation and aerospace. Visitor traffic, demographic statistics and attitudinal survey data will be collected to assess the impact of this initiative.

## **Introduction**

Elizabeth City State University (ECSU) is one of the nine sites nationwide that hosts a NASA Aerospace Academy program for K-12 students, especially students from underrepresented groups in science, technology, engineering, and mathematics (STEM). The mobile Aerospace Education Lab (m-AEL) initiative extends program resources to all school districts/communities within the counties in the region served by ECSU. The region has long suffered the effects of poverty and has lacked the opportunities for most students to encounter the 21<sup>st</sup> century workplace that is readily accessible in more urban areas of the state. However, with recent growth in the aviation, aerospace, and manufacturing industry in the region, there now exists the potential to link K-12 STEM education to these industries. The hands-on learning activities, integrate modern educational technology tools to expose students to the potential career opportunities that exist in aviation/aerospace fields and why background in advanced science and mathematics is crucial to achieve these careers. The initiative will extend laboratory resources beyond the classroom in the form of a travelling demonstration to engage and inspire people to discover STEM learning and careers [1]. Staffed by ECSU faculty, lab instructor, and undergraduate students, the hands-on activities housed in the mobile learning lab is designed to engage visitors of all ages. The aerospace and aviation-focused mobile STEM lab vehicle is outfitted with wireless Internet access, laptops, large high-definition monitor and audio/video equipment, and house various laboratory experiments to support hands-on STEM learning experience.

The expected outcomes of the m-AEL initiative are:

- Increased understanding of STEM content both for students and teachers
- Increased interest in pursuing STEM knowledge, STEM degrees and careers
- Increased community participation in STEM experiences
- Increase in number of historically underserved and underrepresented students selecting a STEM major for post-secondary

The mobile-AEL is housed in a 40-foot trailer (see Figure 1) that is equipped with desktop flight simulators, aircraft design stations, desktop wind tunnel, flow visualization tunnel, weather stations, model rocketry, GPS, computer programming station, 3D printers, 3D scanners, sensor data acquisition stations, small Unmanned Aerial Vehicles (UAVs), mobile robots, solar and wind energy stations, and hand-held data loggers and sensors to support several science experiments. The aerospace-themed mobile STEM learning lab will allow for students and teachers from within the serving school districts to immerse themselves in science, technology, engineering and mathematics activities.



Figure 1: Mobile Aerospace Education Lab

This traveling demonstration (Roadshow-in-a-Box) will complement the outreach program activities that includes a more in-depth program that invites students from the participating county area to the ECSU campus and its satellite partners for a one-week camps during summer. The camp focuses on NASA STEM curriculum and hands-on learning modules, as well as guest speakers and field trips in related subject matter. Undergraduate student interns will be used to help develop and present the message. As their “near peers,” student presenters can connect with

school audiences in a distinct way. Developing and presenting the message serves an important part of the interns' education as well.

### **Program Implementation**

*Scope and Impact:* The program will serve to carry these STEM areas to all students in the 21 counties surrounding ECSU. This program will be tailored to grade-specific groups of students to ensure appropriate levels of understanding are considered. The program will be structured to demonstrate STEM concepts and build interest in, and tying to, educational opportunities in line with the Next Generation Science Standards [2]. It will also bring technology to our future workforce, consequently sparking interest in related STEM programs and attract the attention of industry that would build and grow in the region surrounding ECSU.

The targeted audiences are:

1. Elementary Schools
2. Middle Schools
3. High Schools
4. Community (special events)

There are approximately 256 Schools in the ECSU Service area. This program is designed to reach out to those students of all ages to generate interest in staying in school, pursuing college and careers in STEM related fields. Our target is to reach out to at least 5000 students/year.

*Program Development:* There are many factors to consider in the development of a mobile learning lab outreach program. The m-AEL initiative at ECSU has adopted the Roadshow-in-a-Box model developed by the National Center for Women and Information Technology [3]. This model defines the value of having an outreach program to motivate and recruit students and carries the message of opportunities in specific industries. Using this model as a guide, the project management team identified six development components that were used in implementing the mobile Aerospace Education Lab initiative:

1. Controlled Message
2. Support
3. Ongoing School Partnerships
4. Trained Student Presenters
5. Program Activities
6. Evaluation and Tracking

*Scheduling:* The basic premise for the visits is as follows:

1. Notional 4-6 one-hour sessions/school/day (varies depending on school hours and number of students available to attend). Example: 2-3 sessions before lunch and 2-3 sessions after lunch
2. Stay in one school district per day. For long-distance counties, may be optimal to do more than one school districts
3. Visit one school district/county/week
4. Total 3 school districts/county/month (Elementary, Middle and High Schools)

The schedule will include a total of three visits each month during the school year for a total of

27 visits each year (Fall and Spring semesters). Summer months will be reserved for special community events or requests. The mobile Aerospace Education Lab conducted its launch and maiden visit on January 31, 2017 (see Figure 2).



Figure 2: Mobile Aerospace Education Lab on its maiden visit to local schools

*Program Evaluation:* Evaluation and tracking is an important step for continuous improvement, making it more valuable to all stakeholders involved. Student visitors of the mobile AEL unit are asked upon completion of the exhibit to complete a brief demographic/Feedback survey. This survey will allow us to keep accurate records about visitor traffic, correlations between demographic profiles and attitudes about STEM learning. Visitor traffic, demographic statistics and feedback survey results will be compiled and analyzed for inclusion in required periodic project reporting. Table 1 and Figure 3 summarizes results from preliminary visits.

Table 1: Summary impact of mobile STEM Lab

Visiting Group	Numbers	Description
Students	1568	8 middle schools, 2 high schools, 1 charter school, CIAA
Parents	242	4 Parent/Community STEM events
Educators	71	11 Schools
Others	34	Elected officials, representatives, etc.

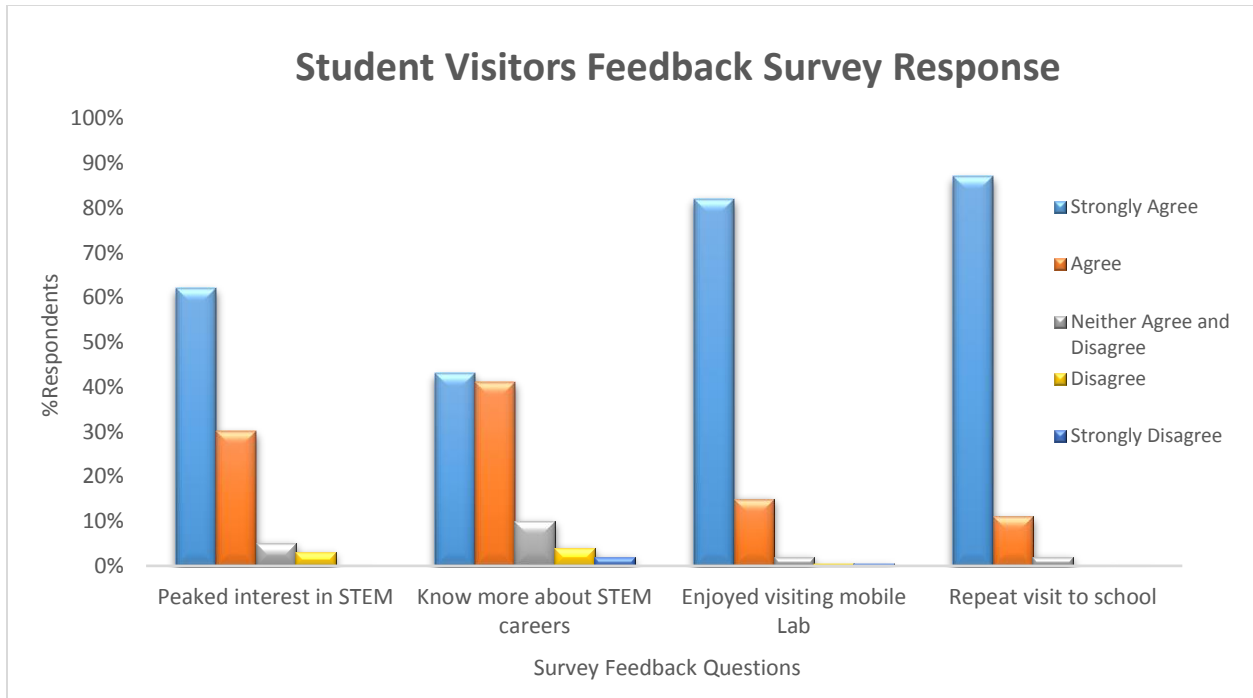


Figure 3: Feedback survey responses from student visitors (N = 147)

As shown in Figure 3, over ninety percent (90%) student visitors expressed that mobile STEM lab peaked their interest in STEM and over eighty percent (80%) expressed interest in knowing more about STEM careers. Over ninety-five (95%) student visitors enjoyed visiting mobile STEM lab and 98% of student visitors were keen to have mobile STEM lab visit their school again.

## Conclusion

In this WIP paper an aerospace and aviation-focused “Roadshow-in-a-Box” initiative was discussed. The objective of this initiative supported through public-private partnership is to improve STEM literacy in rural and underserved regions of the state. The program is expected to serve over 200 schools during three-year period. This highly interactive laboratory in a Roadshow-In-A-Box format provides students with hands-on activities, laboratory equipment, simulations, information, and rich digital media content to develop awareness and increase interest of STEM related subjects, especially aviation and aerospace. The mobile STEM lab has reached to over 1500 students since its launch and feedback from initial visits have been very positive.

## References

- [1] National Research Council. (2013). *Monitoring Progress Toward Successful K-12 STEM Education: A Nation Advancing?* Washington, DC: The National Academies Press.
- [2] NGSS. (2016). *Next Generation Science Standards*. Retrieved from <http://www.nextgenscience.org>
- [3] NCWIT, *Roadshow-in-a-Box: Capitalizing on Models for Outreach*. Retrieved from <https://www.ncwit.org/resources/roadshow-box-capitalizing-models-outreach>.

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