

Annual Summary of leaderSTATE 2013

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Program Overview

LeaderSTATE-STEM consists of a summer residential Science, Technology, Engineering, and Mathematics (STEM) training camp and fall-semester STEM outreach/education program. LeaderSTATE-STEM was made possible by a partnership between the U.S. Army, the Department of Aerospace Engineering at Mississippi State University (MSU), and the Office of Student Leadership and Community Engagement (SLCE) at MSU. During the 2012/2013 year, a total of 380 high school Junior ROTC (JROTC) cadets from Mississippi, Louisiana, and Alabama participated in these programs. Collectively, about 18,000 hours of STEM education and outreach were delivered through leaderSTATE-STEM.



Program Goals

The desired leaderSTATE-STEM learning outcomes include: 1) a greater understanding of self; 2) a greater appreciation for the preferences of others; 3) increased collaborative/teamwork skills; 4) increased written and verbal communication skills; 5) a greater understanding of application of STEM in colleges/university research units; 6) a greater understanding of application of STEM in high tech industries; 7) a greater understanding of educational and STEM opportunities afforded through Army, Navy, and Air Force ROTC units in Mississippi Schools; 8) a greater understanding of higher education opportunities offered by community colleges and 4-year institutions; 9) a greater understanding of how to prepare for and navigate college enrollment,



admission, and graduation; 10) learning fundamental STEM principles; 11) learning how to synergistically apply STEM principles through concept, design, build, and perform segments of a student-led, hands-on aerospace engineering challenge; and 12) increasing the future orientation of JROTC cadets so that they can understand how it looks and feels to be a successful college student.



Summer Residential LeaderSTATE-STEM Training Program Enrollment Data

Prior to the 2013 week-long summer residential STEM training camp, cadre pre-enrolled 322 cadets in leaderSTATE, of which, 220 ultimately participated (58 in cycle 1, 54 in cycle 2, 56 in cycle 3, and 52 in cycle 4). The majority of participating cadets were from Mississippi (64 percent). Twenty-three (23) percent of the cadets were from Louisiana and 13 percent were from Alabama. Females comprised 60 percent of the participants. The racial demographics were 73 percent African-Americans, 24 percent Caucasian, and 3 percent other.



Program Structure

During the summer STEM training program, cadets learned leadership, STEM, and fitness skills, and ultimately applied those skills during student-led, team-based challenges (see **Appendix 1** – press release). The typical day at leaderSTATE included a 4:45 AM wakeup and 10:30 PM lights-out.



Throughout the day, cadets participated in about 1.5 hours of physical training, 3.0 hours of engaged learning activities, 1.5 hours of cadet-led presentations, 2.0 hours of tours, 2.0 hours of interactive lectures, and 1.0 hour of discussion/reflection. Meals and personal time totaled about 4.0 hours per day, and transitional/transport time was about 2.0 hours per day.

Mr. Charlie Anderton (Graduate Student in Aerospace Engineering) and Dr. Keith Koenig (Professor of Aerospace

Engineering) collaborated to create and deliver the STEM curriculum that was imbedded within all aspects of the training camp from teambuilding challenges through engineering projects and final team presentations. Additionally, cadets learned from MSU scientists/engineers, students, administrators, admissions counselors, coaches, ROTC personnel, and student/career development professionals. To supplement on-campus learning, cadets participated in an East Mississippi Community College orientation and tours of STEM applications in industry (Nissan Manufacturing, Canton, MS; Mercedes Manufacturing, Birmingham, AL) and research facilities (Raspet Flight Research Laboratories, Starkville, MS; the Center for Advanced Vehicular Systems, Starkville, MS).



Assessment of STEM Training Camp Effectiveness

Two complementary pre-camp assessments and post-camp assessments were administered on the first and last day of camp, respectively, to determine the effectiveness of leaderSTATE-STEM. The first Pre/Post assessment was an internationally validated Test of Science-Related Attitudes (TOSRA), which focuses on measuring the attitudes of respondents toward science and science-related items. Designed to measure seven distinct science-related attitudes among secondary school students, TOSRA results were first published in 1978 by Barry J. Fraser¹. During its development, the assessment was extensively field-tested and, after being internationally cross-validated, shown to be highly reliable. The seven scales included in TOSRA are: 1) Social Implications of Science (S), which measures the manifestation of favorable attitudes towards science; 2) Normality of Scientists (N), which measures the manifestation of favorable attitudes toward scientists; 3) Attitude to Scientific Inquiry (I), which measures acceptance of scientific inquiry as a way of thought; 4) Adoption of Scientific



Attitudes (A), which measures adoption of 'scientific attitudes' such as open-mindedness and willingness to revise opinions; 5) Enjoyment of Science Lessons (E), which measures the enjoyment of science learning experiences; 6) Leisure Interest in Science (L), which measures the development of interest in science and science-related

activities; and 7) Career Interest in Science (C), which measures the development of interest in pursuing a career in science.

The second Pre/Post assessment was created by SLCE staff to determine changes in cadets as they relate to the stated leaderSTATE-STEM learning outcomes. Assessments consisted of Likert-type items addressing various desired learning outcomes with "5" equaling a very positive response and "1" equaling a very negative response.

The effect of leaderSTATE-STEM on cadets attitudes toward STEM and STEM-related issues and regarding the stated learning outcomes were determined by changes in the average cadet response from the Pre-camp the Post-camp assessments. Cadet's responses were analyzed using Student's T-

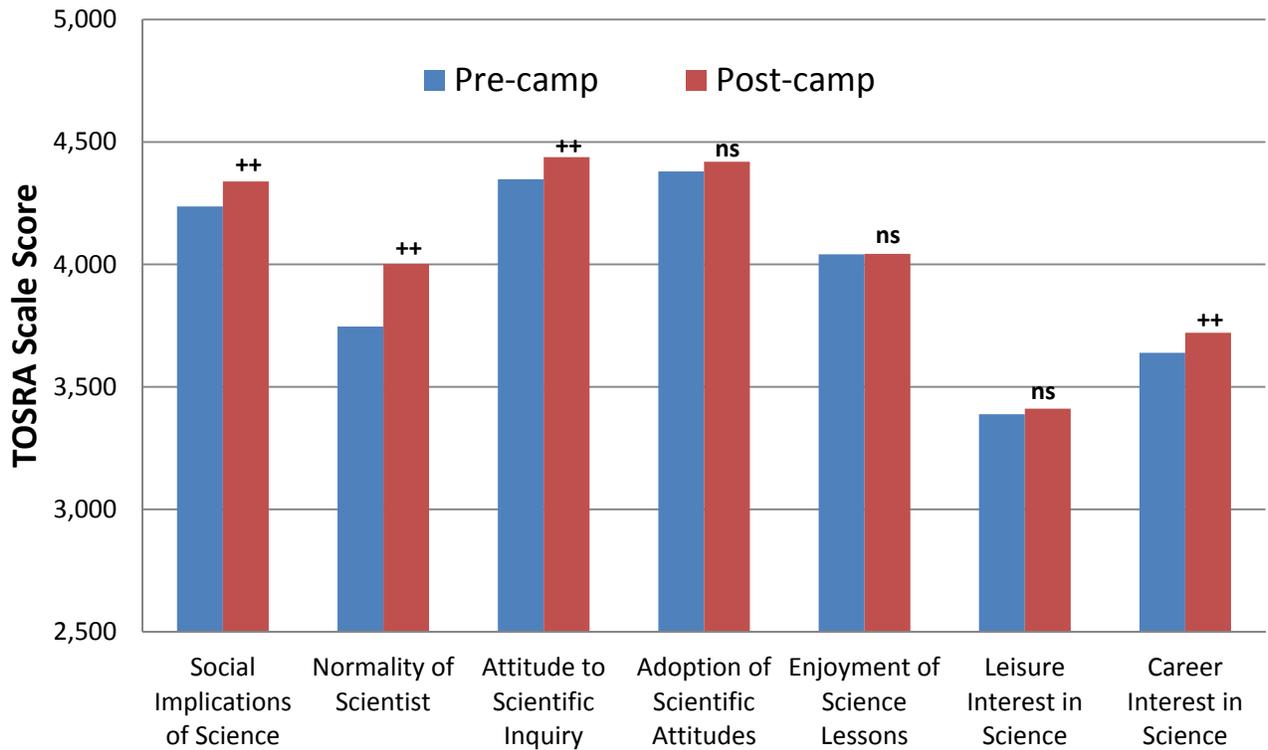
¹TOSRA: *Test of Science-Related Attitudes*, The Australian Council for Educational Research Limited, Radford House, Frederick Street, Hawthorn, Victoria 3122, p 1.
(http://www.ecu.edu/ncspacegrant/docs/RESTEPdocs/TOSRA_BJF_paper.pdf)

test, and statistical significance was classified as **not significant** (ns, p-value ≥ 0.10), **significant** (+, p-value < 0.10 but ≥ 0.05) and **highly significant** (++, p-value < 0.05).

Results of the Test of Science-Related Attitudes (TOSRA) – Figure 1.

Two-hundred-sixteen (216) cadets took the Pre-camp TOSRA, and 213 cadets took the Post-camp TOSRA. The difference between the Pre- and Post-camp assessments for the seven scales and their statistical significance are presented in [Figure 1](#). When compared to the Pre-camp scores, the leaderSTATE-STEM experience improved the cadets’ scale scores in the Social Implications of Science (increased 102 points), the Normality of Scientist (increased 256 points), Attitude to Scientific Inquiry (increased 90 points), and Career Interest in Science (increased 82 points). The scale scores of Adoption of Scientific Attitudes, Enjoyment of Science Lessons, and Leisure Interest in Science were unaffected. Finally, no scale scores were negatively affected by leaderSTATE-STEM.

Figure 1. Pre-camp and POST-camp Scores of Cadets taking the Test of Science-Related Attitudes (TOSRA).



++ = highly significant (pvalue < 0.05)
 ns = not significant (pvalue ≥ 0.10)

Results of the leaderSTATE-STEM Learning Outcomes Assessment – Table 1.

Two-hundred-sixteen (216) cadets took the Pre-camp learning outcomes assessment, and 213 cadets completed the Post-camp learning outcomes assessment.

The results of the camp assessment analysis are featured in Table 1. The cadet responses increased from pre-assessment to post-assessment on average 0.90 points on a 5-point scale when asked about their understanding of types of STEM jobs available in university research units,

understanding of how STEM is used in high tech industries, understanding of types of STEM jobs available in high tech industries, the ability to explain the fundamentals of how a rocket works, and their understanding of how STEM is used in university research units.

Cadet responses increased, on average 0.60 points on a 5-point scale when asked about their understanding of STEM opportunities available through Senior ROTC program, understanding of types of STEM educational opportunities available to them in college, understanding of the educational opportunities available in community colleges, and understanding of how to prepare for college enrollment.

Cadet responses increased on average 0.32 points from pre-assessment to post-assessment when asked about their understanding of college educational opportunities available through Senior ROTC program, their understanding of educational opportunities available at 4-year colleges/universities, and the likelihood of them pursuing a degree in a STEM-related field.

Upon completion of camp, cadets expressed more confidence in their ability to address a STEM related challenge by creating a plan to address the challenge, identifying individuals or groups who could help them solve the challenge, be interviewed about the challenge, get other people to understand the challenge, and calling someone on the phone that they had never met before to get their help with the challenge (increased on average 0.27 points from pre- to post-assessment).

Furthermore, after the completion of leaderSTATE, cadets expressed more confidence in their ability to communicate ideas using written words, to work on a collaborative team, and to express their views and solutions to problems in front of a group of people, increasing on average 0.19 points from pre- to post-assessment.

Several assessment items did not statically change from the pre-assessment to the post-assessment. Typically, these items focused on the cadets' assessment of their appreciation of other people's perspectives and skills and their own self-awareness. Each of these items had an average Pre-camp response above 4.15. Additionally, the camp did not affect how cadets evaluated their ability to speak publically, their attitude toward the working in larger teams, or their comfort in pursuing a STEM degree.

Fall Outreach STEM Training Program

During the fall of 2012, the Office of Student Leadership and Community Engagement partnered with the Department of Aerospace Engineering to provide STEM outreach and education programming to 180 JROTC cadets and educators in eight high schools in the Jackson Public School District. Mr. Charlie Anderton facilitated hands-on learning activities and provided students a framework to complete a variety of student-led, team-based challenges. Mr. Anderton returned to the schools and juried the presentation/demonstration of the teams' projects. The winning team from each school was transported to Mississippi State in December. JROTC educators (8) and 45 cadets toured research laboratories, learned from MSU scientists and admissions counselors, and attended a men's basketball game. Programs assessment is ongoing to determine the impact of this program on the cadets' attitudes toward science-related issues.

Table 1. leaderSTATE STEM 2013 Assessment of Program Effectiveness.

Learning Outcomes	Assessment Statement	Pre-camp ¹ (N=216)	Post-camp ² (N=213)	Change in Response (Post - Pre)	Level of Statistical Significance ³
Scale for the Following Items:					
1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly Agree					
LO ⁴ : 5	I understand what types of STEM jobs are available in university research units.	3.40	4.35	0.94	++
LO: 6	I understand how STEM is used in high tech industries.	3.48	4.40	0.93	++
LO: 6	I understand what types of STEM jobs are available in high tech industries.	3.44	4.32	0.88	++
LO: 10	If someone asked me, I would be able to explain the fundamentals of how rockets work.	2.92	3.76	0.84	++
LO: 5	I understand how STEM is used in university research units.	3.49	4.33	0.84	++
LO: 7	I have a good understanding of STEM opportunities available through Senior ROTC programs.	3.69	4.41	0.73	++
LO: 8	I understand what type of STEM educational opportunities are available to me in college.	3.77	4.43	0.67	++
LO: 8	I have a good understanding of what educational opportunities are available at community colleges (2 year colleges).	3.71	4.26	0.56	++
LO: 9	I have a good understanding of how to prepare for college enrollment.	3.71	4.16	0.45	++
LO: 7	I have a good understanding of college educational opportunities available through Senior ROTC programs.	4.11	4.44	0.33	++
LO: 12	I will pursue a degree in a STEM-related field.	3.35	3.67	0.32	++
LO: 12	I have a good understanding of what educational opportunities are available at 4-year colleges/universities.	4.11	4.43	0.31	++
LO: 1,4	I am good at communicating ideas using written words.	3.70	3.89	0.20	++
LO: 1,3	I am skilled at working on a collaborative team.	4.02	4.21	0.19	++
LO: 1,3,4	I would be comfortable with my ability to express my views and solutions in front of a group of people.	4.04	4.23	0.18	++
LO: 1,3,4	I am good at speaking in front of people.	3.38	3.52	0.14	ns
LO: 1,2,3	I think it is good that other people solve challenges differently than how I solve them.	4.34	4.45	0.11	ns
LO: 1,3	I understand why I make the choices that I do.	4.38	4.47	0.09	ns
LO: 1,2,3	I value that other people have ideas that are different than mine.	4.44	4.51	0.07	ns
LO: 1,2,3	I am skilled at working with other people to solve a common challenge.	4.16	4.23	0.07	ns
LO: 1,2,3	The more people you have working to solve a challenge, the more likely you are to achieve success.	3.98	3.87	-0.10	ns

Table 1. continued next page

Table 1. continued

Learning Outcomes	Assessment Statement	Pre-camp ¹ (N=216)	Post-camp ² (N=213)	Change in Response (Post - Pre)	Level of Statistical Significance ³
Scale for the Following Items: 1 = Definitely Can't, 2 = Probably Can't, 3 = Not Sure, 4 = Probably Can, 5 = Definitely Can					
LO: 11	Faced with a STEM challenge, I would be comfortable with my ability to create a plan to address the challenge.	4.07	4.38	0.30	++
LO: 11	Faced with a STEM challenge, I would be comfortable with my ability to identify individuals or groups who could help me solve the challenge.	4.17	4.47	0.30	++
LO: 11	Faced with a STEM challenge, I would be comfortable with my ability to be interviewed about the challenge.	3.81	4.10	0.29	++
LO: 11	Faced with a STEM challenge, I would be comfortable with my ability to get other people to understand the challenge.	4.12	4.40	0.28	++
LO: 11	Faced with a STEM challenge, I would be comfortable with my ability to call someone on the phone that I had never met before to get their help with the challenge.	3.72	3.92	0.20	+
LO: 1	Faced with a STEM challenge, I would be comfortable pursuing a degree in Science, Technology, Engineering, or Math.	3.97	3.97	-0.01	ns

¹Pre-camp assessments given upon arrival.

²Post-camp assessments given prior to departure.

³Determined by Student's T-test, two-tails with unequal variance. ++ = (P-value < 0.05), + = (P-value < 0.10), ns = (P-value ≥ 0.10)

⁴LO = Learning Outcomes:

- 1) a greater understanding of self;
- 2) a greater appreciation for the preferences of others;
- 3) increased collaborative/teamwork skills;
- 4) increased written and verbal communication skills;
- 5) a greater understanding of application of STEM in colleges/university research units;
- 6) a greater understanding of application of STEM in high tech industries;
- 7) a greater understanding of educational and STEM opportunities afforded through Army, Navy, and Air Force ROTC units in Mississippi Schools;
- 8) a greater understanding of higher education opportunities offered by community colleges and 4-year institutions;
- 9) a greater understanding of how to prepare for and navigate college enrollment, admission, and graduation;
- 10) learning fundamental STEM principles;
- 11) learning how to synergistically apply STEM principles through concept, design, build, and perform segments of a student-led, hands-on aerospace engineering challenge;
- 12) increasing the future orientation of JROTC cadets so that they can understand how it looks and feels to be a successful college student.

STEM program at MSU prepares students to be future leaders

By: Jessica Bays

On a bright and sunny Tuesday afternoon, a group of high school students came to the third floor of Moseley Hall on the campus of Mississippi State University to practice an educational activity on vectors.

Dressed in Army fatigues, they carried foam boards and paper gliders they built with phone book pages. Holding their boards, they began to walk behind the gliders, and as air pushed over the boards, the gliders began to fly.

For students involved in junior reserve officer training corps across the state and in parts of Alabama, and Louisiana this activity was more than just a fun experiment for them, but one of the many educational activities they were learning in a program called leaderSTATE.

Funded by the U.S. Army and in partnership with MSU's Office of Student Leadership and Community Engagement, leaderSTATE is a week-long summer residential training camp that provides high school students in JROTC the opportunity to build their leadership skills and enhance their development in the areas of science, technology, engineering and mathematics – also known as STEM— while improving their physical fitness and gaining exposure to a college environment.



Dakota Walters, a 16-year-old 11th grader in the JROTC program at Florence High School in Florence, Miss. said that the camp was turning out to be a good experience.

“So far, it’s really fun,” Walters said. “We go on all the tours and stuff. We have a lot to do in one day.”

Their day starts with waking up at 4:45 a.m. for physical training. Afterwards, they eat breakfast then either go on tours or do a leadership activity scheduled on their itinerary before lunch. After lunch they participate in other scheduled leadership and educational activities before going to bed around 10 p.m.

The camps are divided into four, five-day cycles, beginning from June 3-7, June 10-14, June 17-21, and June 24-28. A total of 240 students are participating this year. Students come in groups of 60. Each group will be on campus for one cycle.

Appendix 1. Press release 2013 leaderSTATE STEM.

The students in each group are divided into subgroups of eight students where a student counselor will guide them. There is also one student director, and two k-12 school teachers that will give the participants in leaderSTATE the highest quality of learning and experience possible.

Col. Paul Willis, director of Army JROTC for the Jackson Public School District, has been involved with leaderSTATE in its current form since the beginning. Willis said that initially leaderSTATE started as a program called Young Guns that was sponsored by MSU. The program was very similar to the current leaderSTATE, but it did not focus on STEM challenges.

“I had established a relationship with Cade Smith the director of the SLCE office,” said Willis. “The program was about to be closed due to lack of funding, so I went to the Army to secure funding to continue leaderSTATE in the current form as a STEM program for JROTC students. We are in the third year of our four-year contract and we hope to continue this program.”

In 2011, state rankings in science and math from the Science and Engineering Readiness Index were released. Mississippi ranked the worst in the country behind West Virginia and Louisiana, while Massachusetts, Minnesota and New Jersey topped the list.

Willis said that STEM was extremely important to the Army because they are trying to develop more students to be competitive in a global society which is the surmise of leaderSTATE.

“High school students are our future leaders and it’s important for us to develop the right type of student to meet the future of society,” Willis said. “Programs such as leaderSTATE show the students what’s possible and it does it in a college environment. We have to make them aware while still in high school what the possibilities are. We are in a global society and as technology advances we need more professionals to continue our technological advances so that we will remain a competitive nation and a leading nation in the world.”

Lt. Col. Veronica Baker has also been involved with leaderSTATE since the beginning. Baker, who works with the JROTC at Murrah High School in Jackson has been responsible for coordinating MSU with other schools in the state to participate in leaderSTATE.

“We try to cover three areas—the scholar, the athlete and the leader,” Baker said about leaderSTATE. “There’s physical fitness involved, team related activities to participate in, and the academic piece which involves the STEM piece where grad student Charlie Anderton has come up with various projects for the students to do.”

Such projects include having students to take raw eggs and drop them from a particular height without cracking, or taking empty bottles and launching them on the band field. The activities are student-led, team-based challenges. They are also hands on which means that students are being actively engaged in learning. For example, the glider activity, also known as “Big Mouth Tumbler”, exposed the students to the physics of how the different vectors work with gravity and the force of the air to make the unique gliders fly.

Appendix 1. Press release 2013 leaderSTATE STEM.

Anderton, one of the co-coordinators for leaderSTATE, is a master's aerospace engineering graduate student at MSU. His thesis will examine the outcomes of leaderSTATE.

"Some of the literature that I've read suggests that when you teach high school aged children using a lot of hands on projects that that can increase their attitude for whatever subject that the projects are on," Anderton said, who also mentioned that African Americans are currently under-represented in science and technology fields.

"We know that if you have a higher attitude towards something then you're more likely to pursue that and do well in that. So we hope that by using projects in the summer camp and in the fall outreach camp as well, that we will be able to increase their attitude toward science in hopes that that will possibly motivate them to pursue an education in science or pursue some sort of science degree or job," he said.

In order to participate in leaderSTATE, the students must have a minimum grade point average of 2.5. Additionally, they must be recommended by their senior army instructor and have high moral character, as well as a reasonable level of physical fitness.

The camp seems intense enough for the students who are getting their first look of what life in the ROTC at a college or university will be like, but Smith, the director of the SLCE office, said that it would also be a rewarding experience for them.

"We'll have students from across Mississippi and a few students from Alabama and Louisiana that will come here and they will not quite know what to expect, but they will overcome their inhibitions and embrace the opportunity that is given to them," Smith said. "There will be challenges, but we'll make it through and everyone will come out better because of the experience they've had."

Anderton said he thinks the significance of the camp is to number one, expose the students to STEM if they haven't already been exposed, two, to hopefully increase their attitude and interest in STEM, and thirdly, just to let them know that it's possible to be successful in the field.

"It seems like every week we have at least one or two cadets that anytime you mention math they just kind of shake their heads and it looks like they've already kind of given up on being good in math or understanding math," Anderton said. "But I think that maybe at the end of the camp they won't know how to use the Pythagorean Theorem or quadratic equations, but they will just realize that science in particular and STEM is all around them and it's very obtainable through scholarships and grants to college, community college and trade schools and things like that. It's not only prevalent but also accessible if they're willing to work for it."

Baker agreed.

"The camp is an extension of what we do in JROTC in and out of the classroom," she said. "Every time you turn on the TV, you always hear or you see that the President is always talking about STEM and we want to encourage kids to take the hard classes, and for them to be shown, 'hey you

Appendix 1. Press release 2013 leaderSTATE STEM.

can do this, you are capable.’ If you apply yourself you can do anything you want. It’s so critical for our kids to get it early on that they can be somebody only if you try.”

In addition to the activities, students visited STEM related work sites to expose them to the work environment where STEM specialists engage in their careers so students can see what they do.

Some of the places the students went to this year were Mercedes Benz in Vance, Ala.; Nissan in Canton, Miss. and the Raspet Flight Research Laboratory and Center for Advanced Vehicular Systems both in Starkville.

Willis and Baker both said that in the future they would like to see the program continued as a permanent part of opportunities for high school students especially in Mississippi, and expanded to more students across the country in other universities. They commend both Smith and the SLCE for their “vision and commitment to youth.”

Smith said that he and SLCE staff are honored and very fortunate to be able to partner with the Army and JROTC program in Mississippi, Louisiana and Alabama, as well as work with the leaders of tomorrow.

“They’re young men and women from various social classes and family resources, races and political perspectives that come together to learn how to work together to do something that’s meaningful,” Smith said.

“And to think that we give these cadets from all these different walks of life an opportunity to learn about the opportunities that are available in higher education such as career and educational opportunities in STEM is really neat. And I have no doubt that we’re planting seeds that will bear fruit in the future that’s not only going to benefit these students but society.”



Walters said that when he finishes school he wants to go into the Air Force and become a pilot. He said he thinks the opportunities that leaderSTATE presents will help him to reach his goal.

“It’ll motivate me to be a better leader,” Walters said.