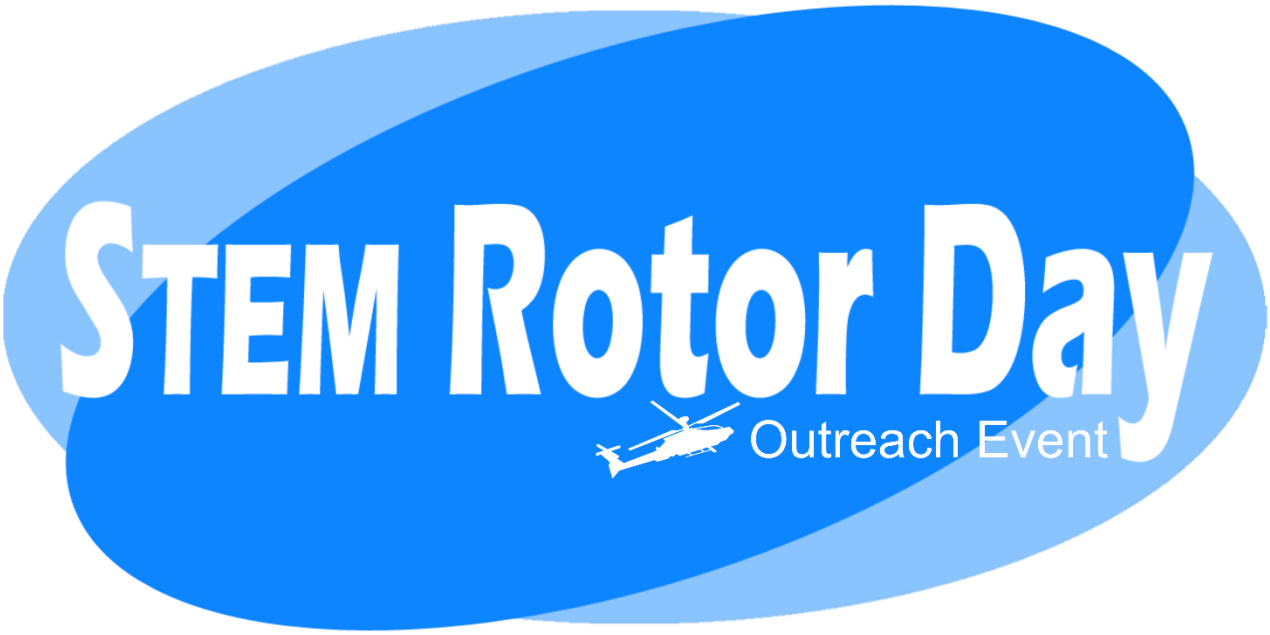
# 4th Annual STEM Rotor Day

***Our mission: To inspire the STEM leaders of tomorrow and create an excitement about the STEM fields***




This event was made possible by the generous contributions of the LORD Corporation, the American Helicopter Society International, and the AERTS Lab.

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# Introduction

On Saturday, October 14th, 2017, the Penn State Chapter of the American Helicopter Society came together, once again, to offer a free community rotor-themed STEM event. This event was made possible by the contributions of the LORD Corporation, the American Helicopter Society International, and the AERTS lab at Penn State. The purpose of this event was to provide exciting STEM activities and aerospace facility tours to elementary and middle school aged children and their families. This event, however, was open to children of all ages. Following registration, children were encouraged to enjoy a multitude of hands on STEM activities, and then attend facility tours while enjoying PSU Berkey Creamery ice cream. Following the event, parents were asked to fill out an exit survey. The survey results were processed to obtain valuable feedback on the event while providing a focus for the efforts for the 2018 event.

This report will outline the event and the event feedback. This event consisted of hands on activities (small scale wind tunnel, flight simulator, K-MAX gears, gyroscopic stability, RC helicopter lessons, high-speed camera, a large RC helicopter exhibit, a QH-50 hub, and a paper helicopter craft) and facility tours (AERTS lab and wind tunnel, Hammond Wind Tunnel, Helicopter Museum). The surveys suggest that the efforts in advertising were successful. They also suggest that the participants enjoy actively engaging activities and were pleased with the activities that could accommodate even the youngest of attendees.

The feedback also suggests that STEM Rotor Day was a complete success, and is succeeding in its mission to inspire the STEM leaders of tomorrow and create an excitement about the STEM fields.

# Hands-on Activities

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|  | **Small Scale Wind Tunnel**<br><br>The small scale wind tunnel used was built and donated to AHS in 2015 by Pierson J. Holcombe Jr. This tunnel was modified for a load cell and data acquisition system. This allowed children to actively investigate the relationship between lift and angle of attack. The children were also able to visually understand why airfoils stall at high angles of attack by the addition of tufts on the airfoil. |
|  | **Flight Simulator**<br><br>X Plane flight simulation software was used for the flight simulations. The children were able to fly fixed wing aircraft using a joystick. This year, we used a control wheel and throttle controller for the simulator. We hope to have inspired future pilots! |

**K-MAX Gears**

The main bevel gears of a Kaman K-Max gear box were set up to show how mechanical power is distributed from the engine to the rotors. These large gears were great for the students to play with. They saw how the two main rotors of the K-Max could spin in opposite directions even though it only has one engine

**Gyroscopic Stability**

A bicycle wheel and turntable were used to teach children about gyroscopic stability and conservation of momentum. The kids were able to see how changing the direction of the wheel would affect the spin of the turn table. This was a fun event that drew a lot of attention!

**RC Helicopter Lessons**

Children were very enthusiastic about the opportunity to learn and fly RC helicopters. Volunteers taught the children the controls for the quadcopters and challenged them to fly through a course of hula-hoops.

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|  | **High-Speed Camera**<br><br>Children were able to explore life in slow motion. They dropped small objects into water, popped balloons, and make funny faces in front of a high-speed camera. This allowed them to see as they never had before! |
|  | **QH-50**<br><br>A QH-50 hub was used to teach children about the various control mechanisms of a helicopter rotor and hub. |
|  | **Paper Helicopter Craft**<br><br>Children of all ages were invited to decorate and cut out their own paper helicopter. They could then release it and watch it descend to a designated area below. |

## Facility Tours

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|  | **AERTS Lab**<br><br>Children and their families were taken on guided tours of the AERTS Lab and wind tunnel. After a brief lesson on the importance of icing research, an icing demonstration took place. Afterwards, the families were able to enter the rotor test stand to see and touch the ice on the rotor! This was very exciting for children and their families. |

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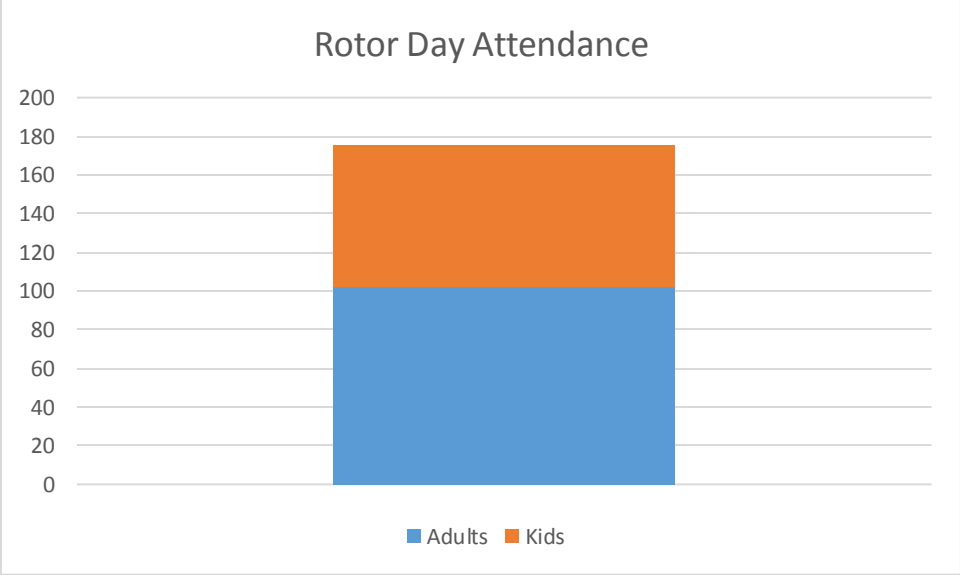
|  | **Hammond Wind Tunnel**<br><br>Members of the wind energy club joined AHS at the event and, as part of the facility tours, demonstrated how a wind turbine can be used to power lights. |
|  | **XV-15 Flight Simulator**<br><br>Children visited the XV-15 simulator facility in the Vertical Lift Research Center of Excellence. They enjoyed sitting in the pilot seat of this actual XV-15 cockpit and taking photos! |

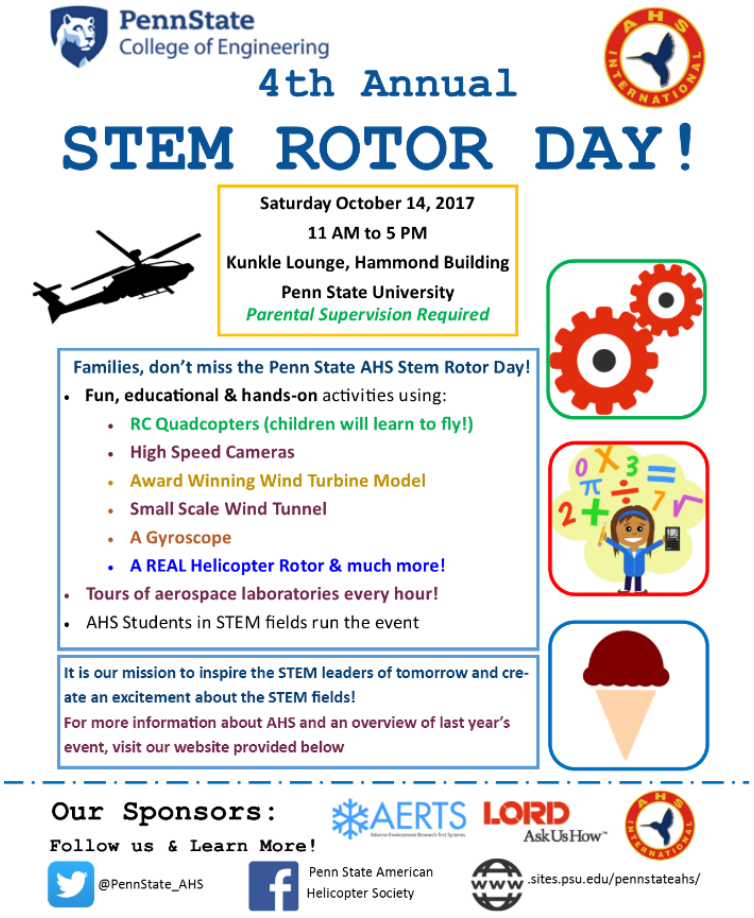
## Attendance Data

The event attendance this year was as expected. A total of 73 children were in attendance throughout the event. The average attendance from previous Rotor Days is 67 children. Parents and adults that attended with children were also counted. 102 adults attended the event this year. This leads to an attendance of 175 people! The success in attracting a large attendance can still be attributed to advertising. This will be discussed in the following section of the report.



## Advertising Efforts

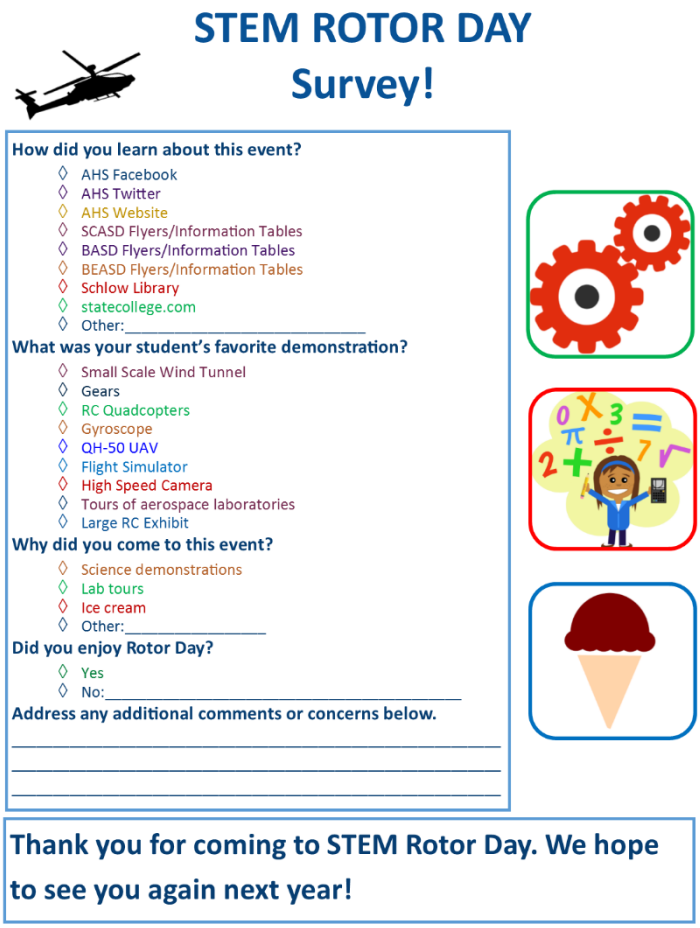
At the 1st Annual STEM Rotor Day in 2014, there were 18 children in total who attended. The primary advertisement for the event was through STEM teachers at middle and high schools in State College. 75 percent of the attendees in 2014 were in 6th and 7th grade. In order to improve the overall attendance and interest in the event, elementary and middle school aged children were targeted for the 2015 event in place of high school students. For 2016, elementary and middle school children were again targeted. Advertising efforts were improved from 2014 to 2015. A flyer was developed for the 2015 event and it was updated for the 2016 event, the updated flyer can be seen below.




This flyer was developed with modern, simple graphics and colors that would draw attention. The flyer was distributed to the information tables of all 11 elementary and middle schools in the State College Area School District, as well as the Our Lady of Victory Catholic School and the Young Scholars of Central PA charter school. The flyers also reached two other nearby school districts, the Bald Eagle Area School District and the Bellefonte Area School District. The event was also advertised on statecollege.com, a local event website, and the Penn State AHS Facebook, Twitter, and website. Last year, flyers were handed out at the Fall Festival in downtown State College, two blocks from the event location, which was on the same day of the event. This year, the Fall Festival did not draw a huge crowd due to the weather so flyers were not handed out.

## Event Feedback

An exit survey was provided for the groups to fill out before going home. This addressed advertising, favorite demonstrations, reason for coming, and general comments. This survey can be seen below.



**STEM ROTOR DAY**
**Survey!**

**How did you learn about this event?**

- ◊ AHS Facebook
- ◊ AHS Twitter
- ◊ AHS Website
- ◊ SCASD Flyers/Information Tables
- ◊ BASD Flyers/Information Tables
- ◊ BEASD Flyers/Information Tables
- ◊ Schlow Library
- ◊ statecollege.com
- ◊ Other:_____

**What was your student's favorite demonstration?**

- ◊ Small Scale Wind Tunnel
- ◊ Gears
- ◊ RC Quadcopters
- ◊ Gyroscope
- ◊ QH-50 UAV
- ◊ Flight Simulator
- ◊ High Speed Camera
- ◊ Tours of aerospace laboratories
- ◊ Large RC Exhibit

**Why did you come to this event?**

- ◊ Science demonstrations
- ◊ Lab tours
- ◊ Ice cream
- ◊ Other:_____

**Did you enjoy Rotor Day?**

- ◊ Yes
- ◊ No:_____

**Address any additional comments or concerns below.**

_____
_____
_____

**Thank you for coming to STEM Rotor Day. We hope to see you again next year!**

Not all groups filled an exit survey but the information from those who did will help future AHS STEM Rotor Day events. The data is valuable for better advertising, improving demonstrations, and meeting people's expectations.

## Advertising

The question "How did you learn about this event?" was asked on the survey. The results can be found below.

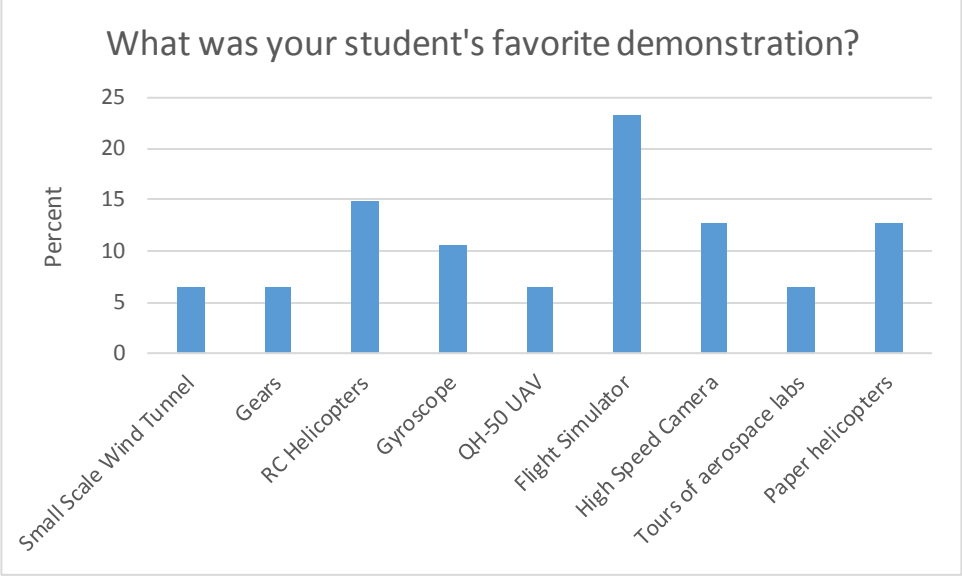

Based on the survey responses, 35 percent of attendees learned about the event from word of mouth. This is the largest source of attendees based on the survey sample. Rotor Day is well received in the community and people share their experience with their friends and family.

Other sources that people heard about the event from included Happy Valley Moms Facebook page, the sign placed outside of the event location, flyers posted in various locations. Another 35 percent of attendees learned about the event online; 42.8 percent on the AHS Facebook page. 15 percent saw flyers on information tables at SCASD and BASD schools and other locations. Some advertising did not reach any attendees (shown in the bar graph).

Recommendations for advertising for the event next year would be to search for and advertise on more event websites and other STEM events as well as continuing to deliver flyers to all of the local schools.

## Preferred Demonstrations

The question "What was your student's favorite demonstration?" was asked on the survey. The results can be found below.



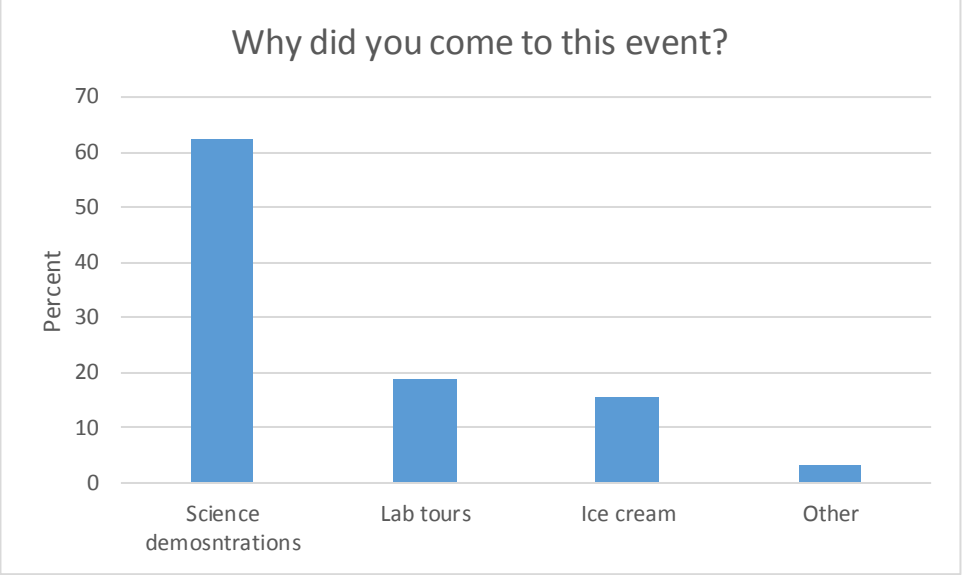

This year, the flight simulator activity was chosen as the favorite by 23.4 percent of the attendees. 14.9 percent flying RC helicopters as their favorite activity and 12.8 percent chose the high speed camera demonstration and the paper helicopter craft. The gyroscope demonstration was the favorite of 10.6 percent. The QH-50, the gears, and the wind tunnel were each the favorite of 6.4 percent of attendees. Multiple surveys responded with two favorite demonstrations. Last year, the high speed camera demonstration was the favorite of 36.4 percent of attendees, followed by the flight simulator at 27.3 percent, and the lab tours at 18.2 percent. The QH-50 hub, gears and wind tunnel were chosen as favorites by 3% of attendees last year.

The results suggest that the participants enjoy actively engaging activities. The demonstration with the high-speed camera allowed the students and parents to work together to make a video that they could then watch in slow-motion. The students were able to observe how balloons popped or see how water behaved when an object was dropped into it. The students also enjoyed making silly faces and strumming rubber bands to see how they moved. The flight simulator was challenging and likely a new experience. The tours gave the children an opportunity to see something they had never seen before and the paper helicopter craft allowed them to make and keep a craft related to parts of the demonstrations that they saw throughout the event, both were very engaging. The students also had the opportunity to attempt to fly a small RC quadcopter which was challenging and exciting. By contrast, the gyroscope, gears, wind tunnel, and QH-50 hub were much more passive and observation based activities.

This data suggests that AHS should focus its efforts on making all of the activities engaging, exciting, and new for the children. Although it cannot be avoided with demonstrations such as certain parts of lab tours, it is recommended that activities limit pure observation to keep the children interested.

## Reason for attending

The question "Why did you come to this event?" was asked on the survey. The results can be found below.




A number of attendees came to the event for multiple reasons. The main reason was the science demonstrations at 62.5 percent. For 18.75 percent of attendees, the reason for coming was the facility tours. 15.6 percent of attendees responded that they came for the ice cream and 3 percent responded with 'other'.

This data suggests that STEM Rotor Day is targeting the proper attendee needs and is serving its designed purpose. This is an event meant to inspire children to enjoy the STEM fields and become interested in STEM education. It is also meant to show children what a career in STEM could look like. Science demonstrations and tours achieve this goal. It is important that the AHS club and sponsor recourses for a STEM activity are not going to an event which people are attending for the ice cream!

## General Feedback

The final question of the survey was "Did you enjoy rotor day?" 100 percent of survey participants did enjoy Rotor Day! The comments and concerns section also provided very positive feedback addressing two main areas:

1. Thanking AHS for the opportunity
2. Enjoyment of the lab tours and event as a whole

This feedback is encouraging because it both shows that the event was very strong and popular, and the participants are looking to return to next year's event. The comments predict growth in the event. A couple of comments mentioned that the attendees were able to learn a lot and that they thought that their children benefitted from the experience and from seeing college students putting on such an event.

# Conclusion

The 4th Annual STEM Rotor Day was a great success. The event still attracted a large number of families from the community. Based on survey feedback, everyone enjoyed rotor day and is looking to come back in future years.

AHS is encouraged by the success of the event this year and is looking to broaden its efforts to expand the event next year. The recommended focus areas for next year's event are listed below:

- Advertise on more local event websites and event pages in the towns surrounding State College, including Bellefonte, Centre Hall, Penns Valley, etc.
- Deliver flyers to more local schools and to more STEM events
- Make surveys more easily accessible upon exit
- Ensure all activities are actively engaging

Implementing these recommendations will ensure that STEM Rotor Day will continue to grow as an event and that AHS can continue to serve the children of the community. It is our mission to inspire the STEM leaders of tomorrow and create an excitement about the STEM fields, and STEM Rotor Day fits this mission.

# Acknowledgments

Penn State AHS would like to acknowledge its sponsors and volunteers.

## Sponsors

Penn State AHS would like to thank the generous sponsorship of the Lord Corporation. Their contribution continues to make STEM Rotor Day possible and allows us to continually inspire the STEM leaders of tomorrow. We would also like to thank AHS International for their support. AHS also thanks the AERTS lab and aerospace engineering students for their contribution to the event.

## Volunteers

This event would not be possible without the hard work and dedication of its volunteers. The volunteers are pictured and named below.


Left to right:

Sihong Yan: Ph.D. Candidate – AHS Member – High speed cameras
Nathan O'Brien: B.S. Student – AHS Member – Simulation
Matt McPherson: BS. Student – AHS Member – Bicycle Wheel
Matt Shaw: M.S. Student – AHS Member – Gears
James Kenna: B.S. Student – AHS Vice President – Tours (AERTS Lab)
Ahmad Haidar: Ph.D. Candidate – AHS President – Tour Guide
Regis Thedin: Ph.D. Candidate – AHS Member – Small Wind Tunnel
Amrat Ranka: M.S. Student – AHS Member – Paper Helicopter Craft
Ameya Landge: M.S. Student – AHS Member – Registration
Rebekah Douglass: M.S. Student – AHS Member – Ice Cream Scooper
Payam Ranka: M.S. Student – AHS Member – RC Helicopter Lessons
Carter Forry: B.S. Student – AHS Treasurer – Tours (AERTS Lab)

Not pictured:

Miguel Alvarez: Ph.D. Student – AHS Secretary – RC Helicopter Lessons
Jason Cornelius: B.S. Student – AHS Member – Tours (Wind Energy Lab)
Wind Energy Club: Hammond Wind Tunnel
Dr. Jose Palacios – AHS Chapter Advisor – Event Sponsor
Dr. Edward Smith – AHS Chapter Advisor