Dear Readers,

This is the first newsletter for CySLI. I am proud to say this newsletter, combined with a brochure and technical document, represent the bulk of my Honors project. These documents are the culmination of a year spent outside of my department learning about rockets, CySLI, and the M:2:I program.

I want to thank all who helped make this project possible. Thanks to my Honors project adviser, Charlie Kostelnick, for assisting me with my document designs; Aerospace major and friend, Rebecca Salter, for introducing me to the M:2:I program; CySLI project lead, Austin Kaiser, and team members for putting up with all my rocketry questions; And to the all who work in and with the Honors department. I am grateful for all they have done during my time at Iowa State.

Cassandra S. Gearhart

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The Cyclone Student Launch Initiative (CySLI) is one of the most popular projects in the aerospace department’s Make-to-Innovate (M:2:I) program. CySLI is in its third year as an M:2:I project and is currently lead by Austin Kaiser, a junior in aerospace engineering at Iowa State.

For those who are unfamiliar with CySLI, the organization allows students to design, build, and test a high-powered rocket. Students in the organization collaborate with various mentors from Iowa State, the National Rocketry Association (NAR), the Tripoli Rocketry Association (TRA), and NASA.

In fall 2014, the team was chartered in the M:2:I program and entered in NASA’s Student Launch Challenge. Each year since, the team has participated in this competition, with the official competition launch date in April.

CySLI works diligently to maintain their status as an M:2:I project and a team in good standing with NASA. For M:2:I, this involves completing multiple required milestones and a team charter signed by the individual team members. NASA requires the completion of five documents, three of which are design reviews presented to their scientists for review.

The team charter lays out CySLI’s overall team structure. This year’s teams are the rocket team and avionics team. Rocket team lead, Adam Bodensteiner, and avionics team lead, Brad Wisser, are in charge of individual groups of eight students. These students make up the remaining membership of CySLI.

Regular meetings for CySLI are once a week, on Monday evenings at 7 PM in 2228 Howe Hall. Avionics and rocket sub-team meetings are scheduled outside of normal meeting times. The team also meets during M:2:I lab hours to build the rocket.

CySLI members not only work hard all year to develop the rocket, but they work to increase their technical skills. CySLI is the perfect opportunity for students to apply their learnings to real world problems, giving them skills that can apply to future careers in the engineering field.

The competition in April is the culmination of their hard work and applied technical skills. Good luck to this year’s team as they make final preparations for the launch.

The week of April 5, CySLI made their annual trip to Huntsville, Alabama to compete in NASA’s annual Student Launch challenge. The week had a full itinerary that included presentations, tours of Marshall Space Flight Center, and Student Launch competition activities.

Early Wednesday, eleven of sixteen CySLI members made the trip to Huntsville, Alabama. The trip began with a fourteen-hour drive across country to reach Rocket City, USA. The following day, NASA welcomed over sixty teams—middle school, high school, and university levels—with a meeting and astronaut guest speaker, Dr. Kate Rubins. Activities were set to occur over the next three days.

Following the welcome session, CySLI toured Marshall Space Flight Center. There, the team saw historic sites such as the test stands where NASA first fired the F-1 rocket engines, which were the engines used on the rocket that put man on the moon. CySLI was also able to see some testing facilities for the current NASA Space Launch System (SLS) project.

That night, CySLI presented their rocket to National Association of Rocketry (NAR) officials for the Launch Readiness Review inspection. This presentation is to ensure the rocket has been built to NASA’s safety standards and is read for competition launch. They gave the team a short list of changes to make to their rocket before the competition flight.

The following day, the team was allowed time to view presentations from NASA about the SLS, the Pathways internship program, and their partner in space, Orbital ATK. CySLI was then allowed the afternoon to enjoy the U.S. Space and Rocket Center museum exhibits.

Saturday brought CySLI to Bragg Farms bright and early for the competition launch. The morning was spent preparing the rocket by assembling the bays and ensuring the functionality of all the parts. Intermittent launches occurred throughout the day as the teams demonstrated the culmination of their hard work. CySLI’s rocket was one of the last to be launched that day.

Despite the afternoon launch, the weather conditions were perfect. Wind and clouds were almost non-existent. The rocket ascended with no complications. The trajectory was perfect and the recovery components deployed at the correct altitudes. The on-board cameras captured amazing video of the launch and the area surrounding Bragg farms. CySLI was very satisfied with the launch.

Overall, the Alabama trip was a beneficial aerospace educational and competitive experience. In addition to being successful in the competition, the team received the Best Looking Rocket award at the closing banquet ceremonies. CySLI is very satisfied with the award and is glad to return to Ames with the rocket in one piece.

Meet the Team
Project Lead:
- Austin Kaiser - Junior

Rocket Team:
- Team Lead:
  - Adam Bodensteiner - Junior
- Members:
  - Rebecca Salter - Junior
  - Connor Coffey - Junior
  - Daniel Pace - Junior
  - Nicholas Hendrickson - Freshman
  - Andrew Fialkowski - Freshman
  - Cassandra Gearhart - Junior
  - Michelle Camp - Junior
  - Blake Julius - Freshman

Avionics Team:
- Team Lead:
  - Brad Wisser - Junior
- Members:
  - Bradlee Fair - Sophomore
  - John Orefice - Junior
  - Alexander Harpenau - Senior
  - Kin Yeng Tan - Sophomore
  - Keng Yren Ho - Junior

Find the Team Online
- m21.aere.iastate.edu/cysli
- https://www.facebook.com/ISUcysli/

Pictured Left:
CySLI team members pose with the Cardinal Heavy, ready for competition launch in Huntsville. It was a beautiful, calm day to watch the rocket launches.
CySLI Tests Full-Scale Rocket Design with Subscale Rocket

This year’s subscale rocket was designed to be 1/3 the size of the full-scale rocket. This replicates the Center of Pressure and Center of Gravity locations in the rocket, simulating the flight stability of the full-scale. However, the motor couldn’t be scaled to 1/3 size as 1/3 of the force would destroy the subscale upon launch. With this in mind, CySLI members used Aerotech motors scaled to the subscale’s actual size.

November 12, 2016 was the designated subscale launch date. A farmer in Boone County kindly allowed CySLI the use of his field over which to launch the rocket. Many of CySLI’s members attended the launch, including project lead Austin Kaiser. There, the subscale completed two of the four scheduled launches.

The first launch was initially riddled with issues. There was a problem with the twelve-volt battery in the launch controller that secured the connection and launched the rocket. After the battery issue was fixed, the first launch was a success. The rocket ascended, deployed the recovery parachute, and landed safely.

However, since the altimeter was secured to the parachute shock cord via masking tape, its binding tore at apogee and the altimeter hit the ground without recovery sys. No flight data was saved as the altimeter battery was damaged when it hit the ground post-ejection. The battery was replaced and the rocket prepared for a second launch.

Launch number two was less successful than the first one. A breeze picked up just as the rocket launched, skewing the angle off vertical the rocket took. This results in more drift away from the initial launch site. In addition, the recovery parachute was packed too tightly in the rocket body and failed to deploy, allowing the rocket to come in nose down (ballistic).

CySLI members unfortunately had to recover the second launch in pieces from the cornfield as the subscale was destroyed on impact. The altimeter, though not ejected from this flight, did not record data as it completely broke with the rest of the subscale.

These subscale launches did reveal that rocket design was sound, as there appeared to be no aerodynamic flaw in the reviewed video, and the rocket flew straight and true for the duration of both launches. The errors in the tests resulted from a subscale design flaw (no good method to secure the altimeter in the rocket) and a too tightly packed parachute. The full-scale rocket will fix these issues with a pilot parachute to deploy the main one, and a flight computer bay to house the altimeters.

Pictured Above: First launch of the subscale rocket.
A Look at the 2017 Rocket: Cardinal Heavy

This year’s NASA Student Launch Challenge requires the building of a rocket that will reach an apogee (highest point in the flight) of 5,280 feet and conduct one onboard experiment. CySLI gave a series of five presentations to NASA scientists to prove the validity of this design.

CySLI team members considered a variety of materials when designing the rocket. The main airframe is constructed of Blue Tube, a strong, durable material that is commonly used in high-powered rocketry. Fiberglass was selected for the nose cone and main fin components as it is a strong, better alternative to metal or plastic. The air brakes and roll control fins were designed out of carbon fiber as it is extremely lightweight and durable. Bay components are housed within Blue Tube couplers and birch wood bulkheads held together with steel threaded rods.

The rocket is comprised of seven main body sections equaling a total length of 132 inches and a diameter of 6 inches. The sections include two parachute bays, a camera bay, motor mount, flight computer bay, avionics bay, and the nose cone. The avionics, flight computer, and camera bays are housed in Blue Tube couplers. The components in these bays are attached to birch plywood sleds and enclosed with two birch plywood bulkheads and threaded rods.

The nose cone is 6 inches in diameter, with a 6-inch shoulder that slides into the first section of Blue Tube. CySLI selected a 30-inch long nose cone, which lengthens the rocket enough to meet NASA’s stability margin requirement. It is filament wound fiberglass with an aluminum tip to prevent fracturing from forces exerted upon the cone.

Inside the camera bay there are seven cameras, five arranged in a 360-degree array to capture a 360-degree launch video. The other two will be pointed at 45-degree angle mirrors to capture roll control and air brake actuation.

CySLI’s flight computer bay houses the computer that runs programming to control the target apogee of the rocket and the roll control system (RCS). The flight computer calculates the projected apogee using accelerometers and altimeters. Using this system, the computer tells a servo in the bay connected to the air brake subsystem whether or not to deploy the air brakes to slow the rocket. The air brakes are connected to the servo using pulleys and cables via tubes in the motor mount.

The RCS is CySLI’s chosen onboard experiment, and the system is actuated in a similar method to the air brakes. Accelerometers pick up an increase in speed from motor ignition that starts a motor-burnout timer in the flight computer that is connected to the RCS configuration. After motor burnout is reached, the computer tells the servo connected to the RCS fins via an axle to initiate the roll. The rocket should roll twice then return to its original flight pattern as calculated by the computer.

Final special design elements for CySLI’s rocket are the motor mount and split fin designs. The motor mount houses an internal 75-millimeter Blue Tube airframe centered in the rocket via five birch plywood centering rings. A flanged retainer cap screws into the aft retainer ring and holds the motor container in place. Epoxied into the motor mount are the split fins made of G-10 sheet fiberglass. Not only are these fins designed for aesthetic reasons, but they provide a larger safety margin between the expected and maximum fin flutter velocity.