

2018 STUDENT ROCKET LAUNCH PROGRAM

Request for Future Heavy
Payload Proposals



Future Heavy Flies Again in 2018

United Launch Alliance (ULA) and Ball Aerospace have a unique educational program offering students from kindergarten through graduate school hands-on experience working with rockets and payloads. In 2018, the Future Heavy rocket is expected to launch in July (location TBD, Colorado), and will fly to an altitude of approximately 2,500 feet above ground level. ULA interns design, build and refurbish the high-power sport rocket, while interns from Ball Aerospace and K-12 students design and build payloads that launch on the rocket.

Payloads are objects, experiments or instruments launched on and deployed (if desired) from the rocket. A payload can be almost anything a team can dream up within the guidelines. There is no cost to the students or schools to fly payloads on the Future Heavy rocket.

Program Objectives

- Give students design, analysis, test and hands-on fabrication experience
- Allow students and interns to be involved in launching the rocket
- Provide a fun and enriching experience that inspires students to pursue a technical career

Whether they're working on the rocket or payloads, all participants are encouraged to attend the launch and participate.

What's New for 2018

Water Challenge

- ULA will be making a splash! To mimic real launches where our boosters land in the ocean, and to add a bit of fun and complexity, we plan to launch our single stage Future Heavy over a reservoir (launch site pending). Teams are encouraged to find a creative solution to deal with this new water obstacle.

Payload Competition

- Ten payload slots can participate in a payload competition, with the top three teams winning cash prizes! Please see the competition section for further details. An additional ten slots will be reserved for teams not wanting to compete but who want to build a payload.

Join Us!

Wanted: Elementary, middle and high schools interested in forming a team to design and build a payload

- Teams should be led by a teacher or mentor associated with the school/organization
- Teams will be supported by ULA or Ball engineers/mentors as needed
- Important dates:
 - As soon as possible: Interested teams should notify Sabrina Ball at ULA of their intent to participate
 - Jan. 31, 2018: Team leaders submit a simple payload proposal to ULA
 - Feb. 7, 2018: Teams notified of their status; 20 payloads plus two backups will be selected for the 2018 launch
 - July 2018: Planned launch
- **See proposal form at the end of this presentation for detailed instructions**

Overall Length: 41 ft
Liftoff Mass: 932 lbs
Initial Thrust: 6800 lbs
Total Impulse: 65,000 n-s
Number of Payloads: 23
Altitude Target: 2,500 ft AGL

1 C-Class Payload



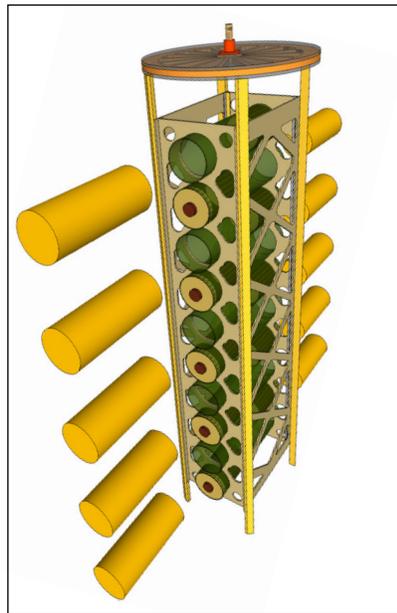
1 A-Class Payload



1 B-Class Payload

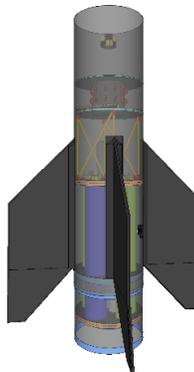


Non-competition Payload Dispenser
10 K-12 Payloads
6" dia x 15" Long Each



Competition Payload Module
10 K-12 Payloads
6" dia x 15" Long Each

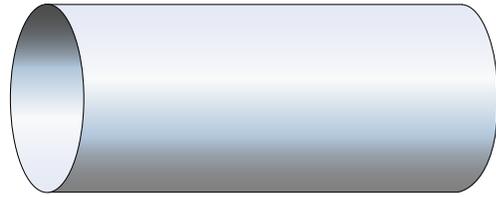
4 M-Class Motors
2 N-Class Motors



Future Heavy Payload Classes

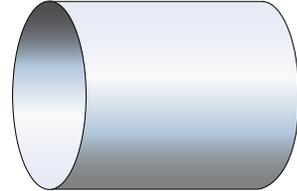
Class A Payload

Dimensions: 54" Long x 24.5" Dia
Mass Limit: 75 lbs max
Available: 1



Class B Payload

Dimensions: 28" Long x 24.5" Dia
Mass Limit: 25 lbs max
Available: 1



Class C Payload

Dimensions: 24" Long x 11.4" Dia
Mass Limit: 20 lbs max
Available: 1



Class D Payload

Dimensions: 15" Long x 6.0" Dia
Mass Limit: 5 lbs max
Available: 20



Payload Requirements

1. Payloads can be electrically and functionally active or passive, simple or complicated. They can be or do almost anything you can dream up.
2. Payloads may not include live animals, explosives, flammable liquids, bio-hazards or nuclear materials. Small pyrotechnics for device actuation are permissible.
3. Payloads can be deployed from the rocket or remain in rocket (team's choice). If payloads are not deployed, a piston is not needed, so payload length can increase by an amount equal to the payload diameter, i.e. a 6" dia x 15" long payload can increase to 21" long.
4. Estimated maximum acceleration during flight = 10 Gs.
 - In other words...make your payload sturdy. A good test to see if your payload is sturdy enough is to drop it from a height 10 inches onto a medium thickness carpeted floor several times, dropping it from vertical and horizontal positions. If it survives this drop test, it should survive the flight and jettison events.
5. Each payload team will be provided with a payload tube. A payload tube is a phenolic-reinforced cardboard tube that matches the maximum dimensions specified for each class of payload, i.e. 15" long x 6" diameter for a Class D payload. This is the largest possible tube that will fit inside your payload's compartment in the rocket. You should write the name and address of your team on the payload tube, but do not paint outside of the tube or it may not fit in its compartment. The payload tube can be used in several ways, or teams can choose to not use the tube. For instance:
 - It can be used as the outer structure of the payload, i.e. items can be installed inside or attached to the inside of payload tube

- The payload tube can be split into two 180-degree half shells that surround payload and protect it during jettison, then fall away from the payload after jettison
 - If you choose not to use the payload tube as a part of the payload, use the tube as a fit check tube. If your payload fits in the payload tube, it will fit in the rocket.
6. A parachute or other provision shall be used to ensure that payload does not descend at more than 20 mph.
 7. Payload maximum allowable dimensions must include a payload parachute if the payload will be ejected. For instance, a Class D payload compartment (15" long x 6" diameter) can accommodate a 14" long x 6" diameter payload plus a 1" long x 6" diameter packed parachute.
 8. Payload installation in the rocket must be complete with no further access at least 90 minutes (preferably 120 minutes) prior to launch. Some lessons learned from previous launches:
 - Test your payload if applicable to ensure it has adequate battery life and/or memory
 - Test your payload to ensure it does not auto-power-off after 90 minutes or less of inactivity, darkness, quiet, etc.
 - Temperature of payload in the rocket prior to launch may reach 140° F or higher depending on weather
 9. If a payload plans to transmit radio frequency (RF) signals, transmissions must be coordinated in advance with ULA. Due to possible interference with rocket system electronics, payloads may not transmit RF signals until after the payload has been ejected from rocket. Additional restrictions governing RF transmissions and unmanned aerial vehicles (UAVs) will be provided in early 2018.
 10. Large payloads shall be designed to be installed the day before launch. Power application shall occur on the launch pad approximately 1 hour before launch with the payload in the rocket. Payload shall coordinate with rocket the means for applying power.
 11. All unmanned aerial vehicles (UAVs) greater than 0.55 lbs in weight must be registered with the FAA.
 12. Loss of control of any UAV must result in a spiral descent
 13. All payloads must float. In the event of a water landing, all payloads need to be recoverable. Teams should test this out by placing the payload in a bath tub filled with water.

Payload Competition

In honor of the 10th year of the student rocket launch, ULA is adding a payload competition option for teams.

The goal of the competition is to encourage students to design, build, and operate a payload to guide it to a designated ground-based target. Teams must avoid the water hazard over which the rocket is flying or else they will meet the same soggy fate as the booster.

Teams reaching the shoreline, and within a 100-yard radius of the designated docking station, will be in the running for the following cash prizes:

- **First place: \$5,000**
- **Second place: \$3,000**
- **Third place: \$1,500**

Participation in the payload competition is optional. Ten payload compartments will be reserved for teams wanting to compete for the prize money. An additional ten compartments will be reserved for teams NOT wanting to compete for the prize money.

Payload Competition Additional Requirements



Class D Payload

Dimensions: 15" Long x 6.0" Dia

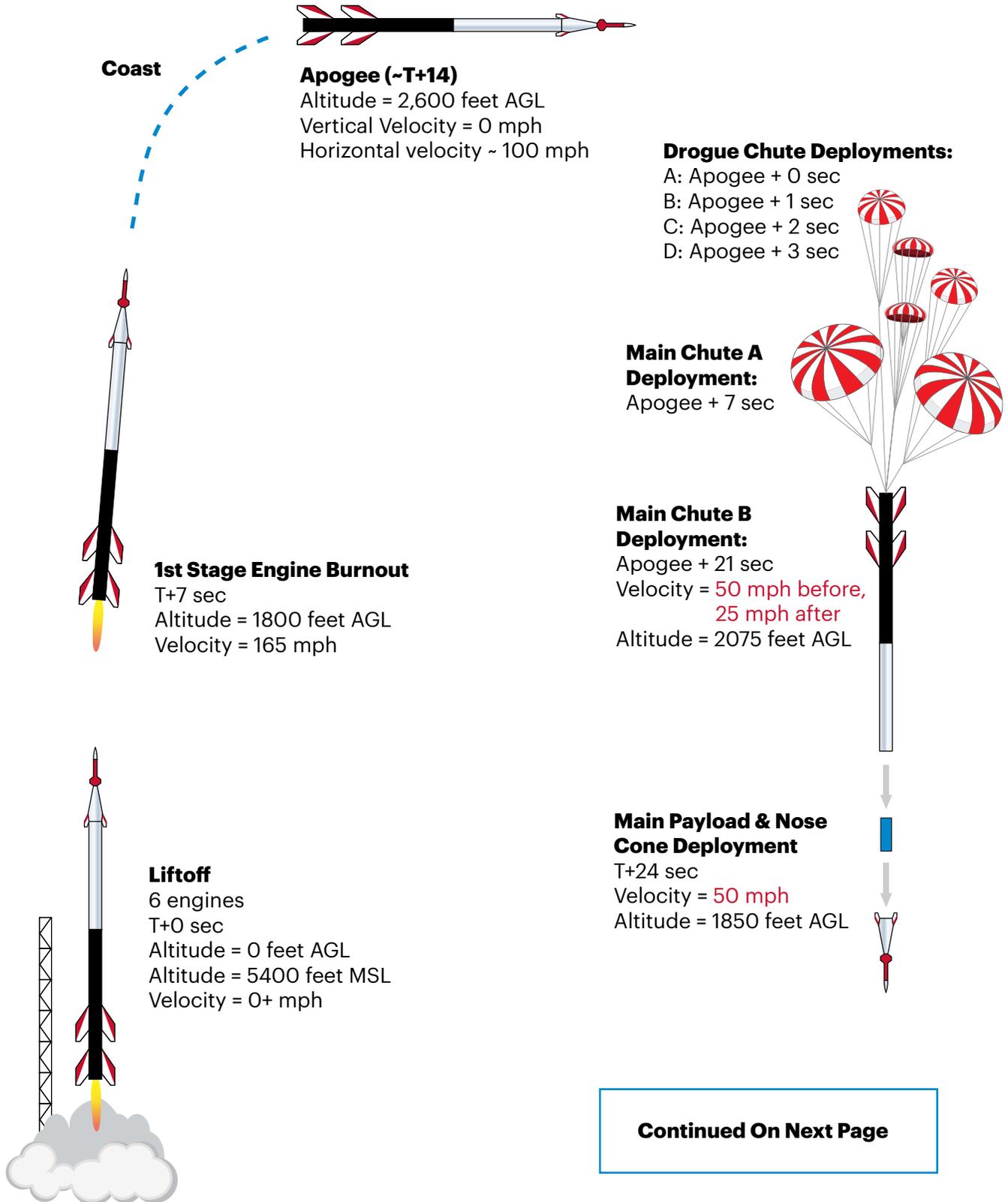
Mass Limit: 5 lbs max

Number Available: 20

In **addition** to the standard payload requirements on pages 7-8, teams interested in the payload competition must abide by the following:

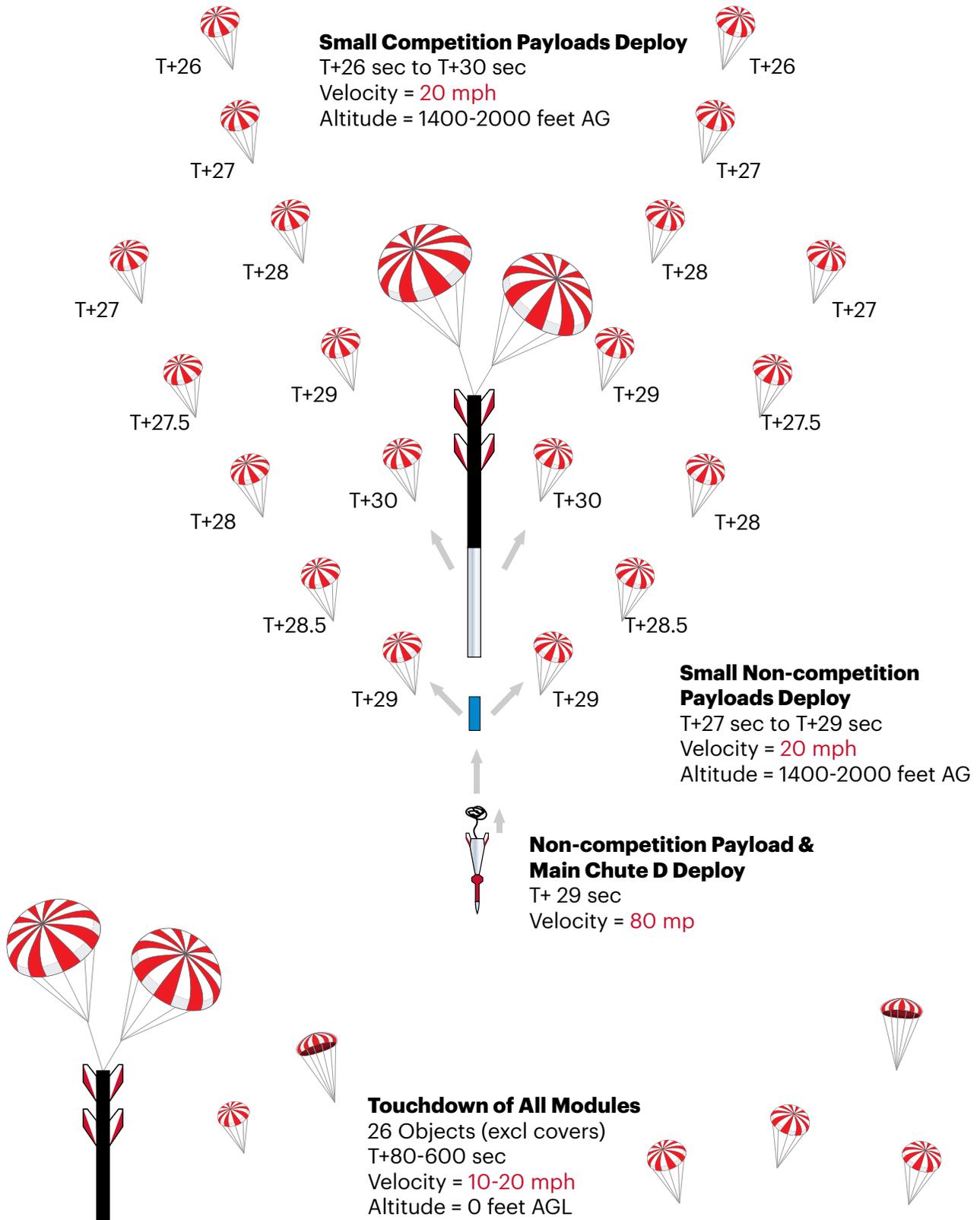
1. Teams must complete the additional information on proposal payload competition form
2. Teams must complete and conduct a design review with ULA prior to the launch.
 - This design review will serve as the scoring differentiator in the following events:
 - Launch vehicle anomalies
 - Weather/natural disaster launch cancellation
 - All payloads are greater than 100 yards away from the target
 - Two or more payloads are the same distance away from the target
 - Design review outline and example will be given to competitors in spring 2018.
 - Design review must be presented by students, not their mentors
3. A detailed score card will be released in spring 2018
4. All competition payloads will be of the Class D configuration (as shown above)
5. Payloads will be ejected laterally out of the side of the airframe after apogee, two at a time, in opposite directions at 1-second intervals
6. Payload positioning within the airframe will be randomly assigned
7. No weaponry will be allowed in the payload design (you can't shoot down the other competitors)
8. No metallic propellers or sharp edges are allowed
9. The majority of the payload must make it within 100 yards of the target docking station. ULA will release further details of the target (GPS, maps, navigation aids) in the spring.
10. Competing teams must be made up of K-12 students with the following requirements:
 - Prizes must be paid out to U.S.-based 501(c)3 nonprofit organizations; teams that do not fit this requirement may still design a payload without competing
 - Collaborative teams are encouraged over individuals
11. Mentorship is encouraged, however the MAJORITY of the design and construction of the payload must be conducted by students
12. No cheating! ULA reserves the right to disqualify any team at any time for ignoring these requirements or failing to meet the educational spirit of this competition
13. Questions are highly encouraged! We are here to help!
 - This is the first time running this competition, there are probably questions you have that many other teams have too! We will do our best to communicate with all teams the responses to any questions or concerns associated with the launch or competition
 - ULA reserves the right to update and add to these requirements as needed
 - Send all inquiries to: Sabrina Ball, Sabrina.l.ball@ulalaunch.com, 303-269-6501

Future Heavy Flight Profile

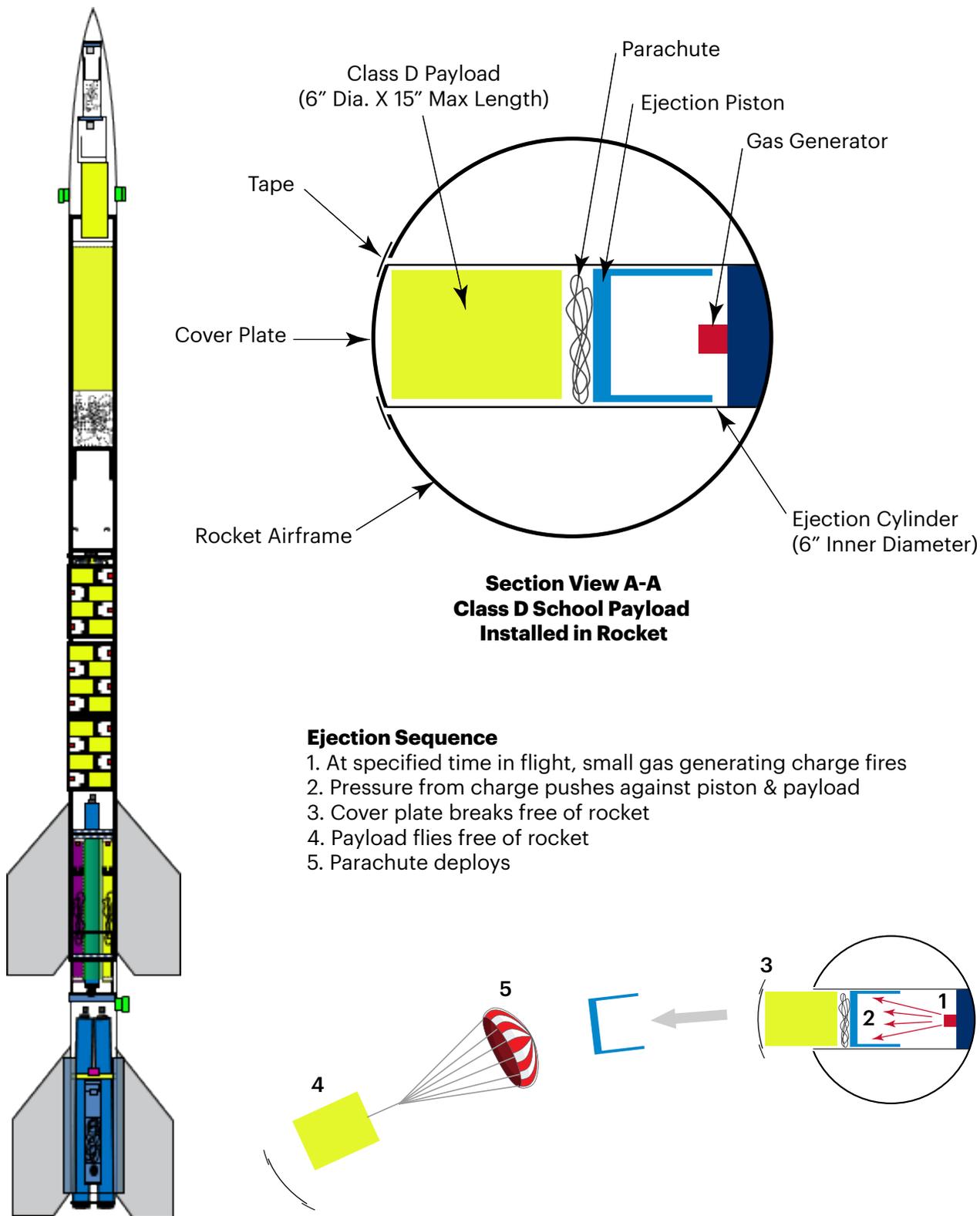


Continued On Next Page

Future Heavy Flight Profile (Continued)



Class D Payload Accommodations and Ejection Sequence



**Section View A-A
Class D School Payload
Installed in Rocket**

Ejection Sequence

1. At specified time in flight, small gas generating charge fires
2. Pressure from charge pushes against piston & payload
3. Cover plate breaks free of rocket
4. Payload flies free of rocket
5. Parachute deploys

Additional Information

The following vendors sell parts that could be used to build rocket or payloads. You are not limited to these sources, but they are a good place to start.

Miscellaneous rocketry components

www.giantleaprocketry.com/hpdefault.asp

Miscellaneous parts, fasteners, materials

www.mcmaster.com/#

Timers and Altimeters

www.perfectflite.com

Parachutes

<http://topflightrecoveryllc.homestead.com>

National Association of Rocketry

<http://www.nar.org/>

Miscellaneous Electronics

www.radioshack.com/home/index.jsp

Miscellaneous Electronics

www.sparkfun.com

Launch Videos

2015: www.youtube.com/watch?v=RZsnOSdqVOI

2016: www.youtube.com/watch?v=rb8_tkSU6TO

2017: www.youtube.com/watch?v=zvSLUHnO7jM&feature=youtu.be

ULA Intern Rocket Home Page

www.ulalaunch.com/Intern_RocketLaunch.aspx

Questions, Comments and Proposal Forms

Sabrina Ball

United Launch Alliance

Sabrina.l.ball@ulalaunch.com

2018 Payload Proposal Form

Title/Name of your Payload Concept:

Team Leader Name and Contact Info:

Payload Concept Description:

Team Description:

Are any members of your team planning to attend the launch in person?

Sell Your Project/Team Here:

Please put a 1, 2, 3 or X in each box below to indicate your payload category preference
(1 = first choice, 2 = second choice, 3 = third choice, X = not interested in this option or not applicable)

We want to compete for the prize money in the payload competition

We want to build a non-competing payload

If interested in the payload competition or AAS scholarship, please complete the questions on the Payload Competition and/or AAS Scholarship Application Forms.

Instructions

1. Complete the information requested above in the space provided.
2. If you think your school wants to participate in the July 2018 launch event, please notify ULA (reference contact info below) of your intent to participate as soon as possible, so that we gauge interest in the program.
3. Submit this proposal form to Sabrina Ball at ULA by Jan. 31, 2018.
4. Proposal team leaders will be notified by Feb. 7, 2018, if their payload has been selected to fly on the ULA rocket.
5. Chances of being awarded a payload spot on the rocket depend on the number of proposals submitted. Proposals will be judged based on creativity, credibility and completeness.
6. There is no cost to the school to fly on the rocket.
7. A team may submit more than one proposal, but no team will be awarded more than one payload spot on the rocket unless there are more spots available than proposals received.
8. This form may be expanded to multiple pages if required.
9. ULA and Ball engineers can be available to consult with the elementary through high school payload teams as required during the development of the payloads.
10. Contact Info: Submit questions, notification of intent to participate and proposals to Sabrina Ball at Sabrina.l.ball@ulalaunch.com

Payload Competition Form

These questions are only required for teams looking at participating in the payload competition. Please have the mentors and students brainstorm together and answer this section!

Guidance & Control Plan:

Water Landing:

Test Program:

Requests (optional):