Suborbital Rocket Experiment

DESIGN GUIDELINES

NASA TECHRISE STUDENT CHALLENGE

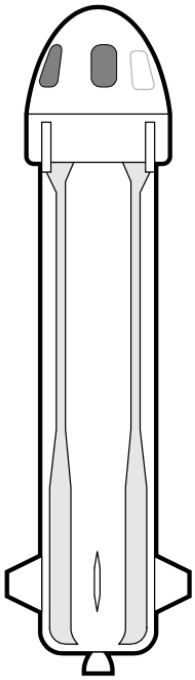
Below are guidelines to reference when developing your rocket experiment proposal. We encourage participation first and foremost, so remember that you won't be disqualified if your entry doesn't comply with every guideline. But if you do, your entry will score higher!

Experiment Cost

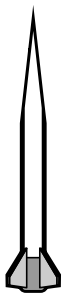
When developing your proposal build plan, keep in mind that all purchased components to build your proposed experiment **should not exceed $1500**. The judges are not requesting a budget nor will any team be disqualified based on cost, but proposals that require additional funding or outside sponsorship beyond the $1500 prize value will score lower.

Do we need to choose between Blue Origin and UP Aerospace rockets?

No, teams do not need to (or get to) choose which rocket their experiment will fly on. There are two rockets, with two sets of unique requirements, but all proposals should be developed using these general NASA TechRise suborbital rocket design guidelines and the Proposal Template. If selected as a winner, your team's experiment will be assigned by NASA to fly on either Blue Origin's New Shepard or UP Aerospace's SpaceLoft rocket. During development, the winning teams may need to make slight design changes to comply with the specific requirements of your assigned rocket. Future Engineers will advise teams as needed on those vehicle requirements.



BLUE ORIGIN
NEW SHEPARD



UP AEROSPACE
SPACELOFT

Generalized Suborbital Rocket Flight Summary

When a rocket goes up and comes back down without going around the Earth, it's called a suborbital rocket. The NASA TechRise suborbital rocket flights will be an 11-16 minute trip to the edge of space, where at the peak of flight (>100 km altitude), all experiments will experience about 3 minutes of microgravity (i.e., weightlessness). Suborbital rocket experiments will be secured in a payload container inside the rocket, so all suborbital rocket experiment ideas should focus on what's going on INSIDE the flight experiment box during flight. The experiments will not have views down to Earth. On the other hand, the experiments will be IN SPACE! The experiments will undergo very strong vibrations throughout the flight, and depending on the vehicle, may endure accelerations of up to 18-G (axial & radial), temperatures between 10-85 degrees C, and ambient air pressures that could range between 0 to 14.7 psi. Depending on the rocket, your experiment could undergo strong spin & de-spin maneuvers prior to reaching microgravity conditions. During its return trip to Earth, the experiments will experience shock forces when the parachutes are deployed prior to touchdown. Please refer to the suborbital rocket experiment design guidelines below to plan your experiment.

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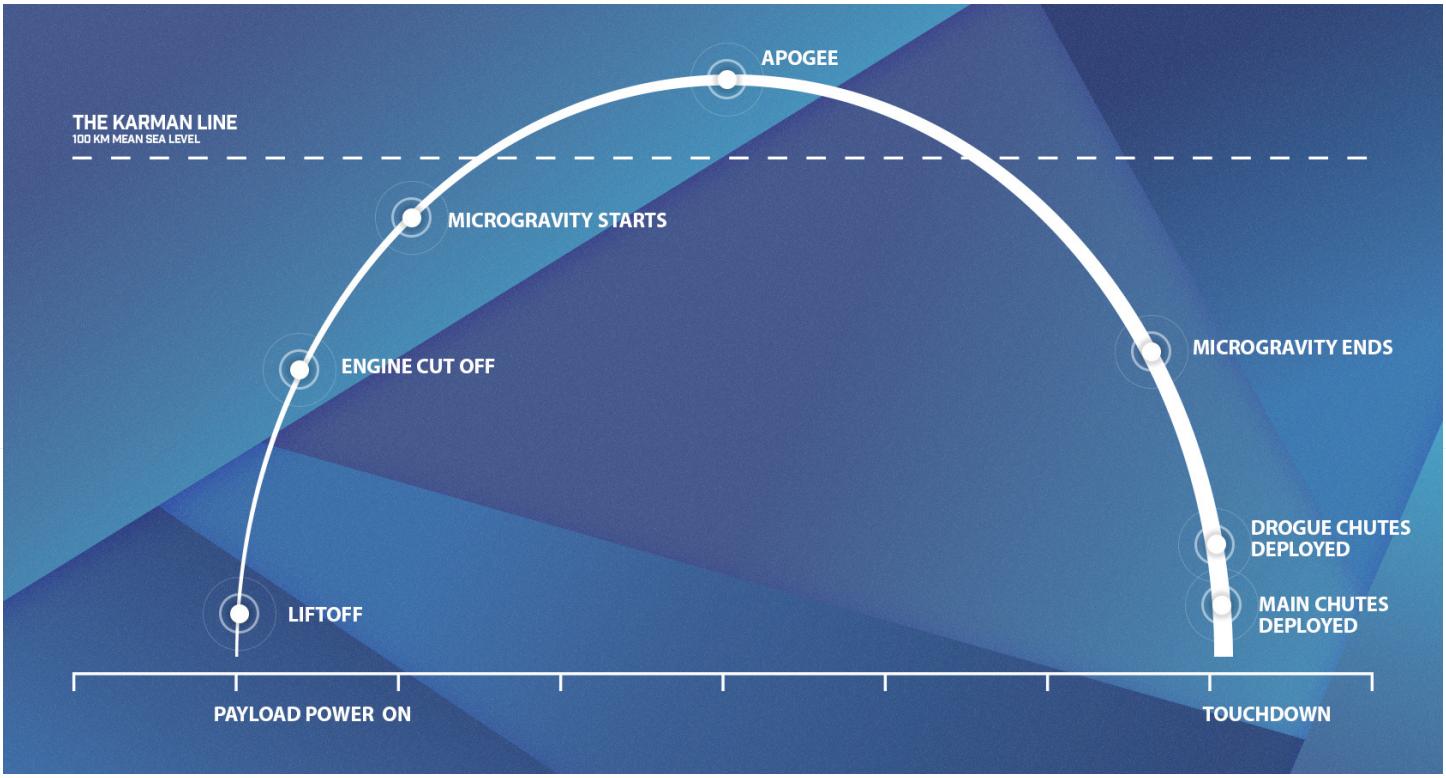
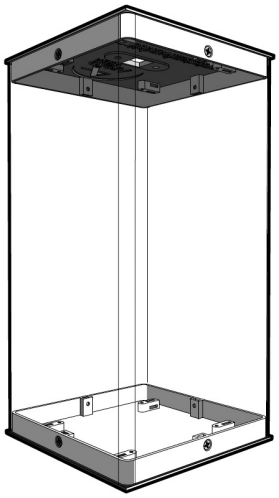
GENERALIZED FLIGHT PROFILE DETAIL

For purposes of your experiment design, please consider using the following simplified flight profile



FLIGHT BOX

Winning teams assigned to suborbital rocket flights will receive a 3D-printed Flight Box and a Technical Development Setup Guide.



FLIGHT PROFILE DETAIL

Payload Power On	Flight experiments will be powered on and readied for flight
Liftoff	The rocket will begin its journey up to space
Engine Cut Off	Main rocket engines cut off
Microgravity Starts	The experiments start their 3 minutes of microgravity
Apogee	Peak of the suborbital rocket flight
Microgravity Ends	The experiments end their 3 minutes of microgravity and descend
Drogue Chutes Deployed	Small parachutes deployed
Main Chutes Deployed	Large, main parachute deployed
Touchdown	Experiments land, the flight crew recovers the experiments and returns them to the student teams

UP AEROSPACE TECH SHEET

BLUE ORIGIN TECH SHEET

ABOUT SUBORBITAL ROCKETS

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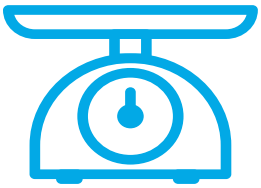
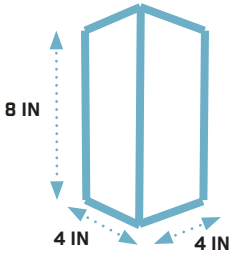
REPEATABLE

Generally speaking, there are two types of experiments - repeatable experiments (i.e., those that can be tested over and over again) and "one and done" experiments (i.e., red paint and blue paint mix). Either experiment type is allowed, but repeatability is encouraged when possible so that the experiment can be tested and refined.



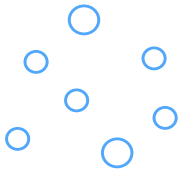
MASS

Your entire experiment including the 3D printed box, screws, electronics, and all components inside can weigh no more than 0.5 kg or 1.1 pounds. The 3D-printed box will be provided to the winners and it will weigh between 130 - 180 grams, so that leaves your team with about 320 - 370 grams to think about when designing your experiment.



SIZE / VOLUME

Winners will be sent a 3D-printed box that is 4 inches x 4 inches x 8 inches in size. When brainstorming your design, it is important for your experiment idea to fit within this volume. The flight box will also have mounting points available on each side, which can be used to attach experiment components.



AIR PRESSURE

Blue Origin's New Shepard rocket has a pressurized cabin with air (similar to being inside the space station). UP Aerospace's SpaceLoft rocket will have ZERO air inside the rocket (i.e., vacuum) during the three minutes of microgravity. NASA TechRise is open to proposals of either kind - those that need air or don't need air.

POWER & DATA

Your experiment will be plugged into the rocket for power and data. When designing your experiment, please assume that the experiment will receive 9V / 1 A of voltage and current from the rocket. This may limit the types of components you choose. Flight data will be sent in a serial byte format that can be received by a microcontroller through USB or UART and interpreted as strings of text and numeric data.

NO VIEWS OF EARTH

All suborbital rocket experiments will be mounted within a rack or container and then loaded INSIDE the rocket. During flight, there will be no views of Earth and no sensors on the outside of the rocket. However, you may still want a camera inside your experiment to take photos/videos of what happened during your three minutes of microgravity!

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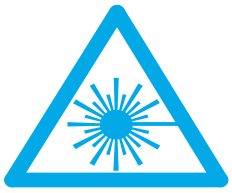
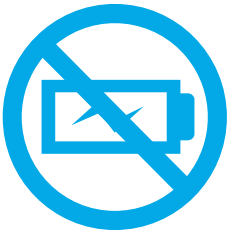


SAFETY FIRST!

Safety IS IMPERATIVE! Laser use is limited to small Class 1 and 1M lasers. All other lasers are NOT allowed. Compressed gas is NOT allowed. Hazardous materials are also NOT allowed. If in doubt, you can email Future Engineers with questions at support@futureengineers.org



NO BATTERIES

Your experiment will be plugged into the balloon for power. Please design your experiment to operate solely using the rocket's power. By relying on rocket power there is less risk of a battery losing its charge before or during flight. If you want to use a component that is typically battery powered, we recommend hard wiring if possible.

NO BLUETOOTH / WIFI / RF

Radio frequency transmissions are NOT allowed on NASA TechRise experiments. This means no Bluetooth, WiFi, Cellular Phone, or RF Communications.

LIQUIDS

Experiments can have no more than 150 milliliters of non-hazardous liquid. Combustible liquids are hazardous and are not allowed. If your team chooses to propose an experiment with liquids, double containment is required. This means you need a container within a container to be extra sure that it doesn't leak.

NO BIOLOGY

Experiments that grow or monitor LIVE organisms are not allowed. All experiments will be stored in a dark place for many months, which means no plants, animals, or cellular focused experiments. (Unintentional bacteria/ germs are fine.) Exceptions are: Seeds on their own or soils or artificial soils for space farming related experiments.

ACCELERATIONS

Be prepared for a rocket ride! All experiments should be designed to withstand up to 18-G's of acceleration axially and radially. This means that your experiment will feel the vertical forces of launch, and, if flying on the UP Aerospace rocket specifically, it will also feel the rapid despin during flight.