High-Altitude Balloon Experiment

2026-27 DESIGN GUIDELINES

NASA TECHRISE STUDENT CHALLENGE

Below are guidelines to reference when developing your balloon experiment proposal. We encourage participation first and foremost - so 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 AND TIMELINE

When preparing your proposal, keep in mind that all purchased components to build your proposed experiment **should not exceed a total cost of $1,500**. The judges are not requesting a budget, nor will any team be disqualified based on cost. Still, proposals that require additional funding or outside sponsorship beyond the $1,500 prize value will score lower. Additionally, all experiments must be feasibly completed within the challenge build period of approximately four months.

HOW HIGH-ALTITUDE BALLOON EXPERIMENTS WILL FLY

A gondola frame will hang from the high-altitude balloon and carry 60 TechRise experiments. All experiments will have the opportunity to sense the atmosphere and capture images in two directions: 1) nadir: looking down to Earth's surface, and 2) horizontal: looking out to the horizon. Payloads will be insulated with foam on three sides (back, left, and right) and access upwards will be blocked, so teams should be sure to plan their experiments to take full advantage of the two sides with a view. Each experiment will be attached to the gondola and plugged in to the balloon's power and data source. All parts of the experiment must remain inside the provided flight box for the entire duration of the flight

EXPERIMENT FLIGHT BOX

VEHICLE FLIGHT EVENTS SENT TO EXPERIMENTS

Launch
Float
Terminate

VEHICLE POWER SENT TO EXPERIMENTS

Voltage	9 V
Current	1.5 A (maximum)

VEHICLE DATA (DATA STREAM) SENT TO EXPERIMENTS

Elapsed Time
Latitude/Longitude
Altitude
Atmospheric Pressure
Course
Velocity XYZ
Temperature

AEROSTAR'S CYCLONE ZERO-PRESSURE BALLOON FLIGHT SUMMARY

Aerostar's Cyclone zero-pressure balloon system is a rapidly-deployable balloon system capable of achieving altitudes from 50,000 ft – 130,000 ft with a wide variety of user payloads. For TechRise, the Aerostar high-altitude balloon will launch from the Midwest US and ascend to the float altitude of approximately 70,000 - 95,000 ft, where it will float for approximately 4-8 hours. Once the flight vehicle reaches float altitude, the system takes advantage of stratospheric wind patterns to steer the balloon. Using altitude control maneuvers like venting lift gas (causing the balloon system to descend) or dropping ballast (causing the balloon system to ascend), the Aerostar flight engineer will find the best wind layer to steer the platform in the desired direction. Once the mission is complete, the Cyclone flight is terminated, and the payloads are cut away from the balloon and descend under a parachute for recovery by Aerostar flight crews. Aerostar's Cyclone zero-pressure balloon system will enable NASA TechRise students to conduct remote sensing and climate/atmospheric experiments.

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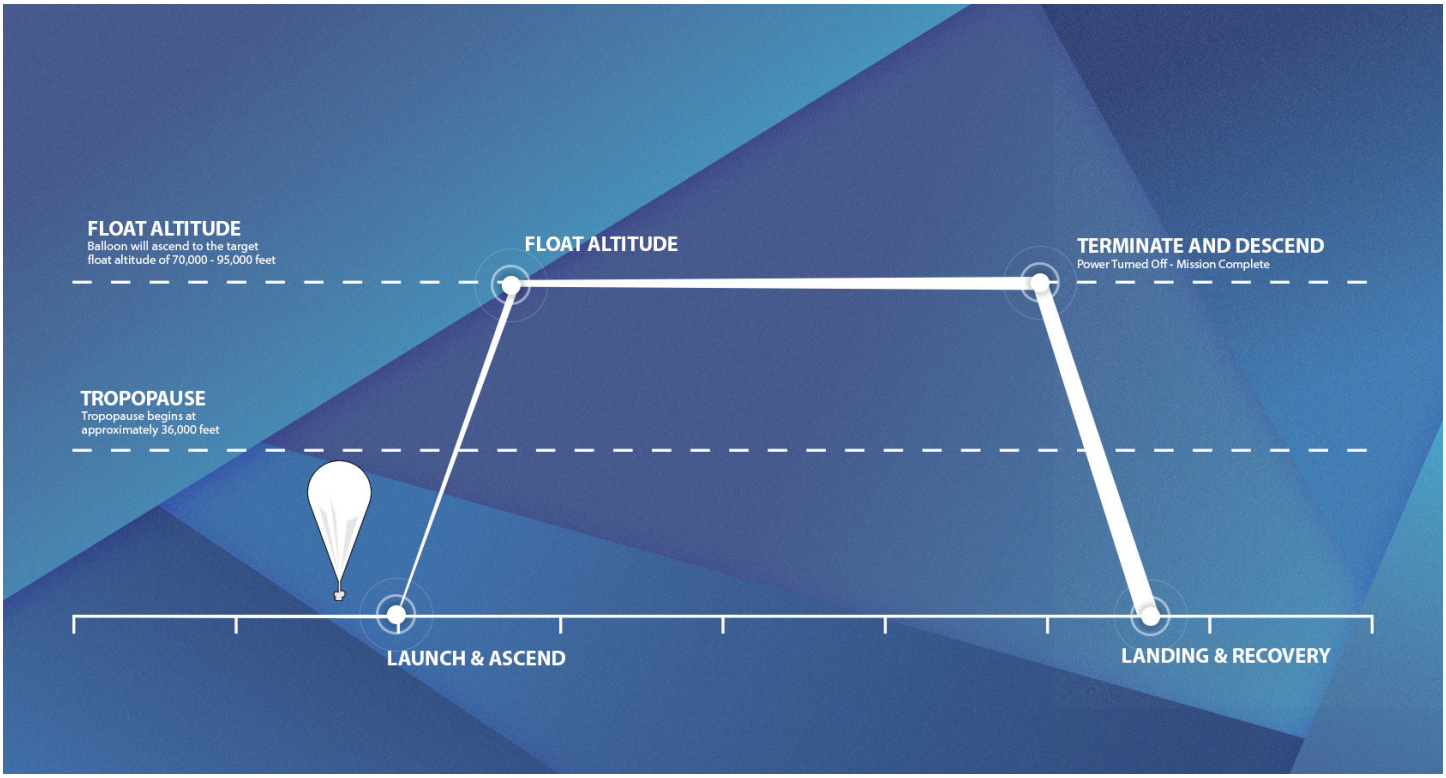
FLIGHT PROFILE



EXPERIMENT FLIGHT BOX

Winning teams will receive a flight box and a technical development guide to prepare for their balloon flight. All components of your experiment must remain in the flight box for the duration of the flight.

Maximum Size: 4 x 4 x 8 in (10 x 10 x 20 cm)
Total Maximum Weight: 2.2 pounds (1 kg)

FLIGHT PROFILE DETAIL

Prepare for Launch	Flight experiments will be powered on and readied for flight. Target launch time is in the morning shortly after sunrise with minimal cloud cover and no rain.
Launch & Ascent	Experiments will ascend through the troposphere into the stratosphere for approximately 1 hour. During this time, experiments will be powered-on and can collect data. Experiments are powered on for ~90 minutes prior to launch.
Float Altitude	Upon reaching the target altitude of approximately 70,000 - 95,000 feet, the experiments will float and gather data for at least 4 - 8 hours.
Termination & Descent	After 4 - 8 hours at float altitude, power to the experiments will be turned off, the balloon will release from the gondola, a parachute will deploy and the experiments will descend until touch-down.
Landing & Recovery	Experiments land, the location is tracked, and best efforts will be made to recover the experiments and mail them back to teams.

SAMPLE FLIGHT VIDEO

ABOUT HIGH-ALTITUDE BALLOONS

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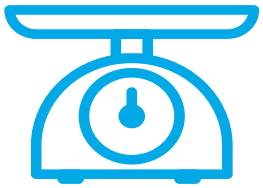
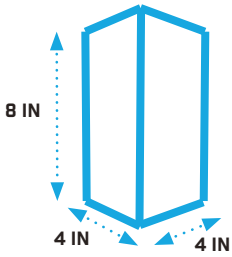


MASS

Your entire experiment, including the flight box, screws, electronics, and all components inside, can weigh no more than 2.2 pounds (1 kilogram). The flight box provided to winners will weigh about 0.5 pounds (230 grams), leaving your team with about 1.7 pounds (770 grams) left for accommodating your experiment.

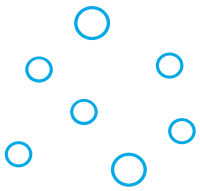


SIZE / VOLUME

Winners will be sent a flight box that is 4 x 4 x 8 inches (10 x 10 x 20 centimeters) in size. When brainstorming your design, it is essential for the components of your experiment idea to fit within this volume and **remain there for the entire flight**. The flight box will also have mounting points available on each side, which can be used to attach different experiment components.

POWER & DATA

Your experiment will be plugged into the balloon gondola for power and data. Experiments will receive 9 volts / 1.5 amps power from the balloon during flight. Batteries are not permitted as part of your experiment. Please rely solely on the balloon to power your payload. Flight data will be sent in a serial format that can easily be received by a microcontroller and interpreted as text and numeric data. Future Engineers mentors will help advise on power and data if selected as a winner.



ATMOSPHERIC SENSING

Your experiment will be exposed to the surrounding environment's atmospheric temperature and pressure (~4,400 Pa to ~100,000 Pa) during flight. If using sensors to measure atmospheric conditions, it is recommended to mount sensors as close to the outer face of the experiment as possible. You may cut holes in the outer face of the flight box as needed to facilitate environmental access.

ACCELERATIONS

Your experiment should be designed to withstand 6 *g*-forces in any direction. Balloons are generally known for their gentle, smooth rides, but there are two main points during flight to keep in mind when thinking about accelerations (or decelerations). The first is when the parachute deploys, and the second is when the payloads land on the ground. Future Engineers will help advise on how to make your payload as robust as possible to survive these accelerations.

TEMPERATURE

Temperatures during balloon flights could range between -116°F and 41°F (-82°C and 5°C). However, we don't advise designing for -116°F! Please design for a cold flight, but also know that there is time to refine your component selections during the experiment build period. Future Engineers will help advise on insulation and temperature management strategies if selected as a winner.

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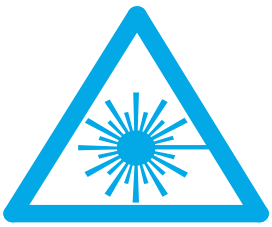
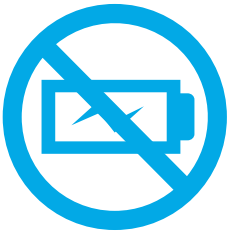


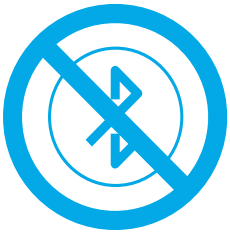
LASER SAFETY

For safety, lasers will not be allowed, including laser-transmitting technologies, such as lidar (light detection and ranging). However, exceptions will be made for commercial sensors that use internal lasers to detect particles or gather other data (e.g., air quality sensors), so long as students are not directly interacting with a laser and a laser does not transmit outside of the experiment.



NO BATTERIES

Your experiment will be plugged into the balloon for power. Please design your experiment to operate solely using the balloon's power.

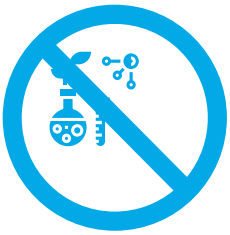


NO BLUETOOTH / WIFI / RF

Radiofrequency (RF) transmissions are NOT allowed on NASA TechRise experiments. This means no Bluetooth, Wi-Fi, cellular phone, or RF transmitters. You can, however, receive signals like GPS coordinates if needed.

LIQUIDS

Experiments can have no more than 5.2 fluid ounces (150 milliliters) of non-hazardous liquid. Liquids must be securely contained within the payload for the duration of the experiment.



NO BIOLOGICAL MATERIALS

Experiments that grow or monitor LIVE organisms, including plant, animal, or cellular-focused experiments are not allowed. (Unintentional bacteria/ germs are fine.) Exceptions are seeds on their own, soils, or artificial soils for space farming-related experiments, and substances such as yeast that remain dormant until activated. Dormant microorganisms such as tardigrades are allowed.

MAGNETS

Experiments that propose magnets are allowed, but the magnets cannot adversely impact, affect, or alter the neighboring experiments around it. You should assume that another experiment will be directly adjacent to your experiment. No N55 or N52 magnets. If selected, Future Engineers will help advise whether the magnets you have described in your proposal are appropriate for flight.

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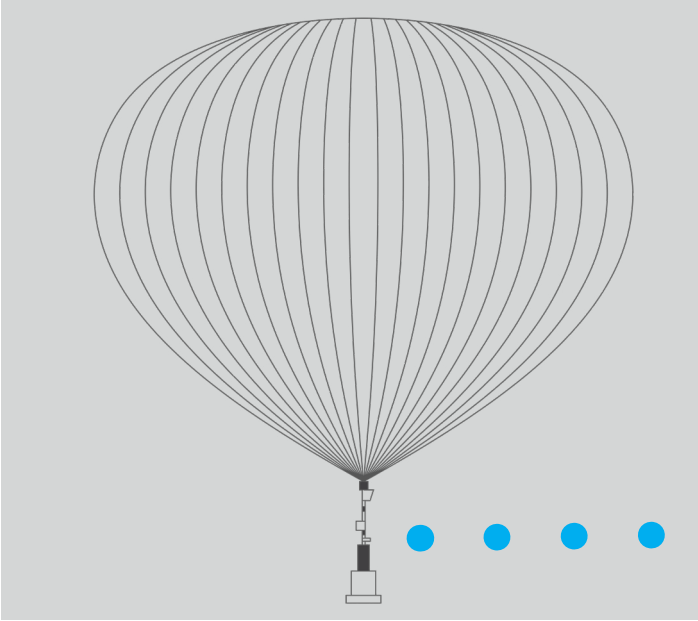
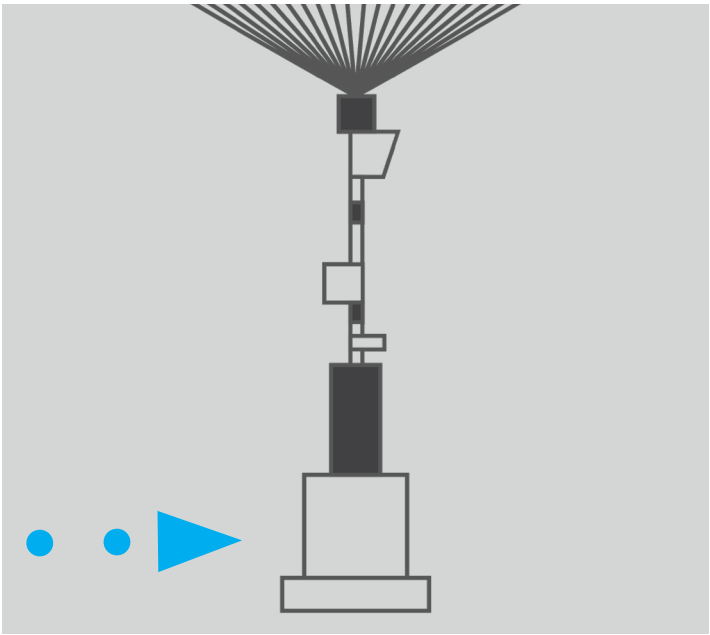
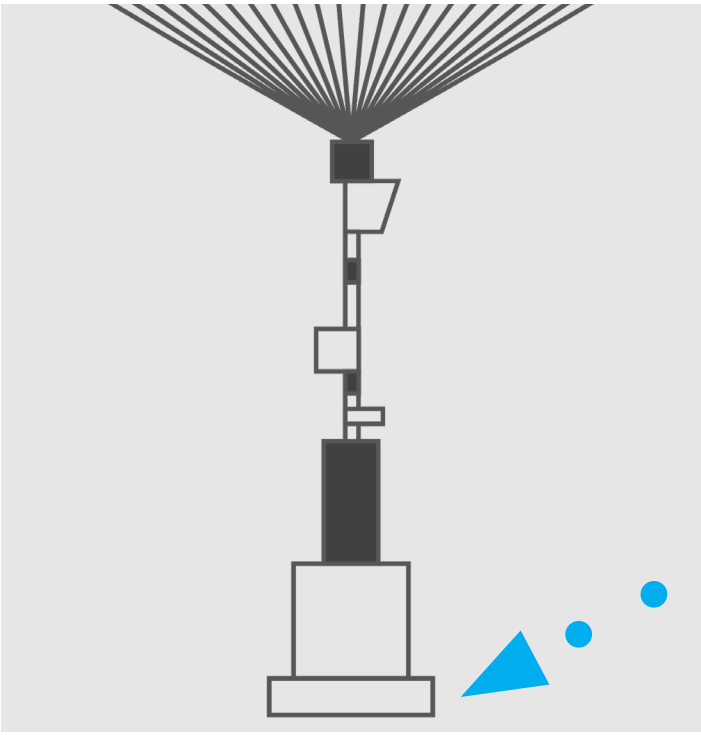
AEROSTAR'S CYCLONE BALLOON



GONDOLA HANGING FROM BALLOON



GONDOLA HANGING FROM BALLOON



EXPERIMENT FLIGHT BOX