High-Altitude Balloon Experiment

2024-25 DESIGN GUIDELINES

NASA TECHRISE STUDENT CHALLENGE

Below are guidelines to reference when developing your balloon 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! In addition to these design guidelines, you are invited to also review the World View Tech Sheet for more information.

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 Balloon Experiments Will Fly

A gondola frame will hang from the 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. The inflated balloon will block any upward views, so there will be no zenith views. Each experiment will be attached to the gondola, plugged into the balloon's power and data source, and insulated with foam sheets cut out with holes for any cameras or sensors that may be included in each experiment. Inserts will also be placed between each experiment to insulate each flight box further.

VEHICLE FLIGHT EVENTS SENT TO EXPERIMENTS

Launch
Float
Terminate

VEHICLE DATA (DATA STREAM) SENT TO EXPERIMENTS

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

Flight Summary

The balloon will launch and ascend to an altitude of approximately 70,000 - 95,000 feet (21-29 kilometers!), where it will float for approximately 4 - 8 hours. The anticipated location for the balloon flight is Southwestern US. The flight crew will target a morning launch time with the following launch conditions:

- Minimal to no cloud cover
- No rain

The experiments can collect data during the balloon's ascent up to the float altitude and during the approximate 4 - 8 hour float time. During flight, the balloon will traverse land features such as trees, fields, farms, and bodies of water (e.g., rivers, reservoirs, or lakes). At the end of the float time, power will be shut off, data collection will stop, and the experiments will parachute down to the ground.

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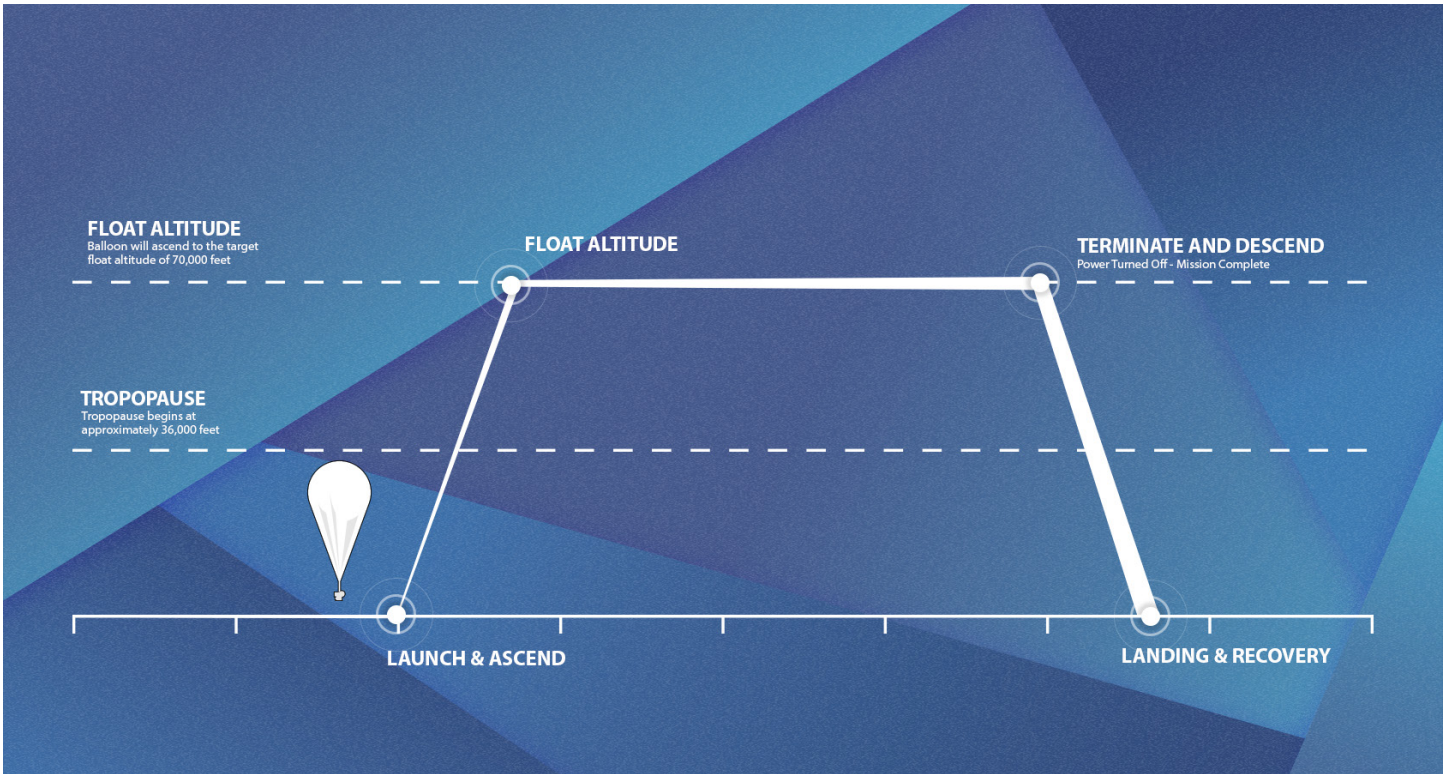
FLIGHT PROFILE



EXPERIMENT FLIGHT BOX

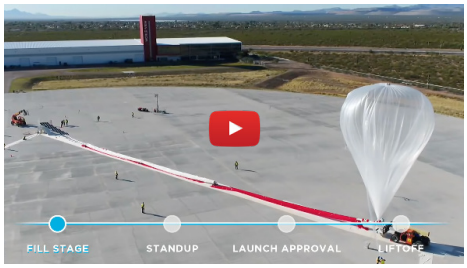
Winning teams will receive a flight box and a technical development guide to prepare for their balloon flight.

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.
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.
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 descend.
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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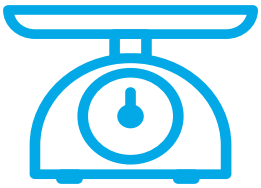
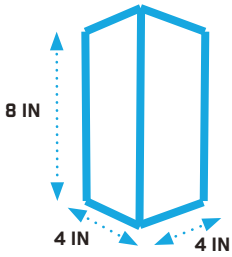


MASS

Your entire balloon 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.

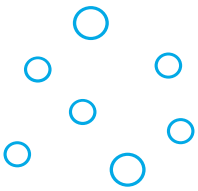


SIZE / VOLUME

Winners will be sent a flight box 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. 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 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 ambient atmospheric temperature and pressure 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.

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 degrees F and 41 degrees F (-82 degrees C and 5 degrees C). However, we don't advise designing for -116F! 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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2023-24 DESIGN GUIDELINES

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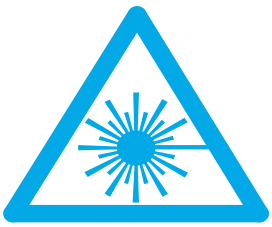
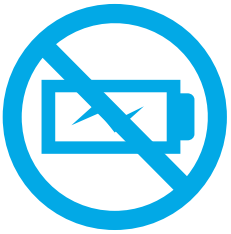


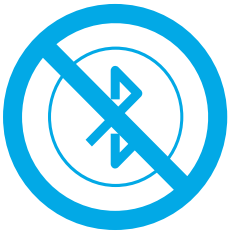
LASER SAFETY

For safety, lasers will not be allowed, including laser-transmitting technologies, such as LIDAR. 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.

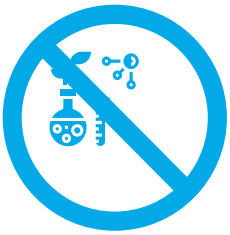


NO BLUETOOTH / WIFI / RF

Radiofrequency (RF) transmissions are NOT allowed on NASA TechRise experiments. This means no Bluetooth, Wi-Fi, cellular phone, or RF communications. 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. If selected, Future Engineers will help advise whether the magnets you have selected in your proposal are appropriate for flight.