NASA

TECHRISE STUDENT CHALLENGE

Step 3 Learn About High-Altitude Balloons

2025

Step 3: Learn About High-Altitude Balloons

Learn all about high-altitude balloon flights.

Think about the following questions when learning about the high-altitude balloon:

- What environment does the high-altitude balloon provide? How long will your experiment/payload be in that environment?
- What types of experiments can you conduct on the high-altitude balloon?
- What kind of data can you collect on the high-altitude balloon? (e.g., can you collect temperature, pressure, altitude, visual data?)

About High-Altitude Balloons Video

High-Altitude Balloons

High-altitude balloons are large, helium-filled balloons that carry scientific payloads and experiments up into the Earth's atmosphere and closer to the edge of space.

They can sustain long periods of time in the Earth's atmosphere. Balloon flight tests for NASA's TechRise payloads will fly for approximately 4-8 hours.

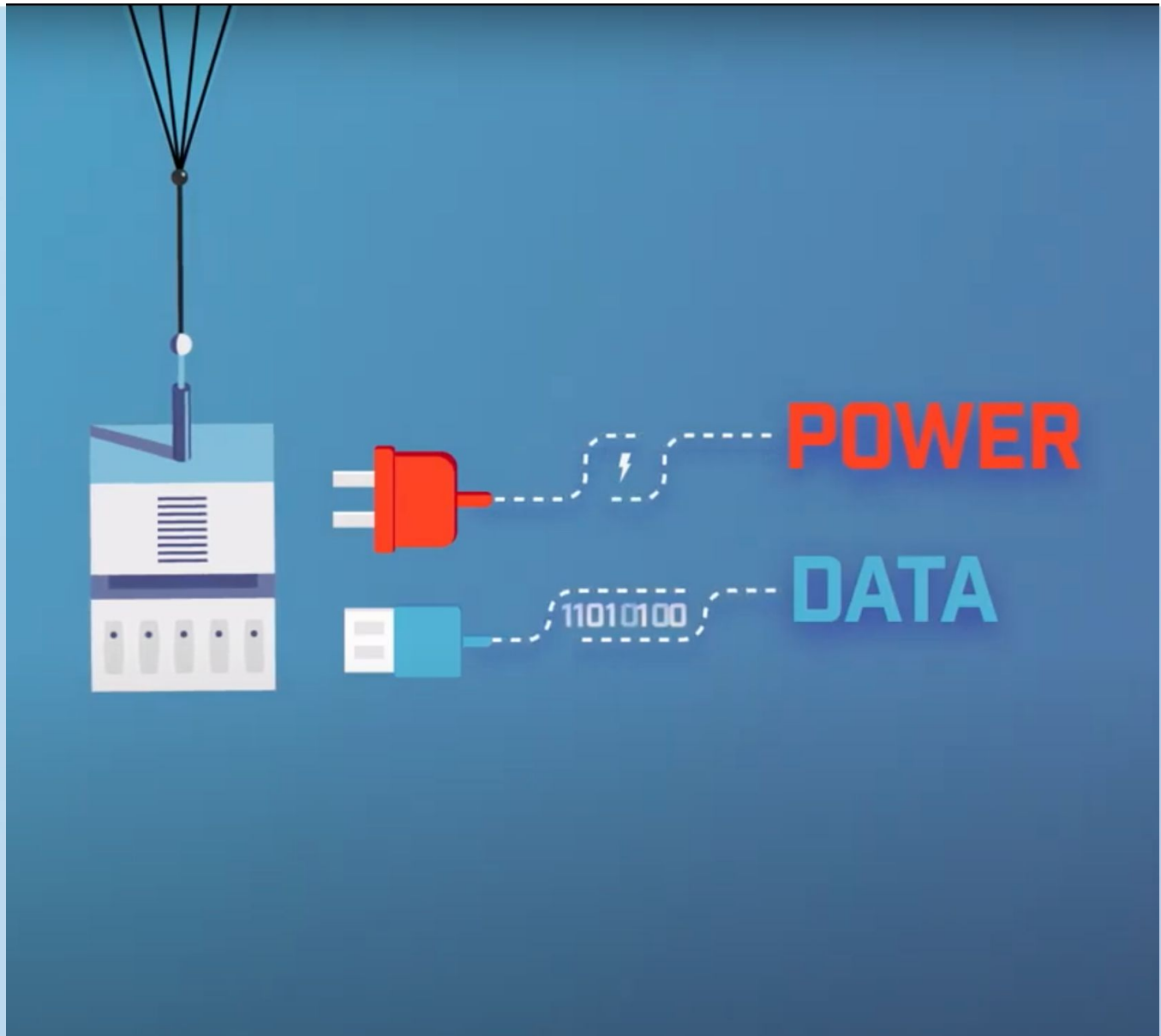
High-Altitude Balloons

The 2025-26 NASA TechRise Student Challenge will have one balloon flight provider: World View Enterprises. Once the flight vehicle reaches the 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 flight engineer will find the best wind layer to steer the platform in the desired direction.

Photo Credit: World View

Power and Data

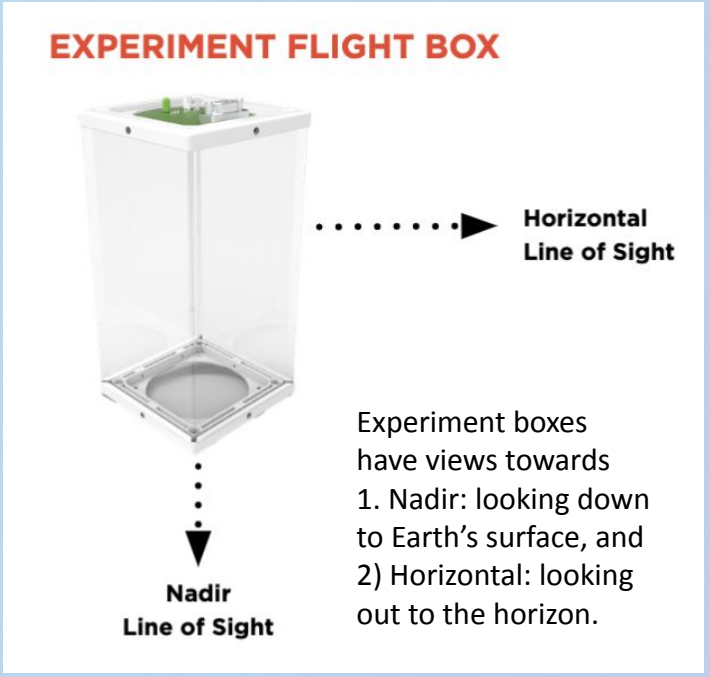
Before flight, all NASA TechRise experiments will be hooked up to the balloon's power and data systems, and mounted to a frame called a gondola. If it is morning, not raining, low winds, and with little/no cloud cover, then we are GO for launch.

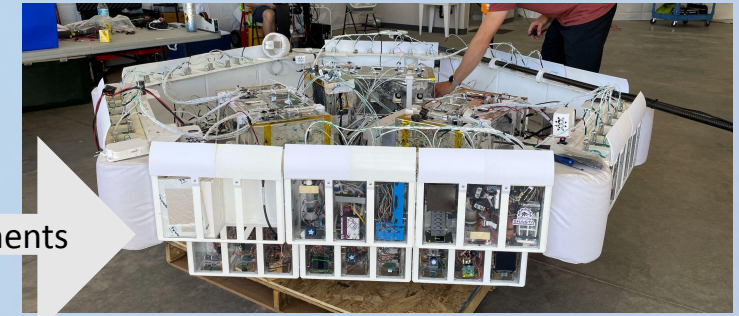


Flight

Once the balloon and gondola start ascending into the sky, the experiments can start using their onboard sensors and cameras to collect data. The experiments will have exposure to the air around them, views down to Earth's surface, and views out to the horizon.

Photo Credit: World View





Gondola holds experiments

Flight

The balloon will traverse over surfaces that encompass discernible surface features such as vegetation (natural or agricultural) and/or bodies of water (e.g., rivers, reservoirs, lakes).

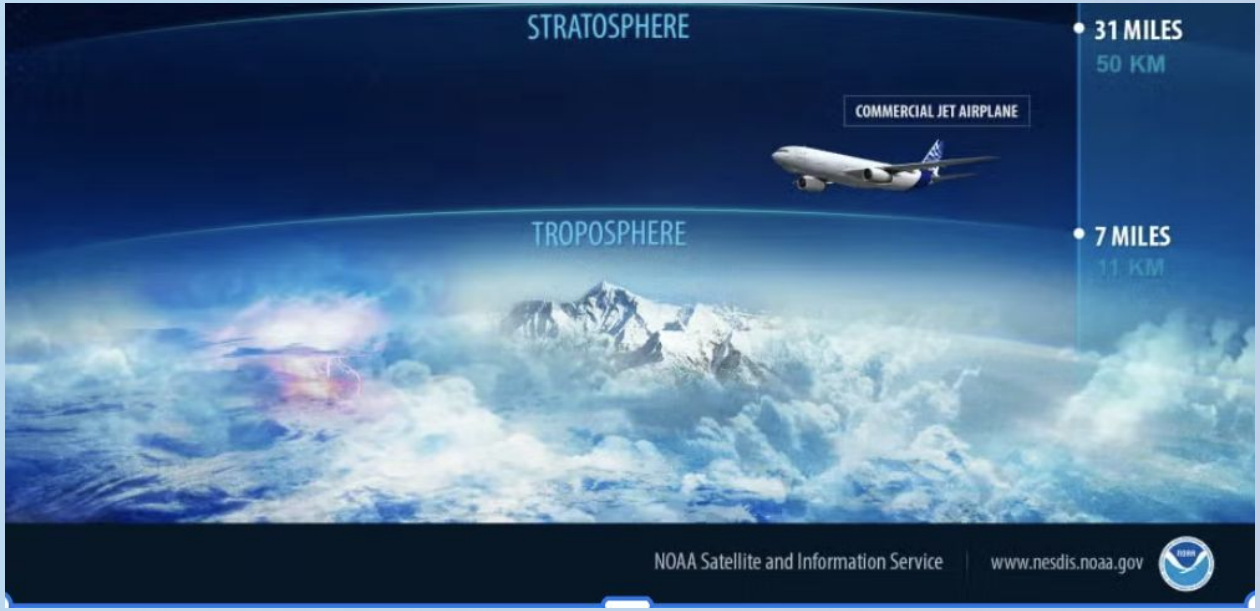
The higher the balloon goes, the colder it gets. And since air pressure decreases with altitude, the balloon will expand from big to HUGE.

Atmospheric Layers

The balloon will also travel through different layers of the atmosphere.

It will take about 30 to 45 minutes to ascend through the troposphere, which is the layer we live in and extends from ground level to on average 33,000 feet or 6.2 miles above sea level. It is the layer that has almost all of our planet's weather, like clouds and water vapor, which are constantly moving. About 75% of the air from our atmosphere is in the troposphere and it is by far the wettest layer.

Next is the stratosphere, which extends from the top of the troposphere to on average 164,000 feet or 31 miles. This is above the clouds and where the winds are calm and dry. This is where commercial airplanes typically fly within the lower altitudes of the stratosphere and it is also where you'll find the ozone layer. Ozone molecules in the stratosphere absorb a lot of the Sun's harmful UV radiation, and in the process generate heat. Unlike the troposphere, it actually gets warmer the higher up you go in the stratosphere!



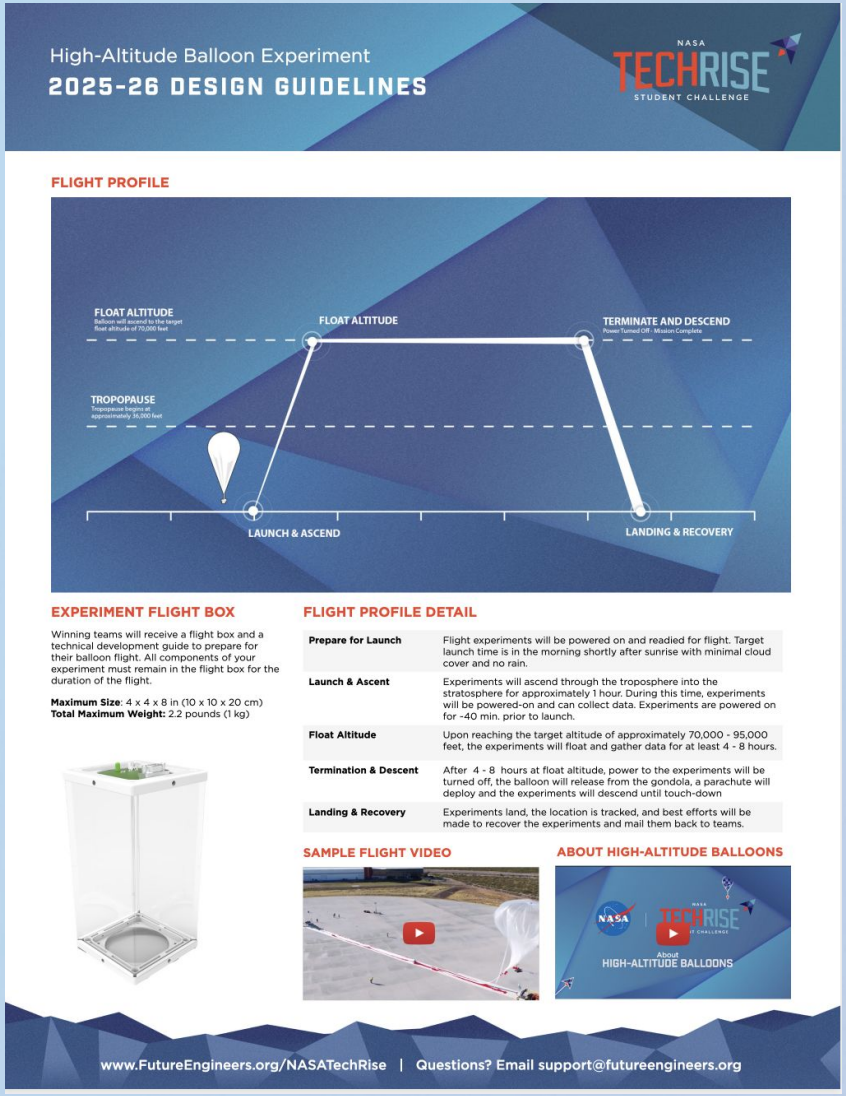
Target Float Altitude

During flight, the balloon's altitude can be adjusted by venting helium to go lower or dropping weight to go higher, until it reaches its target float altitude of approximately 70,000-95,00 feet, where NASA TechRise experiments will float for at least 4-8 hours.

Flight Data

Experiments can also use the balloon's onboard data. The balloon's onboard flight computer will send messages to the experiments, including GPS data of where it is, altitude data of how high it is, or acceleration data of how fast it is changing speed.

You can program a microcontroller to use this data to start or stop your experiment at a certain altitude, map where you took a particular photo, or log how far your experiment traveled.



Experiment Retrieval

And once the mission is complete, the experiment will be powered off before the gondola separates from the balloon and parachutes back down to Earth.

After the balloon lands, a crew will try to retrieve it and send your experiment home.

Photo Credit: Aerostar

Key Points: High-Altitude Balloon

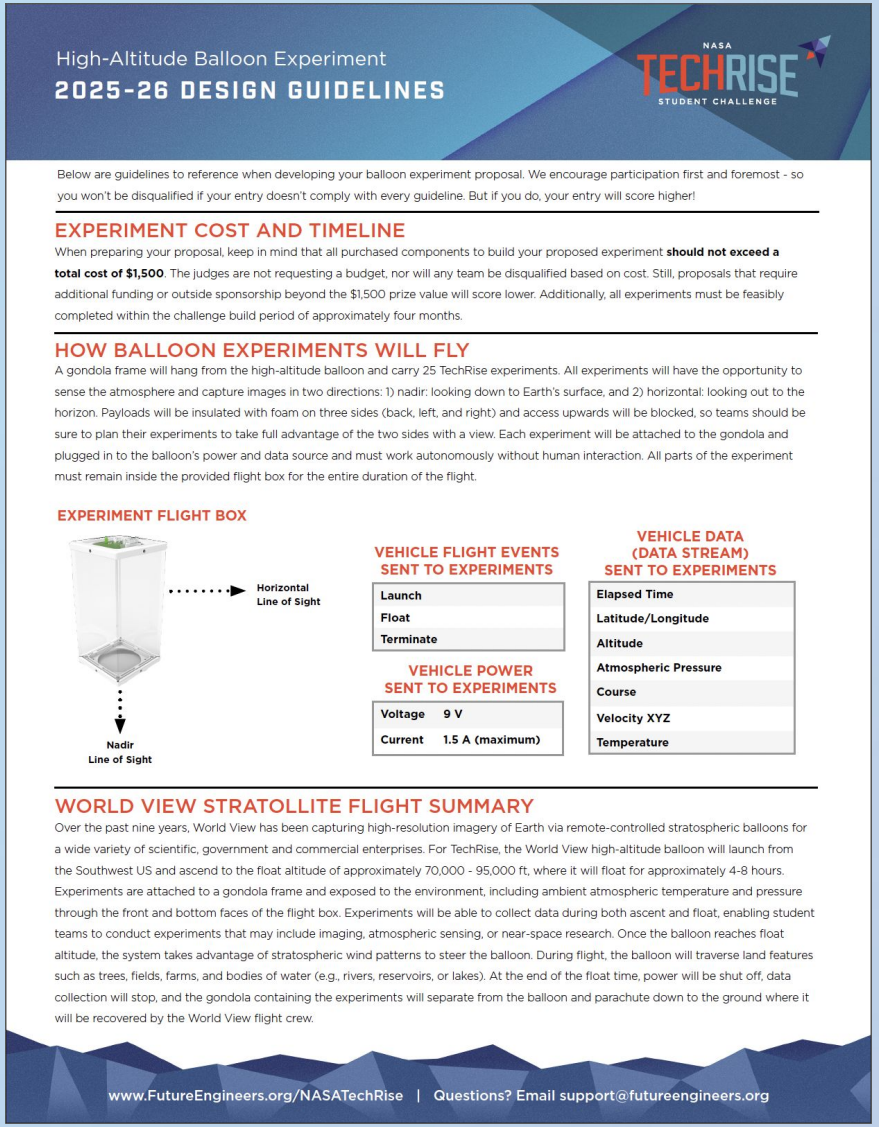
- Flight time of 4-8 hours at approximately 70,000-95,000 feet
- Experiment will have line of sight in two directions during flight: down to Earth (nadir) and out to the horizon (horizontal)
- Experiment will be exposed to ambient atmospheric temperature and pressure
- Power is provided to each experiment; no additional batteries are permitted
- Vehicle data is streamed to each experiment
- No plants or animals!

Possible Experiments Topics: High-Altitude Balloon

- Comparing Atmospheric Layers
- Ozone
- Temperature, Pressure & Humidity
- Greenhouse Gases
- Air Quality
- Radiation
- Thermodynamic Experiments
- Remote Sensing/Imaging of Earth
- Materials Experiments
- Earth's Magnetic Field Measurements
- Moon & Mars Landing Systems
- Lunar Dust Mitigation
- Living in Space - Air Quality on Spacecraft
- You Choose!

Design Guidelines

The NASA TechRise Student Challenge website has the High-Altitude Balloon Design Guidelines with more information.



High-Altitude Balloon Experiment

2025-26 DESIGN GUIDELINES

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 BALLOON EXPERIMENTS WILL FLY

A gondola frame will hang from the high-altitude balloon and carry 25 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 and must work autonomously without human interaction. 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

WORLD VIEW STRATOLLITE FLIGHT SUMMARY

Over the past nine years, World View has been capturing high-resolution imagery of Earth via remote-controlled stratospheric balloons for a wide variety of scientific, government and commercial enterprises. For TechRise, the World View high-altitude balloon will launch from the Southwest US and ascend to the float altitude of approximately 70,000 - 95,000 ft, where it will float for approximately 4-8 hours. Experiments are attached to a gondola frame and exposed to the environment, including ambient atmospheric temperature and pressure through the front and bottom faces of the flight box. Experiments will be able to collect data during both ascent and float, enabling student teams to conduct experiments that may include imaging, atmospheric sensing, or near-space research. Once the balloon reaches float altitude, the system takes advantage of stratospheric wind patterns to steer the balloon. 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 gondola containing the experiments will separate from the balloon and parachute down to the ground where it will be recovered by the World View flight crew.

www.FutureEngineers.org/NASATechRise | Questions? Email support@futureengineers.org