NASA

TECHRISE STUDENT CHALLENGE

Step 3 Learn About High-Altitude Balloons

Step 3: Learn About Balloons

Learn all about the high-altitude balloon flights.

Think about the following questions when learning about the balloon:

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

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 4+ hours.

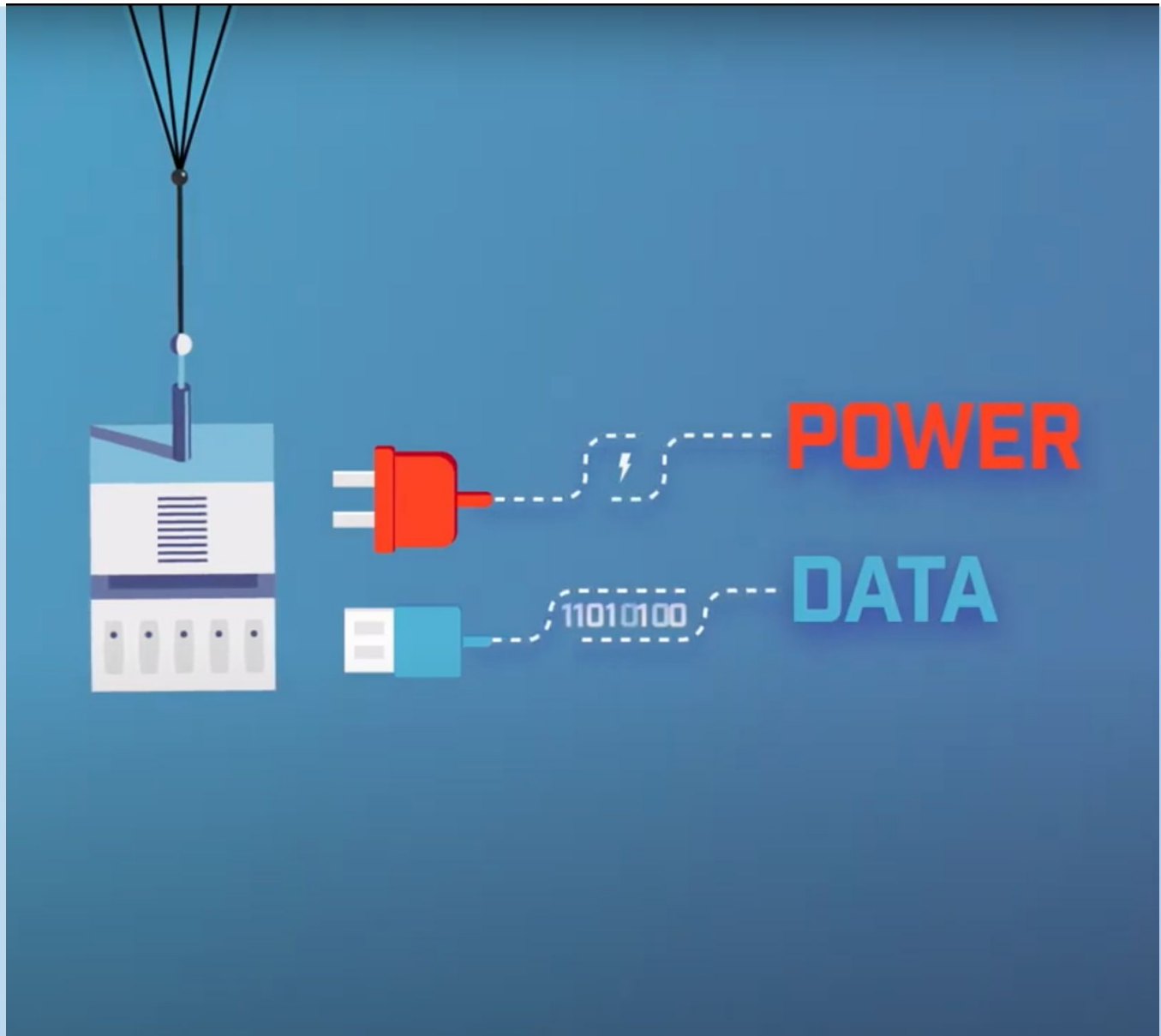
High-altitude Balloons

The NASA TechRise Challenge will have two flight providers: Aerostar and World View. 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 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 and mounted to a frame called a gondola. If it is morning time, not raining, 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

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, other).

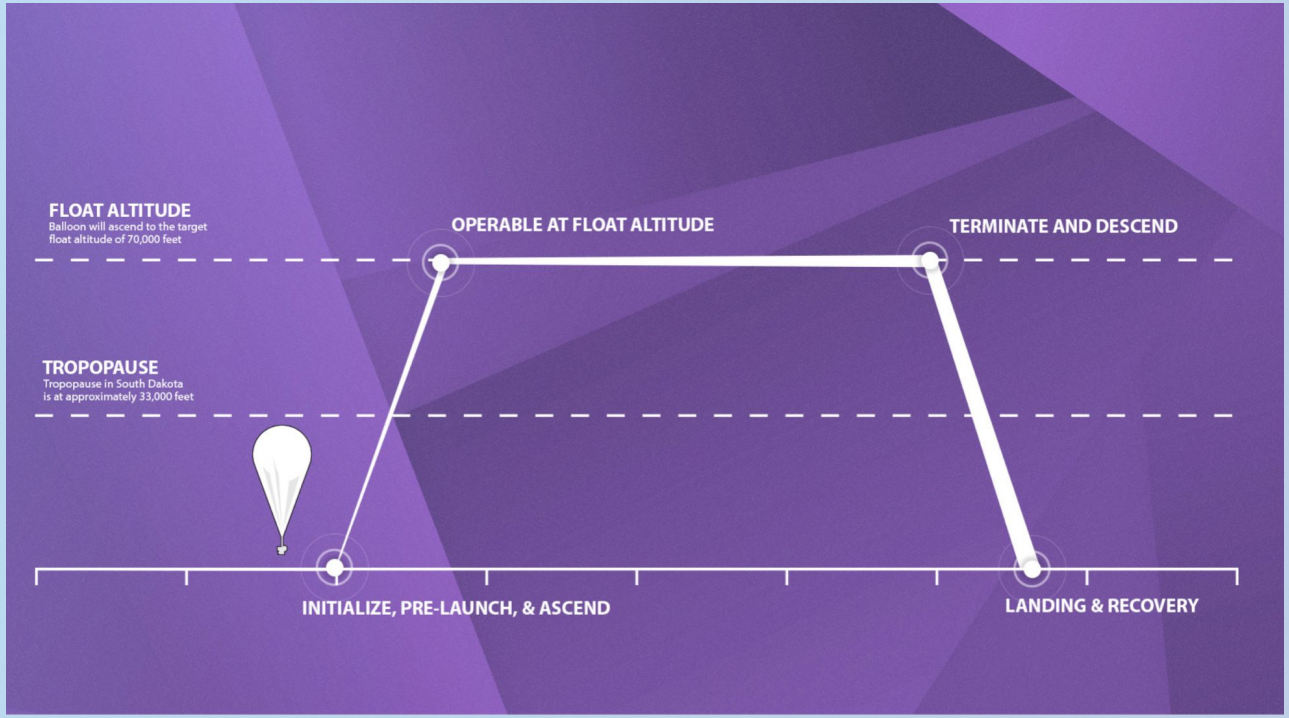
The higher the balloon goes, the colder it gets. And since air pressure decreases with altitude, the balloon will expand from big to HUGE.

Atmospheric Layers

It 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 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 is above the clouds and where the winds are calm and dry. This is where commercial airplanes typically fly and 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!



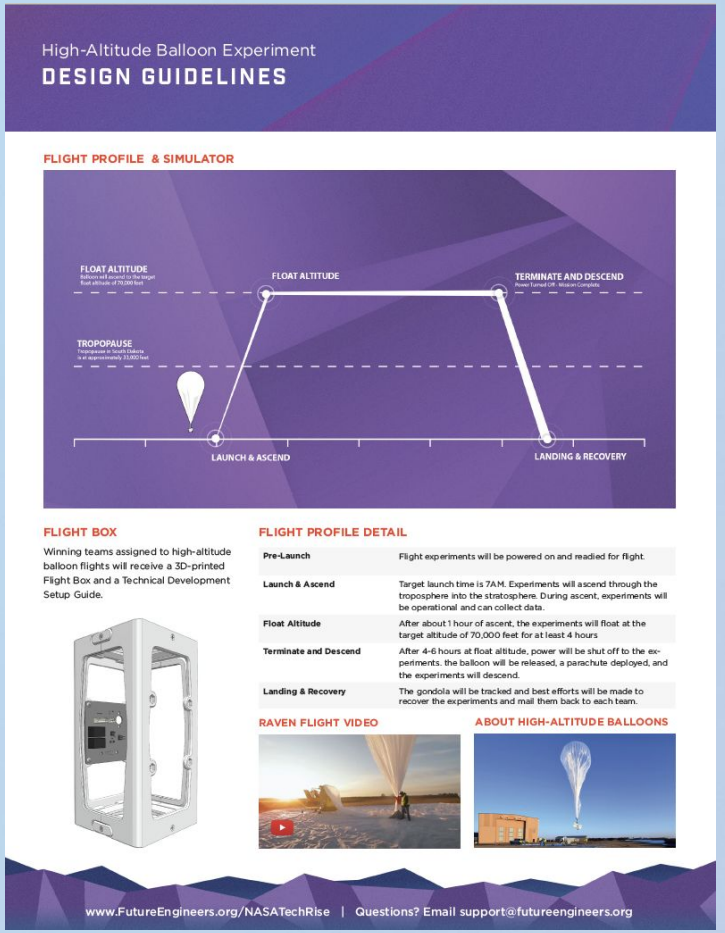
Target Float Altitude

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 feet, where NASA TechRise experiments will float for at least 4 hours.

Flight Data

Experiments can also use the balloon's on-board 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, or to map where you took a particular photo, or to 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 Balloons

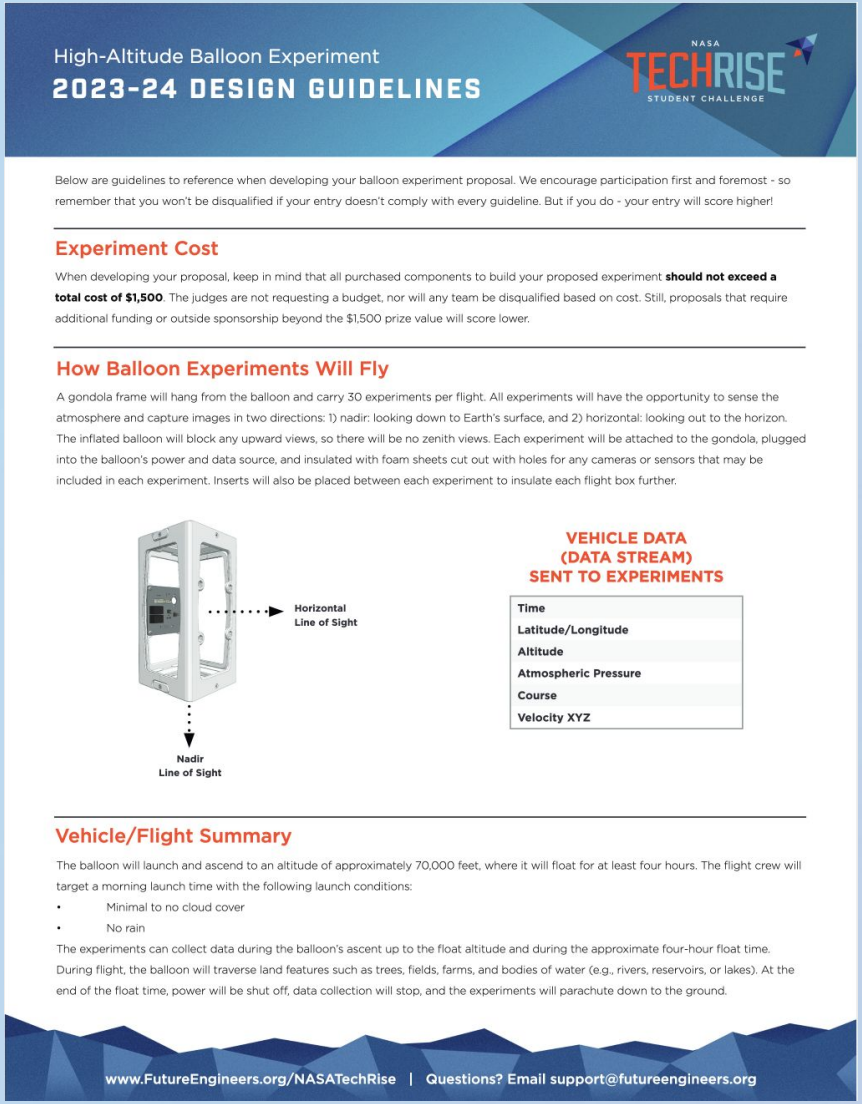
- Flight Time: 4+ hours at 70,000 feet
- Experiment will have line of sight in two directions during flight - Down to Earth (Nadir) and out to the horizon (Horizontal)
- Exposed to ambient atmospheric temperature and pressure
- Power is provided to each experiment. No additional batteries permitted
- Vehicle data is streamed to each experiment

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 Balloon Design Guidelines with more information.



High-Altitude Balloon Experiment

2023-24 DESIGN GUIDELINES

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!

Experiment Cost

When developing 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.

How Balloon Experiments Will Fly

A gondola frame will hang from the balloon and carry 30 experiments per flight. 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 DATA (DATA STREAM) SENT TO EXPERIMENTS

Time
Latitude/Longitude
Altitude
Atmospheric Pressure
Course
Velocity XYZ

Vehicle/Flight Summary

The balloon will launch and ascend to an altitude of approximately 70,000 feet, where it will float for at least four hours. 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 four-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.

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