



Brainstorm Activity Worksheet (High-altitude Balloon)

Brainstorm possible balloon flight experiment ideas for the TechRise challenge

Brainstorm Activity Procedure

1. Use the balloon brainstorm topics and questions below as a guide to come up with possible balloon flight experiment ideas.
2. All ideas are welcome, simple or complex.

Questions

1. What is special about the balloon's flight environment?
2. What brainstorm topic most interests your group? Read the brainstorm topic out loud and discuss what experiment ideas come to mind. Expand on your experiment ideas.
3. Would you like to conduct a science experiment on the balloon?
 - a. What do you want to study in the environment that the balloon provides?
 - b. What kind of data would you like to collect?
 - c. What is your hypothesis?
4. Would you like to use the balloon to test a new technology?
 - a. What new technology would you like to test?
 - b. How do you think the new technology will react on the balloon flight?

Write your ideas below

BALLOON BRAINSTORM TOPICS

Compare Atmospheric Layers

Your experiment will ascend through two very different atmospheric layers. What can you measure, compare, and learn between the troposphere and the stratosphere? What different sensors can you use to measure atmospheric pressure, air temperature, humidity, or light levels as your experiment travels through different atmospheric layers?

Ozone

The target float altitude of the balloon is right in the middle of the ozone layer, which is part of the stratosphere. What can you measure to understand the ozone layer better? How does temperature change as you move through the ozone layer? How do UV radiation levels change? How important is ozone to our planet?

Temperature, Pressure & Humidity

As the balloon ascends through the troposphere and stratosphere, the air temperature and pressure will change. Can you think of an experiment that measures or tests the air temperature and/or air pressure? What about humidity? Our atmosphere provides a superhighway for water vapor to move around the globe. Think about the water cycle and how water is constantly evaporating, transpiring, and moving upward to form clouds. For example, your experiment will be surrounded by water vapor as it ascends through the troposphere. But after the balloon flies above the clouds, it will enter the stratosphere which is very dry and has little water vapor. How might you monitor or assess changes in temperature, pressure, and/or humidity?

Greenhouse Gases

Understanding climate change is dependent on our understanding of greenhouse gases. What data can you gather to understand CO₂ levels in our atmosphere? Or methane? How do greenhouse gases change with altitude? Is it the same or different as you fly over different areas? Why is it important to study greenhouse gases?

Air Quality

The air that we breathe is filled with small particles suspended in the atmosphere like dust, mold, microplastics, pollen, soot, smoke, and other fine substances. Particulate matter is typically separated into three classifications: coarse, fine, and ultrafine particles. Large particulate matter is generally filtered away in our nose and throat, but smaller particles can move into the cardiovascular system and cause health concerns. How can you use sensors to better understand the amount and size of particles in our atmosphere?

Radiation

As humans explore further and longer in space and near-space, or even high in our atmosphere on planes, NASA needs to understand ionizing radiation and its effects on living things. Just like NASA plans to fly a [Moonikin](#) around the Moon, how can you test the radiation levels a living thing or person may experience the closer they get to space? Or what kind of radiation shield can you invent and test during your flight?

Thermodynamic Experiments

Temperatures during flight can go as low as -80 degrees Fahrenheit, and even colder in space. How can you use the extreme temperatures during flight to test ways to keep things warm on a long journey? From onboard heaters to innovative methods of insulation, there are many ways to study heat transfer and the impacts of cold climates on everything from people to electronics.

Remote Sensing/Imaging of Earth

There is a world of visible and invisible imagery to explore during a balloon flight. From high-resolution cameras to thermal imaging, a picture is worth a thousand words. What image capture techniques can you test – from stereo/3D imaging to time-lapse to stitching together panoramas? And how can you compare your photos to historical archives to learn something new or see the impacts of climate change? During flight, your experiment will receive real-time GPS data. How can you use that data to help identify the locations that you see during flight? Imaging is about both software and hardware. What mechanisms can you invent to help focus, zoom, or stabilize the camera during flight?

Materials Experiments

Materials react differently the farther away they get from Earth's surface – from rubber to plastics to organic substrates, like soil and seeds. Temperature can affect how much materials expand or contract. Ambient air pressure can affect how much an object inflates – like when a chip bag gets puffier at altitude. Radiation can affect how much materials degrade. What materials could you fly, test, and compare to objects here on Earth to study the effects of flight?

Landing Systems

Did you know that the Perseverance Rover's Terrain Relative Navigation System was tested on a flight? The software used to avoid dangerous obstacles and identify safe landing zones was tested at altitude before it was used on Mars. What system or algorithm could you develop to identify key objects during descent and landing? How could it help NASA land spacecraft safely on the Moon or Mars?

Earth's Magnetic Field Measurements

Magnetometers aboard high-altitude balloons can measure the Earth's magnetic field. Do you think you can map magnetic field fluctuations? Why do magnetic field fluctuations matter? What can they tell us about our planet?

You Choose!

There are so many experiments to consider! Maybe you want to investigate the types of research that has historically been done in the stratosphere – and push things further to learn more. Or what can you invent entirely new that can be tested on a high-altitude balloon flight? The stratosphere can be used to test and understand both our planet and our solar system, as well as create technologies that improve our knowledge and increase our capability to explore space.