

# TOP Science ONE Slide Report Selections

CAP Challenge 2021

# Accuracy of Urine Dipsticks in Space

**Testable Question:** If a Siemens Multistix dipstick is exposed to extremes of UV radiation, will the accuracy of its glucose measurement be affected?

**Hypothesis:** If the dipstick is exposed to extremes of UV radiation, then the accuracy of its glucose measurement will be impaired.

**Hypothesis supported by data: YES**

In a urine sample obtained from a poorly controlled diabetic male with his consent, the control dipstick detected the presence of glucose while the flight dipstick did not. Glucose peroxidase, an antioxidant, is the reagent used to detect glucose on the Multistix. UV radiation is known to deplete antioxidants and causes oxidative damage.<sup>1</sup>

**How would you improve your experiment?**

We also planned on comparing and contrasting protein detection on the Multistix using a urine sample from a person with renal disease. However, we were unable to obtain consent. We procured a urine sample from one of our team members. However, the sample had only trace protein, making accurate interpretation of control versus flight Multistix results difficult to interpret.



**Mission Name:**  
#StratoStar0436  
**Launch Date / Time:**  
(08/21/2021)  
(18:00 GMT)  
**Maximum Altitude:**  
(103, 058 ft)  
**Flight Duration:**  
(3 Hr: 37 Min)  
**Team Number: 285B**  
**By: Maeve C.**

**Materials Used:**  
Siemens Multistix  
Reagent 10SG



**Grade HS Subject:** Bio Chemistry

**Mission Link:** <https://tracking.stratostar.net/mission/0436>

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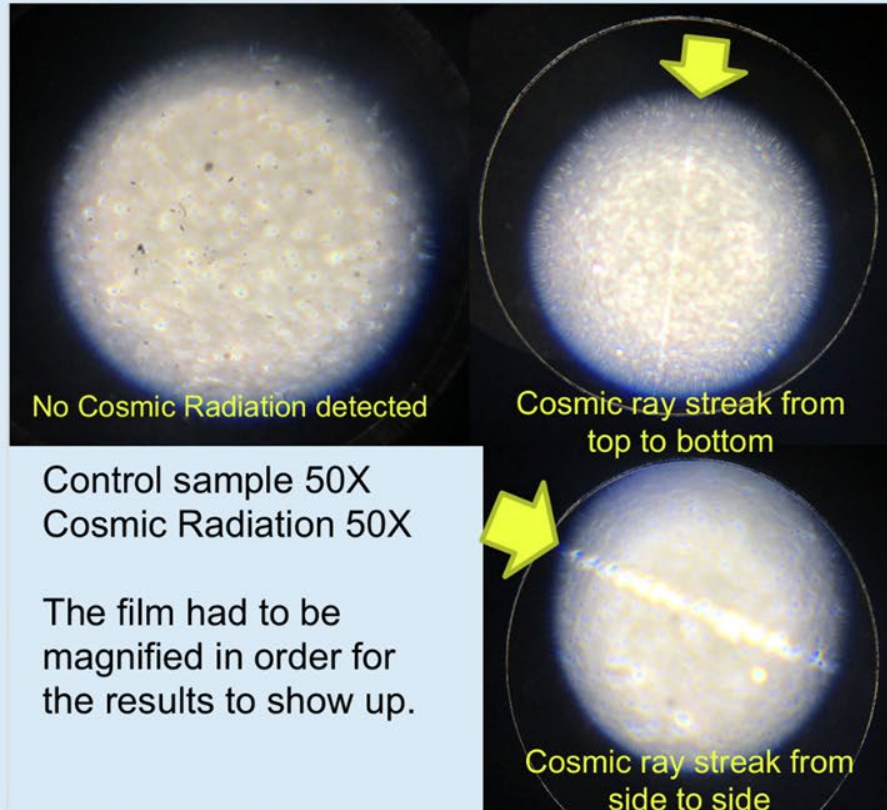
# Searching for Cosmic Radiation

**Testable Question:** Is there more Cosmic Radiation at altitude than at ground level.

**Hypothesis:** The film will capture cosmic radiation in the form of an exposure on the film.

**Hypothesis supported by data: Yes**  
The flight film was exposed to significantly more streaks than the control film.

**How would you improve your experiment?**  
We would have encased the test tubes in a metallic shielding during transit.



**Mission Name:**  
#StratoStar0436  
**Launch Date / Time:**  
(08/21/2021)  
(15:48GMT)  
**Maximum Altitude:**  
(103,058ft)  
**Flight Duration**  
(02:04hr)  
**Team Number: 153B**  
**By: Troy M**

**Materials Used:** ISO 3,200 Black and White film canister.

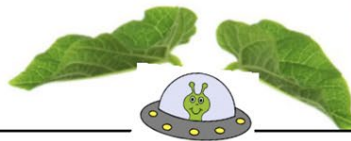


**Grade HS Subject:** Earth Science  
**Mission Link:** <https://tracking.stratostar.net/mission/0436>

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# Beans in Space!



## Testable Question:

Will exposure to the space environment affect the germination and growth rate of a bean?

## Hypothesis:

The more intense UV light at the edge of space will provide the bean with more nutrients to increase growth rate when planted.

## Hypothesis Supported by Data: NO

When planted, the control bean sprouted and grew faster than the bean that flew. This could be because the vacuum of space removed moisture from the bean or the exposure to extreme cold delayed growth.

## How would you improve your experiment?

The experiment could be improved by placing the bean in an airtight container or insulating the container in some way.



Control bean grew faster than bean that flew.

Grade Level: (MS, HS) Subject: (LS, ESS)

Mission Link:

<https://tracking.stratostar.net/mission/0436>

Mission Name:

#StratoStar0436

Launch

Date/Time:

August 21,  
2021/15:48 UTC

Maximum

Altitude:

103,057 ft.

Flight Duration:

3 hrs. 34 min.

Team #:

Capsule # 185F  
NCR-MO-147

By:

Taran F.

Materials Used:

2 beans, 2 cups,  
potting soil, water



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# Adhesives in Space

## Testable Question:

How does the high altitude environment affect adhesive strength?

## Hypothesis:

Based on our research, we believe that the adhesives binding the wooden blocks together will experience outgassing due to the low pressure environment, causing the adhesives bonding them to severely weaken.

## Hypothesis supported by data: (Yes)

Our data supported our hypothesis. Most of the flight sample blocks lost strength compared to the control samples, losing 37-63% of strength (mean loss of 33% of bond strength). However, contrary to our prediction, the CraZart trial gained strength. We believe that this result was caused by the outgassing of water present within the glue, which helped to further cure it.

## How would you improve your experiment?

The main way to improve this experiment would be to apply a consistent amount of glue. 3 trial outliers were removed due to outlying results. Ultimately, this could be achieved through a variety of means such as weighing pre-flight blocks to ensure consistent glue application, or more precisely measuring the volume of glue applied to each block.

## 1) Scientific Background

### 1: Outgassing

- Low pressure pressure + extreme temps in space environment allows for liquids which compose the adhesive to vaporize



### 2: Glue weakens

- The departure of liquid components causes adhesive weakening
- School glue base is PVA, vaporizes easily @ low pressures

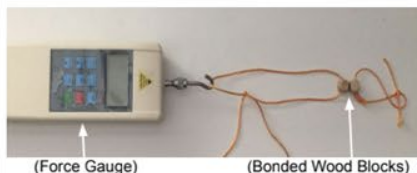


## 2) Procedure

1: Wooden blocks are glued together on one side

2: Blocks are pulled apart using string, force is measured

3: Experiment repeated across 4 glues, each with 3 trials (12 trials total)



(Force Gauge)

(Bonded Wood Blocks)



## 3) Results

### Raw Data

Blue 202					Blue 202				
	Brand	Failure	Avg	Delta		Brand	Failure	Avg	Delta
Flight	Sample 1	26.18			Flight	Sample 1	11.93		
Test	Sample 2	27.95	25.907		Test	Sample 2	25.65	13	
Artifacts	Sample 3	25.25			Artifacts	Sample 3	26.88		
				-2.55					1.88
Control	Sample 1	26.18			Control	Sample 1	23.72		
Sample 2	26.17	23.337			Control	Sample 2	23.98	17	
Sample 3	25.12				Control	Sample 3	24.51		

Blue 202					Blue 202				
	Brand	Failure	Avg	Delta		Brand	Failure	Avg	Delta
Flight	Sample 1	32.62			Flight	Sample 1	6.27		
Test	Sample 2	32.66	13.6		Test	Sample 2	10.79	14.09	
Artifacts	Sample 3	32.32			Artifacts	Sample 3	8.46		
				6.11					12.00
Control	Sample 1	31.64			Control	Sample 1	20.05		
Sample 2	31.79	19.7			Control	Sample 2	21.51	17.007	
Sample 3	31.79				Control	Sample 3	21.52		

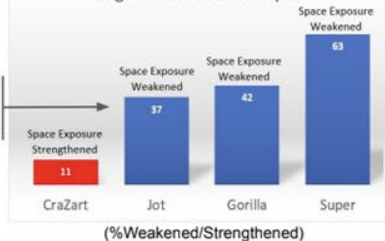
Series are averaged, minimizing effects of procedural inconsistencies

Trials display an inverse relationship between space exposure and bond strength

Outliers which were removed from analysis

### Processed Data

Percent Differences Flight and Control Samples



Grade (HS) Subject: (Eng.)

Mission Link: <https://tracking.stratostar.net/mission/0436>

Mission Name:  
CAP Challenge 2021

Launch Date / Time:  
08/21/2021 // 15:04 GMT

Maximum Altitude:  
87621 ft

Flight Duration  
2hr 57min

Team Number:  
#236

By:  
Burke Composite Sqn.

Materials Used:  
Force Gauge (x1), Wood cubes (x24), school glue (x2), super glue (x1), wood glue (x1)



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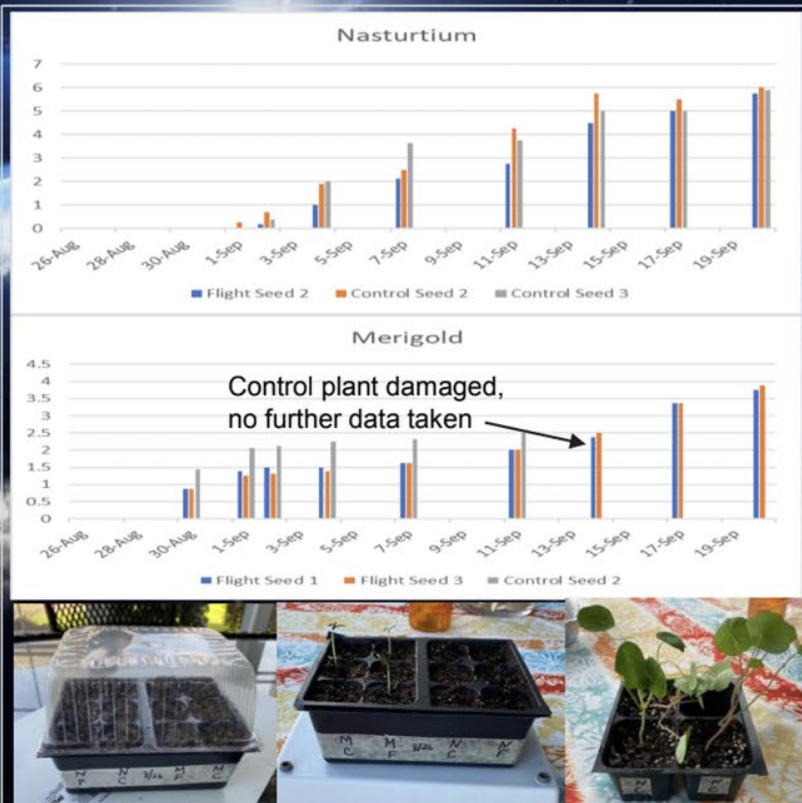
# Flower Seeds In Space

**Testable Question:** How are flower seeds affected by exposure to the conditions at the edge of space?

**Hypothesis:** We expect the time to germination and growth rate of the flight seeds to be different from the control seeds. The texture of the seeds may also be different.

**Hypothesis supported by data: (YES / NO):** Yes. The first sign of germination and growth rate were faster for the controlled sample than the seeds that went to space. At the end of observation, it appears the Nosturtium plants had more leaves on the control than the space sample.

**How would you improve your experiment?** We would use more seeds to improve the chances for germination and create a larger data sample.



**Grade** (MS,HS) **Subject:** (Life Sci)

**Mission Link:** <https://tracking.stratostar.net/mission/0436>

**Mission Name:**

#StratoStar 0436

**Launch Date / Time:**

8/21/2021/19:38 GMT

**Maximum Altitude:**

103,358 ft

**Flight Duration**

2 Hrs 33 Min

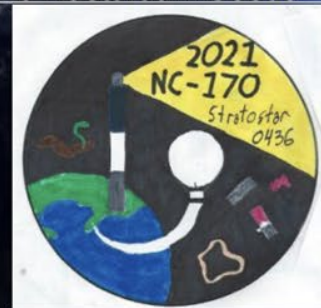
**Team Number:** 149

**By:** Brunswick County Composite Squadron

**Materials Used:**

6 Marigold Seeds

6 Nasturtium Seeds



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# Tooth Fairy's Goodies in Space

**Testable Question:** Does the atmosphere of space/near space affect the strength and durability of human tissue such as bone and teeth?

**Hypothesis:** The tooth will not be weakened.

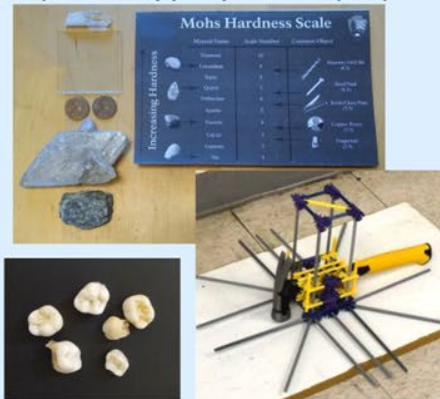
**Hypothesis supported by data:** YES

The control tooth broke when struck on the flat surface of the tooth with an energy of 0.277 Joules. The flight tooth broke when it was struck on the flat surface of the tooth with an energy of 0.555 Joules of force.

**How would you improve your experiment?**

Send different people's teeth as well as different types of teeth. Send multiple teeth to compare a larger sample size.

On the Moh's hardness scale, both teeth measured from 5.5-7. They both scratched a glass plate (5.5) but did not scratch a quartz crystal (7). They also scratched talc (1), gypsum (2), fingernail (2.5), and copper pennies (3.5).



We designed and built a machine to drop a hammer onto each tooth from a measured height. Using the weight of the hammer, the height of the hammer above the tooth, and the acceleration due to gravity, we were able to calculate (using  $P_e = m \cdot g \cdot h$ ) the energy with which the hammer hit the tooth.

**Grade MS/ HS Subject:** Life Science, Biology, Physics, Engineering  
**Mission Link:** <https://tracking.stratostar.net/mission/0436>

**Mission Name:**  
#StratoStar0436  
**Launch Date/Time:**  
08/21/2021  
11:00:00 GMT  
**Maximum Altitude:**  
87,621 ft.  
**Flight Duration**  
3 hours and 37 minutes  
**Team Number:** 235  
**By:** MAR-MD-879  
Granite Cadet  
Squadron

**Materials Used:** C/1st Lt  
A. Martucci's baby teeth  
(first molars)



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# Eagle Cadet Squadron HAB 2021

**Testable Question:** If we send a Dosimeter Badge into space, how much radiation will it be subjected to?

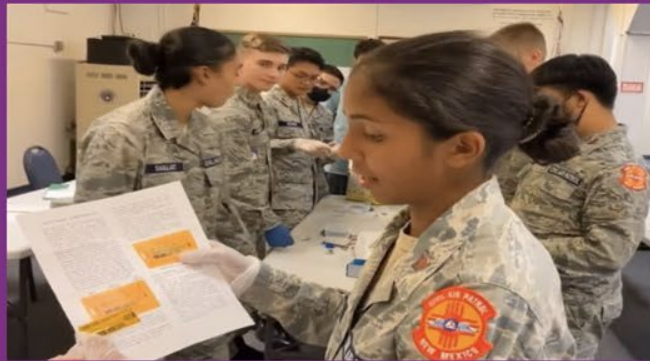
**Hypothesis:** The Dosimeter Badge will exceed the highest reading displayable on the badge when compared to the control.

**Hypothesis supported by data:** No, the Dosimeter badge did not achieve the highest reading of 4,000 mSv, however reading was much higher than the control.

**How would you improve your experiment?** Launch our own balloon to give more control vs. mail. Less plastic may have allowed more radiation.

## Data Shows the following:

- The dosimeter that flew in the balloon recorded a level of 500-600 mSv.
- The control recorded a level of 250 mSv. We speculate the package was subjected to X-Ray radiation while in the mail system.
- From NASA: Milli-Sievert is mSv. Astronauts are exposed to ionizing radiation with effective doses in the range from 50 to 2,000 mSv. 1 mSv of radiation is equivalent to about three chest x-rays.



Civil Air Patrol: SWR-NM-012 Subject: Engineering Science  
Mission Link: <https://tracking.stratostar.net/mission/0436>

**Mission Name:**  
#StratoStar0436  
**Launch Date / Time:**  
08/21/2021  
15:04 GMT  
**Maximum Altitude:**  
87621.394 ft  
**Flight Duration**  
2 Hr, 57 Min  
**Team Number:** 12  
**By:** Capt James M

**Materials Used:** Chia Seeds, Dosimeter, and Alkaline Battery



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# The Toilet Bacteria

## Testable Question:

Will the sample of bacteria taken from a school toilet survive its journey into space?

## Hypothesis:

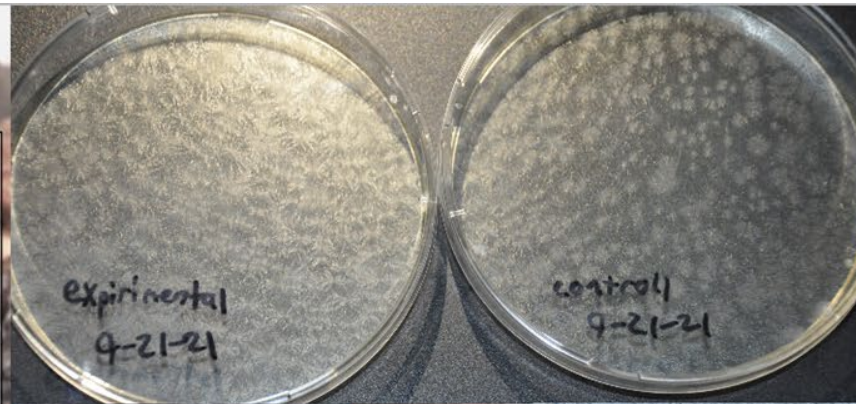
If the bacterial sample is sent into the stratosphere then it will not grow as much as bacteria on Earth because the stratosphere experience is higher UV rays which destroys bacteria

## Hypothesis supported by data: (Yes)

Both petri dishes had had bacteria growing in them but the one that was the control (284 colonies) had more growth than the experiment (193 Colonies).

## How would you improve your experiment?

Now we know that bacteria will survive the trip, we could improve our experiment by isolating variables to see why the experiment sample grew larger colonies.



The bacteria has similar filiform structure in both samples but there are more bacteria colonies on the control sample. The experimental colonies seem larger.

## Mission Name:

#Stratostar4036

## Launch Date / Time:

08/21/21

(15:04 GMT)

## Maximum Altitude:

(87,621 ft)

## Flight Duration

(3 hrs, 37 mins)

## Team Number: 7

By: Brownlowe X,  
Richter B

## Materials Used: Q-tip,

petri dish



**Grade Level** (MS,HS) **Subject** : (Biology, Chem, Eng)

**Mission Link:** <https://tracking.stratostar.net/mission/4036>

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# Tensile strength of Carbon Fiber Drone Blades

## Testable Question:

If carbon fiber drone blades are exposed to the low temperature and low pressure of high altitude, will their strength and durability will decrease?

## Hypothesis:

We expect that exposing carbon fiber drone blades to high altitude conditions ( 29,500m and -65C) will have a negative impact on the integrity of the blades (tensile strength will decrease).

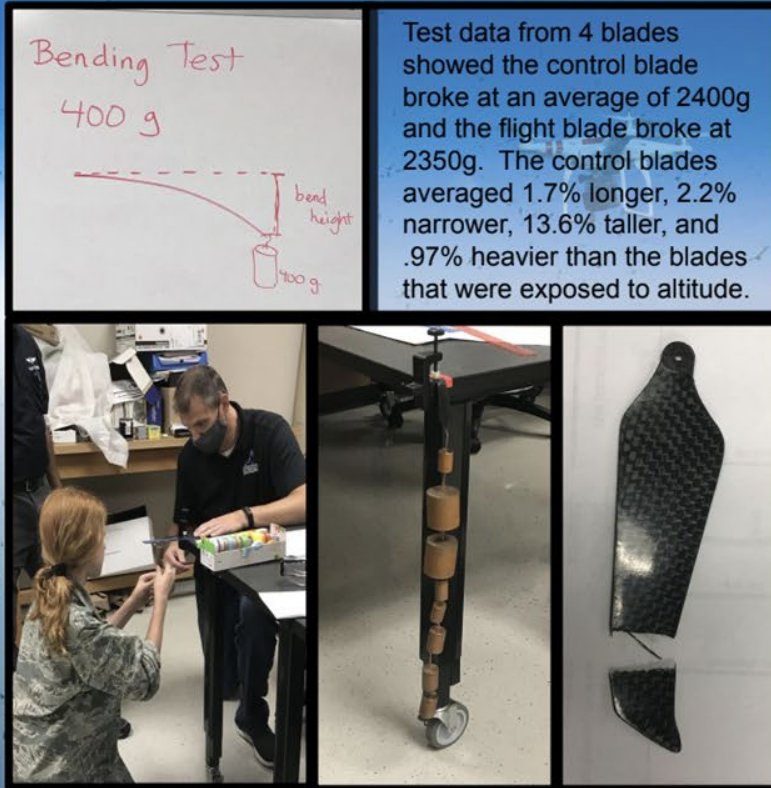
## Hypothesis supported by data:

Unsupported. There was no significant data that supported our hypothesis.

## How would you improve your experiment?

We did not have the correct equipment to test the carbon fiber blades tensile. In addition, during our "bend" test we did not factor in the impact of adding weight slowly. In the future a machine that adds pressure without flexing the blade back to its original position would be needed. We would also like to look at the break under a microscope.

*Thank you to Kirkwood Community College Department of Math and Science for allowing us to use their equipment to test our blades.*



## Mission Name:

#StratoStar0436

## Launch Date / Time:

08/21/2021

15:04 UTC

## Maximum Altitude:

87,621 ft

## Flight Duration

1hr 53 min

## Team Number: 0225

By: NCR-IA-129

## Materials Used:

Woven Carbon Fiber Drone Blades with plastic covering  
Clamp, weights, ruler

## Mission Patch



Grade Level 8-12th grade Subject Phy

Mission Link: <https://tracking.stratostar.net/mission/0436>

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# Martian Pizza: SWR-TX-456

**Testable Question:** Will sending ingredients for a pizza to space have a negative effect on them?

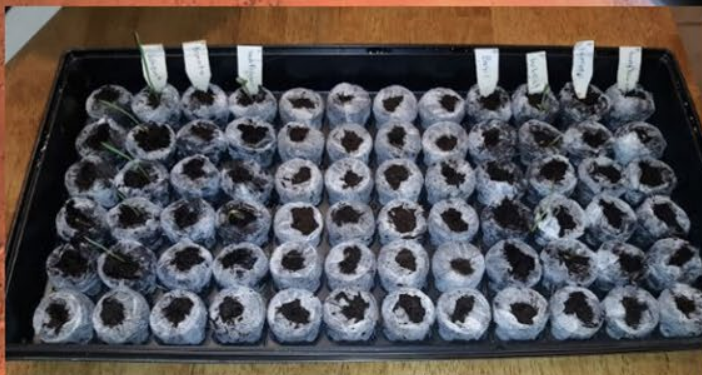
**Hypothesis:** The ingredients (seeds) will be unaffected

**Hypothesis supported by data:**  
Inconclusive

After the flight, during the growth portion of our experiment, all seedlings died due to overheating. Some had sprouted, and some had not.

How would you improve your experiment?

Better environmental controls during the growth phase.



Grade (MS) Subject: (Life Science, Biology)

Mission Link:

<https://tracking.stratostar.net/#/missions/60a73afce2cd110016f9919d>

**Mission Name:**

#StratoStar251

**Launch Date / Time:**

08/21/2021

15:04:20 UTC

**Maximum Altitude:**

87,621 ft

**Flight Duration**

3hr 37min

**Team Number: 251**

**By: Tx 456**

**Materials used:** wheat

seeds, basil seeds, tomato

seeds, yeast, sunflower

seeds, parmesan cheese.



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## Light Sensitive Color-Changing Beads

How will exposure to UV radiation affect the opacity of the beads compared with the non-flight sample.

**Hypothesis:** We believe when there is more UV radiation, the beads will become more opaque compared to the non-flight sample.

### Was the hypothesis supported by data?

Our hypothesis was proven incorrect based on the data that we collected from the sensor.

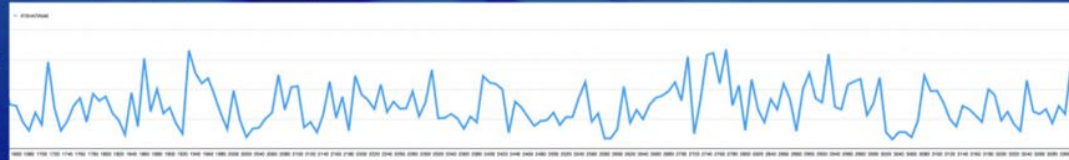
### How would you improve the experiment?

First, we would test the life of the battery to make sure it lasts the full 3 hours. Then, ensure that all the beads are exposed to light regardless of the spinning of the payload, and filter the sensor so there is minimal peaking of max light exposure. Finally, make experiments prior to the flight to determine which color of bead has the longest lasting color change.



## RESULTS

Readings taken every 10-seconds for first 55-minutes of flight show fluctuations in all bands of light. Graph is of 415nm / Violet band where we hoped to see most difference. If the beads were affected the way we thought they would, the beads would darken resulting in lower values being recorded. Dip in light level seen at 3020 seconds (50 min) through 3060 seconds (51 min) but not enough to prove hypothesis.



## CAP CHALLENGE 2021

Launch time: 15:04 (UTC)

Max Alt: 87621 ft.

Flight Duration: 3 hrs 37 min

Team Number: 129

### Equipment

- Adafruit QT Py RP2040
- AS7341 10-Channel Light / Color Sensor (415-680nm)
- 32KByte Non-Volatile FRAM
- LiPo Battery
- Switch
- UV Changing Beads



# SPACE BREAD

*"Sending yeast to space and eating space bread"*

Est. 2021, Palo Alto, CA

**Mission Name:**

#StratoStar0436

**Launch Date / Time:**

(08/21/2021)

(15:48 GMT)

**Maximum Altitude:**

(103,058 ft)

**Flight Duration**

(03:37)

**Team Number:**

207-21

**By:** Annabel D.

**Materials Used:**

Yeast, milk, water,  
flour, golden syrup

**Testable Question:** How will the impact of the environment of space on yeast affect the texture, taste, and other qualities of bread?

**Hypothesis:** The environment will have minimal effect on the bread due to yeast's ability to survive harsh conditions.

**Hypothesis supported by data:**

**YES** – There were little to no effects on the yeast, meaning it is able to survive in space. Space bread!

**How would you improve your experiment?**

We would measure the yeast to be exactly the same amount so that changes would be easier to detect. We would also send more yeast so that we can run multiple experiments to account for potential systematic errors such as if conditions during the baking process affect anything.

## Procedures

- Remove yeast from bag, add 150mL warm milk, butter, and golden syrup
- Leave to activate for 15 minutes
- Add bread flour, knead and leave for 40 minutes
- Add to bread pan, leave for 30 minutes
- Bake!

## Qualitative Observations

- Yeasts were similar in appearance, texture, shape
- Experimental yeast mixture was stickier when kneading, required more flour
- Both breads looked and felt similar while rising and baked- similar texture, elasticity, etc.
- Space bread was reportedly saltier than regular even though no salt was added



C/2dL1 Doherty's presentation



Space bread reactions!

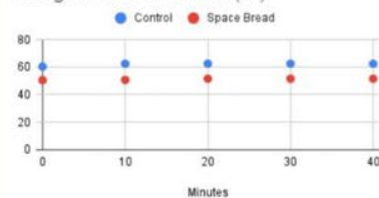


Above: No changes in mass or temperature

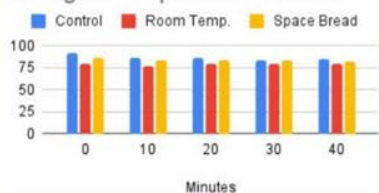
Far left: Space yeast mixture  
Left: Control yeast mixture  
Right: Control yeast (left) vs space yeast (right)



Change in mass over time (oz)



Change in temperature over time



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**Grade HS Subject:** Chemistry, Life Science

**Mission Link:** <https://tracking.stratostar.net/mission/0436>