

WHAT ARE THE EFFECTS OF MICROGRAVITY ON BACTERIA?

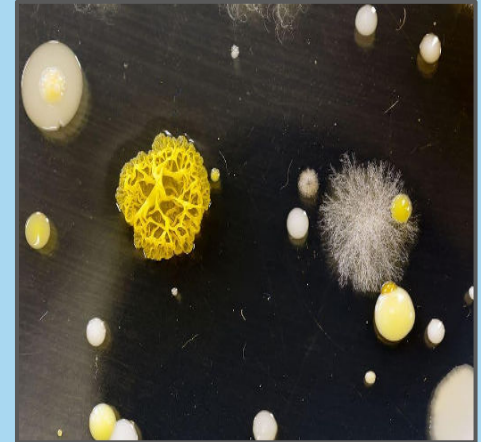
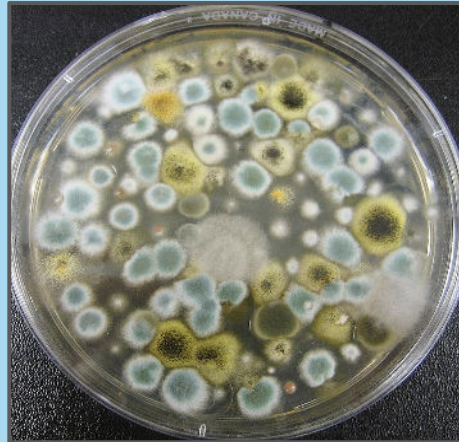
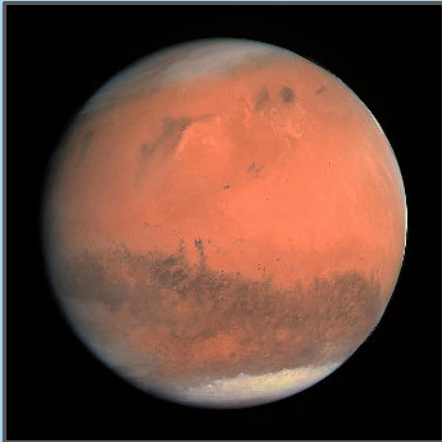
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Grade: 6



ABSTRACT

Does bacteria grow at a different rate in microgravity, if so, can it make certain disease more infectious or deadly?

This is a concern because our world has been fighting a global pandemic since 2020 with no end in sight. If we were to colonize Mars then we need to know how bacteria and viruses work in space. Do they grow faster or slower? Are they more infectious or deadly? If so, would we need to figure out new antibiotics in order to colonize Mars. Would antibiotics work faster or slower? Due to safety concerns, I will only be studying bacteria growth rather than a virus. We will leave that to the experts. However, I am curious if vaccines would need to be different for those in space.



MICROGRAVITY AND THE IMMUNE SYSTEM

Microgravity affects the immune system differently.

According to NASA Flight Controller Robert Frost, "Astronauts do get infections. Space is not a good environment for the immune system."

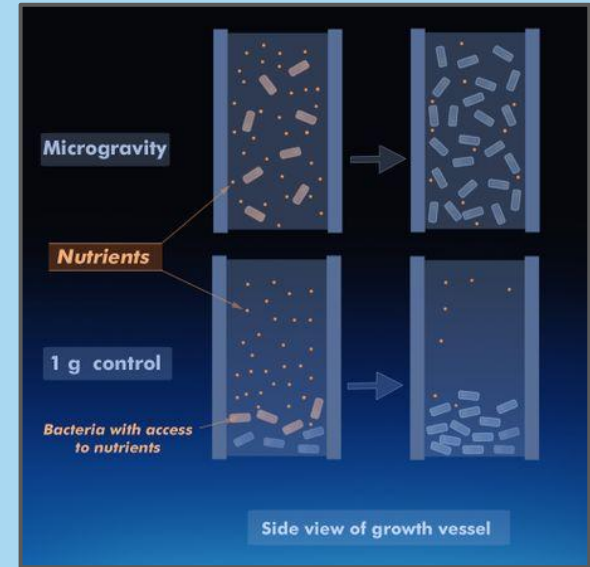
- Production of both antibodies and white blood cells is reduced in microgravity.
- Space is rough on skin, causing abrasions that are entry sites for infection.
- On Earth, bacteria eventually falls to the ground, in space it remains floating, increasing the odds of it making contact with mucus membranes.
- There are dormant viruses in our bodies that can be reactivated by stress . Living in space is stressful.
- Chicken pox, herpes and shingles have been reactivated in astronauts in space.



MICROGRAVITY AND BACTERIA

Scientists cannot fully recreate microgravity on Earth. Therefore, testing the effects on bacteria in space is very important. According to [Science Alert](#), several things happen to bacteria in space.

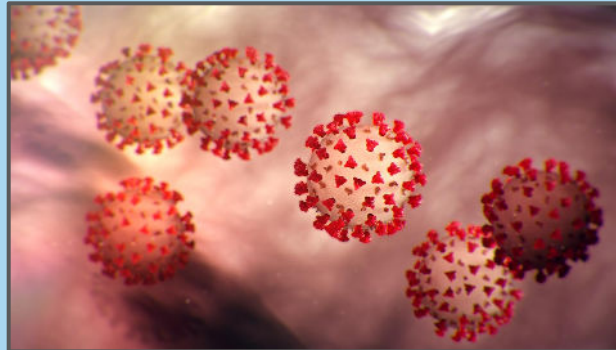
- It can grow faster.
- It can grow slower.
- It can be more resistant to antibacterial sprays and/ or antibiotics.
- It can mutate faster.
- It can be more deadly.
- The shape can change
- It takes in nutrients differently.
- Different structures could create different kinds of drugs.



ABSTRACT CONCLUSION

So we know that the immune system is compromised in space, and we know that microgravity can affect how bacteria grows. If so, that would be a lose-lose. Also, if they grow faster, they could be stronger and maybe vaccines and/or antibiotics would need to work differently in space. If Covid killed millions on Earth with hospitals, what could something like that do to a colony in space with limited health care? Or astronauts on the ISS?

Testing to see if bacteria grows faster does not necessarily let us know if it is more deadly or more concentrated, but testing growth is a start. So, let's see if bacteria grows faster in microgravity vs on Earth. The more varieties of bacteria we test, the better understanding we will have.



EXPERIMENT RATIONALE - AN OUNCE OF PREVENTION IS A POUND OF CURE

I like this experiment because I thought it would be useful and out of the box. I want to do something that is not growing a vegetable.

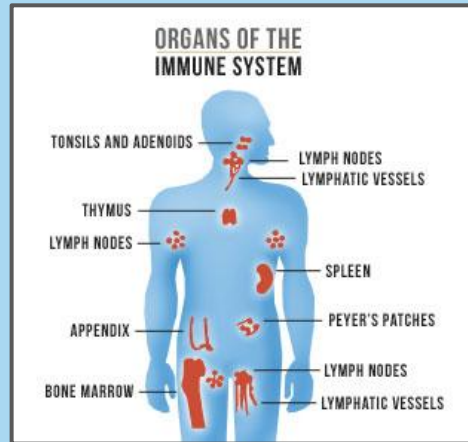
I was in 3rd grade when I had to stay home for 2 years because of a global pandemic. What if there is another that is 10 times worse? Eventually we will be colonizing somewhere in space and will need to know how viruses and bacteria work in microgravity..

If we learned from the Covid pandemic, maybe we can prevent another one from happening. This is an opportunity to be more prepared. Also, if bacteria morphs, maybe different antibiotics can be created using the mutated bacteria benefiting us on Earth.



So if the immune system is compromised and if bacteria grows faster, what will we need to do to combat that?

First, we need to see if bacteria does grow faster. As stated before, just because it grows faster doesn't mean it is more contagious or creates more deadly illnesses. However, it is a starting point which can lead to other experiments.



This will benefit space travel and exploration because we will try to see if disease will spread faster.

If it does, will vaccines work differently?

Would you need dosage or more rounds of vaccine?

Do antibiotics work differently?

Do antibacterial sprays work the same?

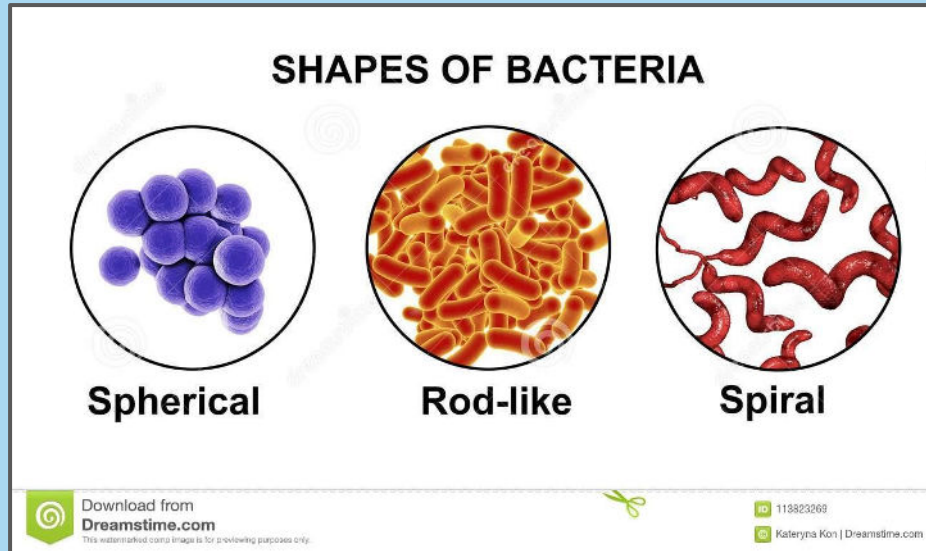
According to Robert Frost, the germs float longer so the astronauts get sick easier. **So what can you do to help prevent that?**



HYPOTHESIS

I think the bacteria will grow faster and the shape will change to a more rod-like shape.

Therefore, we would need to explore how antibacterial sprays and antibiotics would need to be adapted for space as well as if different kinds of antibiotics can be created from bacteria that reproduce in microgravity.



Experiment Design

In order to ensure that we are only tracking one bacteria, we are going to use a freeze dried bacteria sample.

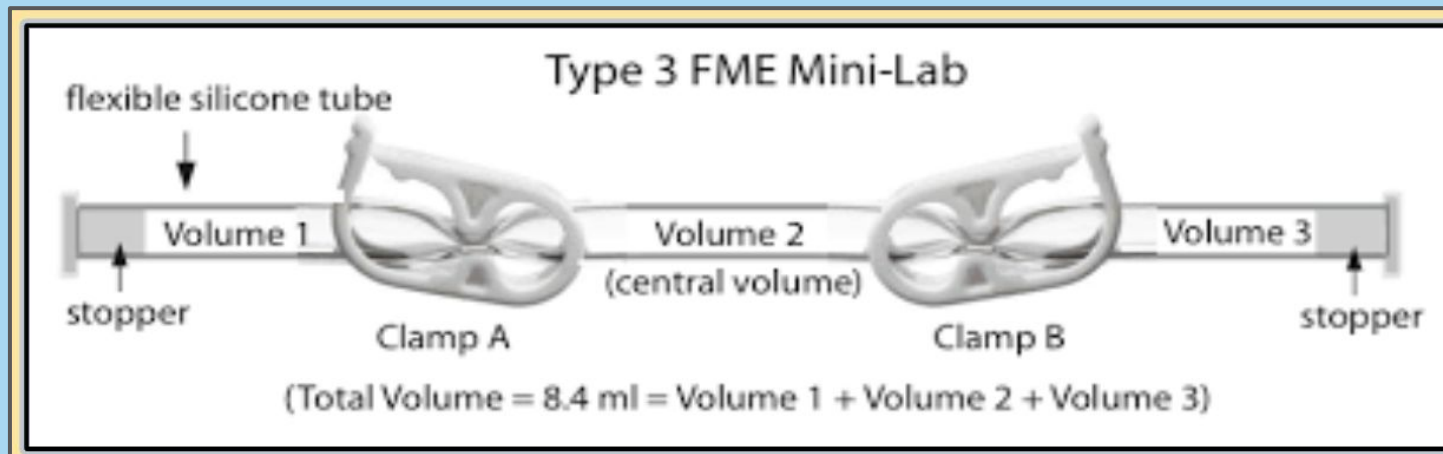
Step 1: Line the Type 3 mixstix with hardened Nutrient Agar in Volume 2 (the middle section of the mixstix).

Step 2: Volume 1 will have 2.8 ML distilled water and be clamped into place.

Step 3: Volume 2 will have the dried bacteria pellet and be clamped into place.

Step 4: Volume 3 will have 2.8 ML of the preservative Formalin and be clamped into place.

Mix Stix Set Up



SUPPLIES

Mix stix - Emailed for price - TBD

Nutrient Agar - 5ml per mixstix- will need to experiment with how much will work on a 10 ml mixstix: Carolina Biological Supply \$26.95

Bacteria - Escheria Coli Bacteria- 1 PELLET (this is the kind of E coli found in your intestine but not the kind that causes food poisoning) \$19.95

Water -

Formalin - Preservative to stop the bacteria growth \$34.98

ASTRONAUT ASKS

The astronauts will need to animate the bacteria by unclamping the first clamp so that water will animate the bacteria (A=0)

The astronaut needs to shake the mixstix (A=0)

Upon return, they will need to unclamp the second clamp so that the preservative stops the bacteria's growth (U-2)

The astronaut needs to shake the mixstix (U-2)



EXPERTS

Steve Spangler - Science teacher- reached out but have not heard back

Dr Darah Himmelhoch - Veterinarian and biologist - I spoke to Dr. Himmelhoch and she said she is not in expert in this field but referred us to her sister who is a professor at a University and may have contacts with PHDs in biology.

Dr. Allison Kelly - Infectious Disease Doctor- reached out but have not heard back

Dr. Leah Himmelhoch - reached out but she needs to ask her potential leads



<https://www.mimg.ucla.edu/> - left a message for the department to get a list of potential contacts

RESOURCES

<https://www.ucsf.edu/news/2021/06/420756/space-travel-weakens-our-immune-systems-now-scientists-may-know-why>

<https://www.science.org/content/article/scienceshot-space-bacteria-defy-zero-gravity#:~:text=Astronauts%20of%20the%20future%20may,even%20when%20starved%20of%20nutrients.>

<https://www.sciencedaily.com/releases/2019/03/190316162211.htm>

<https://www.cnn.com/2019/03/18/health/astronauts-spaceflight-herpes-study/index.html#:~:text=The%20longer%20astronauts%20spend%20in,viral%20reactivation%20on%20Earth%3A%20stress.>

https://www.google.com/search?q=what+do+how+can+you+grow+bacteria+in+a+petri+dish&sxsrf=ALiCzsa_ow-OJVwhGcKPGNc_rqoAhGsRtg%3A1670965087457&ei=X-eYY6HBG5XKkPIpivW2mAk&oq=what+do+how+can+you+grow+bacteria&gs_lcp=Cqxdn3Mtd2l6LXNlcnAQAQARqAMqUIIRCgATIICCEQFhAeEB06CqgAEFcQ1gQQsAM6BQgAEIAEOgglABCABBCxAzoECAAAQAzohCAAQgAQQCjoGCAAQFhAeOgglABAWEB4Q8QQQHToFCCEQgwI6CgghEBYQHhAPEB06DQghEBYQHhAPEPEEEB06BwghEKABEApKBAhBGABKBAhGGABQ1LIBWJXMAWcf3QFoAXABeAGAAZcBiAGdEpIBBDE4LjeYACQgAQHIAQjAAQE&scient=qws-wiz-serp#kpvalbx=i-eYY4u1JM3PkPIPqO6gyAE_36

<https://microbiologyinfo.com/nutrient-agar-composition-preparation-and-uses/>

<https://www.nasa.gov/feature/ip1/high-tech-methods-study-bacteria-on-the-international-space-station>

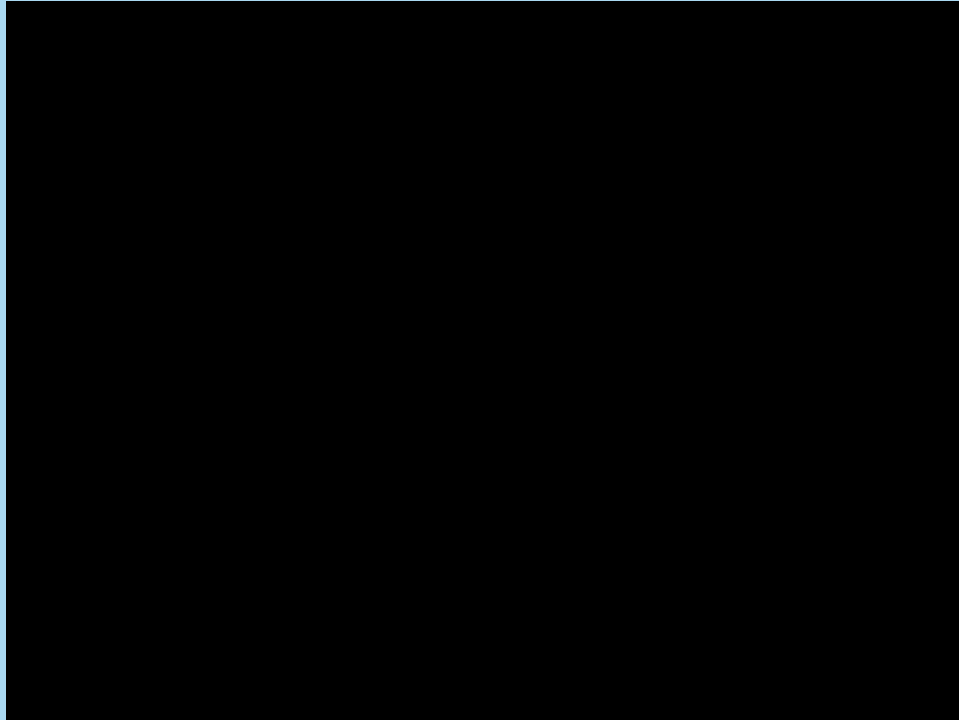
<https://www.sciencealert.com/space-flights-show-bacteria-are-more-deadly-and-resilient-in-microgravity/amp>

<https://www.pbs.org/wgbh/nova/article/bacteria-on-the-international-space-station/>

https://microbewiki.kenyon.edu/index.php/Bacterial_response_to_microgravity

VIDEO PITCH

What are the effects of microgravity on bacteria growing in space?



If my experiment is selected for flight, how will I include other Exploration learners in the process to create a Launch Team? How will I find other Exploration learners + how will they apply for this opportunity? How will we work together? What kinds of roles or jobs will each member have?

I would imagine that we need multiple learners running the experiment prior to launch. So each member would have a mixstix, agar and swabs. We would all document how we did the experiment to see if different ways work better.

First step to get learners would be to ask those who participated in the Dream Up program because they are already interested in this. All ages are included. It would be nice to have a range of ages and experience. If there aren't enough people interested, then I would approach my teacher Heather Tolan and see if she has anybody who wants to join. I could interview people on a zoom call to see if we they serious and that we could work well together.

We would have to work together mostly on zoom unless they live nearby or are willing to commute.

I would be the point person and other roles would reveal themselves based on what people's skill sets are. Some people may be great at organizing, some people may be good at marketing for fundraising, while others may be better at math and science.

If our experiment is selected for flight, how can we use the information that we have gained to benefit our site and the community, and inspire others also to undertake the DreamUp to Space journey? How will we share our stories?

I think if we were selected, this information could benefit human colonization on Mars. It would be one step to further information and experiments as well as a jumping off point.

I think it's inspiring to see kids doing something cool like this and think that it is possible for yourself. When I heard this was an opportunity I thought it was cool to potentially send something to space, Observing other students inspired me and maybe one day I can inspire others.

We can share our stories through an instagram feed that would be based on our journey. Each member could add pictures, reels, etc. We could also do a blog or Vlog. I would prefer to video because visuals tell a story and I'm good at making movies.

If our experiment is selected for flight, how will we fundraise to share in the costs involved with the DreamUp to Space program, including: travel to Kennedy Space Center to present experiment and experience the launch, costs associated with experimentation optimization, and team apparel?

My family said they would pay for my travel to Florida. Not everyone on the team may be able to do that so here are some fundraising ideas:

- **Kickstarter or Gofundme campaign.** The videos and photos from the Instagram account would help that. I raised money for a Toys For Tots by doing funny videos and my mom shared with friends, family and social media.
- **Look into corporate sponsors.** Maybe the company that supplies Nutrient Agar or mixstix would be interested. Maybe approach Virgin Galactic or SpaceX.
- **T-shirt Design and Apparel:** Maybe I could design a tshirt and the sales could help with fundraising. The design would also double as team apparel.

How do you see this opportunity, if your experiment is selected, influencing your life?

I think this is an opportunity to work with other children and develop friendships and collaborations with learners who have similar interests.

In the long term, maybe this could help me get into a good college because how many kids get to send something to space?

When I was little, I went to see the space shuttle, I had a space birthday, I loved space. One day, I'd like to go to space camp. It could be a dream come true.

My mom says, "Dream big." So why not me?



Side note: I am not pointing to space, I'm pointing to where Evel Knievel tried to jump the Snake River.

THANK YOU FOR YOUR CONSIDERATION

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