SSEP Mission 10 to ISS Selected Flight Experiments Communities, Teams, and Abstracts

SSEP *Casper* Experiments Payload Launching on SpaceX-11, Cape Canaveral Air Force Station, Florida

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1. Camden, Arkansas

Testing the Formation of a Polymer in Microgravity

Grade 9
Camden Fairview High School, Camden Fairview School District

Co-Principal Investigators: Lexi Betts, Alexis Bryant, Piper Fain, Hope Hesterly, Trey Jeffus

Teacher Facilitators: Hannah O'Dell, Pam Vaughan

Proposal Summary: In our project we intend to answer the following question: In microgravity, how will the formation of molecules into a solid affect the general characteristics of the finished solid? In order to answer this question, we will create a polymer comprised of liquid Borax, distilled water, and polyvinyl acetate. These ingredients are able to be shaken and mixed without heat or extensive effort, and harden into a polymer. We will conduct this experiment in microgravity and gravity, and then compare the two resulting polymers. After the polymer is created on the International Space Station and returned to us, we will observe the difference in its general characteristics, such as appearance, buoyancy in water, and tensile strength. By observing and testing, we will record the general differences in said characteristics of the two polymers. We have permission to test the tensile strength in lb/in² of both polymers tested by using an Electro Hydraulic Testing Machine, which is owned and operated by Lockheed Martin Missiles and Fire Control, Camden Arkansas Operatives. Knowing how these molecules react and form their chains in microgravity could give us access to a wide range of knowledge on molecules and how they behave when they lack the amount of gravity we have on Earth. In conclusion, the conduction of this experiment could possibly reveal many things that we do not know about polymers formed in microgravity.

2. Elk Grove, California

Does the Structure of a Fairy Shrimp Change in Microgravity?

Grade 5
C.W. Dillard Elementary School, Elk Grove Unified School District

Co-Principal Investigators: Dulcemaria Rodriguez, Josue Escobar, Mason Maroney, Sean Rowing

Teacher Facilitator: Mike Nelson

Proposal Summary: We propose the question does the structure of a fairy shrimp [Anostraca] on Earth change in microgravity? Our team is wondering if fairy shrimp will change if it is grown in microgravity. We want to know if the structure of a fairy shrimp will be normal or will it be deformed. We are planning to use 25 fairy shrimp cysts. Since the structure of a fairy shrimp on earth is made for gravity we are questioning if the structure of the fairy shrimp grown in space will be weaker than of those of Earth. Our hypothesis is that the fairy shrimp grown on earth is going to be stronger and bigger than the fairy shrimp grown in space. Since there is no gravity in space the fairy shrimp won't have to use their body as much and won't build up muscles. If fairy shrimp grows and matures normally then other invertebrates can grow normally and some of those invertebrates we can eat. In the end we will look for abnormalities in the fairy shrimp grown in space.

3. iLEAD Consortium, California

The Effects of Microgravity on Oxidation

Grade 11
Santa Clarita International Charter School, William S. Hart Union High School District

Co-Principal Investigators: Dustin Fields, Alec Lewis, Kai Turner

Teacher Facilitator: Zaloa Goiri Virto

Proposal Summary: In our experiment, we will be observing the effects of microgravity on the formation of iron oxide. Iron (III) Oxide (Fe_2O_3) forms when oxygen and water react with iron to create a brittle, crusty, and often reddish orange substance commonly referred to as "rust". We chose this topic because steel, an iron alloy, is a commonly used material for space exploration. Non stainless steel is prone to rusting. For our experiment we will be using a Type 2 FME. In Volume 1, we will place a 3mm x 65mm rod of iron into the stopper on the Volume 1 side of the FME and secure it using epoxy. In Volume 2 we will have 2 ml of distilled water. Once our experiment has come back to earth, we will conduct three different tests and compare the results to our ground level truth experiment. The first of these tests involves observing rust under a microscope to determine any obvious structural differences. We will also be comparing the frangibility of the two samples. Our third test will be looking at how much rust grew in comparison to our control and how deep the rust penetrated into the iron rod. With the data we collect post flight, we hope to further our understanding of the formation of iron oxide in a microgravity environment. By studying and directly comparing earth and space grown iron oxide, we hope to provide insight on oxidation in microgravity conditions and further the study of materials used in space.

4. Lennox, California

Benefits of Mint

Grade 8
Lennox Middle School, Lennox School District

Principal Investigator: Nayeli Salgado

Investigator: Kaetlyn Gaeta

Collaborators: Ernesto Bueno, Marina Pimentel

Teacher Facilitator: Celina Morales

Proposal Summary: Have you thought how microgravity might affect the growth of a mint plant? Our team will like to experiment on the growth of a mint plant on Earth and in microgravity. Our hypothesis is that the mint plant will grow faster in microgravity than on Earth. We believe that the height of the mint plant will be taller in

microgravity than on Earth. The reason why we want to conduct this experiment is because mint is a medical herb that cures aches. If the growing of mint is successful in microgravity, then we will have the benefit of helping astronauts when they get sick or have pain. Mint also has many impressive medical reliefs. It relieves muscle aches, joint aches, stomachaches, headaches, and toothaches. You can use mint for tea to cure coughs and colds. The scent is also very helpful for nausea and fainting. Mint can be a great help for astronauts in case of an emergency or an unexpected injury. Mint is a fast growing plant, for that reason we chose to test this mint plant in microgravity. Our team knows that mint plant can be a good help if it grows. We think that this experiment is something that can have a great benefit. Mint is a plant that is very helpful instead of just being helpful on Earth it also be helpful in microgravity. We would really like the opportunity to make our experiment be tested in microgravity and see if our hypothesis was correct.

5. Middletown, DE

Growth and Development of Fathead Minnows in Microgravity

Grade 6
Everett Meredith Middle School, Appoquinimink School District

Co-Principal Investigators: Alivia Alessandrini, Kainat Azhar, Olivia Court, Noah Keller, Moulai Nije

Teacher Facilitator: Meredith Swartzendruber

Proposal Summary: The main purpose of our experiment is to find out how the fathead minnows thrive in a habitat completely different than their ancestors. We chose fathead minnows because they have been known to thrive in many different habitats. Also, the fathead minnow is small so they will fit better than the others. Our question to be addressed by the experiment is: Can Fathead minnows develop and grow in space? Can them swim? Will they eat? The experiment addresses the question posed because our experiment is based on how minnows develop and live in space.We will be sending minnow eggs that have not hatched into space.We will see if they are able to hatch and see if they can develop and be able to do everything that they can on Earth.

6. Lansing, Kansas

Possible Effects of Microgravity on Development of Dictyostelium discoideum

Grade 7
Lansing Middle School, Lansing Unified School District 469

Co-Principal Investigators: Aaron Brown, Calista McPherson, Vinay Patel, Geoffrey Stentiford

Teacher Facilitator: Stephanie Major

Proposal Summary: This experiment aims to observe the effects of microgravity on the development of *D. discoideum*, a type of cellular slime mold. *D. discoideum* can be used to model a human fetus in the early stages of development. This experiment is very simple: The interior of a Type-Two Fluid Mixing Enclosure will be coated with one millimeter of nonnutrient agar; Volume 1 will contain a sample of *D. discoideum*; Volume 2 will also contain a small colony of *E. coli* bacteria, which will be grown on Earth prior to launch, to provide food for the slime mold. Once in space, the clamp will be opened, and the amoebas will venture out and feed on the bacteria. However, the bacteria will not have a food source, and will stop multiplying. As a result, the *D. discoideum* will also run out of their food, the bacteria. This starvation will trigger the reproductive cycle where the individual amoebae aggregate and form a slug for migration and eventually into a spore-releasing stalk. During the early stages of this process, the mound of cells is very similar to a human fetus in early development. Observing this process will allow observation of any possible effects of microgravity on human reproduction in

space for long, interplanetary or even interstellar missions.

7. University System of Maryland, Maryland

Bacterial Motility in Microgravity

Grade 15
University of Maryland, College Park

Co-Principal Investigators: Yaniv Kazansky, Aaron Solomon, Garshasb Soroosh

Teacher Facilitator: Dr. Kenneth Frauwirth

Proposal Summary: Long-term space habitation poses numerous issues for astronaut health, including the prevention and treatment of infectious disease. NASA has made public its concern for the threat posed by infectious bacteria to long-term manned missions, and has conducted experiments on the International Space Station (ISS) to determine how microgravity affects pathogens. This prior research suggests that bacterial motility, a crucial component of many infections, is increased aboard the ISS. Our study seeks to confirm these findings and elucidate which bacterial genes specifically are responsible for modified motility, in the hope of better understanding how disease-causing pathogenic bacteria act in space. We will send dormant bacterial spores of *Bacillus subtilis* to the ISS, where they will be activated, allowed to grow and divide, and then preserved in microgravity before returning to Earth. We will explore if microgravity causes the bacteria to express (activate or deactivate) their genes differently compared to an identical control sample grown on Earth. This change is recorded in the mRNA produced by the bacteria, and any changes in the number of mRNA molecules and the individual sequence codes of each mRNA strand can be determined using RNA sequencing. The sequence data can then be processed via high-throughput bioinformatic techniques, allowing determination of which bacterial genes are differentially expressed in microgravity, and the molecular pathways that underlie them. This study will shed light on how bacterial motility differs in space, and serve as a critical step in safeguarding astronauts from acquiring infectious disease.

8. Clark County, NV

Soybean Germination in Microgravity

Grade 5
John C. Vanderburg Elementary School, Clark County School District

Co-Principal Investigators: Shani Abeyakoon, Kendall Allgower, Avery Sanford

Teacher Facilitator: William Gilluly

Proposal Summary: The question we are asking is: Will microgravity affect the germination and root structure of Soybeans? The human body uses certain organs for support, but in zero-gravity their purpose suddenly isn't needed as much. In space, the balance between cells that make the bone and the cells that break the bone down become uneven. Calcium and other minerals that build the bones leach out and make the bone weaker. Two hundred fifty grams of Soybeans is 50% of the daily Calcium a person needs. Astronauts lose 1-2% of bone mass each month in space and muscle mass can be lost at rates as high as 5% each week. Soybeans will help reduce muscle and bone loss which is why this project is so important.

9. Summit, New Jersey

Tiny Wings of Glory

Grades 5 and 7
Kent School

Co-Principal Investigators: Olivia Adamczyk, Alexandra Anderson, Isabella Diaz, Nora Lee, Aya Mtume, Abigail Wall, Elizabeth Wyshner

Teacher Facilitator: Rebecca Van Ry

Proposal Summary: We would like to propose an experiment involving the growth and life cycle of Western Pygmy Blue butterflies in microgravity. We have chosen the Western Pygmy Blue butterfly as the main subject of this experiment because they are the smallest butterfly in the world; that means they will fit into the tube. Gravity plays a part in the metamorphosis process of butterflies because the butterflies have to suspend upside-down in order to pupate correctly. Since there is no up or down in microgravity, the cocoons may have a hard time being able to flourish and grow. If the Western Pygmy Blue butterfly is sent up to space and goes through its life cycle successfully, the knowledge gained may be very beneficial for the growth of plants in space. The butterflies will start in the experiment as eggs because it will take them about 10 days to hatch. This means that they will stay like that for 7-10 days and then they will develop in microgravity. If the butterflies are able to survive in this environment, they could serve as pollinators, leading to healthy seed and fruit production. Plants provide food and also turn carbon dioxide into oxygen which could help oxygen levels for the astronauts on the ISS. On Earth, we are currently observing Painted Lady butterflies, which will give us a sense of the normal life cycle of a butterfly. Sending butterflies up to space could ultimately lead to great gains within future space travel.

10. Houston, Texas

Role of Gravity in Flatworm Regeneration

Grade 10
Harmony Science Academy Houston High, Harmony Public Schools
Co-Principal Investigators: Ben Appiah, Richard Gomez, Isaiah Ogunmakin, Bassam Razzaq, Matthew Vuong

Teacher Facilitator: Guvanchmyrat Payatakov

Proposal Summary: We pose the question, how does gravity affect flatworm regeneration? A flatworm is able to regenerate various parts of its body after being completely severed from those parts because of its use of STEM Cells, which have the ability to turn generalized cells into any kind of cells and proliferate, eventually regrowing specific organs or body parts. Thus our team is experimenting to see how much flatworms regenerate in space, a no gravity environment, compared to Earth. The purpose of the experiment is to investigate if regeneration in a no gravity environment is more proficient than an environment with gravity. The insight of this can open new doors for regenerative medicine and health science. As of right now, we have no way of curing terminal diseases or issues like blindness, however, if there is a large advancement in regenerative medicine we could use it to better our technology used to cure diseases such as those. Thus, it would be useful to test how regeneration works in different environments to better understand regenerative medicine.

11. San Antonio, Texas

Antibiotic Effectiveness in Microgravity: the Good, the Bad and the Astronaut

Grades 9 and 11
Southside High School, Southside Independent School District

Principal Investigator: Alexandria Coleman
Co-Investigators: Clarissa Cantu, Christianna Cosgray, Jonathan A. Garcia, Eberardo Rodriguez

Teacher Facilitator: Sadie Emery

Proposal Summary: Becoming an astronaut involves rigorous training to prepare for the many challenges they will face during their mission. Astronauts are prepared physically and mentally to overcome obstacles they may face. One aspect that has been neglected in previous research is a thorough study of antibiotic effectiveness. While astronauts typically have exceptional health, it is important to study how antibiotics affect the human microbiome as we progress towards future space exploration and possible colonization of Mars. This experiment can aid in our understanding of how to maintain optimal health of future space explorers following an infection. A common side effect of antibiotic use is the killing of advantageous bacteria in the digestive tract. These beneficial bacteria aids in human digestion. Recent research has examined the effect of antibiotics on the beneficial bacteria within the human microbiome. The microbiome is defined as the symbiotic microorganisms that live in the human body. Approximately 10-100 trillion microorganisms live inside the average human. Recent studies have shown that the micro biome is an integral part of maintaining optimal physical and mental health. However, when a person takes antibiotics, there are changes that occur in the microbial population of the gut. These changes are often associated with mild to moderate digestive distress which may require special probiotic supplements to the individual's diet. As space exploration continues maintaining optimal physical and mental health of the human population will be of the utmost importance.