SSEP Mission 7 to ISS Selected Flight Experiments Communities, Teams, and Abstracts

SSEP *Odyssey* Experiments Payload Launching on SpaceX-7, Cape Canaveral Air Force Station, Florida

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1. La Verne, California

Tardigrade Cryptobiotic Strategies vs. Microgravity

Grade 12
Damien High School, Los Angeles Arch Diocese

Co-Principal Investigators: Ashwin Balaji, Garrett Souza, David Washington
Co-Investigators: Richard Conti
Collaborator: Aaditya Patel

Teacher Facilitator: Charity Trojanowski

Proposal Summary: Tardigrades are extremophilic microorganisms, able to inhabit nearly all terrestrial environments by adapting to seemingly inhospitable circumstances. Through a process known as cryptobiosis, tardigrades virtually stop all metabolic processes when introduced to conditions such as extreme temperature, pressure, dehydration, oxygen depletion, or high energy radiation. Tardigrades can survive for years in this ametabolic state, resuming activity once reintroduced to a normal environment. Previous experiments have demonstrated that tardigrades are able to survive the rigors of space using this incredible evolutionary strategy. The proposed experiment is designed to expand upon these results by analyzing if both initially active and ametabolic tardigrades are able to survive six weeks of exposure to microgravity using cryptobiotic strategies.

2. Petaluma, California

At What Rate will Algae Reproduce in a Micro Gravitational Setting Versus on Earth?

Grade 12
Petaluma High School, Petaluma City School District

Co-Principal Investigators: Morgan Giraud, Tara Thomas
Collaborators: Lulabel Seitz, Shelby Metten, Alana Roberts, Liza Strong

Teacher Facilitators: Victor Brazil and Linda Judah

Proposal Summary: Microalgal biomass can be used to produce bio fuel, animal feed and even dietary supplements for human consumption. Microalgae produces an average of 5000-15000 gallons of oil per acre per year, almost seven times more productive than the next productive oilseed yield (oil palm). Previously tested algae samples have shown that certain green algae can produce up to 77% oil content (Schiochytrium). However, because light is not available in the payload box on the International Space Station, for the microalgal biomass sample a heterotrophic strain of algae that can reproduce in the absence of sunlight was chosen. Scenedesmus is an algae used in biofuel production that is known to be durable and have around a 40% lipid content. This strain can also survive solely on glucose in order to reproduce. This investigation proposes to answer the question: At what rate will algae reproduce in a micro gravitational setting versus on Earth? The study is looking for changes in biomass produced in a given period of time in space compared to the number of cells reproduced on Earth in a lab setting. This experiment can later be applied to determine the amount of extractable oil yielded from algae samples, and other realistic applications for industrial, cosmetic, and supplement use. With the increasing concern for scarcity of non-renewable resources, the main intention is to provide a stepping-stone for future research. It is important to study different settings in which algae can grow in order to take advantage of the setting with the highest reproduction rate and highest efficiency. If it is determined that algae reproduce faster in a micro gravitational setting, then it may be beneficial to continue microalgal biomass cultivation in space as opposed to on Earth.

3. Santa Monica, California

The Effect of Microgravity on Paper Chromatography

Grade 8
Lincoln Middle School, Santa Monica/Malibu Unified School District

Co-Principal Investigators: Samuel Buckley-Bonanno, Adam Chamas, Charlie Gooding, Shrayes Raman

Teacher Facilitators: Carol Wrabel, Susan Stivers

Proposal Summary: The investigation proposes to determine whether chromatography can be performed in microgravity, and to discover how it may differ from being performed on Earth. Chromatography is a method by which you separate substances, using the capillary action of a solvent through a permeable medium. Paper chromatography was chosen because of it's simplicity, and ease of use. For the experiment 3 ml. of distilled water, 10 cm. of coffee filter paper, and Papermate PMOP felt tipped pen ink will be used. A Type 3 MixStix was chosen, as it has the necessary capabilities in which the relatively complex experiment can be done. In Volume 1 there will be 3 ml. of Water. In Volume 2, 10 cm of coffee filter paper, and in Volume 3, the ink dot and the rest (9 cm.) of the coffee filter paper. When the experiment returns to Earth, how far, and in what ways the ink and water have traveled through the paper will be measured. This data will be compared with the controlled experiment on Earth. The knowledge gained from this analysis will provide a better understanding of chromatography, and various other aspects of physical chemistry, like capillary action. In the long run, this information can aid in the design of chromatography setups, whether on Earth or in microgravity. Additionally, any enclosure that permits capillary action, or molecular actions of a solute, can be designed in a better way, using the knowledge gained.

4. Littleton, Colorado

Ladybugs in Space

Grade 5
Mount Carbon Elementary School, Jefferson County Public Schools

Co-Principal Investigators: Kylie Dappen, Maddison Gargiulo, Meghan Simpson

Teacher Facilitator: Pamela Laidley

Proposal Summary: Ladybugs are a breed of beetle and can be identified by their red domed shell with black spots. These beneficial insects are a must-have for organic gardening or farming as they eat insects and pests that are destructive to the garden. Ladybugs primarily eat aphids, insects that suck the sap out of plants. An infestation of aphids can destroy whole gardens and decimate crops. A single ladybug can eat up to 5000 aphids, which means they're invaluable to farmers trying to control an aphid population without the use of harsh chemicals. At the present time experiments are being done in space to learn how to best grow food for possible colonization on Mars or future suitable planets. The ladybug may be helpful to control pests in space gardens. This investigation will study if the lifecycle of a ladybug is affected by microgravity. Dormant ladybug eggs, food, and other resources for growing and sustaining the ladybugs will be sent to the ISS (i.e., cotton ball saturated with water, rose leaf, raisins, and honey). Upon return to Earth, the current stages of the microgravity ladybugs will be compared against the current stages of the control group ladybugs to determine any differences in their growth.

5. Hartford, Connecticut

How Does Microgravity Affect the Production of Synthetic Insulin?

Grade 8
Annie Fisher STEM Magnet School, Hartford Public Schools

Co-Principal Investigators: Alec Bulkovitch, Quishana Gillett, Nina Hall, Anxhela Mete

Teacher Facilitator: Keith Sevigny

Proposal Summary: The investigation will study how microgravity affects genetically modified yeast's ability to produce insulin. Saccharomyces cerevisiae is a type of yeast that when genetically modified, can produce synthetic insulin. (Ostergaard, Olsson, and Nielsen 2014) This insulin helps save a countless number of lives each year, more specifically people diagnosed with Type I and II diabetes. The investigation will include sending a sample of Saccharomyces cerevisiae to the ISS, have it produce synthetic insulin, and upon return compare it to how much insulin another sample of the yeast produces here on Earth. The hypothesis is that Saccharomyces cerevisiae will produce significantly more synthetic insulin on board the ISS because the genetically modified yeast may find it easier to yield the same amount of insulin than it would normally in Earth's gravity. If it is found that there is no change or that there is a significant increase in the production of synthetic insulin, then the possibility of long-term space travel could be open to diabetics.

6. Bear, Delaware

A Comparative Study of the Effects of Microgravity on Drosophila Melanogaster

Grades 9-10
Caravel Academy

Co-Principal Investigators: Kaelyn Connors, Lasya Katta, Ryan Lapointe, Kathryn North, Kelly Pyle

Teacher Facilitator: Meredith Swartzendruber

Proposal Summary: This experiment will test not only how microgravity affects an organism's body, but also how an organism born and grown in a microgravity environment would survive in Earth's gravity. The investigation will study Drosophila Melanogaster (the common fruit fly) larvae because of their ability to become dormant in cold temperatures, common usage in biological experiments, resemblance to the human body structure, and small size. The larvae will remain dormant (refrigerated) until arrival at ISS. After arrival, the fruit flies will be exposed to the warmer temperature inside the ISS and will exit reproductive dormancy and begin to grow and reproduce. After several weeks, crewmembers will deactivate the experiment by closing one clamp to divide the flies into two populations, and then opening another clamp to introduce a fixative, permethirn-formaldehyde, to one of the populations. Upon return to Earth, the new organisms born in space will be compared to a control group that has been growing in Earth's environment and gravity. From the data collected, the co-Investigators will analyze how microgravity affected the fruit flies and if the fruit flies (that were born in microgravity) are able to survive on Earth.

7. Camden, Delaware

Breakdown of Hydrogen Peroxide in Microgravity

Grades 9, 11-12
Caesar Rodney High School, Caesar Rodney School District

Co-Principal Investigators: Miranda Hunt, Dhruv Kumar, Clay Radford, Kyra Watson
Co-Investigators: Aysia Eskridge, Florin Fuad, Cade Lambert, Joshua Leczner, Kyle Maier, William Mosher, Alexis Webb

Teacher Facilitator: David Moore

Proposal Summary: Our experiment tests the effects of microgravity on a chemical reaction. On earth, the gravity acts as a force pulling the reactants together in a test tube, while in space, there is no gravity pulling the reactants together, taking longer for reactions to occur. The chemical reaction we are testing is the decomposition of hydrogen peroxide (1.5 %H_2O_2) as the enzyme catalase breaks it down. We believe that if there is no microgravity effecting the reaction, the catalase will not break down the hydrogen peroxide (H_2O_2) as much as it would on Earth with the effects of microgravity. After a short time, giving the reaction time to occur, a 10 % H_2SO_4 solution dissolved in distilled water will be added to the solution so that the reaction between catalase and hydrogen peroxide will be stopped so the decomposition can be measured. Back on Earth, the amount of hydrogen peroxide that decomposed will be measured through a titration procedure with potassium permanganate ($KMnO_4$). The results of the experiment will be compared to a control experiment conducted on Earth with the same procedures. Therefore, we will be able to observe the effects of microgravity on an

enzymatic chemical reaction.

8. Hillsborough County, Florida

Operation Germination of Cottonseeds

Grade 5
FishHawk Creek Elementary School, Hillsborough County Public Schools

Co-Principal Investigators: Karinna Crespo, Chandrika Ganduri, Casey Utsler

Teacher Facilitator: Mary Vaughan

Proposal Summary: The investigation will study if microgravity affects the frequency rate of the germination of cottonseeds. Cottonseeds were chosen because research indicates that the seeds can germinate on the space station. The germination of cottonseeds would allow for scientists to learn more of the germination of seeds in microgravity. Cottonseed oil could also be used by humans for many reasons such as food additives, for skin care, and medicinal reasons. This could be beneficial for longer space missions. In volume 1 of the MixStix will be seven cottonseeds wrapped in felt. In volume 2, 5 mL of tap water from FishHawk Creek Elementary School, and in volume 3, seven additional seeds wrapped in felt. Dr. Gioia Massa, the Principal Investigator of Veggie 01 and research on other previous experiments indicated that felt is a good medium for germinating seeds. Cottonseeds require close contact with the material they are germinated in and tightly wrapping the seeds assists with encouraging germination. A cold pack will be used for return shipping when the MixStix is returned to Earth. In microgravity, the early cottonseeds will be activated 2 days after arrival on the space station and the second set of seeds will be activated 14 days before returning to Earth. Cottonseeds have a germination rate of 7-14 days.

9. Sioux City, Iowa

Go Nuts in Space

Grade 9
North High School, Sioux City Community School District

Principal Investigator: Robert Hwang
Co-Investigators: Rachel Hodgins, Tammy Tran

Teacher Facilitator: Pam Malone-Mason

Proposal Summary: The experiment is to conduct a commercially available peanut ELISA test on the International Space Station. It is speculated that astronauts' immune systems are suppressed in microgravity condition, as the astronauts are more likely to develop infections in space. The experiment asks, "Would allergies, another type of immune response, be suppressed as well by the effect of microgravity?" Allergies affect quality of life and cost billions of dollars in medication and hospitalization. Peanut allergies, in particular, have been increasing in number and severity for several decades. Will a person with a documented peanut allergy still develop allergic reactions in space? An allergic person has an excess of a type of antibodies called Immunoglobulin E produced overtime, and these antibodies are bound to the mast cells of the immune system. In an allergic

reaction, the antibodies bind with the allergens, and then the complex binds to a receptor on the mast cell, and causes the mast cells to release histamine. In the experiment, peanut-specific antibodies will be mixed with peanut protein in the MixStix. The same test will be conducted on Earth as a ground experiment. The results will be compared to see if antibody-peanut binding is suppressed, enhanced, or the same in space. The results of the study will reveal the impact of microgravity on allergic reactions, which will in turn, help us understand more about how allergies work and to find a cure to allergies on Earth.

10. Fitchburg, Massachusetts

How is the Growth of the Bacteria Rhizobium radiobacter Affected by Microgravity?

Grade 11
Montachusett Regional Vocational Technical High School, Montachusett Regional Vocational Technical School District

Co-Principal Investigators: Jezrielle Bruno, Marina Good

Teacher Facilitator: Paula deDiego

Proposal Summary: The investigation will study how the growth of the bacteria, *Rhizobium radiobacter*, is affected by microgravity. *R. radiobacter* is a bacterium that causes “plant cancer”, also known as Crown Gall Disease. It has a portion of a T-DNA that inserts itself into the plant’s DNA. This causes the plant cell to alter and expand, forming a tumor, as a result of altered cell genomes. This experiment will provide an understanding of the effects, if any, microgravity has on the growth of *R. radiobacter*. It will investigate whether there is a change in growth rate of the bacteria, and whether the production of endotoxins is affected. Typically, the higher the level of endotoxins, the more bacterial growth there is. Therefore, this is an important factor that will be analyzed after the completion of this experiment. In order to address the concern of over-growth and eventual starvation and/or death of the bacteria, a substance known as acetosyringone, which has resulted in growth-inhibition and decreased virulence in specific strains of *R. radiobacter* has been included. In consideration of this factor, the C58 strain of bacteria was chosen for the experiment, as the acetosyringone has inhibited the growth of this particular strain of *R. radiobacter*.

11. Duluth, Minnesota

The Detriment of Microgravity on Xenopus Laevis

Grade 12
Duluth Marshall High School, ISD 709

Co-Principal Investigators: Allison Hall, Anna Nordin, Pentti Hanlon

Teacher Facilitator: Paul Schonfeld

Proposal Summary: The investigation will analyze the effects of microgravity on *Xenopus laevis* embryos. Previous NASA studies on *Xenopus laevis* in microgravity have investigated how to reduce oxidative damage and stress using glutathione. This investigation will focus solely on the negative effects of microgravity, so an antioxidant will not be added to reduce the oxidative stress, and the

effects of microgravity will be analyzed. The hope is that by studying *Xenopus laevis* invaluable insights into the development of organisms in space will be gained.

12. Brookhaven, Mississippi

Yeast as a Model Organism to Study COX-2 Enzyme Production in Microgravity

Grade 10
Brookhaven Academy

Co-Principal Investigators: Missy Noel Clanton, Mica Bailey Stewart

Teacher Facilitator: Leslie Hood

Proposal Summary: Colorectal cancer (CRC) has affected many lives throughout the nation. Studies show that one in twenty people get CRC each year. This cancer is caused by uncontrolled cell growth in the colon, rectum, or appendix. Colorectal cancer is the second leading cause of cancer-related deaths in the United States. Statistics show that over 90% of people who get colorectal cancer die. Experiments show that the enzyme cyclooxygenase 2 (COX-2) is elevated in 85% of colorectal cancer patients. Aspirin has been shown to inhibit the production of COX-2 enzymes in human test studies. Overexpression of COX-2 results in inflammation and uncontrolled cell proliferation, which may lead to tumor formation. Apoptosis is a highly conserved pathway in eukaryotic organisms to promote programmed cell death (cell suicide) when cell damage can result in cancer. Yeast is often used as a model organism in cancer research. The yeast *Saccharomyces cerevisiae* is used in this study due to its production of the COX-2 enzyme and its suicidal response (apoptosis) to aspirin. Microarray analysis will be used to measure mRNA levels of several thousand genes in yeast, including those involved in the production of COX-2 and the initiation of programmed cell death. The specific aim of this investigation is to evaluate gene expression in *S. cerevisiae* by microarray analysis. Statistical analysis will determine possible variances in the Earth based experiment compared to microgravity.

13. Kansas City, Missouri/Kansas

Will Sunflower Seeds Grow in Microgravity?

Grades 6-7
Crossroads Academy of Kansas City, ISD 709

Principal Investigator: Saul Rodriguez
Co-Investigators: Kevin Alvarez, Jorge Ortiz
Collaborators: Michyla Westbrook-Samuels, Nautica Wiggins

Teacher Facilitator: Kristen Marriott

Proposal Summary: This investigation will study if sunflowers will germinate in microgravity. The hypothesis is that sunflower seeds will germinate in microgravity. The sunflower seeds will be provided purified water and potting soil. Onboard the ISS, crewmembers will open the clamp introducing the water to the soil and seeds, and shaking the MixStik to mix. Sunflower seeds were chosen because they are healthy, and can be a source of food. Upon return to Earth, the flight MixStik will be analyzed to see if the seeds have grown roots and begun germination.

14. Johnson County, Nebraska

Germinating Red Clover (Trifolium pratense L)

Grades 11-12
Johnson County Central High School, Johnson County Central Public Schools

Principal Investigator: Rudy Pooch
Co-Investigator: Isaac Buss
Collaborators: Keelee McClintock, Natalie Roddy, Mason Waring

Teacher Facilitator: Nichole Justesen

Proposal Summary: If humans plan to establish permanent bases in space, they will need to be able to cultivate their own food. On Earth, legumes are used to fixate nitrogen into soil, making it fertile. In this experiment red clover seeds (*Trifolium pratense L*), cotton, potting soil, and water are used to examine how much nitrogen is produced. Upon return to JCC after its time onboard the ISS, the nitrogen levels of both the flight experiment and the control will be assessed using a soil testing kit. Both ground and space experiments will be planted in separate planter boxes and the nitrogen levels will continue to be tested throughout the plants' entire life cycle. The hypothesis is that red clover will release about the same quantities of nitrates after germinating in space as they would after germination on Earth. This study could be a small step in creating a suitable environment in space to grow and harvest crops for future food with a bonus of medicinal purposes. Red clover seeds were chosen for the investigation because they are a legume commonly used by local farmers in Johnson County, NE in crop rotations to enrich the soil. Could this plant be the answer for fertile soil in space? Will the red clover fixate more or less nitrates into the soil? While many studies have dealt with seed germination, none of them have addressed the symbiotic relationship between a legume and Proteobacteria.

15. Pennsauken, New Jersey

Staphylococcus Epidermidis In Microgravity

Grade 8
Howard M. Phifer Middle School, Pennsauken Public Schools

Co-Principal Investigators: T'asiah Lawson, Thaliyyah Eason, Thomas Tran
Collaborators: Alex Little, Dazhane Brown

Teacher Facilitator: Amy Fisher

Proposal Summary: Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium that is resistant to most antibiotics. This investigation is testing if there is a change in the natural antibiotic resistance in *Staphylococcus Epidermidis* (SE) in microgravity. SE, which is a close cousin to MRSA, is less contagious, and safer to handle. The hypothesis is that the bacteria has a weaker resistance against antibiotics in microgravity because the microgravity conditions on the ISS affect the bacteria negatively. The SE bacteria has to adapt to the new environment, allowing the antibiotics to work more effectively against the bacteria. MRSA has been sent up to the ISS to develop a potential vaccine for use on Earth. From this experiment we can learn more about SE as well as work towards developing a better cure for all types of Staph infections in space.

16. Somerset, New Jersey

Evaporation Investigation

Grade 5
Thomas Edison Energy Smart Charter School, Franklin Township New Jersey

Co-Principal Investigators: Natalia Arevalo, Meghan Gajula, Kareena Kapadia

Teacher Facilitator: Maya Ghosh

Proposal Summary: The investigation will study if water evaporates faster under microgravity or on Earth. If water evaporates faster in microgravity, then astronauts need to consume more water to keep them healthy but, if water evaporates slower, then astronauts need to consume less water. Water is in all living things, vegetation, and our body. In a regular environment, water constantly changes its state from liquid to gas. Fruits dry, and the body sweats all because water constantly evaporates. The investigation will simulate water evaporation. In volume 1 of the mini-lab will be placed some cotton containing a few drops of water, and some “silica gel”(tiny, solid micro-beads). The silica gel will absorb moisture from the air within the mini-lab, and force the water from the cotton to evaporate. The same investigation run on the ISS will be run on Earth. The difference in the weight of the cotton before and after the experiment will determine how much water evaporated in the mini-lab. The health of astronauts is heavily dependent on how fast or slow they sweat and how much water they have to drink to replenish fluids in their body. Similarly, astronauts may need to know how long foods will stay fresh to keep enough food if we were to colonize in outer space.

17. West Fargo, North Dakota

How Does Rust Form Differently in a Microgravity Environment?

Grade 7
Liberty Middle School, West Fargo Public Schools

Co-Principal Investigators: Jacob Angus, Abby Bueling, Skyler Manney
Collaborator: Avery Wood

Teacher Facilitator: Eric Dobervich

Proposal Summary: Rust during space travel is a problem. Rust weakens metals and makes them vulnerable to other objects in space. That is a problem to space travel because valuable objects may become lost or broken. Conducting an experiment in microgravity could help this by helping engineers prepare for the future. There has been research done on this by the European Space Technology and Research Centre. They have looked at atomic oxygen corrosion in microgravity and have been successful in proving there can be corrosion or rust in a microgravity environment. There are simple factors that save lives and make space travel successful, rust-free chassis is one of them. This experiment could provide answers to the question, “How does rust form differently in a microgravity environment?” This experiment could help future generations save lives and money by making safer exteriors to aerospace crafts. This experiment using Titanium CP 1-Grade 4 in Volume 1 of the MixStix and 0.5% NaCl solution in Volume 2 will investigate how rust forms differently in a microgravity environment. Upon arrival at ISS, crewmembers will open the clamp between the two volumes introducing the metal to the saltwater solution.

18. Grant County, Oregon

Does Microgravity Affect Variation of the Protein Structure Created?

Grade 9
Grant Union Junior/Senior High School, Grant County Education Service District

Co-Principal Investigators: Zack Deiter, Elijah Humbird, Duane Stokes, Dante Valentine, Cauy Weaver

Teacher Facilitator: Sonna Smith

Proposal Summary: In their native gravity environment, proteins exist as three-dimensional structures. This experiment is being conducted to find out how microgravity affects the three dimensional structure of the GFP (green fluorescent protein) in *E. coli*. To conduct this experiment, GFP transformed into the bacteria *E. coli* will be used. Molecular biologists commonly use the protein synthesizing capabilities of *E. coli* to express recombinant proteins in the 10-150 kD size range. GFP was chosen because of its barrel shape and strong hydrophobicity and its stability as a protein. Even after the bacterial cells break open the GFP will stay intact for a while or until proteases from the *E.coli* start chewing them up. The pH of the nutrient broth will be lowered to encourage misfolded proteins. Glycerol will be used because it slows the bacterial growth rate, but does not damage the protein. This experiment is important because if microgravity causes a higher percentage of misfolded proteins, it could cause proteins to send the wrong message signals to cells, possibly causing short or long-term health problems. Misfolded proteins are believed to be the primary cause of Alzheimer's disease, Parkinson's disease, Huntington's disease, cystic fibroses and many other degenerative and neurodegenerative disorders. These diseases and disorders are slow developing and do not generally show symptoms until misfolded proteins have accumulated. Knowing if microgravity contributes to or diminishes the misfolding of GFP could help prevent long-term health problems for astronauts or provide new treatment pathways in the future.

19. Erie, Pennsylvania

Using the Statocyst System to Investigate how the Vestibular System Would Provide Orientation and Balance to Living Organisms in Microgravity

Grades 5-8
Iroquois Elementary and Junior-Senior High School, Iroquois School District

Co-Principal Investigators: Aalihya Bowersox, Morgan Schnars
Co-Investigator: Tamara Burton
Collaborators: Brandon Brieger, Jadon Spring

Teacher Facilitators: Lyndsay Foriska, Jennifer Foutz, Shannon Glennon, Andrea Hart, Scott Peterman

Proposal Summary: The experiment proposes to test how the Vestibular system in your ear would react in space, by using the statocyst of a sea star. Sea stars were selected because they use a statocyst to maintain equilibrium, which is driven by gravity and is similar to the Otolith organs in your inner ear. If the sea star cannot maintain equilibrium for an extended period of time, it will die. Our null hypothesis is that microgravity will have no effect on the statocyst system and our alternative hypothesis is that microgravity will have an effect on the statocyst system. To test this, three of the sea stars six legs will be trimmed

before loading in the mini-lab and the sea stars will be put in a state of dormancy (i.e. refrigeration) until arrival at IS. Upon return to Earth their growth will be measured, and an average growth will be taken for each sea star. If the growth is minimal, then it can be assumed that the sea star had been allocating its energy towards orienting itself and not toward growth and reproduction (bioenergetics). If there is significant growth or reproduction, it can be assumed that the sea star was unaffected by microgravity, and it has minimally been allocating its energy towards orienting itself. The same experiment will run twice on the ground, one experiment will be continually disturbed (rotated), and the other will be undisturbed; since microgravity is the only variable being tested. By further investigating the effects of microgravity, we can better understand the potential stress on the human body in space.

20. Knox County, Tennessee

Effects of Microgravity on the Efficacy of Ciprofloxacin on Escherichia Coli

Grades 7-8
Gresham Middle School, Knox County Schools

Co-Principal Investigators: Keagan Cross, Hanson Lam
Co-Investigators: Molly Hensley, Andrew Starling
Collaborators: Haley Hill, Katherine Redden

Teacher Facilitator: Amelia Brown

Proposal Summary: *Escherichia Coli*, more commonly known as *E. Coli*, is spread through contaminated food or through contact with an infected person or carrier. Some strains are mild, while others can prove to be life threatening. Should this common illness affect astronauts, a prompt recovery would be imperative. An antibiotic can decrease the risk of complications, and eliminate the bacteria. Ciprofloxacin is commonly used, and is what will be used in the experiment. By testing the efficacy in microgravity, we can potentially decrease the risk of this issue. The Ciprofloxacin will be introduced to the *E. Coli* upon arrival to the International Space Station, and will be compared to results of the ground truth experiment.

21. Austin, Texas

The Growth of Heterotrophic Algae Neochloris oleoabundans in Microgravity

Grade 8
West Ridge Middle School, Eanes Independent School District

Co-Principal Investigators: William Buchanan, Steven Foncerrada, Myles Kovalik, Kyle Shaw

Advisors: Dr. Rhykka Connelly, Dillon Finan, Bobby Levine

Teacher Facilitator: Todd White

Proposal Summary: The Growth of Heterotrophic Algae *Neochloris oleoabundans* in Microgravity experiment investigates the effect of microgravity on the growth rate and development of algae. For a long time algae has been used by labs and industries for many products, including cosmetics, nutrition, and most importantly, biofuel. Scientists predict that years from now algae may replace many limited fossil fuel reserves. Algae are also important oxygen producers as they provide two thirds of the Earth's oxygen.

Because of this, the more that is known about the growth of algae, the more the world's plentiful algae reserves can be used to their greatest extent. In addition, as the prospect of long duration space flight draws nearer, it is necessary to find out whether algae can be grown in these microgravity conditions as a source of fuel, nutrition, and possibly oxygen for future space colonists. The chosen algae are heterotrophic and will grow in the conditions in the mini-lab. The hypothesis is that the algae's growth rate will accelerate, as gravity isn't restricting the growth and division of the cells. A freeze-dried sample of the algae will be sent to the ISS, the crew members will provide the algae with water and glucose, beginning the growth process, and after 14 days the crew members will introduce a puromycin solution preserving the results for the return trip back to Earth.

22. Burleson, Texas

What are the Effects of Hydrogel Polymers when Mixed with Water in Microgravity vs. on Earth?

Grade 5
The Academy at Nola Dunn, Burleson Independent School District

Co-Principal Investigators: Bryston Baker, Westley Mitchell, Kylie Morton, Delaney Storey

Teacher Facilitator: Susan Mundt

Proposal Summary: This investigation will study the question of what hydrogel polymers do when mixed with water in microgravity. The hypothesis is that the polymers will absorb more water due to less gravity. Polymers are an important material as they are used in a variety of items on Earth. They are used in credit cards, bottles, spandex, eyeglasses, and first aid packs. It is important to study the polymers and their absorption because this will one day help when families are living on the space station and not just astronauts.

23. Pharr, Texas

What is the Effect of Microgravity on the Cell Division of an Onion Root?

Grade 5
Cesar Chavez Elementary School, San Juan-Alamo Independent School District

Co-Principal Investigators: Elva Rodriguez, Yadira Vaca

Advisor: Dr. Anxiu Kuang

Teacher Facilitator: Celena Miller

Proposal Summary: The experiment will germinate onion seeds on board the International Space Station (ISS) and on Earth. A Type 3 mini-lab will be used for the experiment. Volume 1 will be filled with 1 mL of distilled water. A cotton ball and three onion seeds will be placed in Volume 2. Volume 3 will contain the fixative glutaraldehyde. Upon arrival on the ISS, the crewmembers will release clamp A of the microgravity experiment and the water will be absorbed onto the cotton ball to begin germination. In the week before undock, the crewmembers will open Clamp B to release the glutaraldehyde to "freeze" the experiment. When the ISS bound experiment is returned to Earth, it will be compared with the ground control, and the observations of the seeds and data will be collected. Observations will include length of

roots, observation of cells for mutations, and number of cells samples that are at each stage of mitosis. Root cells of each experiment will be observed under a microscope to determine the number of cells in each phase and if there are any mutations. Will there be changes in the copy of the cell? Will it form a completely new cell or mutate? The hypothesis is that the cells will not be able to divide because they are in microgravity and could possibly mutate. If it is learned that cells have a hard time dividing and mutating in space, this information could have great consequences for astronauts and other future space travelers.

24. San Antonio, Texas

The Effects of Microgravity on the Rate of Plant Growth

Grade 12
Business Careers High School, Northside Independent School District

Co-Principal Investigators: Kaitlyn Bloch, John Gonzales

Teacher Facilitator: David Powell

Proposal Summary: This experiment will examine the differences in the rate of cell growth and division between a set of radish seeds germinated in microgravity and an identical set of seeds germinated on Earth. The seeds will be kept under the same conditions with the exception of gravity. Upon return to Earth, the seedlings will be cut open and examined under a microscope in order to determine what effect microgravity had on the rate of cell growth and division.