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Over 40 U.S. National Laboratory Sponsored Experiments on SpaceX CRS-11 Destined for the International Space Station

KENNEDY SPACE CENTER, FL. (May 26, 2017) – The SpaceX Falcon 9 vehicle is slated to launch its 11th cargo resupply mission (CRS-11) to the International Space Station (ISS) no earlier than June 1, 2017 from Kennedy Space Center Launch Complex 39A. Onboard the Falcon 9 launch vehicle is the SpaceX Dragon spacecraft, which will carry more than 40 ISS U.S. National Laboratory sponsored experiments. This mission will showcase the breadth of research possible through the ISS National Laboratory, as experiments range from the life and physical sciences, Earth observation and remote sensing, and a variety of student-led investigations. Below highlights the investigations as part of the SpaceX CRS-11 mission:

ADVANCED COLLOIDS EXPERIMENT-TEMPERATURE CONTROLLED-6 (ACE-T-6)

Matthew Lynch, Procter & Gamble (West Chester, OH)
Implementation Partner: NASA Glenn Research Center and Zin Technologies, Inc.

Colloids are suspensions of microscopic particles in a liquid, and they are found in products ranging from milk to fabric softener. Consumer products often use colloidal gels to distribute specialized ingredients, for instance droplets that soften fabrics, but the gels must serve two opposite purposes: they have to disperse the active ingredient so it can work, yet maintain an even distribution so the product does not spoil. Advanced Colloids Experiment-Temperature-6 (ACE-T-6) studies the microscopic behavior of colloids in gels and creams, providing new insight into fundamental interactions that can improve product shelf life.

EFFICIENCY OF VERMICOMPOSTING IN A CLOSED SYSTEM (NANORACKS-NDC-BMS-VERICOMPOSTING)

Bell Middle School (Golden, CO)
Implementation Partner: NanoRacks

Vermicomposting, or using worms to break down food scraps, is an effective way to reduce waste and obtain a nutrient-rich fertilizer for plants. The NanoRacks-NDC-Bell Middle School-Efficiency of Vermicomposting in a Closed System (NanoRacks-NDC-BMS-Vermicomposting) investigation is a student-designed project that studies whether red wiggler worms, a species of earthworm, are able to produce compost in space. Results are used to study the potential for composting as a form of recycling on future long-duration space missions.

FUNCTIONAL EFFECTS OF SPACEFLIGHT ON CARDIOVASCULAR STEM CELLS (CARDIAC STEM CELLS)

Dr. Mary Kearns-Jonker, Loma Linda University (Loma Linda, CA)
Implementation Partner: BioServe Space Technologies

Functional Effects of Spaceflight on Cardiovascular Stem Cells (Cardiac Stem Cells) investigates how microgravity alters stem cells and the factors that govern stem cell activity, including physical and molecular changes. Spaceflight is known to affect cardiac function and structure, but the biological basis for this is not clearly understood. This investigation helps clarify the role of stem cells in cardiac biology and tissue regeneration. In addition, this research could confirm the hypothesis that microgravity accelerates the aging process.

MULTIPLE USER SYSTEM FOR EARTH SENSING (MUSES)

Paul Galloway, Teledyne Brown Engineering (Huntsville, AL)
Implementation Partner: Teledyne Brown Engineering

Teledyne Brown Engineering developed the Multiple User System for Earth Sensing (MUSES), an Earth imaging platform, as part of the company's new commercial space-based digital imaging business. MUSES hosts earth-viewing instruments (Hosted Payloads), such as high resolution digital cameras, hyperspectral imagers, and provides precision pointing and other accommodations. It hosts up to four instruments at the same time, and offers the ability to
change, upgrade, and robotically service those instruments. It also provides a test bed for technology demonstration and technology maturation by providing long-term access to the space environment on the ISS.

NANORACKS-JAMSS-2LAGRANGE-1

Tomohiro Ichikawa, Lagrange Corp. (Tokyo, Japan)
Implementation Partner: NanoRacks

Spaceflight affects organisms in a wide range of ways, from a reduction in human bone density to changes in plant root growth. NanoRacks-JAMSS-2 Lagrange-1 helps students understand potential spaceflight-related changes by exposing plant seeds to microgravity, and then germinating and growing them on Earth. The plants are compared with specimens grown from seeds that remained on the ground. The investigation also connects students to the space program by sending their photographic likenesses and personal messages into orbit. This connection inspires the next generation of scientists and engineers who will work on international space programs.

NEUTRON CRYSTALLOGRAPHIC STUDIES OF HUMAN ACETYLCHOLINESTERASE FOR THE DESIGN OF ACCERERATED REACTIVATORS (ORNL-PCG)

Dr. Andrey Kovalevsky, Oak Ridge National Laboratory (Oak Ridge, TN)
Implementation Partner: CASIS

The investigative team is trying to improve our understanding of acetylcholinesterase, an enzyme essential for normal communication between nerve cells and between nerve and muscle cells. As a target of deadly neurotoxins produced by animals as venom or by man as nerve agents and pesticides, understanding the structure of acetylcholinesterase is critical to designing better antidotes to poisoning by chemicals that attack the nervous system. The Oak Ridge National Lab team plans to use the microgravity environment of space to grow large crystals of the enzyme that will be imaged back on Earth using a powerful imaging approach called neutron diffraction. Neutron diffraction yields very detailed structural information but requires much larger crystals than traditional x-ray diffraction imaging methods. The investigators hypothesize that structural images of space-grown crystals will bring us closer to more effective and less toxic antidotes for neurotoxins that bind and inhibit acetylcholinesterase.

STUDENT SPACEFLIGHTS EXPERIMENT PROGRAM – MISSION 10

Dr. Jeff Goldstein, National Center for Earth and Space Science Education (Washington, D.C.)
Implementation Partner: NanoRacks

The Student Spaceflight Experiments Program (SSEP) provides one of the most exciting educational opportunities available: student-designed experiments to be flown on the International Space Station. The NanoRacks-National Center for Earth and Space Science Education-Odyssey (NanoRacks-NCESSE-Odyssey) investigation contains 24 student experiments, including microgravity studies of plant, algae and bacterial growth; polymers; development of multi-cellular organisms; chemical and physical processes; antibiotic efficacy; and allergic reactions. The program immerses students and teachers in real science, providing first-hand experience conducting scientific experiments and connecting them to the space program.

SYSTEMIC THERAPY OF NELL-1 FOR OSTEOPOROSIS (RODENT RESEARCH-5)

Dr. Chia Soo, University of California at Los Angeles (Los Angeles, CA)
Implementation Partner: NASA Ames Research Center and BioServe Space Technologies

Astronauts living in space for extended durations experience bone density loss, or osteoporosis. Currently, countermeasures include daily exercise designed to prevent bone loss from rapid bone density loss deterioration. However, in space and on Earth, therapies for osteoporosis cannot restore bone that is already

lost. The Systemic Therapy of NELL-1 for Osteoporosis (Rodent Research-5) investigation tests a new drug on rodents that can both rebuild bone and block further bone loss, improving health for crew members in orbit and people on Earth. Dr. Soo's laboratory has been funded by the National Institute of Arthritis and Musculoskeletal and Skin Diseases within the National Institutes of Health. This experiment builds on those previous research investigations.

THE EFFECT OF MICROGRAVITY ON TWO STRAINS OF BIOFUEL PRODUCING ALGAE WITH IMPLICATIONS FOR THE PRODUCTION OF RENEWABLE FUELS IN SPACE-BASED APPLICATIONS
Chatfield High School (Littleton, CO)
Implementation Partner: NanoRacks

Algae can produce both fats and hydrogen, which can each be used as fuel sources on Earth and potentially in space. NanoRacks-National Design Challenge-Chatfield High School-The Effect of Microgravity on Two Strains of Biofuel Producing Algae with Implications for the Production of Renewable Fuels in Space Based Applications (NanoRacks-NDC-CHS-The Green Machine) studies two algae species to determine whether they still produce hydrogen and store fats while growing in microgravity. Results from this student-designed investigation improve efforts to produce a sustainable biofuel in space, as well as remove carbon dioxide from crew quarters.

TOMATOSPHERE-II
Ann Jorss, First the Seed Foundation (Alexandria, VA)
Implementation Partner: CASIS

Tomatosphere is a hands-on student research experience with a standards-based curriculum guide that provides students the opportunity to investigate, create, test, and evaluate a solution for a real world case study. Tomatosphere provides information about how spaceflight affects seed and plant growth and which type of seed is likely to be most suitable for long duration spaceflight. It also exposes students to space research, inspiring the next generation of space explorers. It is particularly valuable in urban school settings where students have little connection to agriculture. In its 15-year existence, the program has reached approximately 3.3 million students.

VALLEY CHRISTIAN HIGH SCHOOL STUDENT EXPERIMENTS
Valley Christian High School (San Jose, CA), in partnership with other high schools throughout the world
Implementation Partner: NanoRacks

Students at Valley Christian High School (VCHS) have a rich history of sending investigations to the ISS through its launch partner, NanoRacks. On SpaceX CRS-11, students from VCHS have partnered with other students from across the world to send 12 total experiments to the ISS National Laboratory. Investigations will range from investigating high quality food nutrients, to the fermentation of microbes, to even an investigation monitoring the growth of a special bacterial strain. The program VCHS has developed with NanoRacks allows students the opportunity to not only conceive a flight project, but learn, understand, and implement the engineering required for a successful experiment in microgravity.

Thus far in 2017, the ISS National Lab has sponsored over 75 separate experiments that have reached the station. This launch manifest adds to an impressive list of experiments from previous missions in 2017 to include; stem cell studies, cell culturing, protein crystal growth, external platform payloads, student experiments, Earth observation and remote sensing. To learn more about those investigations and other station research, visit www.spacestationresearch.com.

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About CASIS: The Center for Advancement of Science in Space (CASIS) is the non-profit organization selected to manage the ISS National Laboratory with a focus on enabling a new era of space research to improve life on Earth. In this innovative role, CASIS promotes and brokers a diverse range of research in life sciences, physical sciences, remote sensing, technology development, and education.

Since 2011, the ISS National Lab portfolio has included hundreds of novel research projects spanning multiple scientific disciplines, all with the intention of benefitting life on Earth.. Working together with NASA, CASIS aims to advance the nation's leadership in commercial space, pursue groundbreaking science not possible on Earth, and leverage the space station to inspire the next generation.

About the ISS National Laboratory: In 2005, Congress designated the U.S. portion of the International Space Station as the nation's newest national laboratory to maximize its use for improving life on Earth, promoting collaboration among diverse users, and advancing STEM education. This unique laboratory environment is available for use by other U.S. government agencies and by academic and private institutions, providing access to the permanent microgravity setting, vantage point in low Earth orbit, and varied environments of space.

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