Master List of Experiment Samples
SSEP Missions to ISS (last revised 09/19/14)

Background

For SSEP on the Space Shuttle (STS-134 and STS-135), the mini-laboratory used for the experiments had “two levels of containment” to guard against an accidental breach and possible introduction of experiment samples into the crew cabin. A 2-level containment system is not deemed secure enough to allow potentially toxic samples to be used. Student proposers were therefore required to use only experiment samples on a **Master List of Experiment Samples (THIS DOCUMENT).** The list included hundreds of allowed non-toxic and low toxicity samples grouped in 9 categories of microgravity science research, yet still restricted experiment design.

For SSEP on the International Space Station, a new mini-laboratory is being used - the Fluids Mixing Enclosure (FME). The FME has three levels of containment so that a fully restrictive Master List of Samples is no longer required. However, the fluids and solids that can be use in the FME are still subject to 4 categories of restrictions regarding: 1) Prohibited Samples, 2) Hazardous Samples, 3) Problematic Samples, and 4) Technology. It is important for all student teams to fully understand the restrictions in each of these categories. For full details, please see Section 6 of the **SSEP Mission 7 to ISS: Mini-Laboratory Operation** page.

Why this Master List of Experiment Samples is Still Useful

Teachers and student teams participating in SSEP on STS-134 and STS-135 also recognized that the Master List of Experiment Samples was a great resource for experiment design. The List provided a starting point for student research on the fluids and solids that are typical of microgravity experiments across the 9 disciplines covered. We are therefore making the Master List of Experiment Samples available for SSEP missions to the International Space Station though there is **no requirement** for student teams to use the samples on the list. However, it is also important to note that a number of samples on the list below also appear on the **NanoRacks List of Problematic Samples**, which means that student researchers cannot assume such samples can be used without contacting NCESSE first, and providing details of the *e.g,* concentrations being proposed. This is also covered on the **SSEP Mission 7 to ISS: Mini-Laboratory Operation** page.

	Experiment Sample	Rationale/Potential Applications
Protein Crystal Growth	5'-Adenyl-imido-triphosphate 3'5'Aminoglycoside phosphotransferase Type IIIa Aldolase protein Ammonium Sulfate Bence-Jones protein Benzamidine C12E8 (detergent) Citrate Buffer (of varying pH) Dodecyl dimethylamine oxide Dodecylmaltoside HEPES, pH 7.5 Heptanetriol Inhibitor B diketo (C4O6PH7) Inhibitor HNAP (C11O6PH7Na2) Lysozyme protein (from Hen egg white) MES buffer MPD (2-Methyl-2,4-pentanediol) Octylglucoside Plant protein p24 Sodium Acetate Sodium Azide Sodium Cacodylate Sodium Chloride (NaCl) Sodium Citrate Sodium HEPES Sodium Phosphate Tris base TRIS-HCl Urokinase protein Lysozyme protein	To obtain highly ordered, large, X-ray diffraction quality crystals in order to determine the three dimensional structure of the protein for development of drugs.
Inorganic Crystal Growth	Food Dye, Various Colors Glycerol Water Monoammonium Phosphate NH4H2PO4 Monoammonium Sulfate Potassium Aluminum Sulfate Potassium Chromium Sulfate Potassium Sodium Tartrate KNaC4H4O6 Sodium Chloride (NaCl)	To obtain more geometrically "perfect" crystals. Students can be introduced to the process of crystal growth and compare the differences between space-grown and Earth-grown crystals using a microscope.

	Sodium metasilicate anhydrous, purum, Na_2O_3Si Various metal filaments (no beryllium, cadmium, magnets) ZnCl2	
Bacteria (and related organisms)	Aqueous suspension of Escherichia coli Agar Bacillus subtilis (Hay bacillus) Bacillus thuringiensis (Bacteria) [var. thuringiensis] Bifidobacterium bifidum Chaetomium globosum (Bacteria) Chromobacterium violaceum ATCC 12472 (pigmented strain representative of an environmental bug and occasional opportunistic pathogen) E.Coli in Luria Broth Medium E.Coli ATCC 23848 (a K-12 wild type strain) E.Coli FBP aldolase (Class II) E.Coli Ferric hydrocamate receptor Lactobacillus GG (LGG) Pseudomonas Aeruginosa PAO-1 R2A Broth containing yeast extract, protease peptone, casamino acids, dextrose, soluble starch, sodium pyruvate, K2HPO4, MgSO4 Bacillus safensis Deinococcus radiodurans E. Coli (B wild) E. Coli (K-12 wild) E. Coli (W) Haloarcula marismortui Lactobacillus acidophilus Lactobacillus fermentum Methanothermobacter wolfeii Pseudomonas aeruginosa Pyrococcus furiosus Staphylococcus aureus	Is microbial competition in sessile (biofilm) and free-swimming (planktonic) populations affected by microgravity? Applications include new disinfectants and/or precautionary measures to prevent biofilm formation. To study the effect of microgravity on bacteria to see if there is any change in the expression of natural antibiotic resistance.
Fish and Other Aquatic Life	Dugesia Tigrina (a planaria worm) in Artesian well water	To determine if microgravity plays a role in the regeneration of body parts of the Planaria worm. This may help give a better understanding of cell regeneration in microgravity. Other applications: tissue engineering on Earth.
	Rainbow Trout Eggs	Eggs of the Rainbow Trout will be flown to study the early development of fish in space. This will be applied to a potential food source for astronauts during long duration space flight (*e.g.*, future missions to Mars).
	Various fish eggs/embryos Various frog eggs/embryos Various shrimp eggs/embryos Algae Aquarium fish food, including brine shrimp food Aquarium water dechlorinator Copepods Dugesia Tigrina (a planaria worm) Phytoplankton Tardigrades (Water bears, Moss Piglets): Milnesium tardigradum, Richtersius coronifer, Echiniscus testudo, Ramazzottius oberhaeuseri Zooplankton	To determine the effect of microgravity on early development of aquatic life
Food Products	Corn powder Egg: Liquid brown chicken egg (clear) Egg: Liquid brown chicken egg (yolk only) Glycerol Monostearate Honey Bovine milk products Oil: Olive Oil "European Oil L." Oil: Sunflower oil "Helianthus annuus L."	Study behavior of common foods in space. Development of new food products.

	Omega-3 fatty acids Peanut powder Refined white sugar (Sucrose) Refined white sugar (Fructose) Tea Leaves, Chamomile Tea leaves from the Azores (manufactured) Tea leaves from the Azores (natural) "Camellia Vitamin A Vitamin B12 Vitamin C Vitamin D Wine (red) Wine (white) Water H2O Port Wine Madeira Wine "Dry" Madeira Wine "Sweet" Yogurt Canola oil Bird egg yolk Bird egg white Cheese (made from cow, goat, sheep milk) Cornstarch Lactose Omega-3 fatty acids Peanut butter Potato starch Tofu Vegetable oil Vitamin A Vitamin B Vitamin C Vitamin D Yeast Yeast extract	
Seeds & Plant Studies	Seeds: Alfalfa Seeds: Ceratonia siliqua L. (Carob tree) Seeds: Coriandrum sativum (L.) Walpers (Coriander) Seeds: Dianthus caryophyllus (Clove Pink) Seeds: Hypericum androsaemum L. (Tutsan) Seeds: Hypericum glandulosum Ait. Seeds: Hypericum perforatum L. (St. John's Wort) Seeds: Marjoram Spice (sheet says: Marjorum Spice) Seeds: Myrtus communis (Myrtus L.) Seeds: Radish (Raphanus sativus) Seeds: Rutgers Tomato Seeds: Salvia sclarea (Clary sage) Seeds: Strawberry Seeds: Strawberry Tree (Arbutus unedo L.) Seeds: Variety of Spices Seeds: Vigna unguiculata L. (Cowpea) Seeds: Wheat Seeds: Various Vegetable Seeds Gibberellic Acid (a plant growth promoter) Soil, various types (must be sterilized) OASIS (substrate material used by florists) Distilled water Arabidopsis thaliana (thale cress) seeds Flower seeds (various types) Fruit seeds (various types) Pieces of various vegetables, fruit, flowers Rockwool / mineral wool Vegetable seeds (various types)	To introduce students to space research through investigation of the effects of microgravity on the germination and root/shoot development of seeds. Does the space environment have any effect on the germination of seeds?

Fluid Diffusion	Distilled Water Food Dye, Various Colors Honey Polystyrene particles Soil, various types (must be sterilized)	Study fluid diffusion processes in microgravity. Applications to other microgravity experiments as well as understanding processes on Earth.
Cell Biology	26 Nucleotide-long oligonucleotide Amphotericin B Ascorbic Acid beta-Glycerophosphate C3H10T1/2-derived cell line (normal) C3H10T1/2-derived cell line (xs Brachyury) Calcitonin (Salmon) Collagen, Type 1 rat tail Cytosine arabinoside (ara-C) Dihydroxyacetone-phosphate (DHAP) DMEM cell culture medium w/ 4.5 g/L glucose, 6 g/L Hepes (also spelled D-MEM) Doxycycline Ferrichrome Fetal Bovine Serum Fetal Calf Serum Fructose-1,6-biphosphate (FBP) Glucose Hexitol biphosphate Human LIF (leukemia inhibitory factor) Hygromycin I-25 (OH) 2D3 KDPG aldolase (2-keto-3-deoxy-6-phosphogluconate) Matrigel (cell basement matrix membrane) CB6F1 mouse embryo cells H1 embryonic mouse stem cells H7 embryonic mouse stem cells H9 embryonic mouse stem cells H14 embryonic mouse stem cells Murine myoblasts (isolated from adult mice) Osteoblasts: MC3T3 mouse osteoblasts cell line Penicillin Penicillin G Rabbit muscle aldolase (Class I) Raloxifene hydrochloride RNA later (RNA stabilization solution) RPMI 1640 medium Sodium Pyruvate Spermine Streptomycin Agar: Plain Agar: Nutrient Agar: Peptone Agar: Tryptic Agar: Trypticase soy Animal blood (including human) Animal eggs (including human) Animal sperm (including human) Cholesterol Eggs: venomless spiders Eggs: venomless lizards Eggs: venomless snakes Eggs: venomless insects (including moths, butterflies) Green Fluorescent Protein (GFP) HeLa cells Hemoglobin Human growth hormone (HGH) Mouse blastocyst Mouse embryonic stem cells: Line B6N Mouse embryonic stem cells: Line 129 Mouse embryonic stem cells: Line C57BL/6 Myoglobin Nutrient broths: lysogeny broth Nutrient broths: luria broth (LB) Nutrient broths:Super Optimal Broth (SOB)	To gain a better understanding of cell growth and function in microgravity. Help understand diseases such as osteoporosis.

	Nutrient broths:Super Optimal Broth with Catabolite Repression (SOC) Oligonucleotide Paramecium Pieces of animal liver, lungs, heart Sperm: fish, frogs, spiders, lizards, snakes	
Micro-encapsulation	Ampicillin Mineral Oil Ciprofloxacin (antibiotic) Cis-Platinum Floxuridine Iodinated Poppy Seed Oil (Lipodiol) Levamisol HCl (Ergamisol) Photofrin (Di-hematoporphryn) Polyvinyl Pyrollidone (hydrolized polyvinyl alcohol) Reglan (Metoclopramide) Velban (vinblastine sulfate) Water	To produce more uniform, stronger, and multi-layered capsules containing medicine.
Miscellaneous	Cotton, 0.1 x 0.1 cm2 HCl NaCl, aqueous Oil: "Hypericum perforatum L." (St. John's Wort) Oil: "Pinus pinaster Ait." (Maritime pine) Natural and synthetic fabric (e.g., wool, silk, polyester) Paper, Various Colors Distilled water Aluminum metal foam Delrin capsules Microbeads (polymer particles) Modeling clay Silly putty Small pieces of metal (no cadmium, beryllium, magnets)	
Biological Fixatives and Growth Inhibitors	Formalin: 10% Neutral Buffered Formalin (NBF) with aprox. 3.7% formaldehyde Puromycin solution: suggested concentration for prokaryotes 100-200 ug/mL Puromycin solution: suggested concentration for eukaryotes 0.5 ug/mL Rifampicin and Cephalexin solution: suggested concentration for prokaryotes (Rifampicin: 150ug/mL, Cephalexin: 10ug/mL)	To stop or slow down the growth of organisms during an experiment to preserve the samples for analysis. The fixatives and growth inhibitors listed here are deemed to be the least hazardous of the numerous possible solutions that could be used for these purposes, so they are included as suggestions. However, the students are not required to limit their experiment design to just these samples for the SSEP missions to the International Space Station.