The Role of Plants as Food and Life Support for Exploration

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MELiSSA Conference November 3rd 2020

BRIEF NASA SPACE FOOD HISTORY

1962
John Glenn Applesauce

2020
Food system on ISS

- Processed & prepackaged
- Fresh food only at resupply
- Testing “Pick-and-Eat”

NASA CURRENT PLANT RESEARCH ON ISS

SPACE PLANT BIOLOGY
Veggie
Food Production and Astronaut Nutrition

SPACE PLANT BIOLOGY
APH
ADVANCED PLANT HABITAT
Large Plant Research Facility

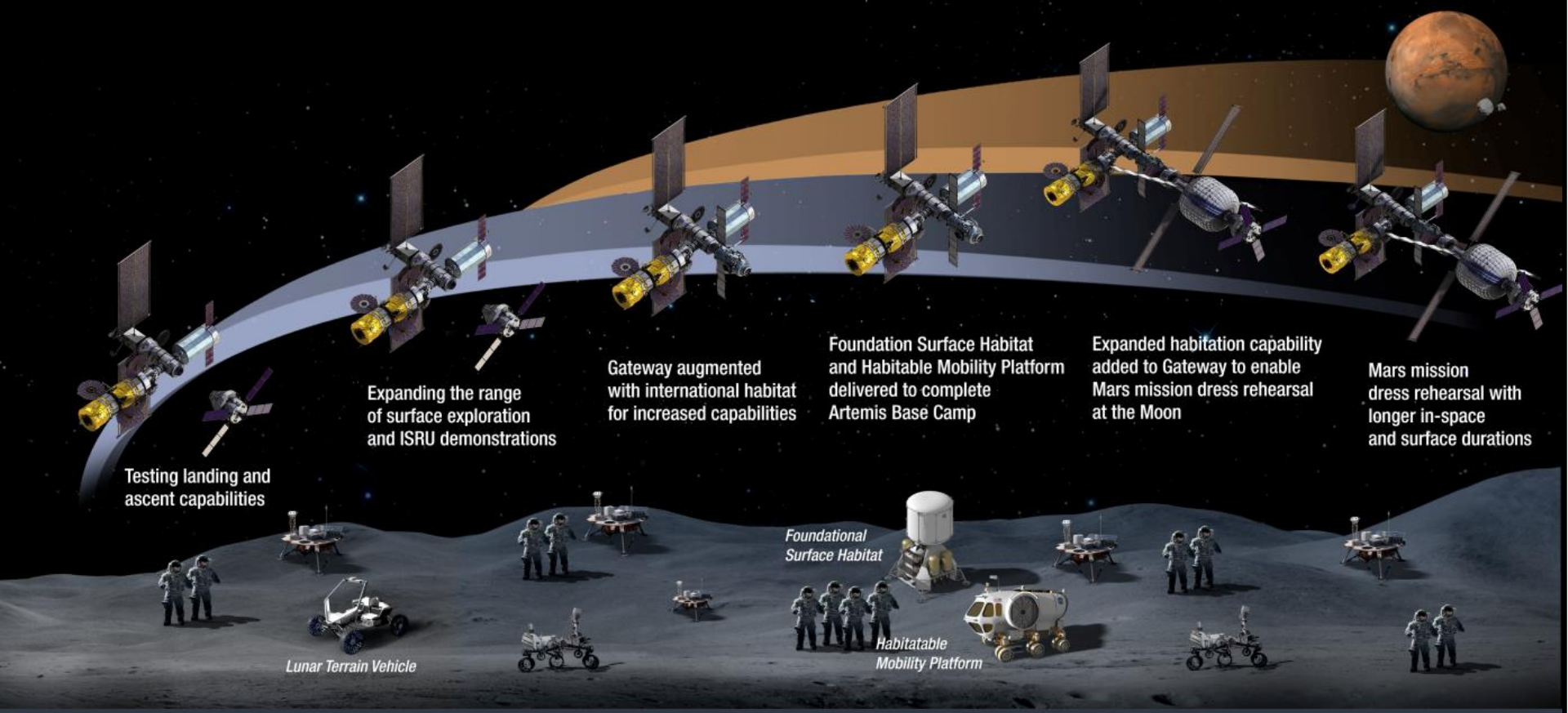
THE SPACE CROP PRODUCTION VISION

Ensure Food System Security on Long Duration Missions Beyond LEO

Near-Term Goal
Nutrient Supplementation of Prepackaged Food

Long-Term Goal
Caloric Replacement to Facilitate Earth Independence

ARTEMIS: LIVING, LEARNING AND WORKING ON THE MOON



SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS | INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

SPACE CROP PRODUCTION ROADMAP FOR EXPLORATION

ISS (*Plant Research and H/W Technology*)

μg

Identify challenges and solutions for growing pick and eat crops in μg to support crew nutrition

Scale: Single Locker to EXPRESS Rack (8 Lockers)

GATEWAY (*Plant Research*)

μg

Proving Ground to study the effect of deep space radiation on pick and eat crops in μg

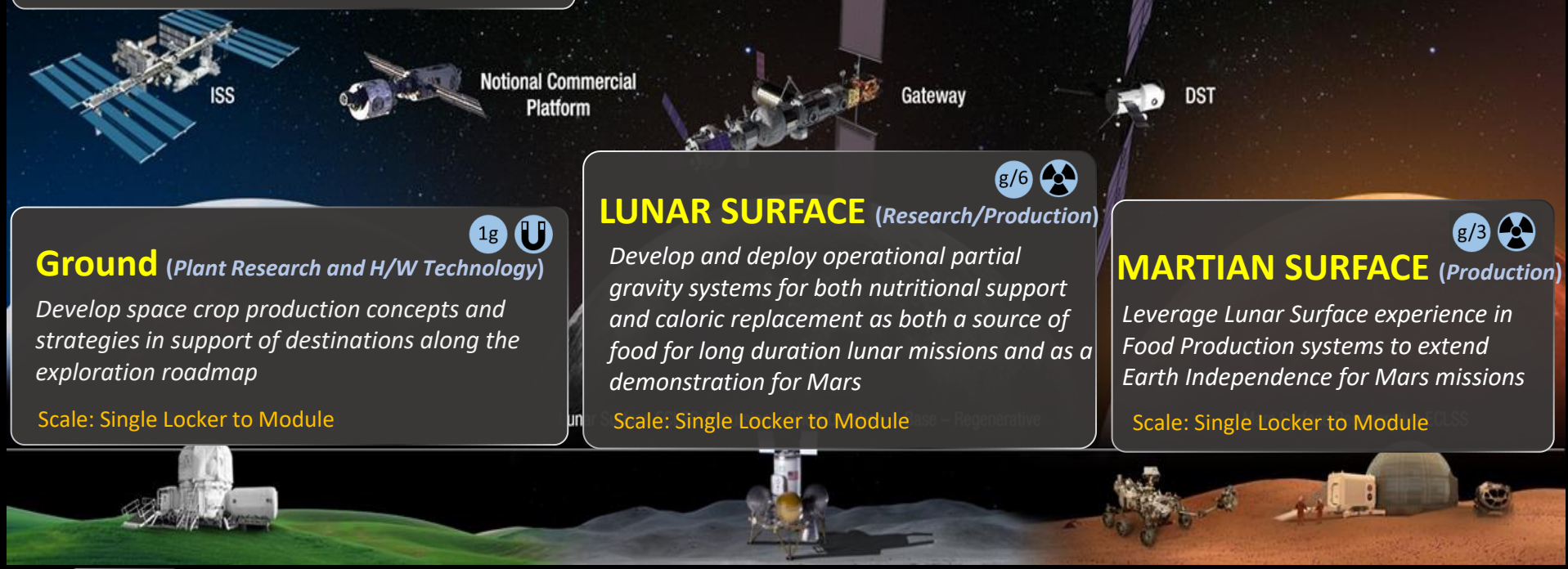
Scale: Single Locker

MARS TRANSIT (*Crop Production*)

μg

Operational μg Food Production capability for pick and eat crops to supplement crew diet

Scale: One to Two EXPRESS Racks (8-16 Lockers)



Ground (*Plant Research and H/W Technology*)

1g

Develop space crop production concepts and strategies in support of destinations along the exploration roadmap

Scale: Single Locker to Module

LUNAR SURFACE (*Research/Production*)

g/6

Develop and deploy operational partial gravity systems for both nutritional support and caloric replacement as both a source of food for long duration lunar missions and as a demonstration for Mars

Scale: Single Locker to Module

MARTIAN SURFACE (*Production*)

g/3

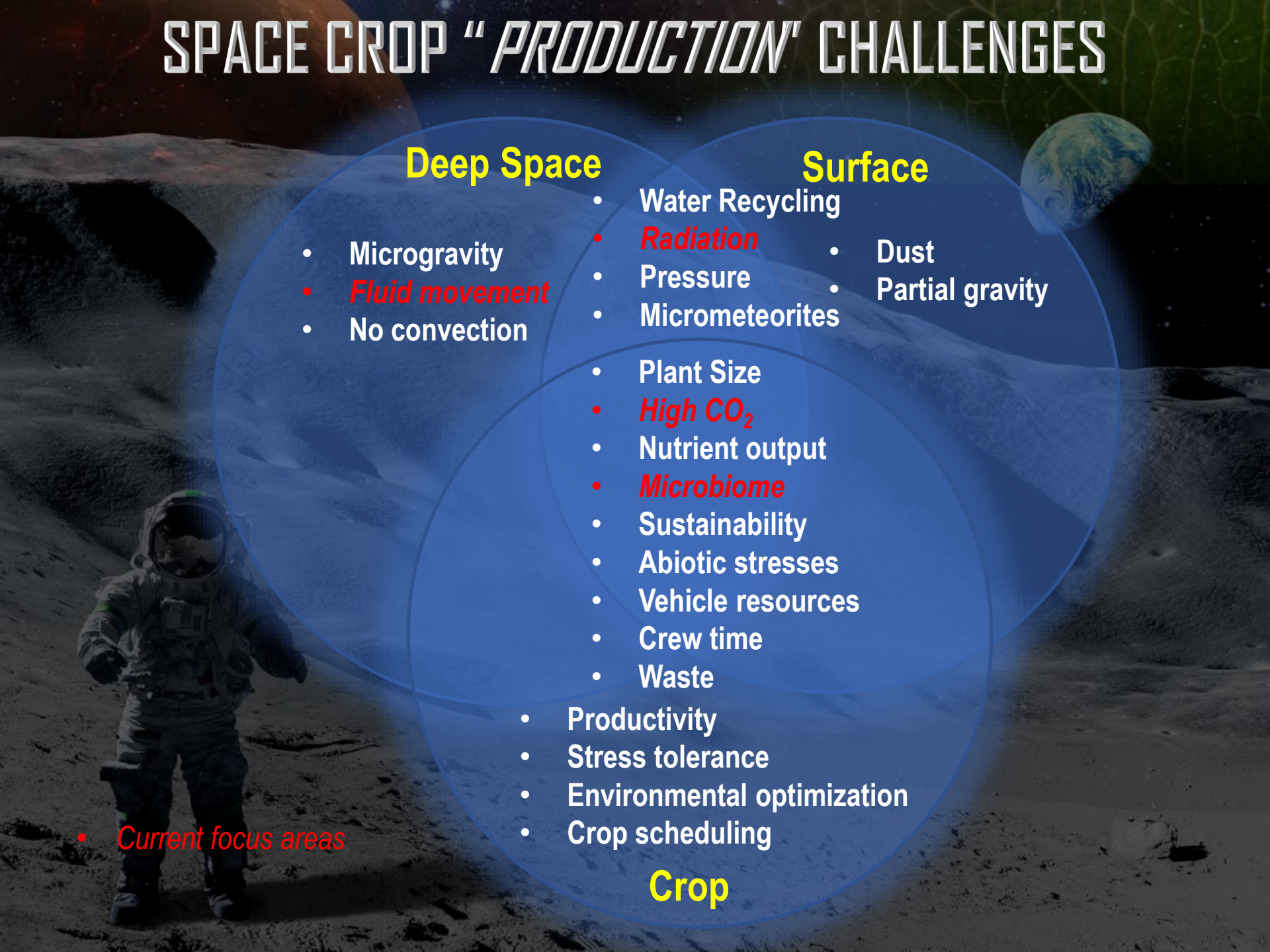
Leverage Lunar Surface experience in Food Production systems to extend Earth Independence for Mars missions

Scale: Single Locker to Module

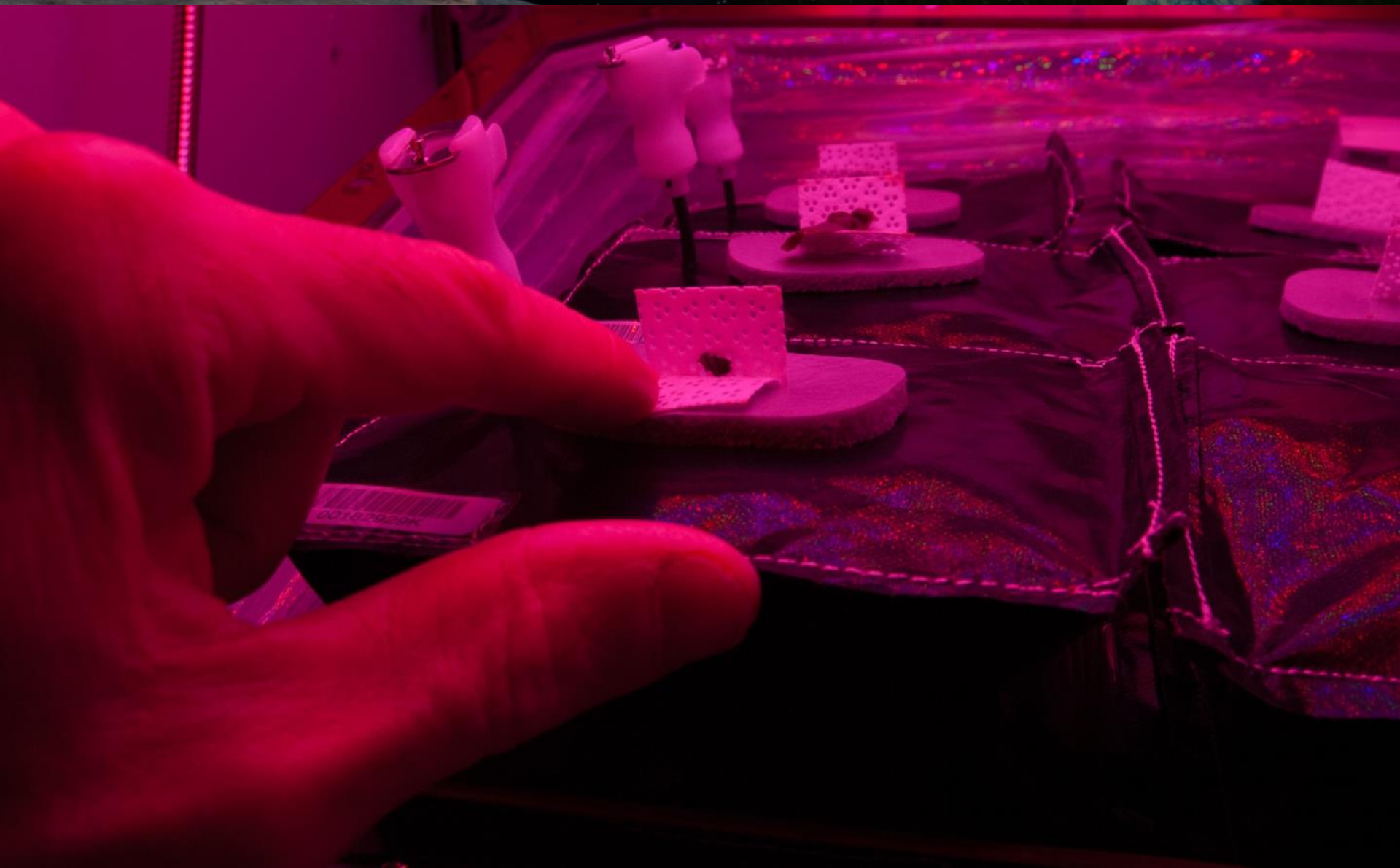
Environment

- 1g Gravity
- Mag Field
- Rad Field

SPACE CROP "*PRODUCTION*" CHALLENGES



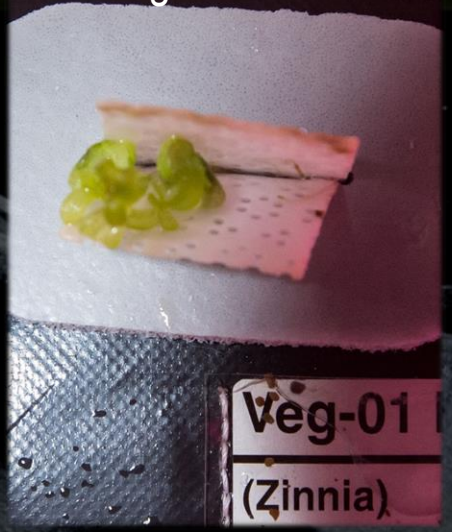
ROOT ZONE WATER – INSUFFICIENT



ROOT ZONE WATER – EXCESS

Condensation on Bellows

Stunting and Chlorosis



Guttation and Leaf Curling

Guttation and Leaf Curling

MICROGRAVITY WATERING

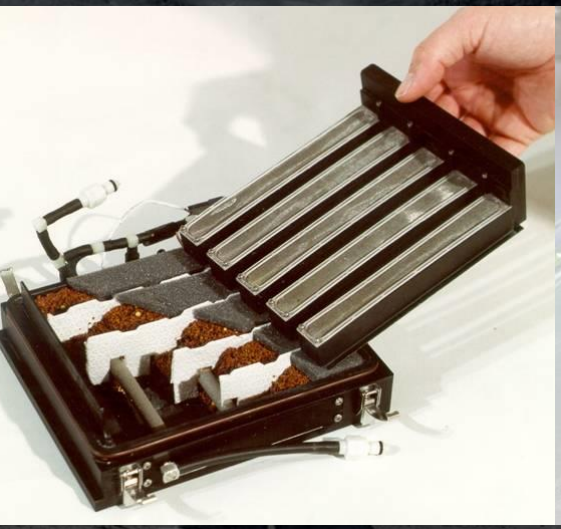
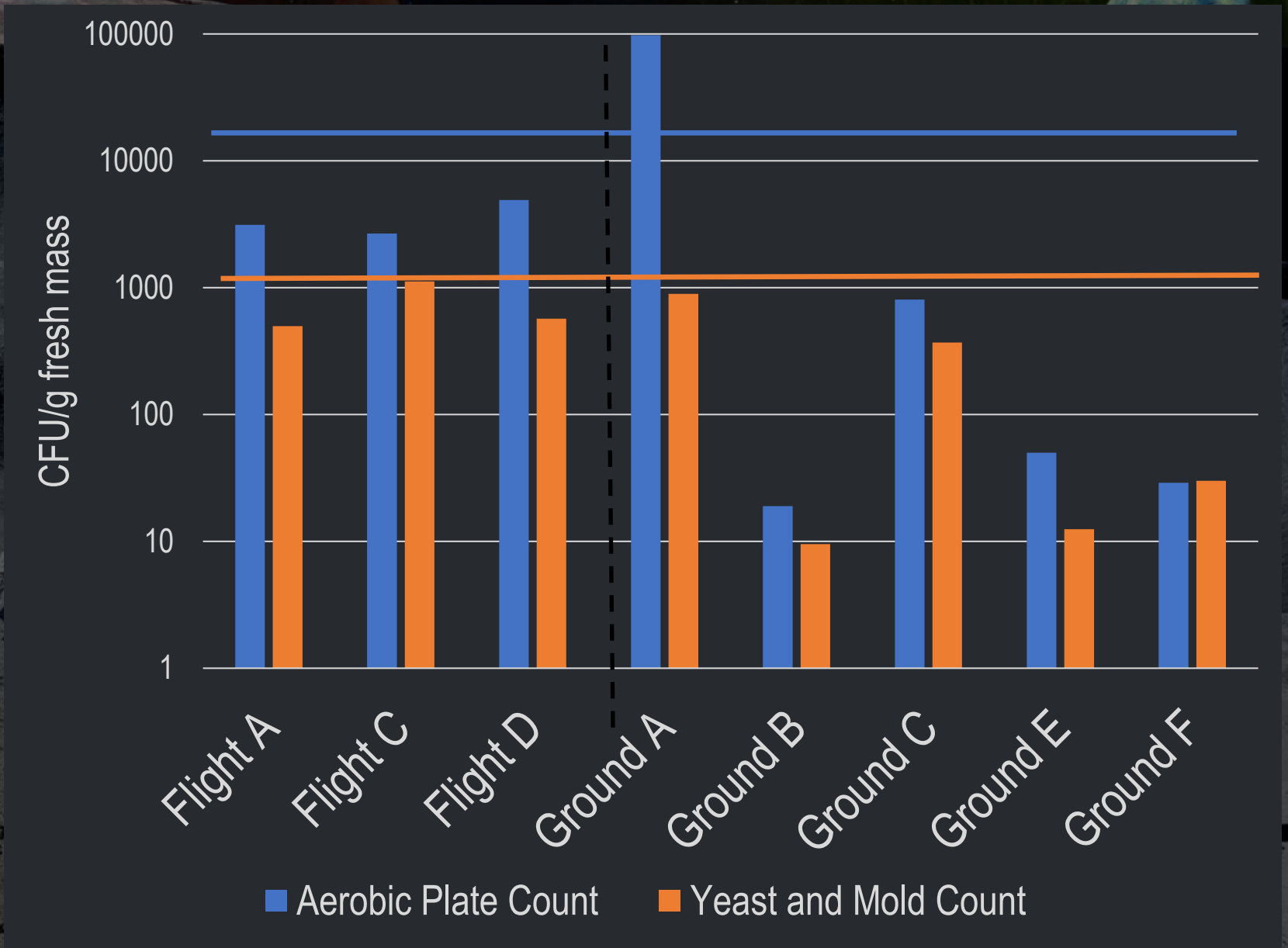


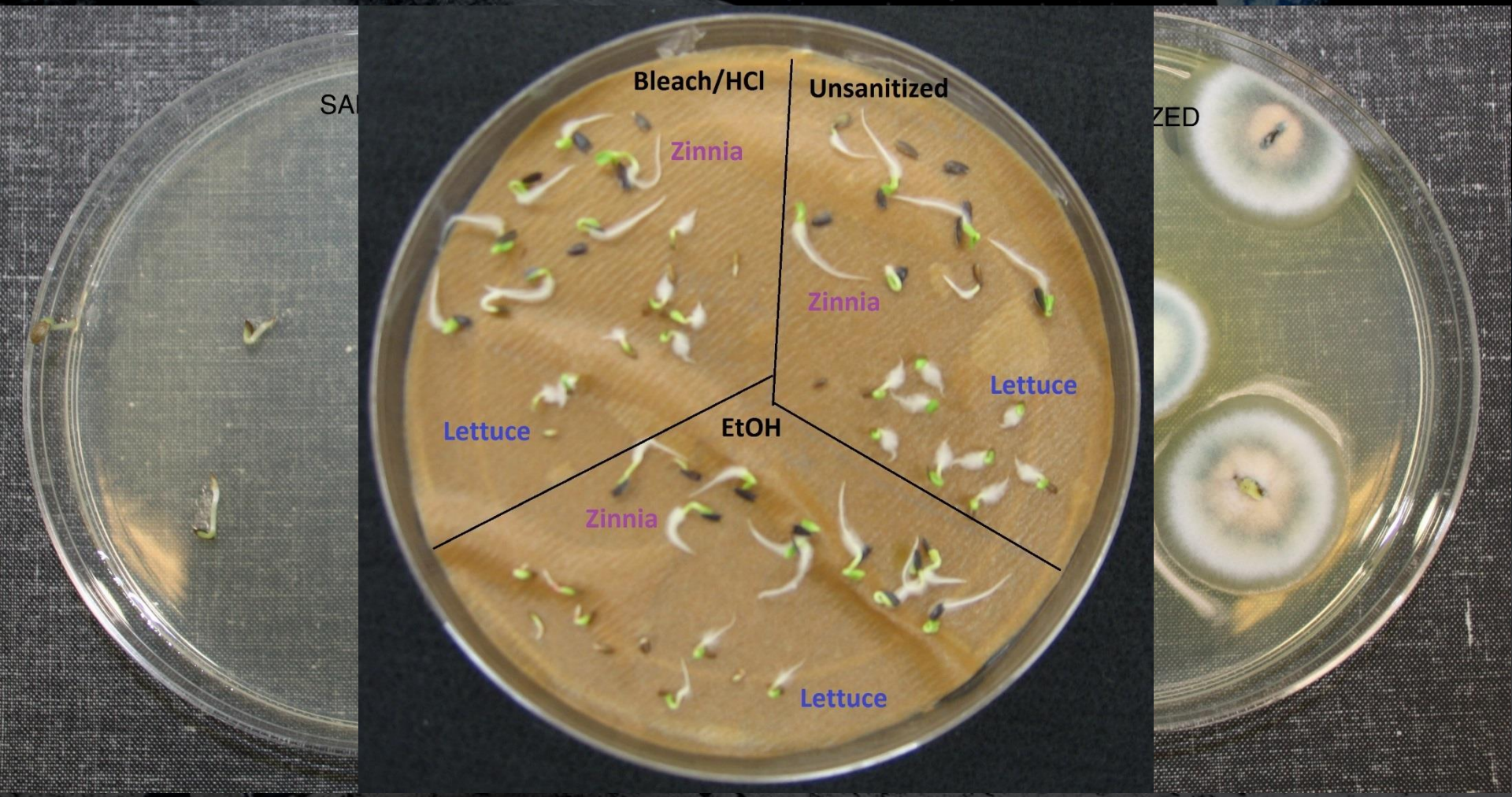
Image courtesy of Techshot and Tupperware Brands

VEGGIE MICROBIOLOGY - PLANT PATHOGENESIS

VEGGIE MICROBIOLOGY – FOOD SAFETY



VEGGIE MICROBIOLOGY – SEED SANITIZING



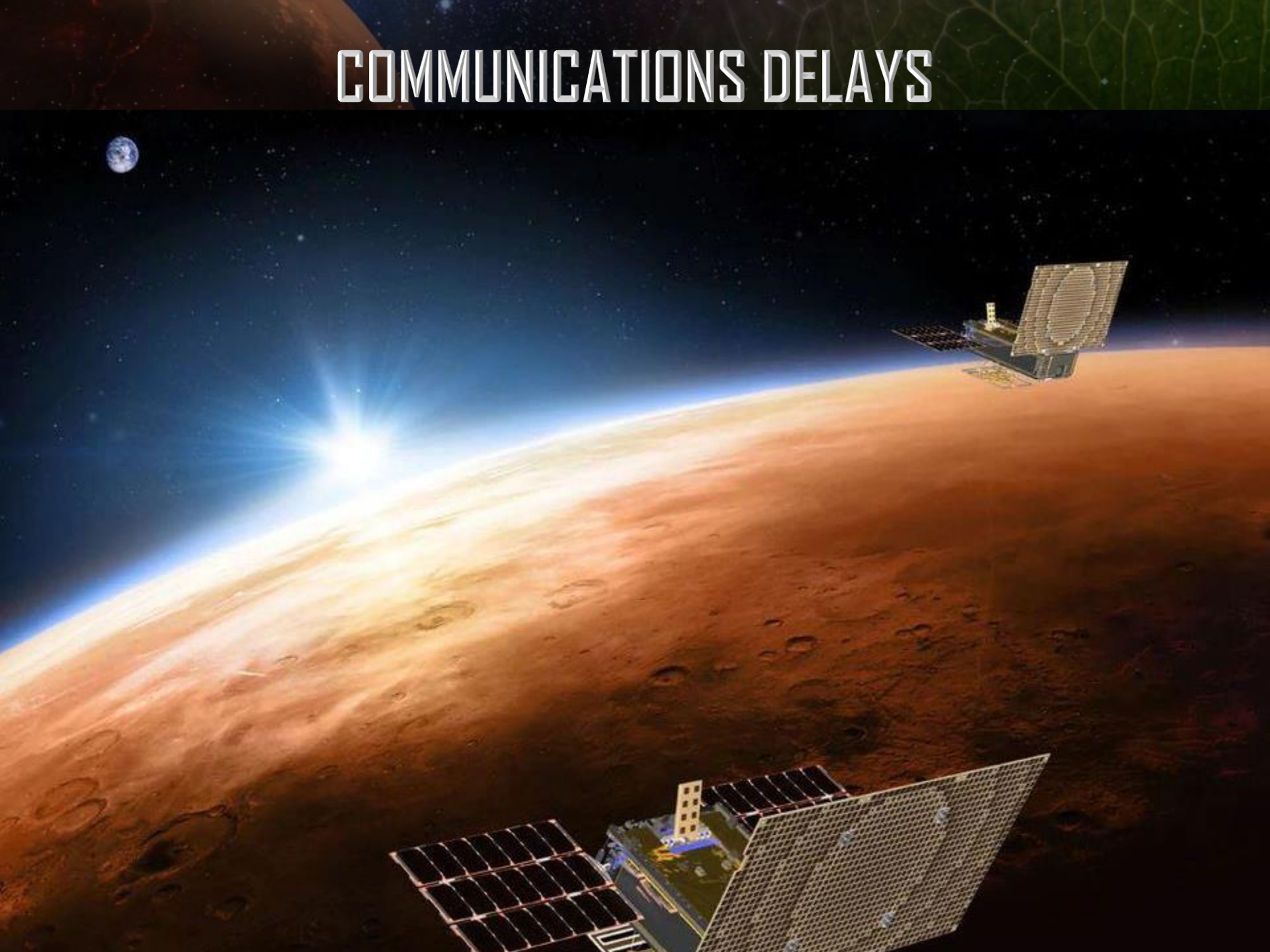
SEED HANDLING

NEW CROP TESTING AT KSC

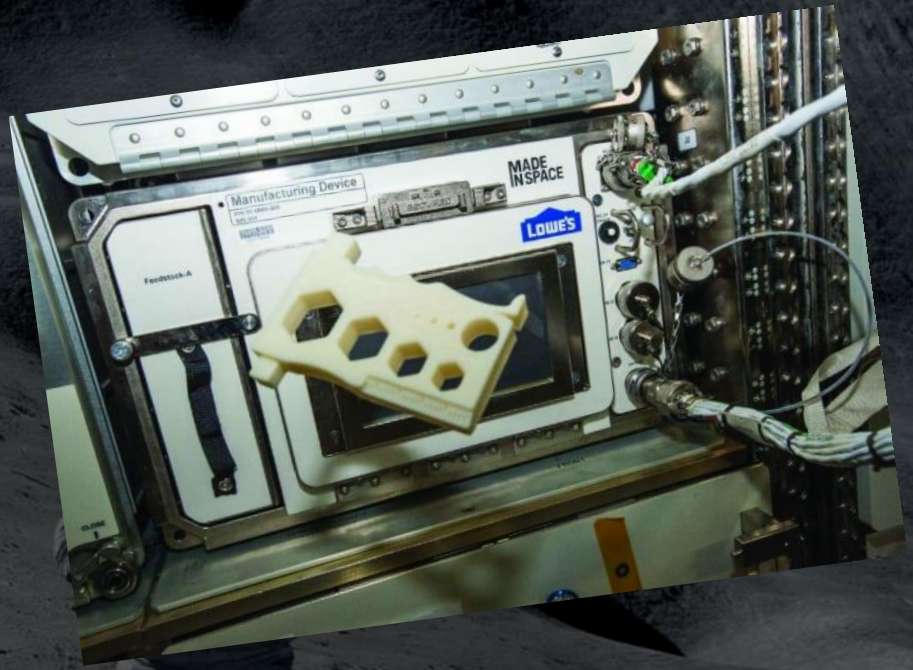
CROP PRODUCTION CHALLENGES BEYOND LOW EARTH ORBIT (LEO)

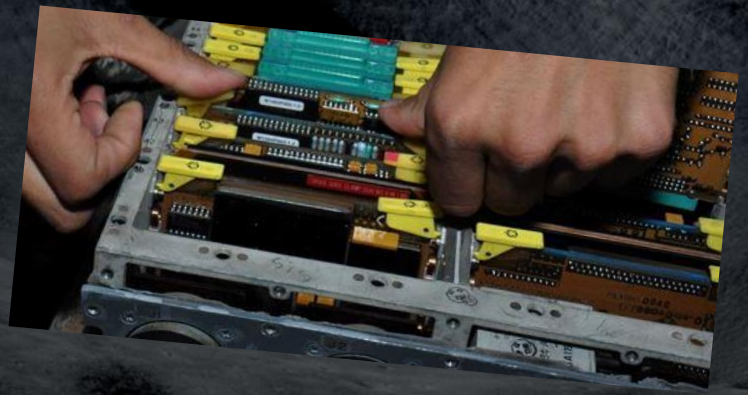
AS DISTANCES INCREASE ACCESS DECREASES

COMMUNICATIONS DELAYS

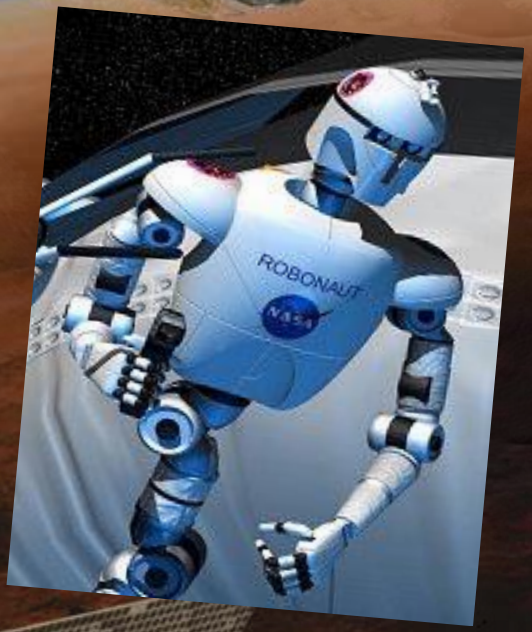


REPLACEMENT TO REPAIR

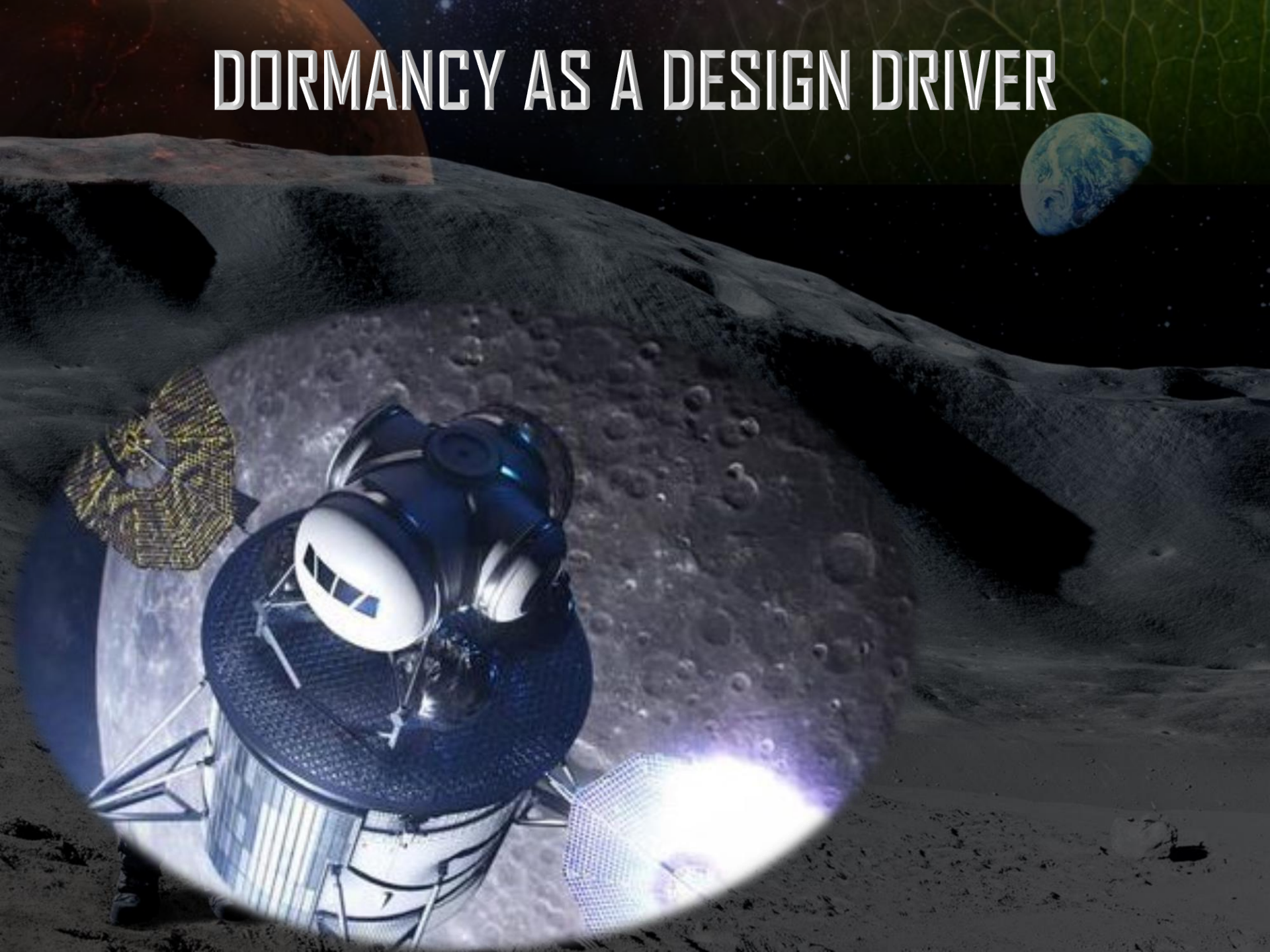




AUTOMATION AND ROBOTICS

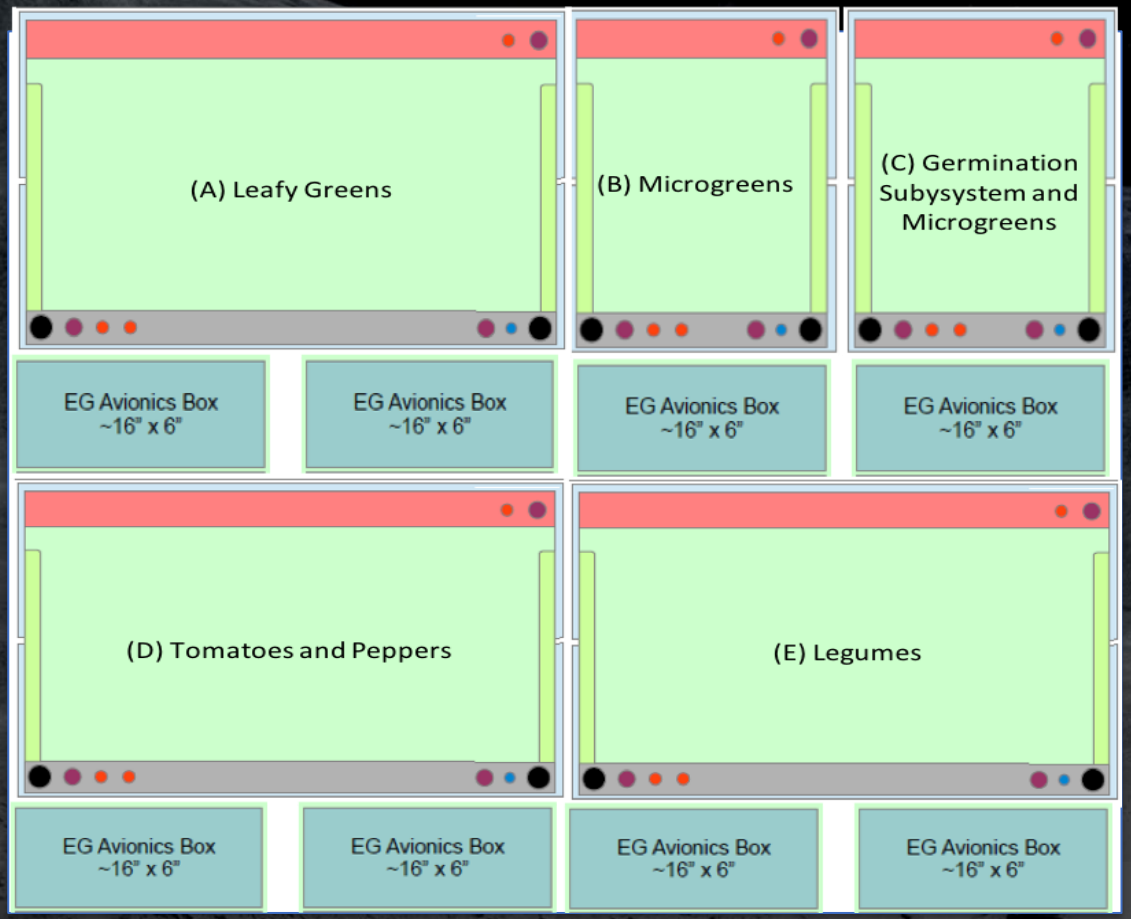


DORMANCY AS A DESIGN DRIVER



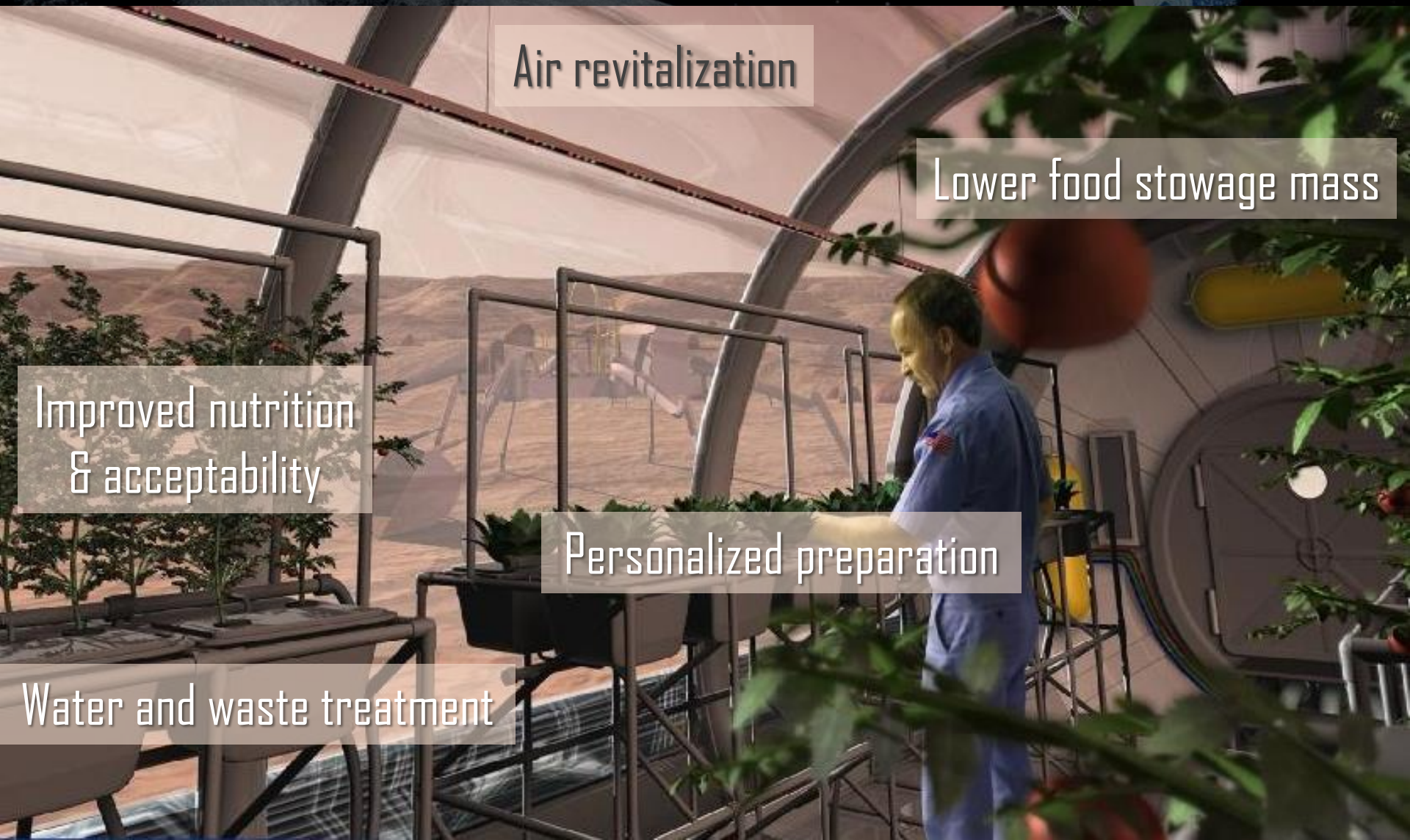
LUNAR SURFACE: THE MOON AS MARS ANALOG

DEEP SPACE TRANSIT CROP PRODUCTION SYSTEM

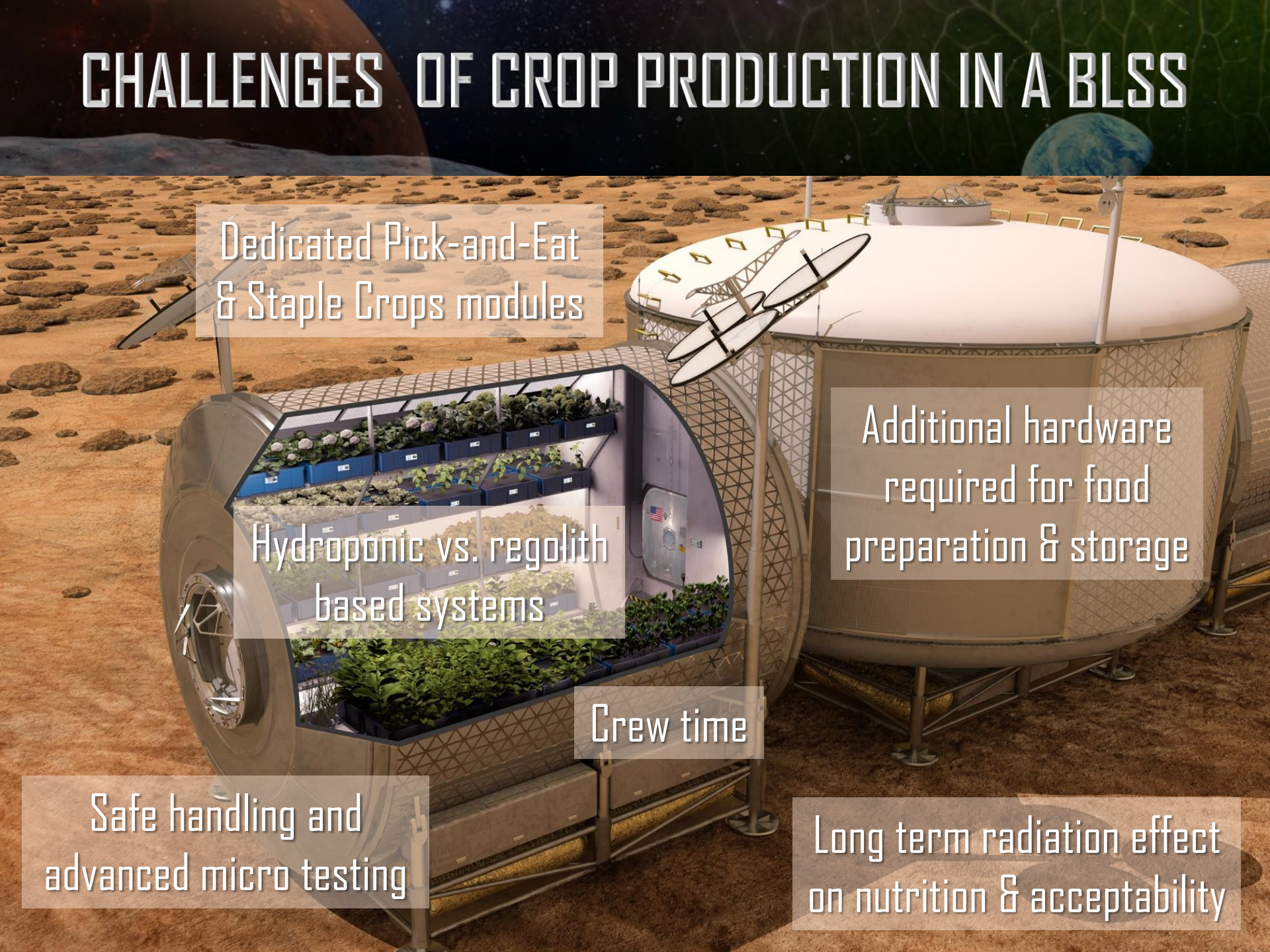


Kenji Aito

MARS SURFACE: CROP PRODUCTION AS A COMPONENT OF A BIOREGENERATIVE LSS



CHALLENGES OF CROP PRODUCTION IN A BLSS



PSYCHOSOCIAL ASPECT OF PLANTS

HAPPY CREW

Thomas Pesquet
@Thom_astro
Follow

#TGIF! On Friday we g
best food items! This ti
lettuce with lobster (cou
-chef @AstroPeggy)

RETWEETS 199 LIKES 725

11:18 AM - 16 Dec 2016

Thomas Pesquet @Tho...

#TGIF! Comm
vendredi soirs
retrouve tous
nos meilleurs
menu ici: sala
par @AstroPe

ISS Research
@ISS_Research

"Better than any le
on the ground." @
space farming is t

Peggy Whitson
@AstroPeggy

I am growing cabbage on station. I love gardening on Earth, and it is just as fun in space... I just need more room to plant more!

SPACE CROP RESEARCH BENEFITS EARTH

Credits:Smoleń et al. Scientia Horticulturae, 240: 530-543, 2018

THANK YOU! QUESTIONS?

MOON **GATEWAY** **MARS**

EXPLORE MOON to MARS