Overview of the Veggie System

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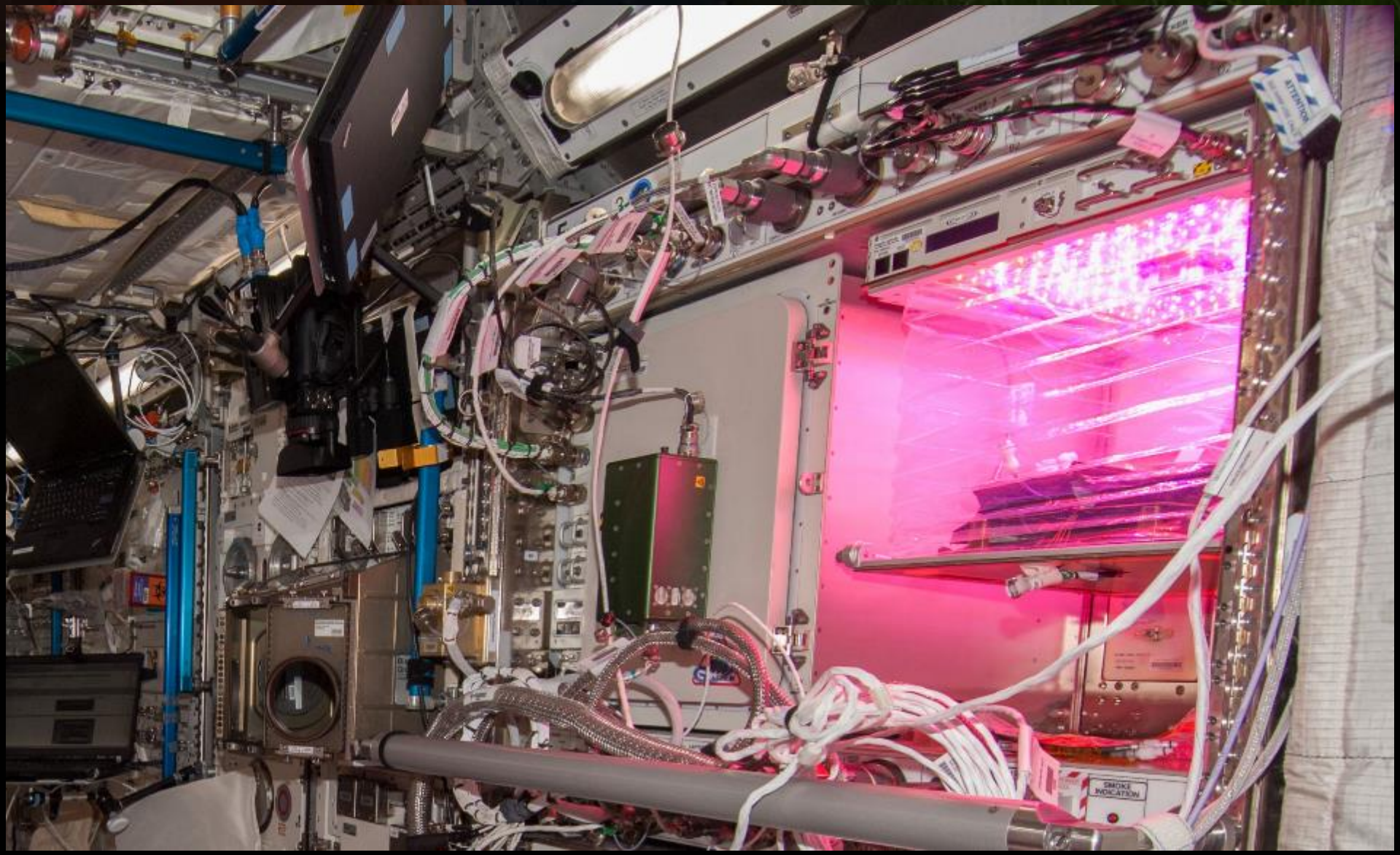
Veggie on ISS

Veg-01 experiment was initiated on 5/8/2014 by Astronaut Steve Swanson



Crop Selection for VEG-01

- Reliable germination
- Rapid growth
- Attractiveness
- Low native microbial levels
- Palatability / acceptability
- Antioxidants

VEG-01 consisted of two sets of ‘Outredgeous’ lettuce and one set of ‘Profusion’ zinnia pillows

‘Outredgeous’ red romaine lettuce

‘Profusion’ Zinnia

VEG-01A (May-June 2014)

Key Points:

- Demonstrated plant growth in Veggie
- Identified watering challenges
- Samples returned and analyzed for food safety and nutrient content
- Gained approval for crew to grow and consume second crop

Veg-01 Harvest (33 DAI)

Plant Harvest with audience– “I have my overalls on, I’m all set”

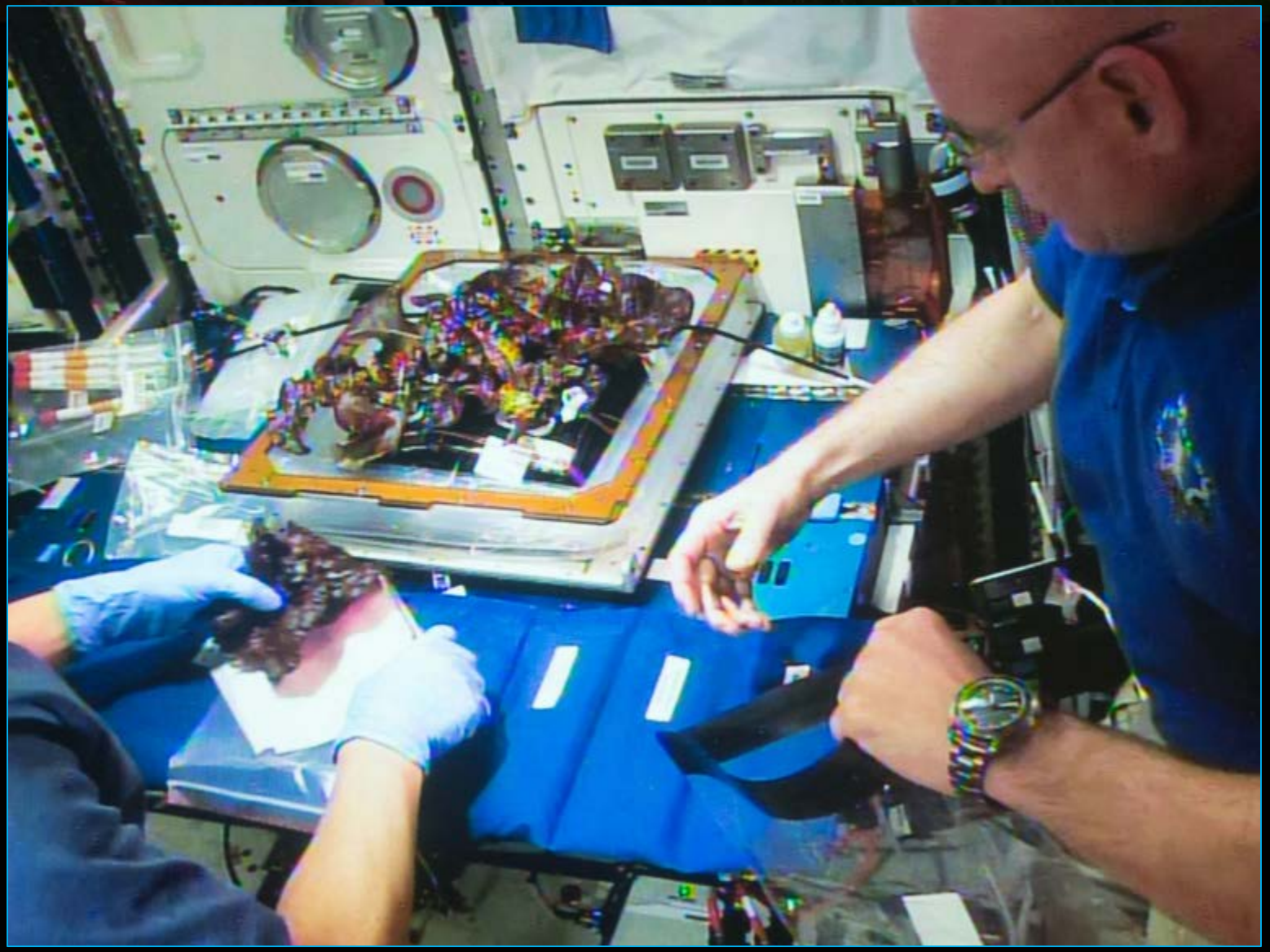
VEG-01B (June-August 2015)

Key Points:

- Better mitigation of water issues
- Tested produce sanitization
- Produce consumed by the crew
- Sub-samples returned and analyzed for food safety and nutrient content

VEG-01B Harvest (August 2015)

VEG-01 B - Sanitizing Produce



Astronaut Comments

- Scott Kelly
  - the logistical complexity of having people live and work in space for long periods
  - the supply chain that is required
  - For Mars, need a space craft that is more self-sustainable with regards to its food supply
- Kjell Lindgren
  - benefit of eating the fresh food
  - contribution that plants have to the ISS ecosystem
  - psychological benefit - it's really fun to see green growing things in the sterile environment of the ISS

VEG-01C - Third Crop – Zinnia (November 2015-February 2016)

Key Points:

- Flowering and seed formation tested in Veggie
- Long duration growth test
- Identified airflow challenges and issues with excess water
- Tested fungal mitigation techniques
- Demonstration of independent crew gardening

Water Issues / Consequences

Guttation and Leaf Curling

Fungal Development
& Abnormal Growth

Zinnia Action Shots

And they bloomed, and bloomed...

90 DAI: Harvest on February 14, 2016

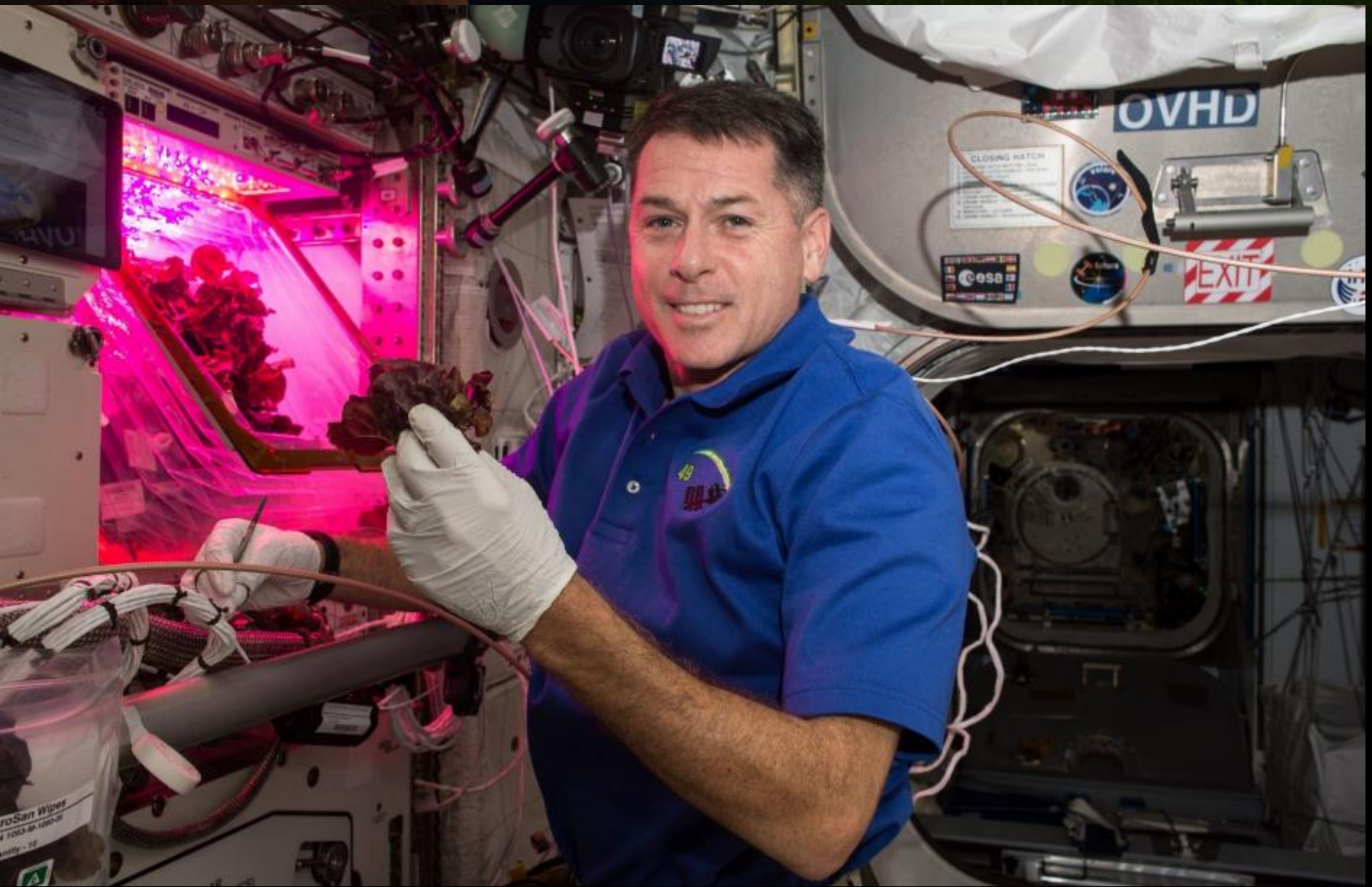
Valentine’s Day Bouquet on the ISS

VEG-03 - A, B, and C (October 2016-May 2017)

Key Points:

- Cut-and-come-again repetitive harvesting tested
- ‘Tokyo Bekana’ Chinese cabbage tested
- Varietal response to elevated CO_2 identified

VEG-03 A Cut-and-Come-Again 1st



VEG-03C Cut-and-Come-Again

VEG-03 C Cut-and-Come-Again

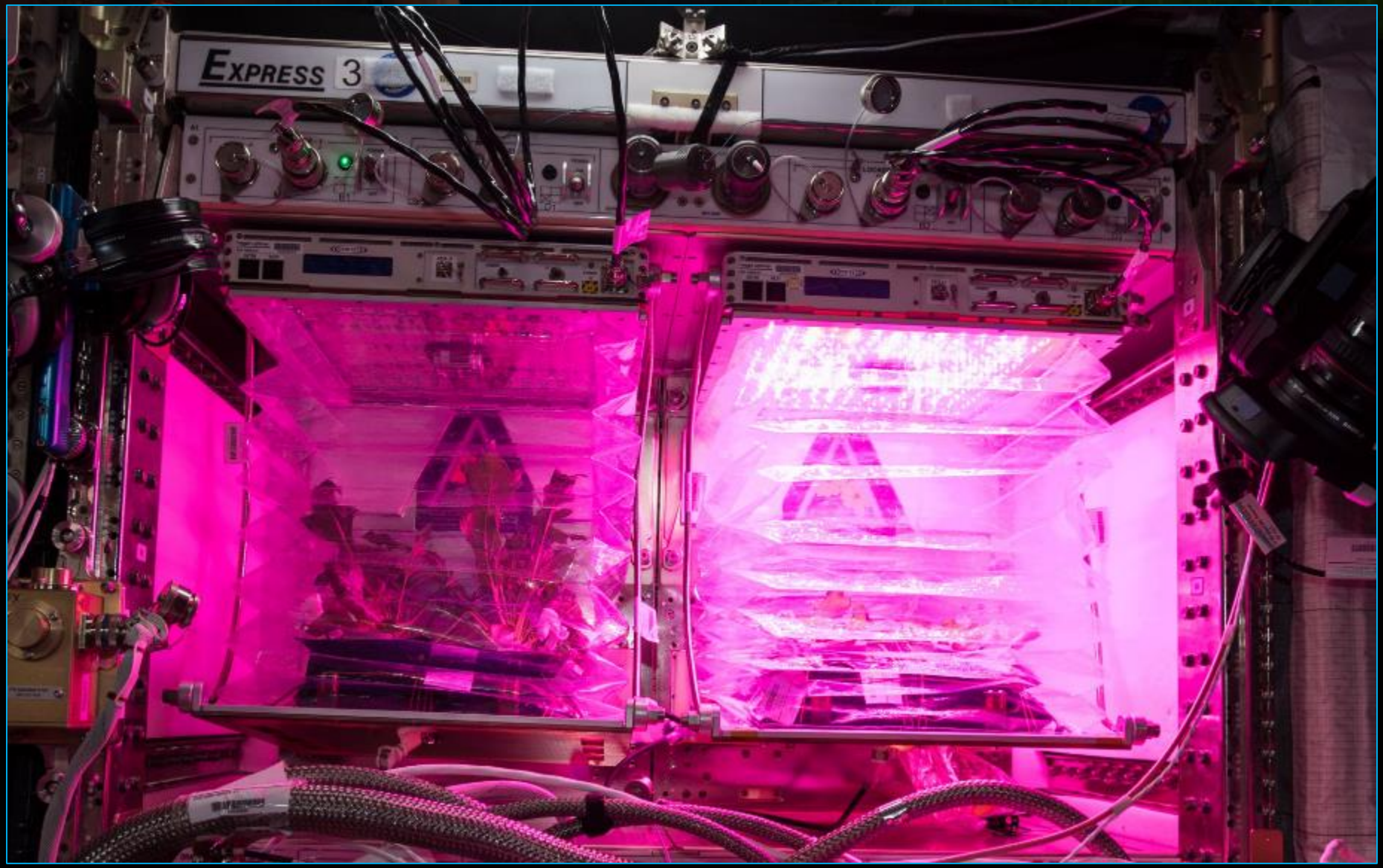
Happy Crew

VEG-03 - D, E, and F (September 2017-April 2018)

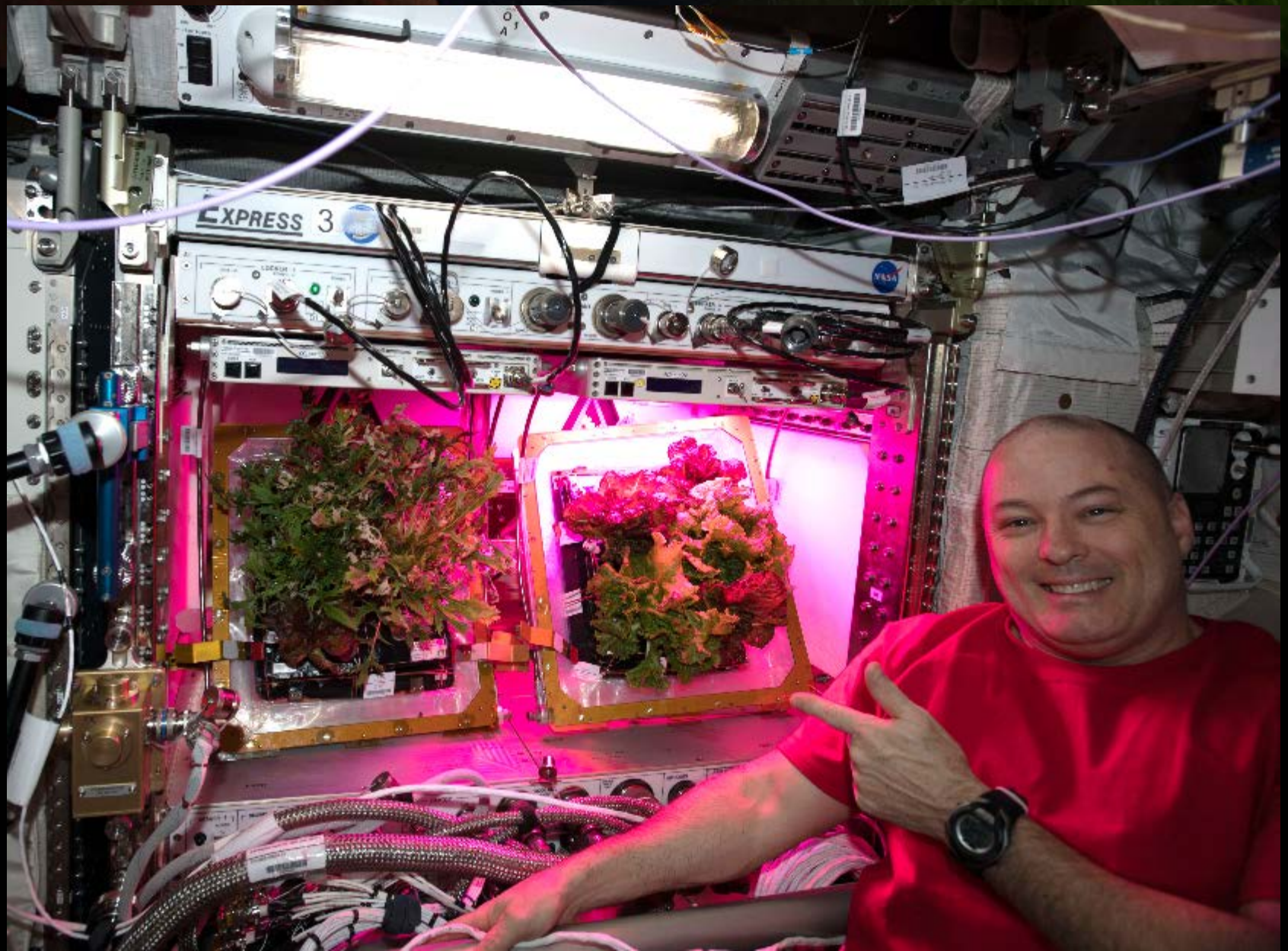
Key Points:

- Second Veggie unit installed
- Mixed crops growing simultaneously
- Additional new crops tested
- Staggered planting in two veggies for near-continuous harvest cycle

VEG-03E & F: Tale of Two Veggies



VEG-03E & F: Tale of Two Veggies



VEG-03 G, H, I - New Crops on Orbit

- Red Russian Kale
- *Dragoon Lettuce
- Wasabi Mustard
- *Extra Dwarf Pak Choy
- Outredgeous lettuce

Three sets will be grown in different combinations

*= Student Selected Crops!

VEG-03 G (October-November 2018)

Photos taken November 21. 2018

VEG-03G – RRK and Dragoon

VEG-03H – Wasabi and Pak

Fairchild Crop Morphology

Flight Extra Dwarf Pak Choi

Flight Dragoon Lettuce

Ground Dragoon Lettuce

Flight Extra Dwarf Pak Choi

Ground Extra Dwarf Pak Choi

Next Up – Light Testing, New Veggie Watering System, and New Crops!

VEG-05 Red Robin Tomato in PONDS
VEG-04 Mizuna Light Testing

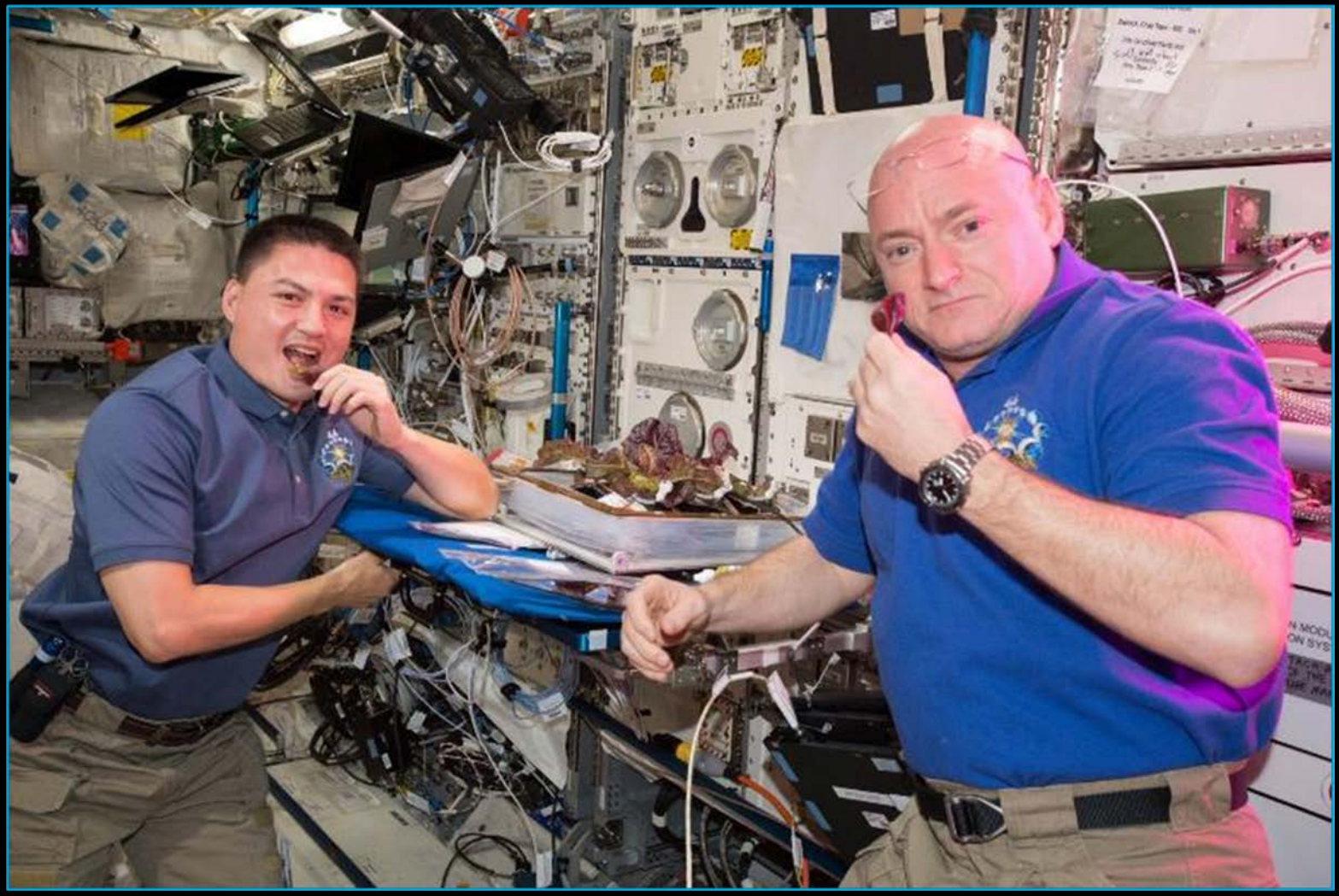
New Space Pot - PONDS

New Space Pot - PONDS

Further down the road

- Technologies to enable astronauts to sow seeds
- Different types of plants: root crops, microgreens, more leafy greens, pick-and-eat fruits, possibly peas, nuts, and beans
- More types of crops to mitigate deep space exploration nutritional needs
- Microbial ecology of plant-human-spacecraft/hab interactions
- More studies of human-plant interactions (behavioral health)
- Technologies to clean produce more efficiently
- Technologies to better monitor on-orbit crops
- Radiation experiments with seeds
- Radiation tolerance of crops (single growth and multi-generation)
- Food production scale up and associated technologies
- Long duration habitation needs (nutritional supplementation becomes caloric replacement)

Questions?



VEGGIE
Vegetable Production System