# SESSION FIVE:
# WHERE WILL WE FARM IN THE FUTURE?

**Round Table Meeting June 2023**

**Please remember to follow Chatham House Rule.**

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# Moderator
# Sylvia Wulf

## CEO
## AquaBounty Technologies, Inc.

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# AquaBounty

## Farm Foundation Roundtable

AquaBounty Technologies, Inc.
NASDAQ: AQB
June 2023

# AquaBounty: Leaders in Aquaculture and Biotechnology

## Company Profile

Headquarters: Maynard, MA
Total Employees: 110
RAS Farms: Albany, Indiana and Prince Edward Island, Canada

- Committed to feeding a growing world with land-based salmon; farmed *efficiently, sustainably and profitably*
- Pioneers in land-based aquaculture, using proprietary technology to deliver game changing solutions to global problems
- Blazed the trail for genetically engineered animal protein; overcoming political, regulatory and perceptual hurdles
- Significantly increasing profitability for salmon farming in land-based Recirculating Aquaculture Systems ("RAS")
- Leveraging 25+ years of operational experience with RAS to produce efficiently and ensure success of new farming methods

## Key Milestones

| | |
|---|---|
| 1989 | First genetically engineered ("GE") Atlantic salmon line created |
| 1995 | Regulatory approval process begins for GE salmon |
| 2015 | U.S. Food and Drug Administration ("FDA") approves GE salmon for consumption in the US |
| 2016 | Health Canada approves GE salmon for consumption in Canada |
| 2017 | AquaBounty purchases Indiana Farm |
| 2018 | Conventional salmon eggs enter Indiana farm hatchery |
| 2019 | GE salmon eggs enter Indiana farm hatchery |
| 2020 | First conventional salmon harvested in June |
| 2021 | First GE salmon harvested in May<br>Selected Pioneer, OH for first large-scale farm<br>Regulatory approval for GE salmon granted in Brazil in June |
| 2022 | Broke ground on Farm 3 site in Pioneer, Ohio |

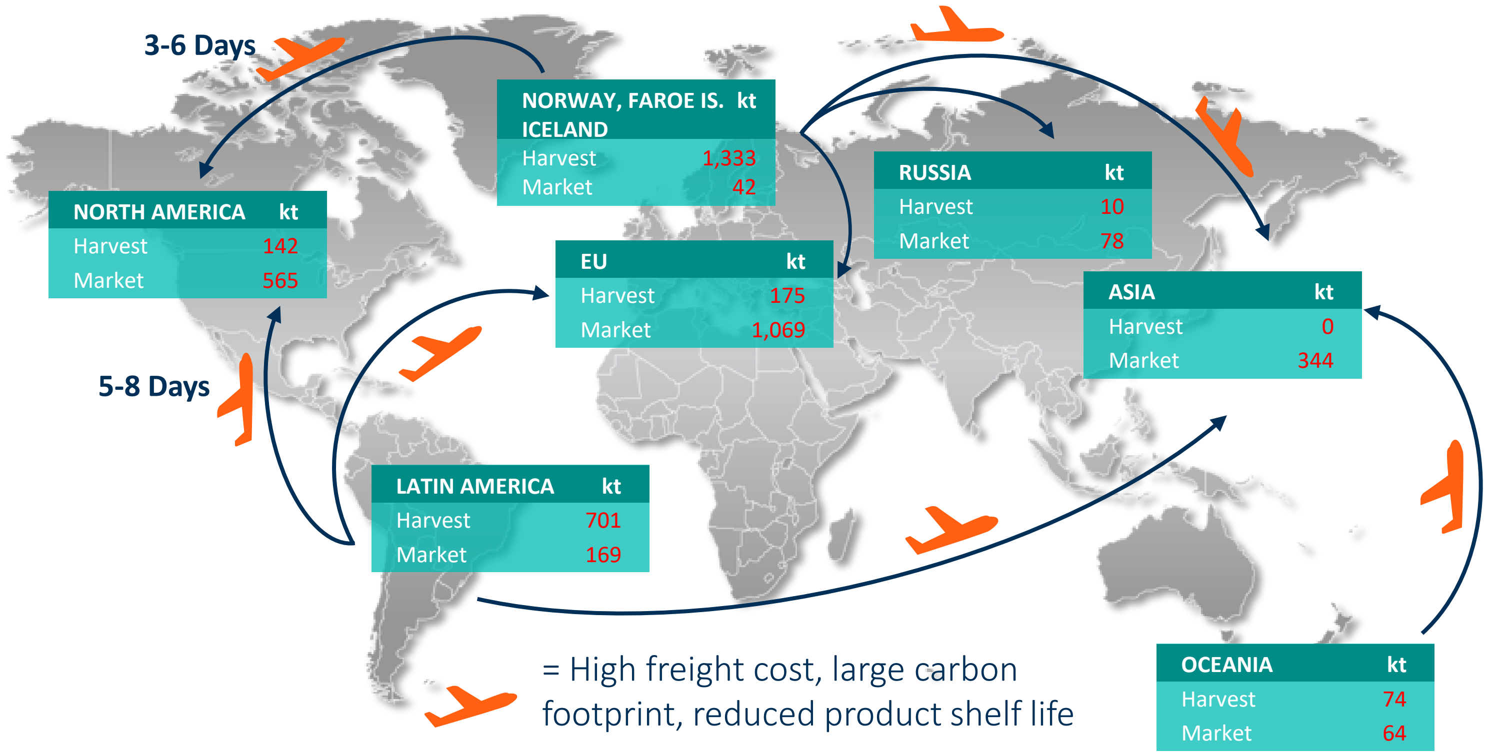
# What Differentiates AquaBounty?

AquaBounty has four core competencies that provide us with a competitive advantage over other forms of aquaculture

- Proprietary GE Atlantic salmon that grows to harvest size faster while consuming less feed providing greater output while consuming less feed versus conventional Atlantic salmon.
- Land-based RAS experience operating farms for over 25 raising Atlantic salmon to maturity by controlling and optimizing their living environment for their general health and productivity
- Vertical integration managing our own Broodstock and egg production with proprietary genetics. Also supplying non-transgenic eggs from our bio-secure pathogen free facility
- Research and development with expertise in biology, chemistry and RAS operations enabling us to continuously focus on improving the breeding, genetics and health of our fish and improving the efficiency of our farm

# Atlantic Salmon – Large Market With Inefficient Supply Chain

## Land-Based RAS Farming Has Potential to Disrupt The Industry




Global Atlantic Salmon Market[2] =
2.6 million metric tons[3] worth $17.1 billion[3]
(Global supply is estimated to grow 4% annually from 2021 to 2026)

### Market Dynamics

Demand Drivers:

- Salmon is widely known to be healthy & nutritious[1]
- Growing population and rising middle class, bringing an increased demand for healthy protein
- COVID-19 drove demand for salmon for at home preparation
- Per capita consumption of seafood has increased at an annualized rate of 1.3% over the last five years[5]

Inefficient Supply Chain:

- Current sea-cage operations are highly dependent on-air freight
- Supply is constrained in production locations for environmental & regulatory issues related to production methods

1. Salmon Nutrition: Everything You Need To Know About Salmon – NFI, July 1, 2019. A Guide To Eating Seafood During Pregnancy – Dish On Fish, April 25, 2019
2. Kontali Analyse - Mowi Handbook 2021
3. FAO Statistical Data Search May 11, 2021
4. Undercurrent News (August 30, 2021): US Atlantic Salmon Market in Midst of Unprecedented Rebound
5. IBISWorld "Fish & Seafood Aquaculture in the US" April 2021

# AquaBounty's GE Salmon:
# Better for the Environment. More for Consumers.

## Enhanced Benefits of Controlled Operations Compared To Sea-Cage Farming

### Faster Growth

Critical during most vulnerable stages of fish lifecycle

### Lower Carbon Footprint

Greater than 95% water recycled and reduced transportation to consumption

### Less Feed Used

25% improvement in Feed Conversion Rate (FCR)[1]

### Aquaponics / Hydroponics

Efficient use of resources and waste utilization as agriculture fertilizer

### Biosecurity

Designed to prevent escapement and impacts on broader ecosystem

### No Chemicals or Antibiotics

Reduced risk of infections commonly seen in sea-cage farming

### Customer Value Proposition

Pricing strategy aligned to market rates with potential to raise prices upon production of Superior Grade salmon

1. Effects of combined 'all-fish' growth hormone transgenics and triploidy on growth and nutrient utilization of Atlantic salmon (Salmo salar L.) fed a practical grower diet of known composition – Elsevier, May 24, 2013

# AquaBounty in Pioneer, Ohio

Preliminary Rendition of Pioneer Farm

## Site Overview

- Estimated Square Footage: 479,000 sq. ft.
- Expected to create 100+ jobs
- Expected Construction Completion: Q2 2025

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# David Nothmann

## Investor, Board Member and CxO Multiple Ag Related Entities

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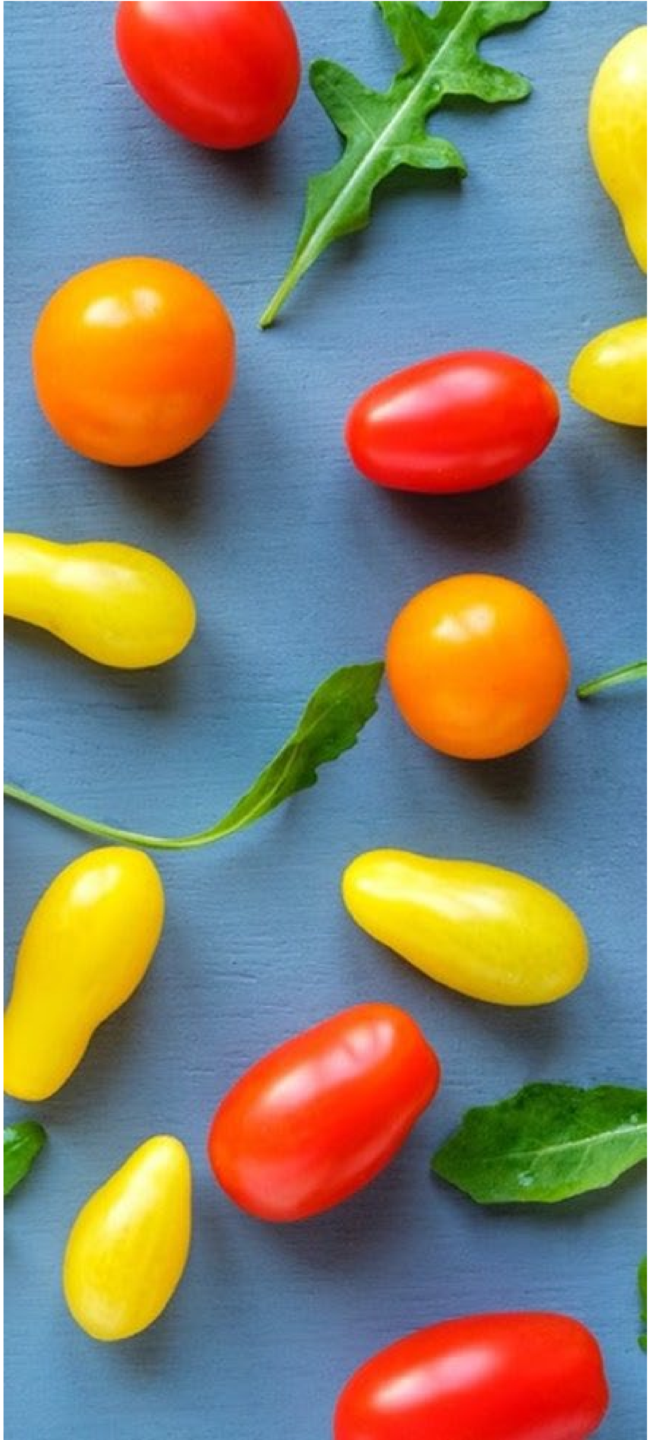
Farm Foundation
David Nothmann
June 2023



# What is CEA?

CEA or Controlled Environment Agriculture is farming within partially or fully artificially controlled environments

## Greenhouse

The most common and commercially viable form of CEA utilized around the world that leverages sunlight.

## Vertical Farming

Purely indoor growing where every variable of a crop's input is controlled, and sunlight is replicated by electricity.

## Hybrid

State-of-the-art hybrid facilities that fully leverage the bountiful energy of our Sun and the scalability and land optimizations of Vertical Farming.

# Why CEA?

Traditional farming is facing several increasingly urgent problems creating opportunities to deliver sustainable innovations.

## CEA Can Deliver

- Chemical free foods
- Locally produced
- With 95% less water
- On 1% of the land footprint
- Predictable, year-round yields
- Reduced emissions

### Increasing Demand

- The world is expected to feed **2 billion more people** in the next 30 years
- Affluence & urbanization will drive increased demand for fresh foods in cities and urban areas

### Resource Constraints

- Fresh water availability is challenged by population growth and climate change
- Arable land is being rapidly eroded by current industrial farming techniques

### Health

- Better availability of healthy foods is a key pillar to tackling the obesity and diabetes epidemics
- Increasing concerns about pesticide residues and their impact on human health

### Supply Chain

- 1.3 billion tons of edible food lost globally each year [source: FAO]
- Current geopolitical situation and recent supply chain shocks have built political pressure for greater food supply self-reliance

Source: Chalsys Impact, LLC, *CEA Presentation.* © 2020

# Market Overview

Market opportunity segmentation in VF/CEA will map concentrically against geography and population density.

**There are 3 large white space opportunities:**

Nursery/MiniFarms; GigaFarms and Genetics – which will be valuable across all segments.

New Genetics & Optimization is needed in all Market Segments

MicroFarms
<20 sq ft

Nurseries & MiniFarms
<30,000 sq ft

MidiFarms
100k-200k sq ft

MegaFarms
+1M sq ft

GigaFarms
×
Scale Energy Production

Source: Chalsys, LLP, *CEA Presentation.* © 2020

# The Reality of Vertical Farming: we've entered the "Trough of Disillusionment"

## A Limited Solution

Apart from leafy greens and very niche markets, current technology is not capable of growing a nutritionally complete meal and we are not addressing some core operational issues.



**+**

## Business Model Challenges

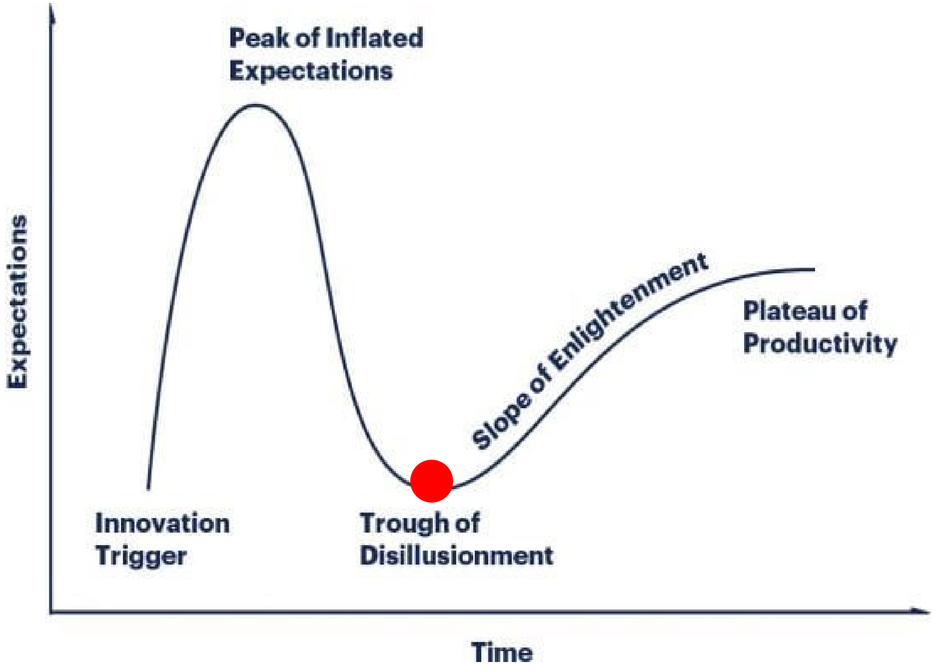
Too much Tech

Insufficient Cash Flow

High Energy Costs

"Go it Alone" Attitude

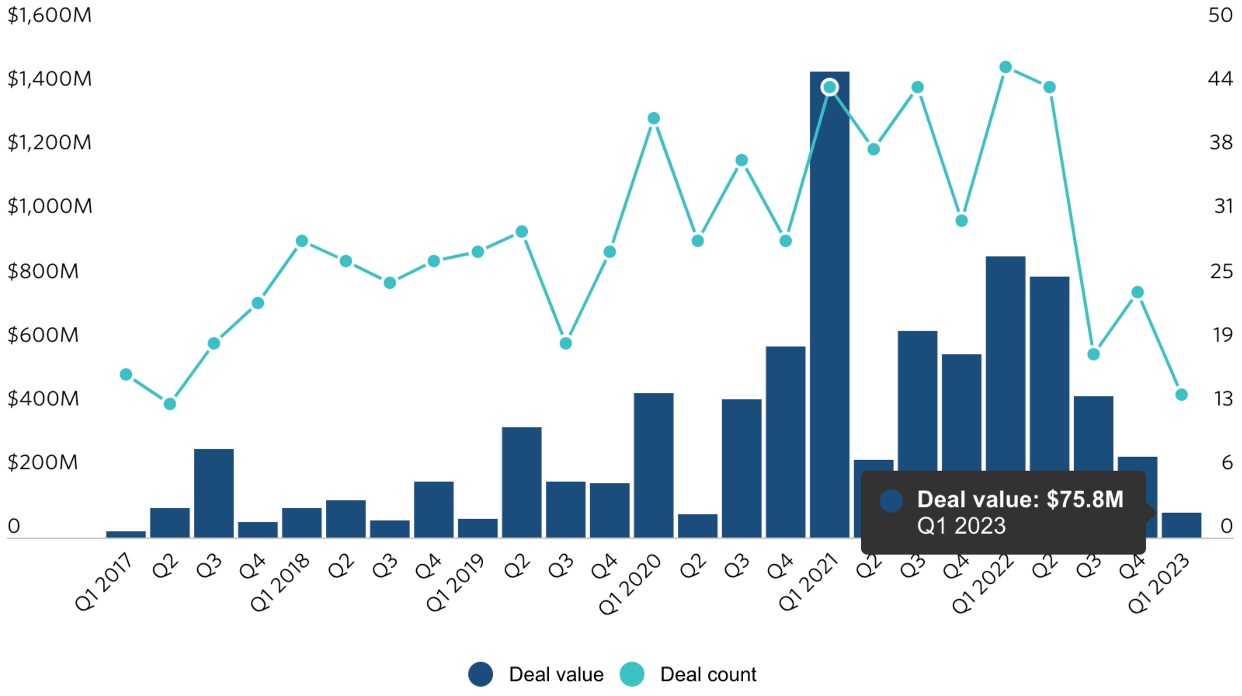
**=**




Bankruptcies, Restructuring, Reductions in Force (RIFs), Consolidation

# (Expensive) Money is Drying Up

## VC funding of indoor farms is on track for its lowest annual total in five years




Source: PitchBook Data

## Opportunity remains for the right business model(s)

- Cash Flow and Profitability Focus
- Right Tech Right Time
- Emphasis on Real Value Drivers
- Collaborative Approaches
- Diversification of Funding Sources

# Addressing Vertical Farming Needs

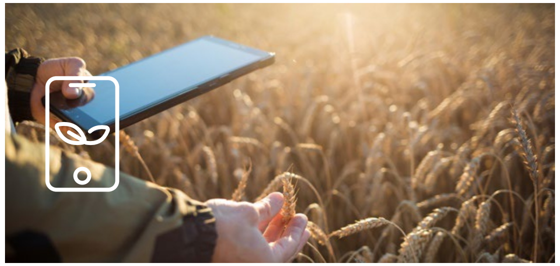
Opportunities to bridge the genetics and data gap for the Vertical Farming industry

## Superior Germplasm

Deliver a consistent supply of high value, quality-controlled, and diverse germplasm to vertical farm operators across the globe

## Agronomics

Develop purpose-built varieties to meet the unique operational challenges and opportunities of the vertical farm environment



## Computational Biology Platform

With scale collection and processing on plant data, create "digital twins" of plant varieties enabling predictive digital breeding.

# Summary

## White Spaces for Innovation

CEA still has a great deal of white space available to innovate and build value

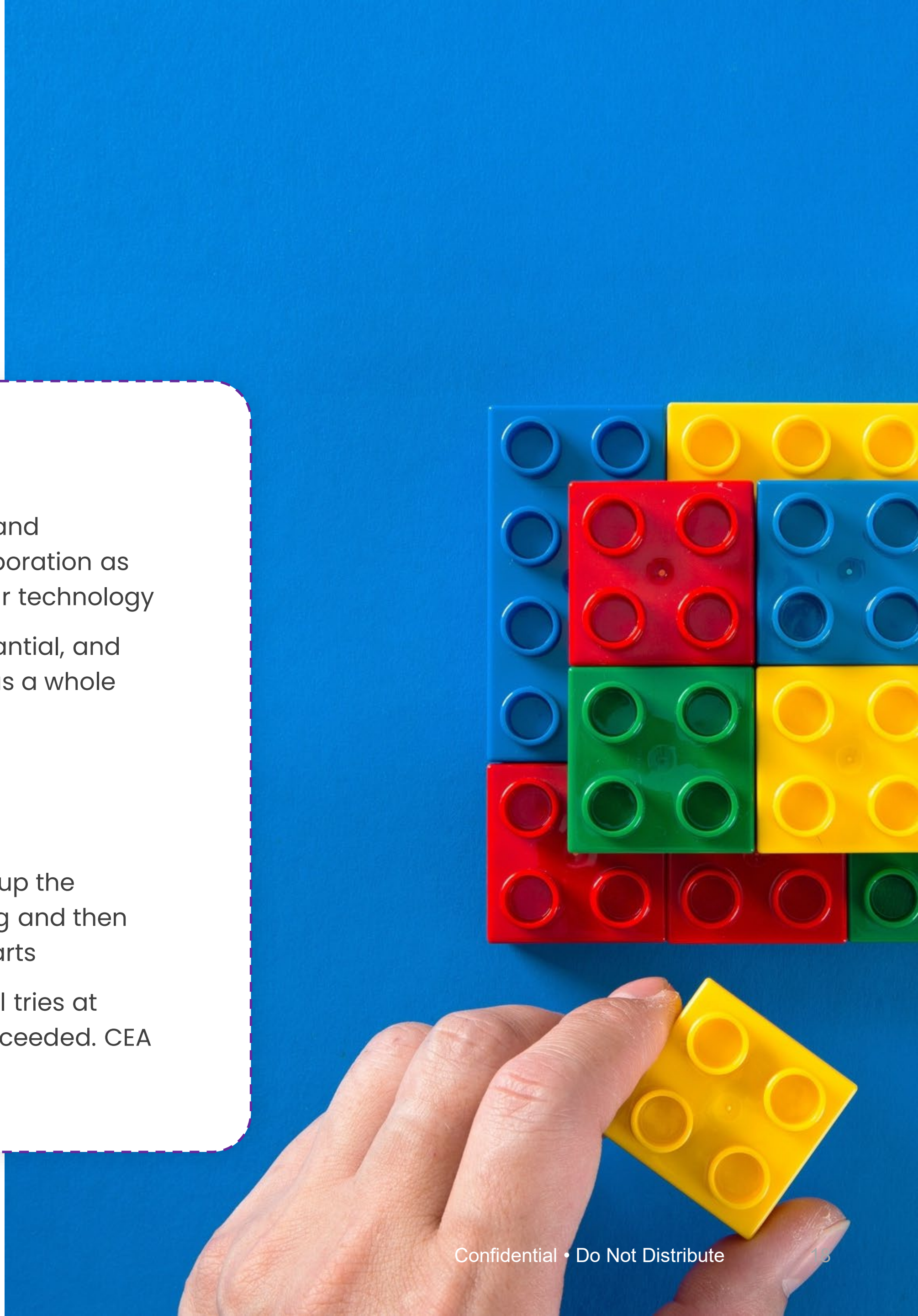
Agriculture Value Chain

### Innovation by Collaboration

- In this value chain, automation and innovation will come from collaboration as opposed to promoting a singular technology
- Data flows will have to be substantial, and shared, in order for agriculture as a whole to benefit.

### Rebuilding the Value Chain

- Disruption comes from breaking up the traditional value chain, recreating and then re-integrating the component parts
- The major innovators had several tries at business models before they succeeded. CEA will be the same.



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# Robert Saik

## CEO
## AGvisorPRO

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# Anna-Lisa Paul

## Research Professor and Director of ICBR University of Florida

# Feeding Explorers – Taking Agriculture off Planet

Farm Foundation Round Table

June 2023

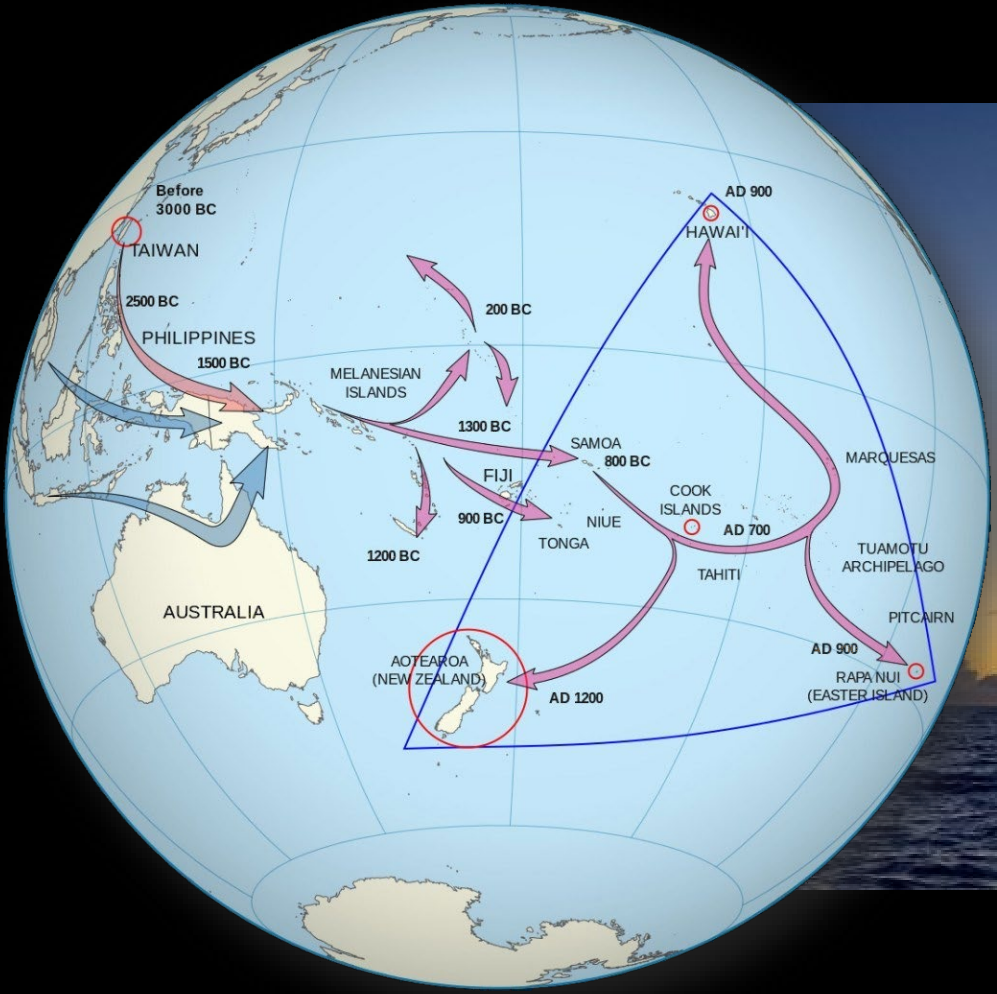
Anna-Lisa Paul

Department of Horticultural Sciences
Program in Plant Molecular and Cellular Biology
Interdisciplinary Center for Biotechnology Research

UF | IFAS
UNIVERSITY of FLORIDA

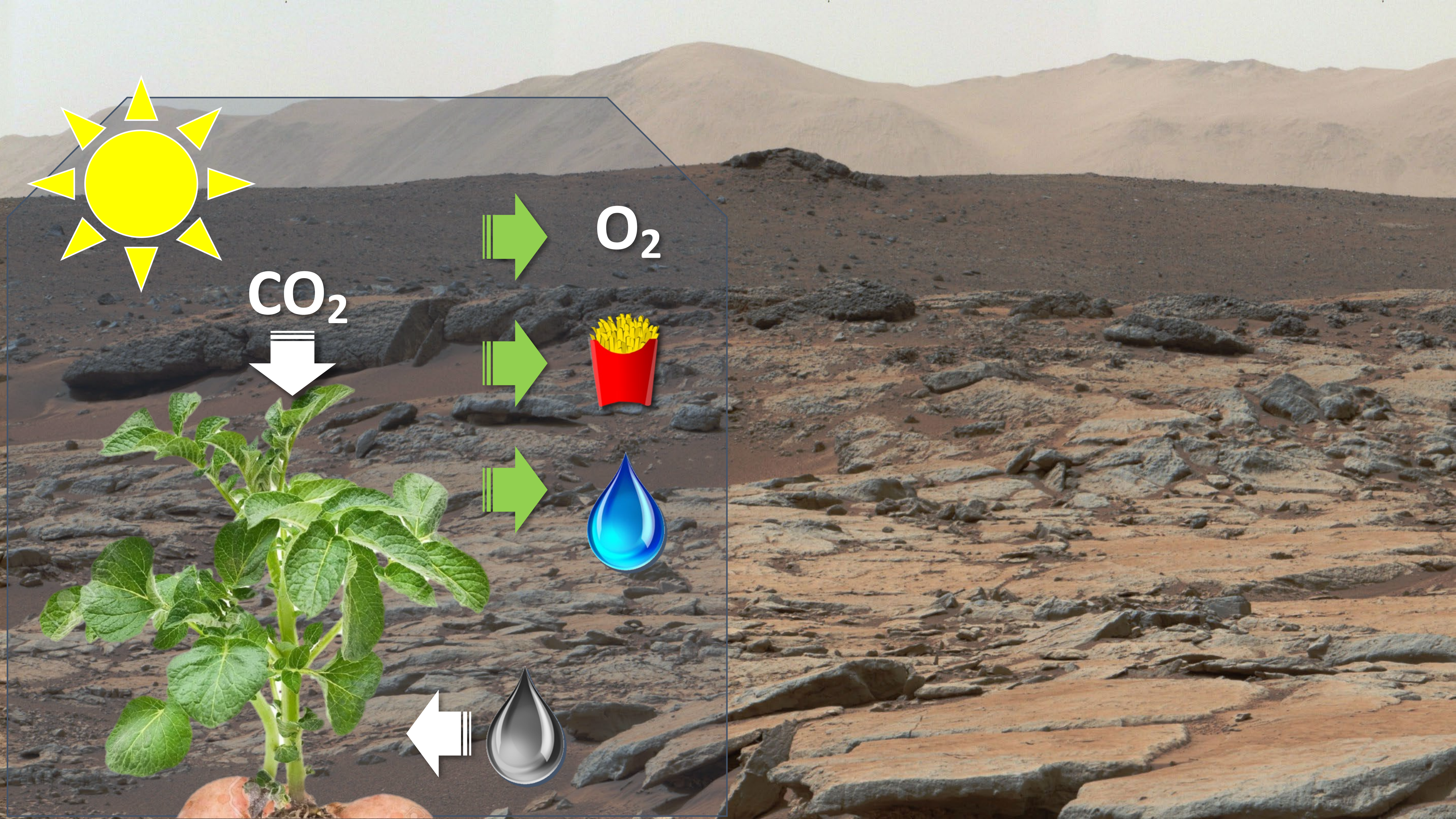
UF | Space Plants
UNIVERSITY of FLORIDA
https://hos.ifas.ufl.edu/spaceplantslab/
A-L Paul & R.J. Ferl

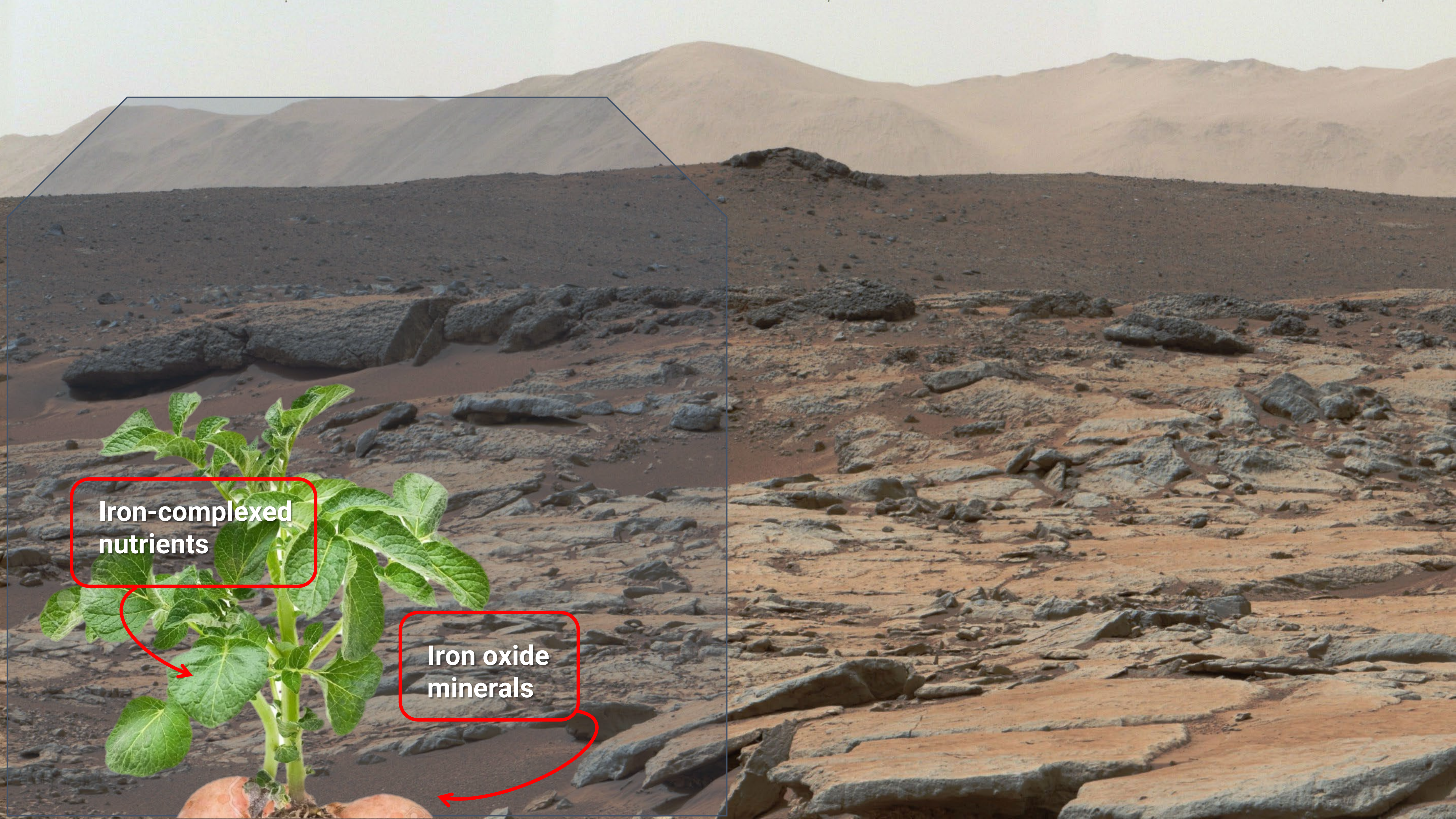
# When we explore, we take our biology with us.

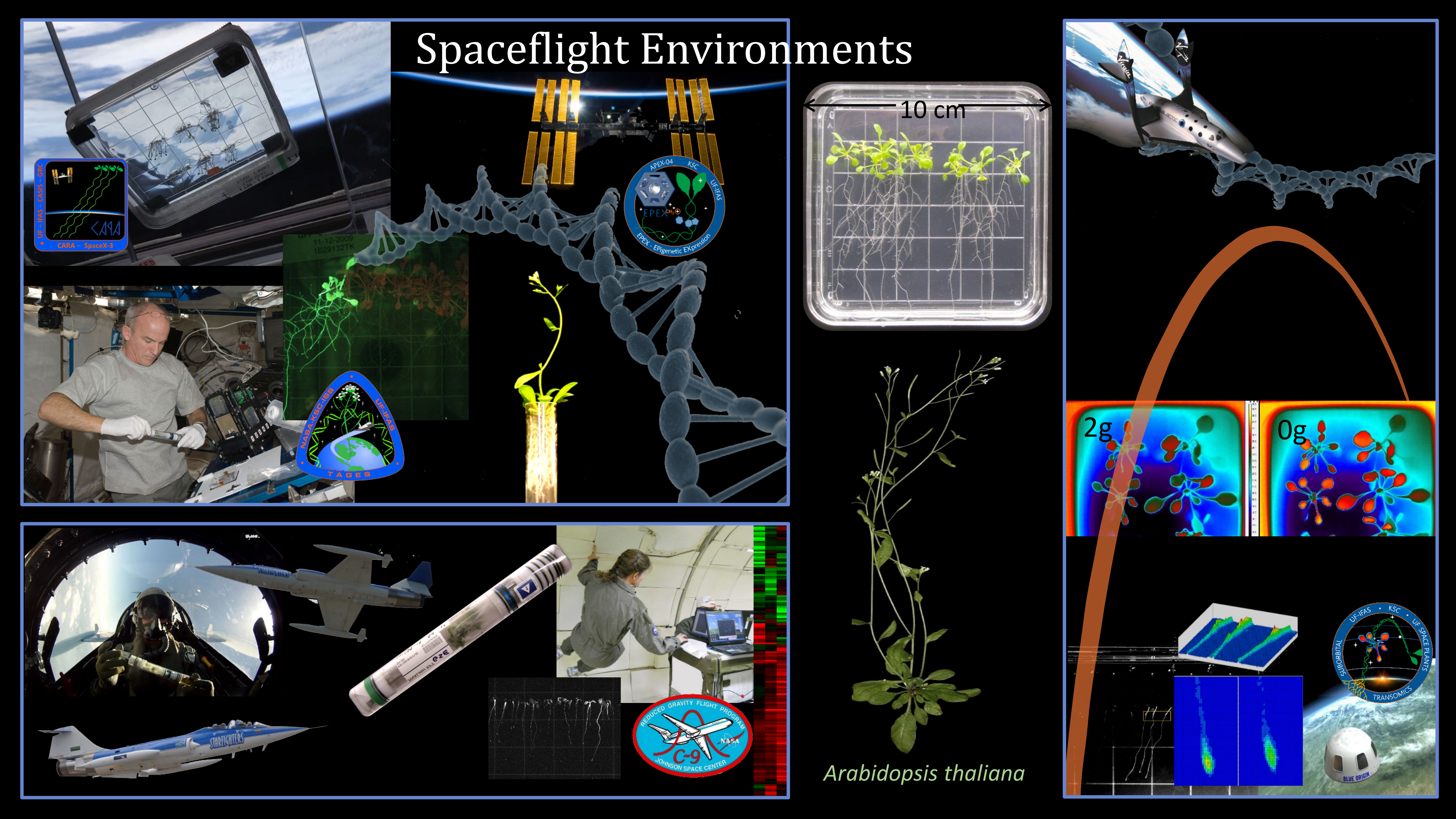



Exploring past the limits of a picnic basket requires we include plants in the journey

A reliable food supply is what allows us to BE explorers


$O_2$
$CO_2$


Iron-complexed nutrients
Iron oxide minerals



Spaceflight Environments
CARA – SpaceX-3
APEX-04
KSC
UF-IFAS
EPEX - EPigenetic EXpression
NASA-KSC-ISS
UF-IFAS
TAGES
10 cm
Arabidopsis thaliana
2g
0g
STARFIGHTERS
REDUCED GRAVITY FLIGHT PROGRAM
NASA
C-9
JOHNSON SPACE CENTER
UF-IFAS
KSC
UF SPACE PLANTS
SUBORBITAL
TRANSOMICS
BLUE ORIGIN

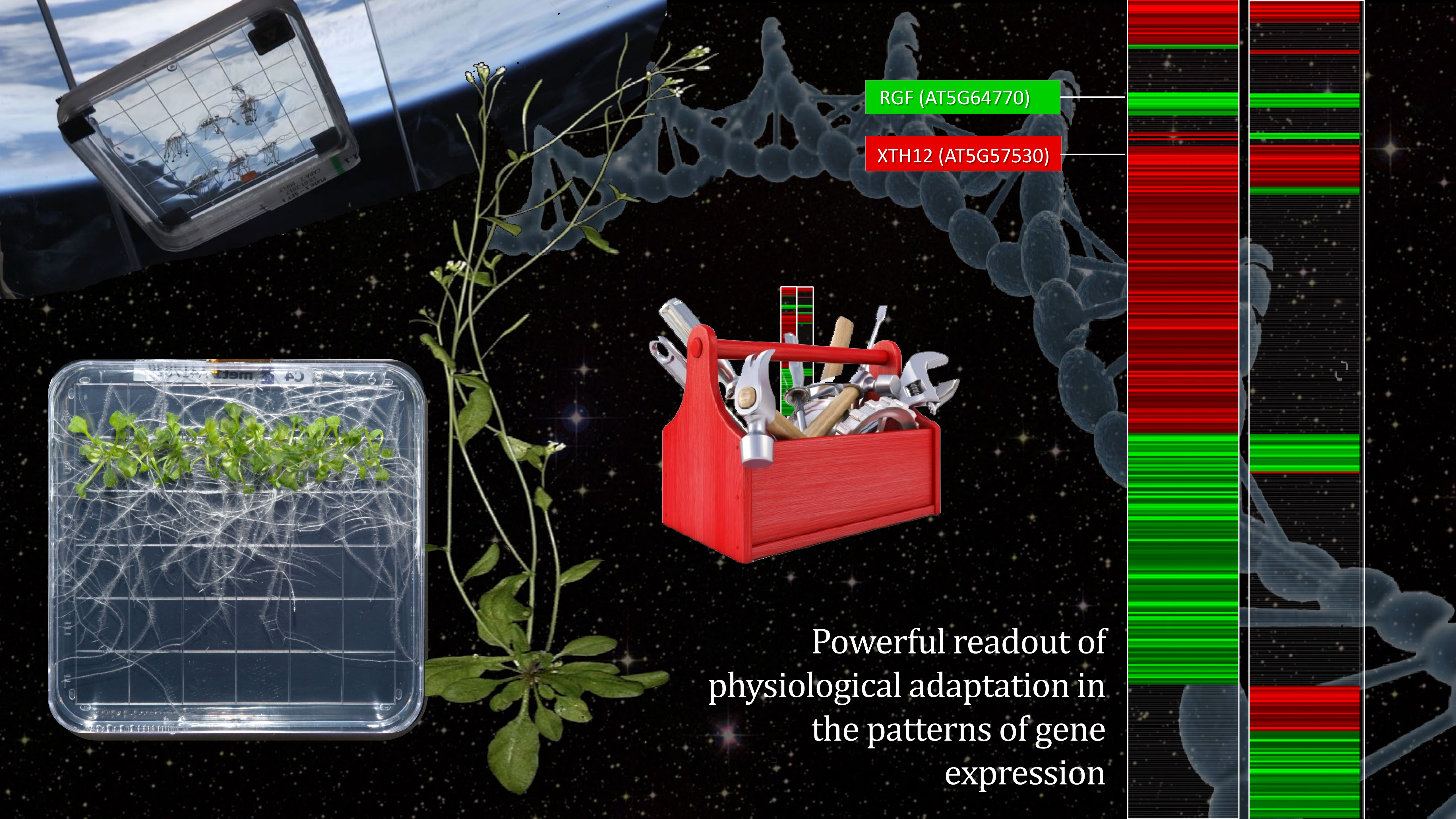
# Planetary Analog Environments

Devon Island, Canadian High Arctic (HMP)

Neumayer III Station, Antarctica

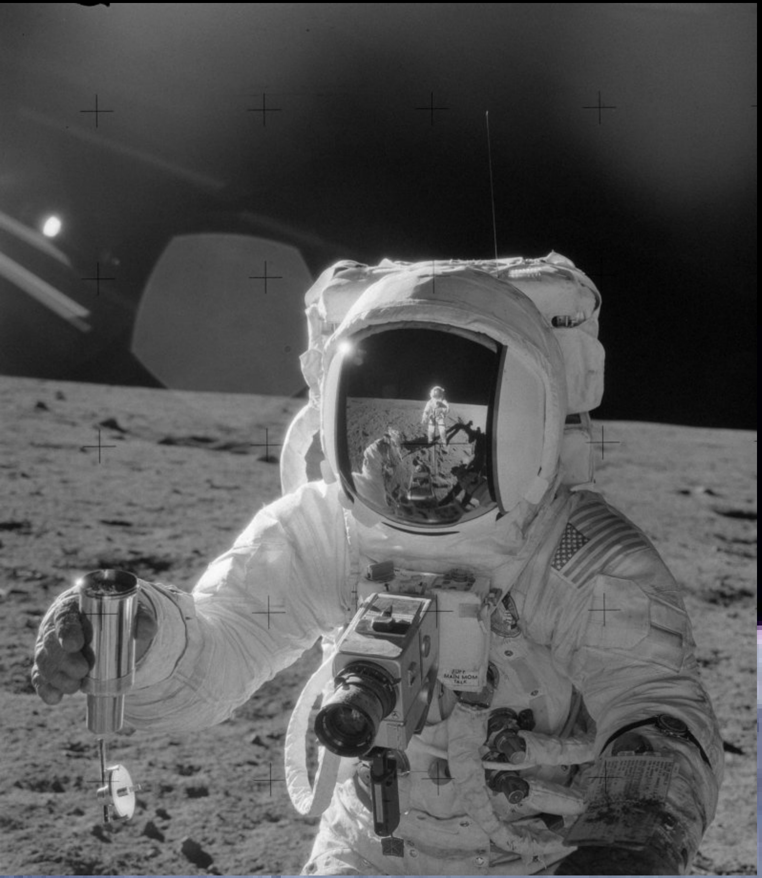
The journey and the destination are novel environments

We need to understand how they will cope


RGF (AT5G64770)
XTH12 (AT5G57530)
Powerful readout of physiological adaptation in the patterns of gene expression

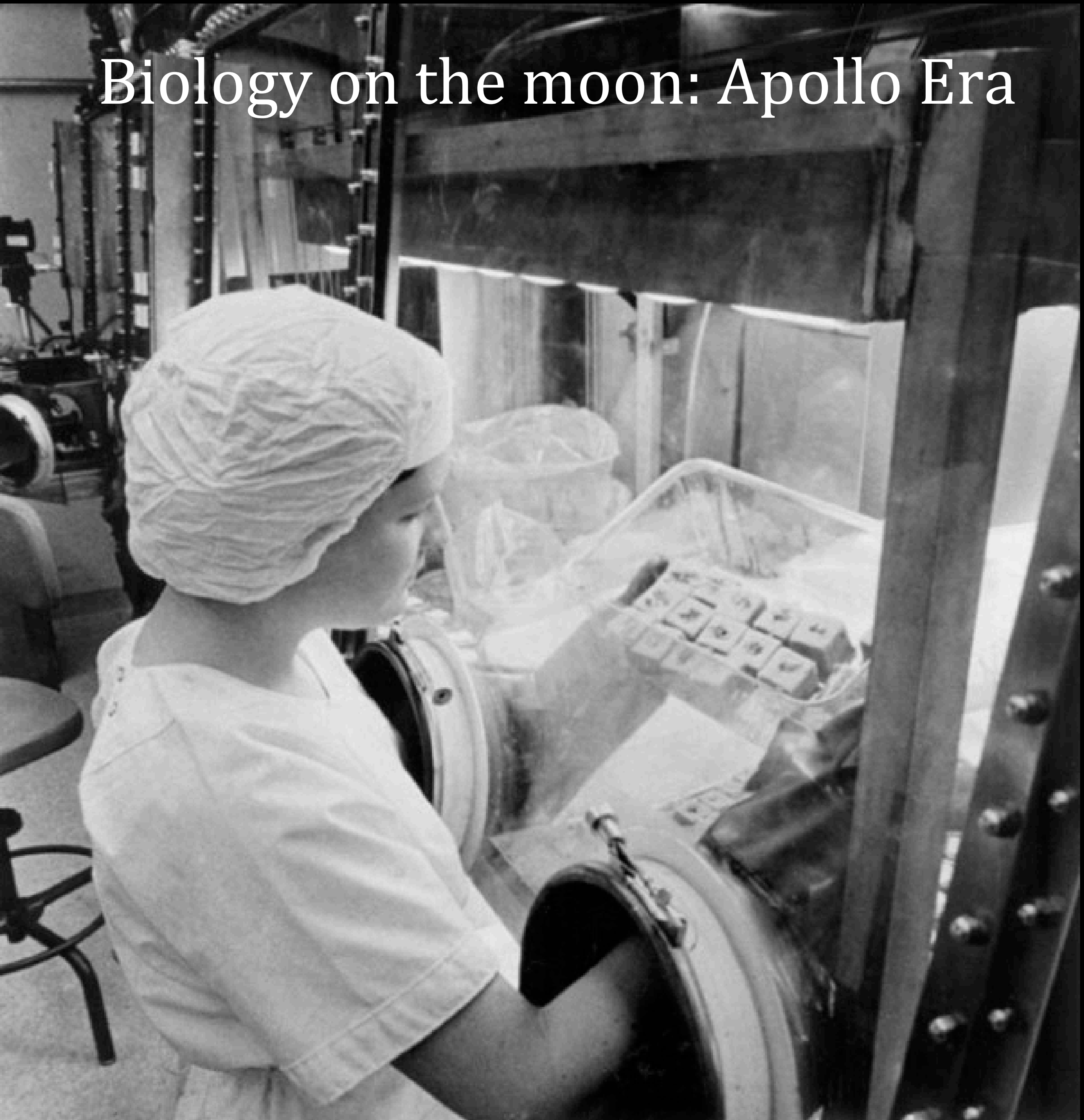

ISRU
Regolith
Habitats – Protected Ag

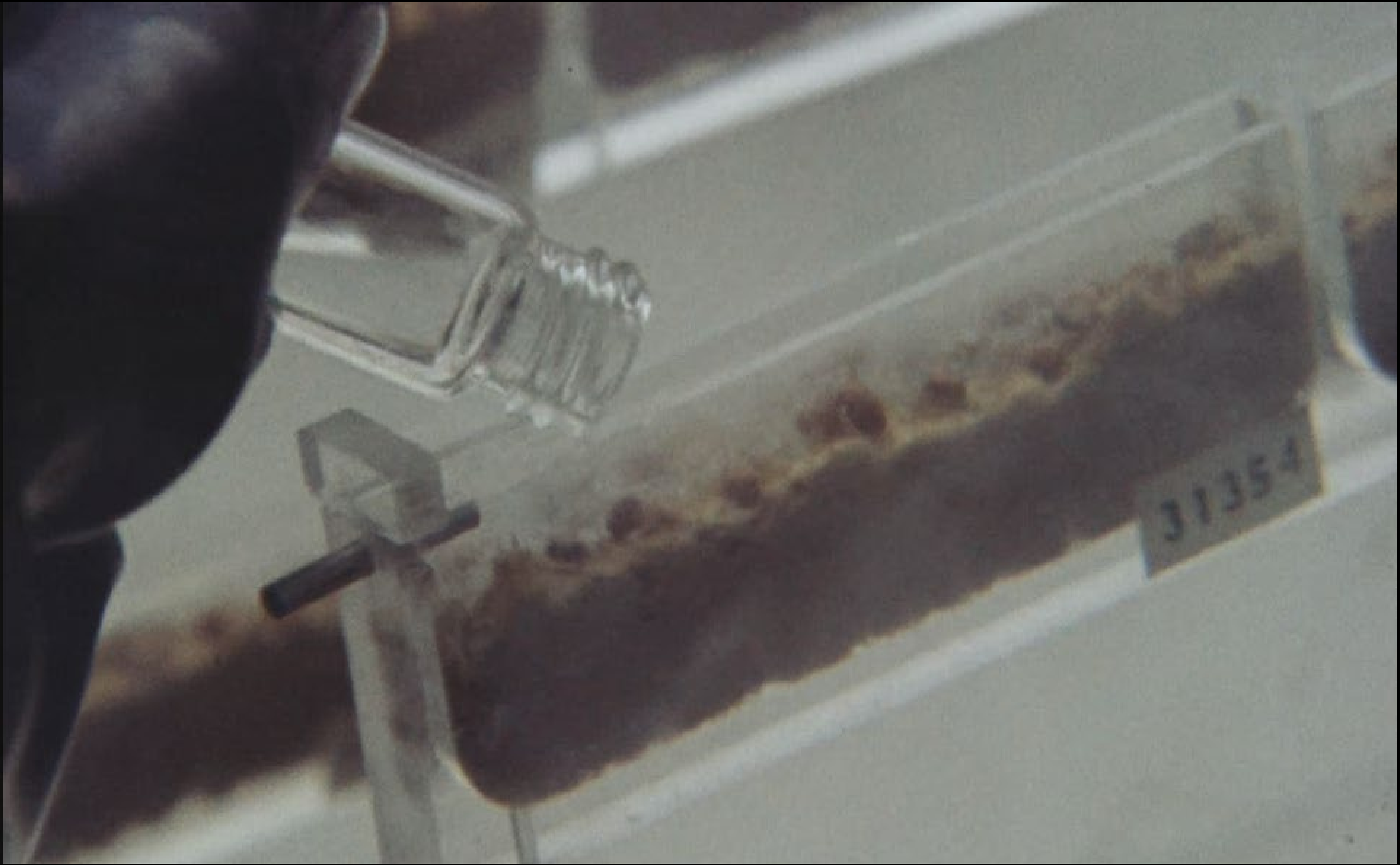
# The Question in 1969 – were lunar materials harmful to terrestrial life?




Family Mountain and edge of South Massif;
Harrison Schmitt works alongside the lunar rover.
Apollo 17-NASA

# Biology on the moon: Apollo Era




31354

# Plants played an important role in determining whether lunar materials were safe for terrestrial life

*But plants were never actually grown in lunar regolith in the Apollo era*

Family Mountain and edge of South Massif;
Harrison Schmitt works alongside the lunar rover.
Apollo 17-NASA

# Biology on the moon: The Artemis Era

nature > communications biology > articles > article

Article | Open Access | Published: 12 May 2022

## Plants grown in Apollo lunar regolith present stress-associated transcriptomes that inform prospects for lunar exploration

Anna-Lisa Paul, Stephen M. Elardo & Robert Ferl

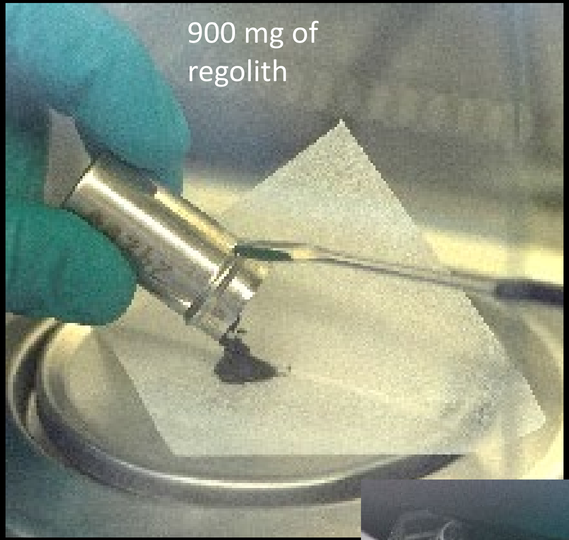
*Communications Biology* **5**, Article number: 382 (2022) | Cite this article



### Abstract

The extent to which plants can enhance human life support on other worlds depends on the ability of plants to thrive in extraterrestrial environments using in-situ resources. Using samples from Apollo 11, 12, and 17, we show that the terrestrial plant *Arabidopsis thaliana* germinates and grows in diverse lunar regoliths. However, our results show that growth is challenging; the lunar regolith plants were slow to develop and many showed severe stress morphologies. Moreover, all plants grown in lunar soils differentially expressed genes indicating ionic stresses, similar to plant reactions to salt, metal and reactive oxygen species. Therefore, although in situ lunar regoliths can be useful for plant production in lunar habitats, they are not benign substrates. The interaction between plants and lunar regolith will need to be further elucidated, and likely mitigated, to best enable efficient use of lunar regolith for life support within lunar stations.

https://www.nature.com/articles/s42003-022-03334-8#article-info



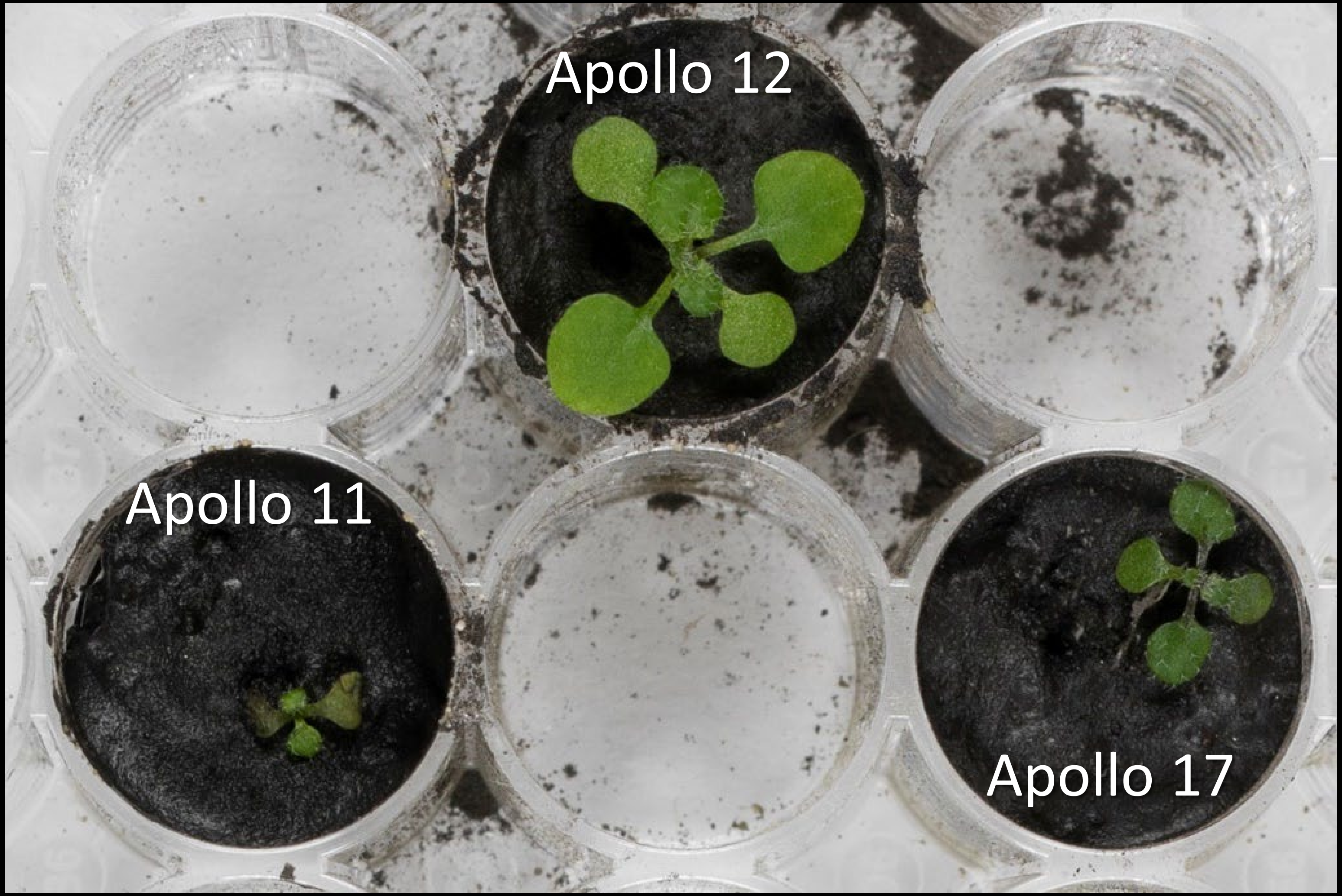

12 grams total
- 4g Apollo 11
- 4g Apollo 12
- 4g Apollo 17

2021

## The first plants to germinate in lunar soil

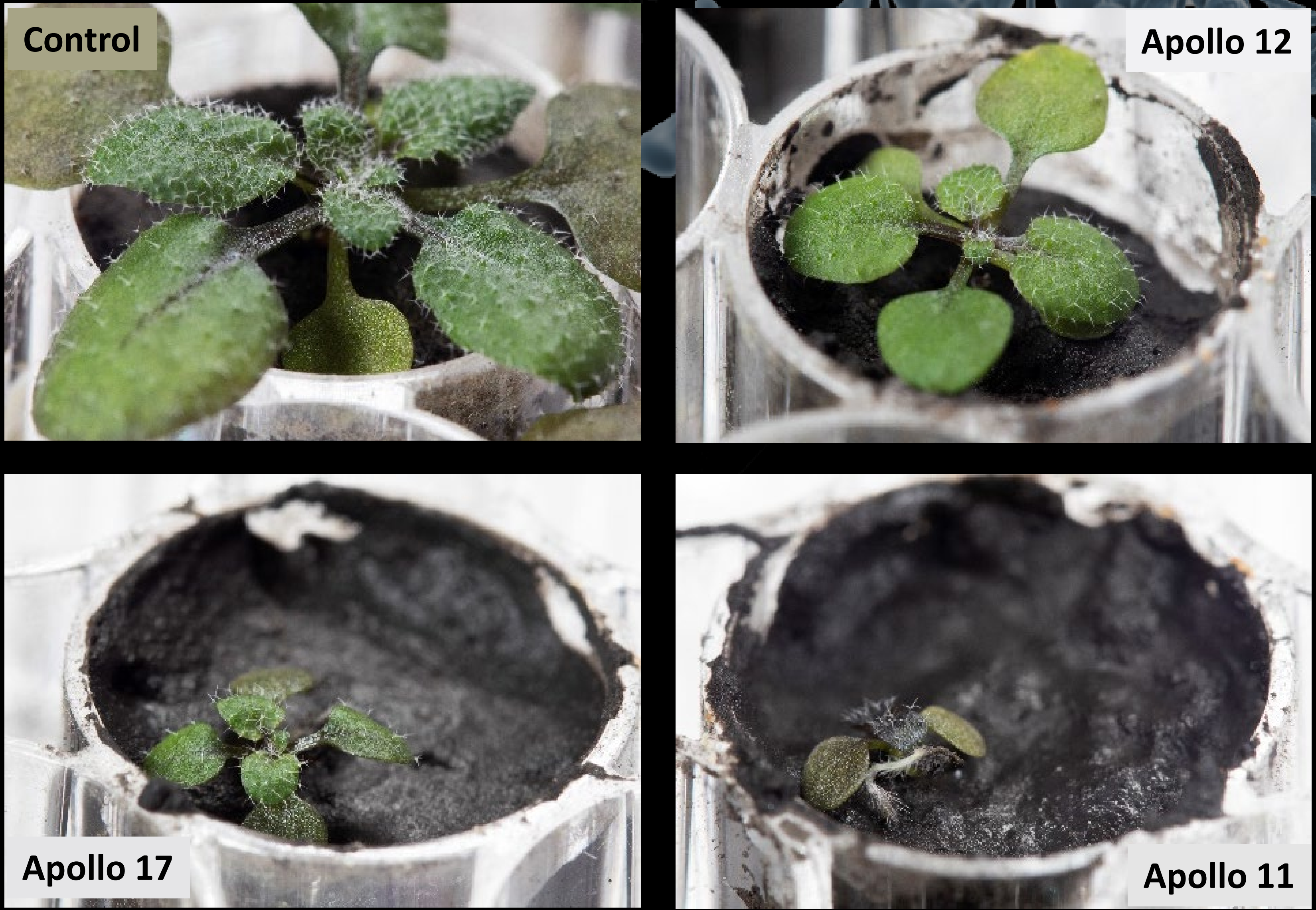
## They all germinated

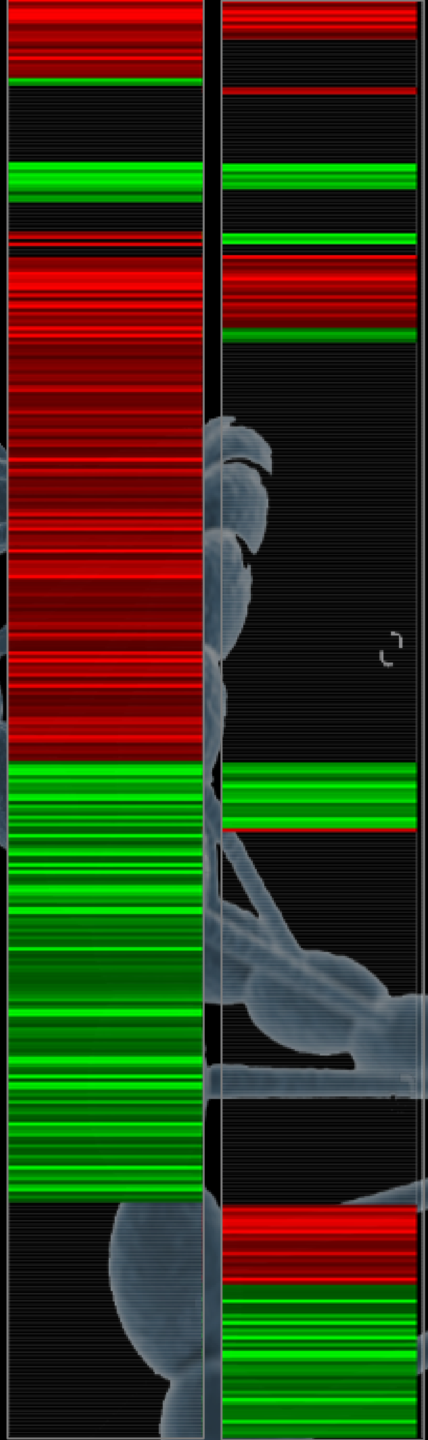
# Terrestrial life growing in extraterrestrial material

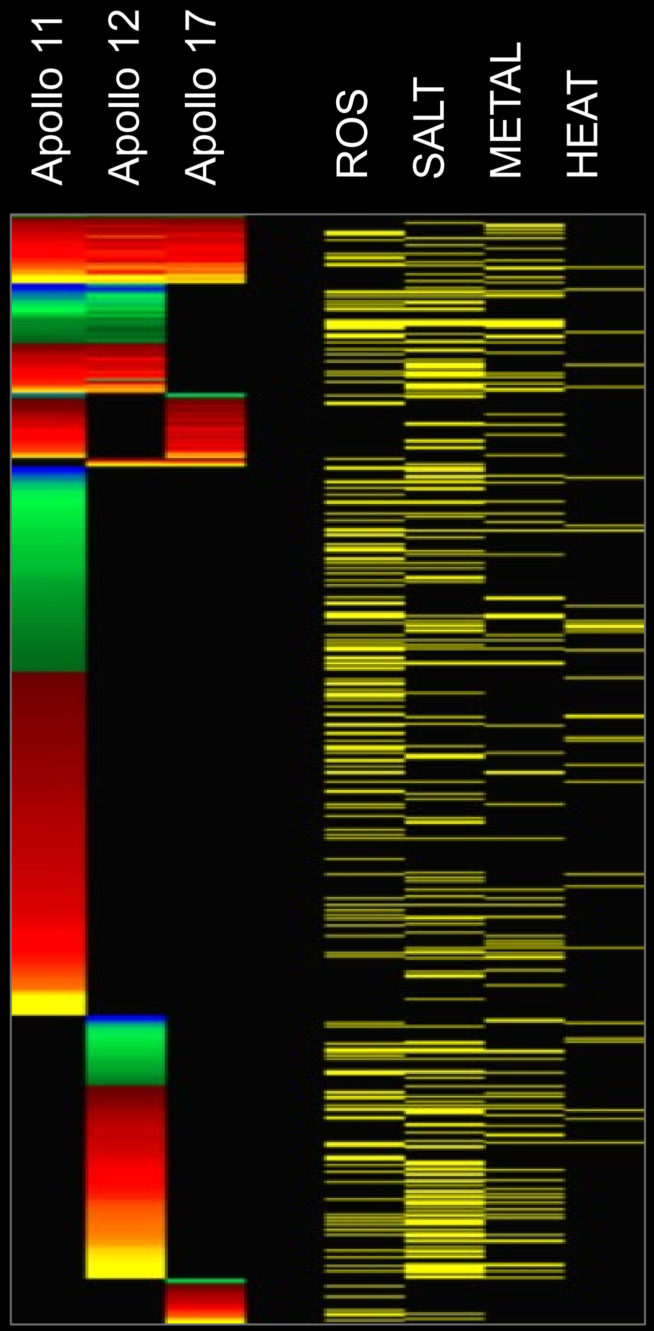

Plants grew differently than the controls
And each Apollo site was different

# Transcriptomics



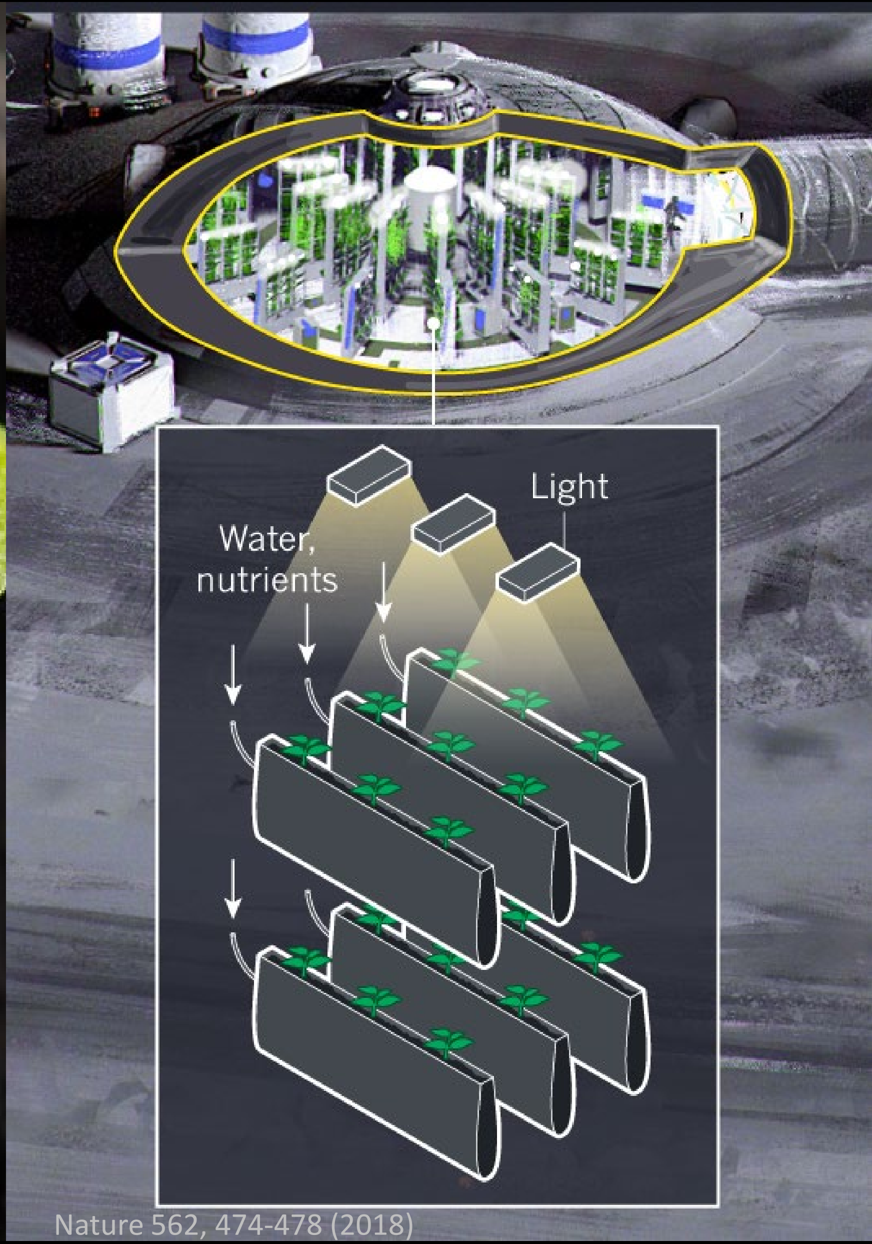



## Sorting by Apollo site

# Getting closer to our exploration visions for extraterrestrial agriculture

Illustration by Maciej Rębisz; Design by Jasiek Krzysztofiak




Nature 562, 474-478 (2018)

# With translational applications to terrestrial agriculture


https://blogs.ifas.ufl.edu/news/2022/05/24/new-uf-ifas-professor-to-combine-ai-and-plant-breeding-teach-tomorrows-ai-innovators-headline/ UF/IFAS Professor Charlie Messina

https://spinoff.nasa.gov/indoor-farming


Go Boldly
UF Space Plants Lab:
Jordan Callaham
Mingqi Zhou
Hunter Strickland
Deanna Baumann
Anna-Lisa Paul
Robert Ferl
Many Thanks
NASA
CASIS
UF Research

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# QUESTIONS AND ANSWER

***Please submit your questions on the meeting app or use one of the microphones.***

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**CxO**
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# CLOSING KEYNOTE

## Round Table Meeting June 2023

Moderator
# Mark Titterington

## Director
## Forum for the Future of Agriculture

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# Aidan Connolly

## President
## AgriTech Capital

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# OPEN MIC SESSION

## Round Table Meeting June 2023

# We look forward to seeing you at the next Round Table January 16-19, in Hawaii!

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