

An Aging Alveolar Lung Model in Microgravity (UG3TR005836)

Y. Shrike Zhang

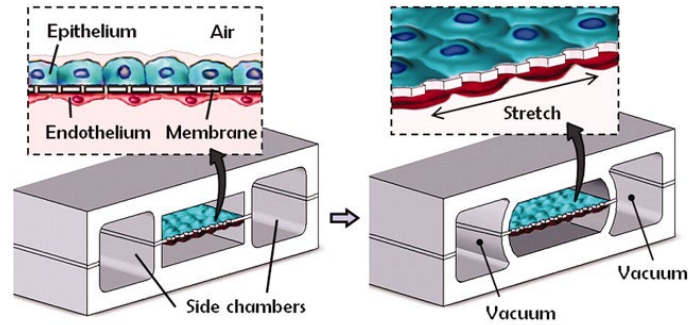
Mingxia Gu

Space Tango

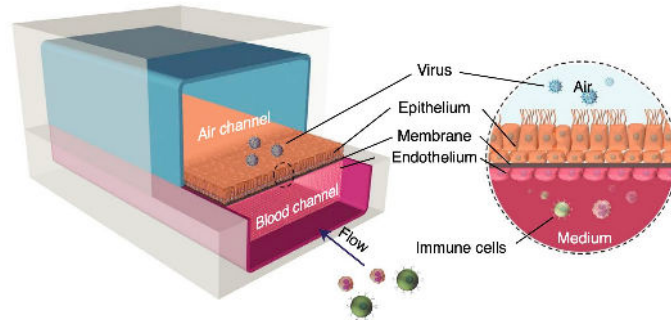
2026-03-05

Existing (Alveolar) Lung-on-a-Chip Models

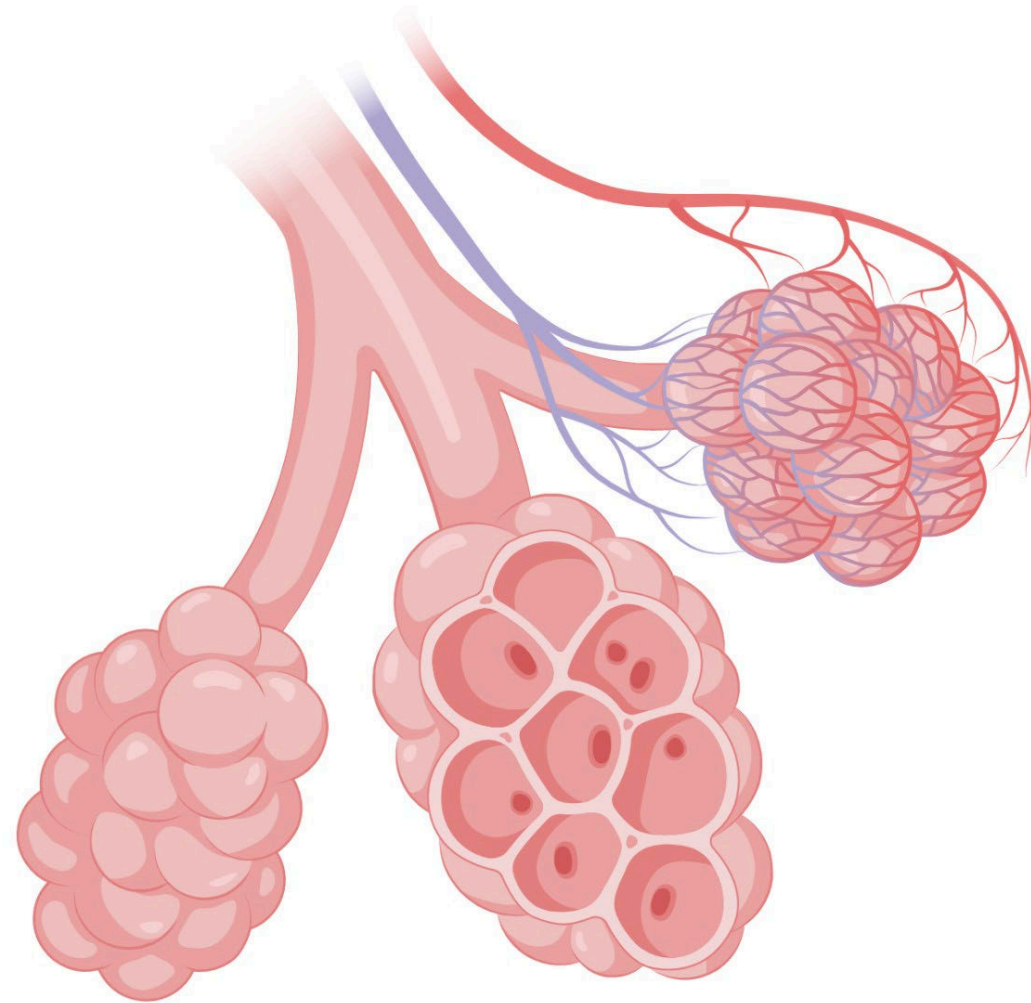
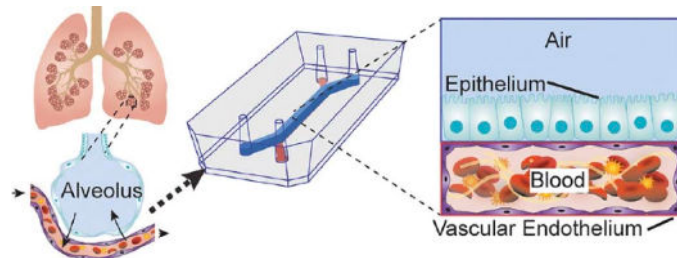
Lung-on-a-chip, 2011



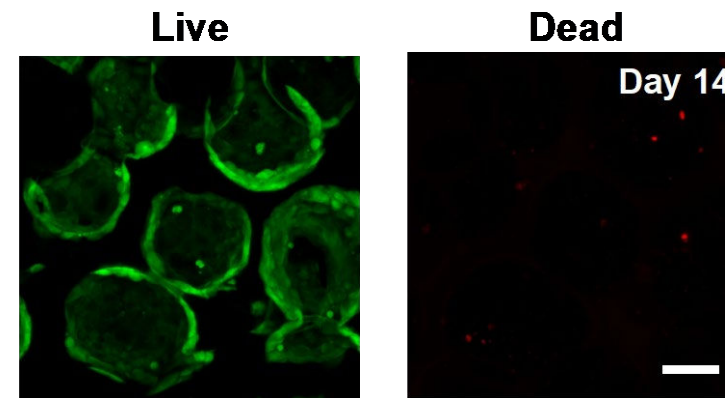
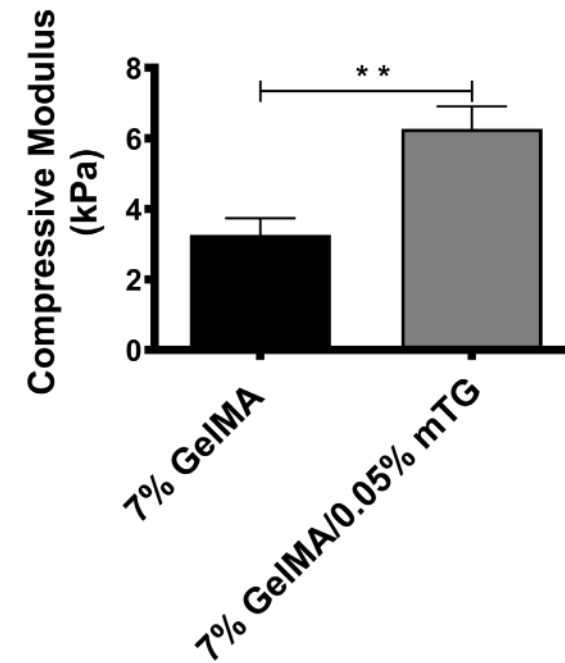
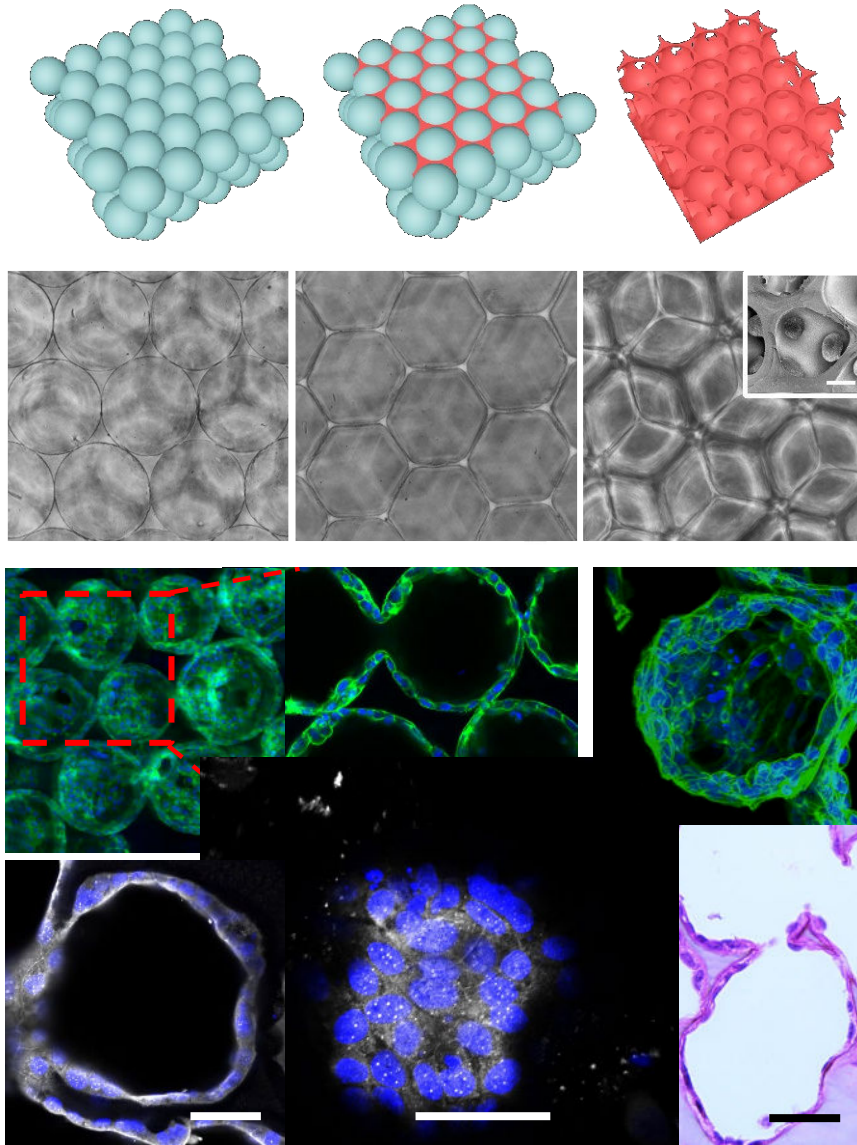
Small airway-on-a-chip, 2016



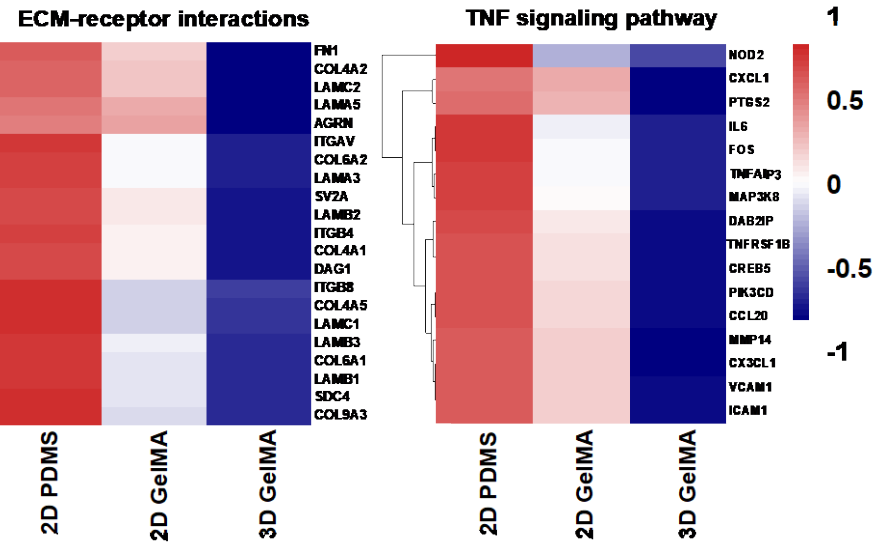
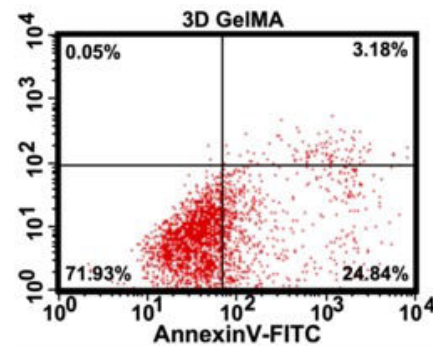
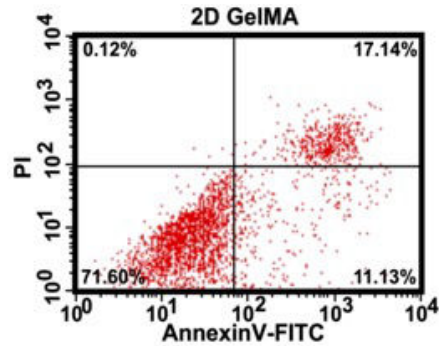
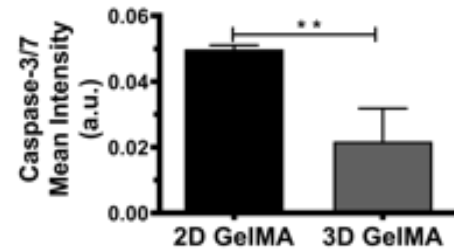
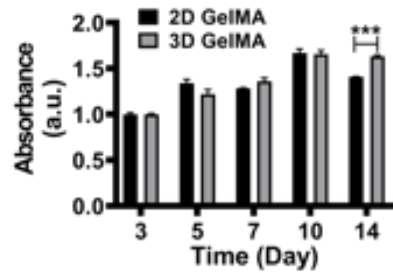
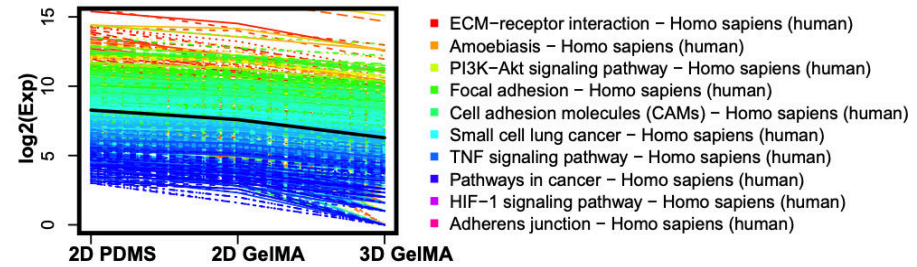
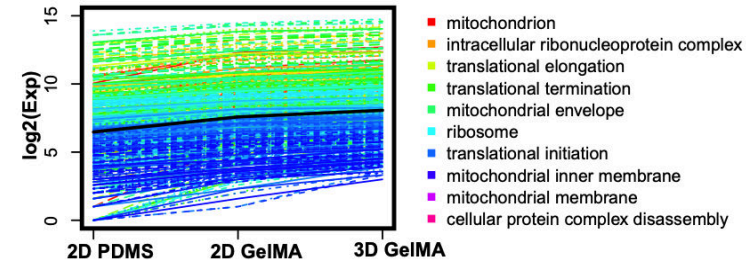
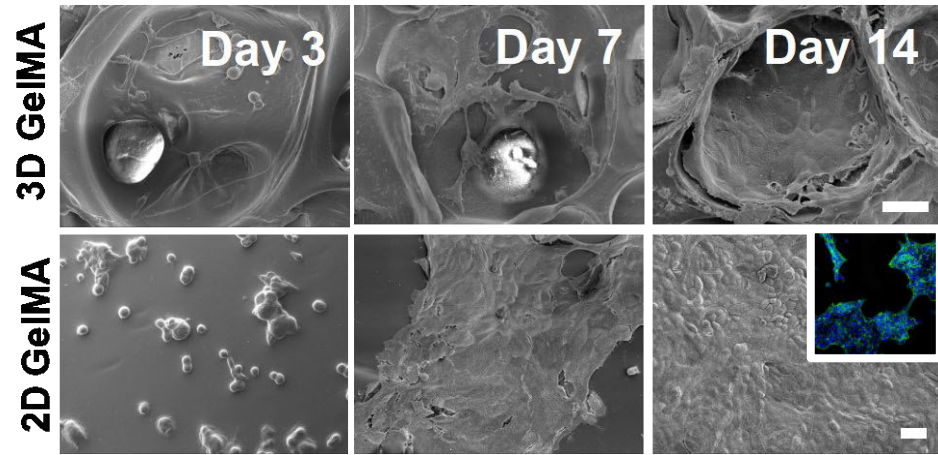
Primary lung alveolus-on-a-chip, 2018



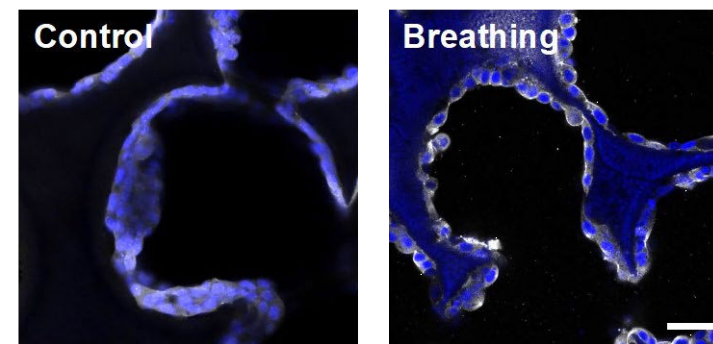
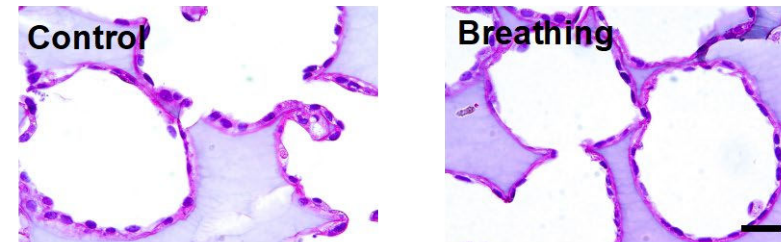
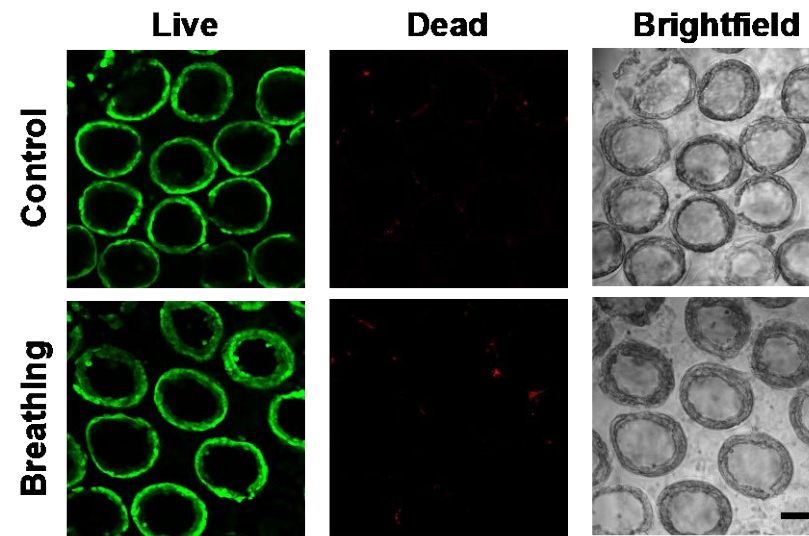
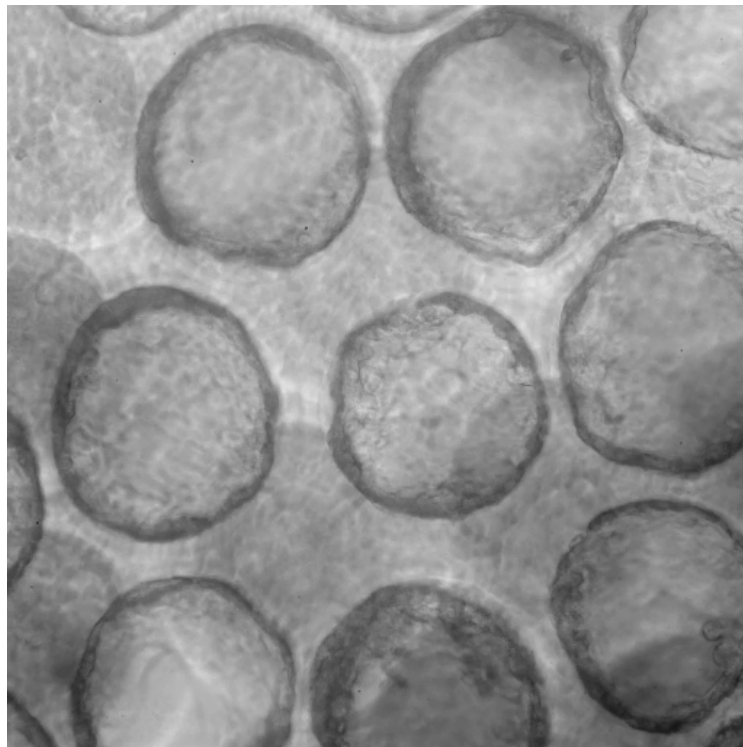
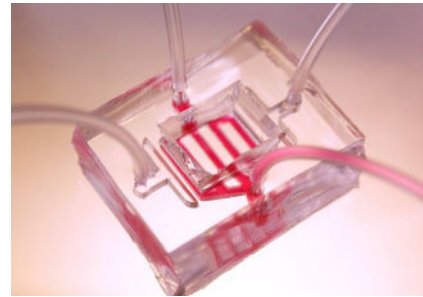
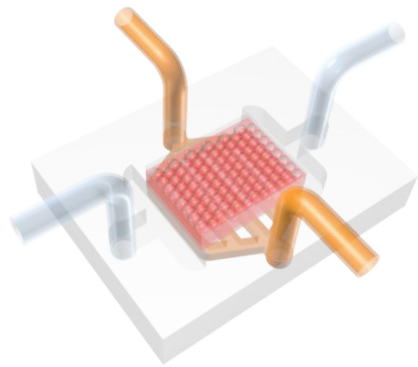
Reverse-Engineered Human Alveolar Lung Model



3D versus 2D and GelMA versus PDMS Comparisons

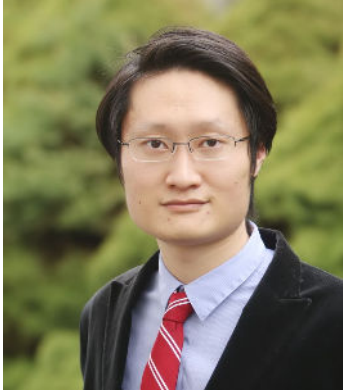


Combination with Breathing Movements



An Aging Alveolar Lung Model in Microgravity (UG3TR005836)

PI: Y. Shrike Zhang
BWH/HMS



Co-I: Mingxia Gu
UCLA



Implementation
Partner



Aim 1 (UH3)

Vascularized and ventilated
alveolar lung

Aim 2 (UH3/UG3)

Immunocompetent and fibrotic
alveolar lung

Aim 1 (UG3/UH3):

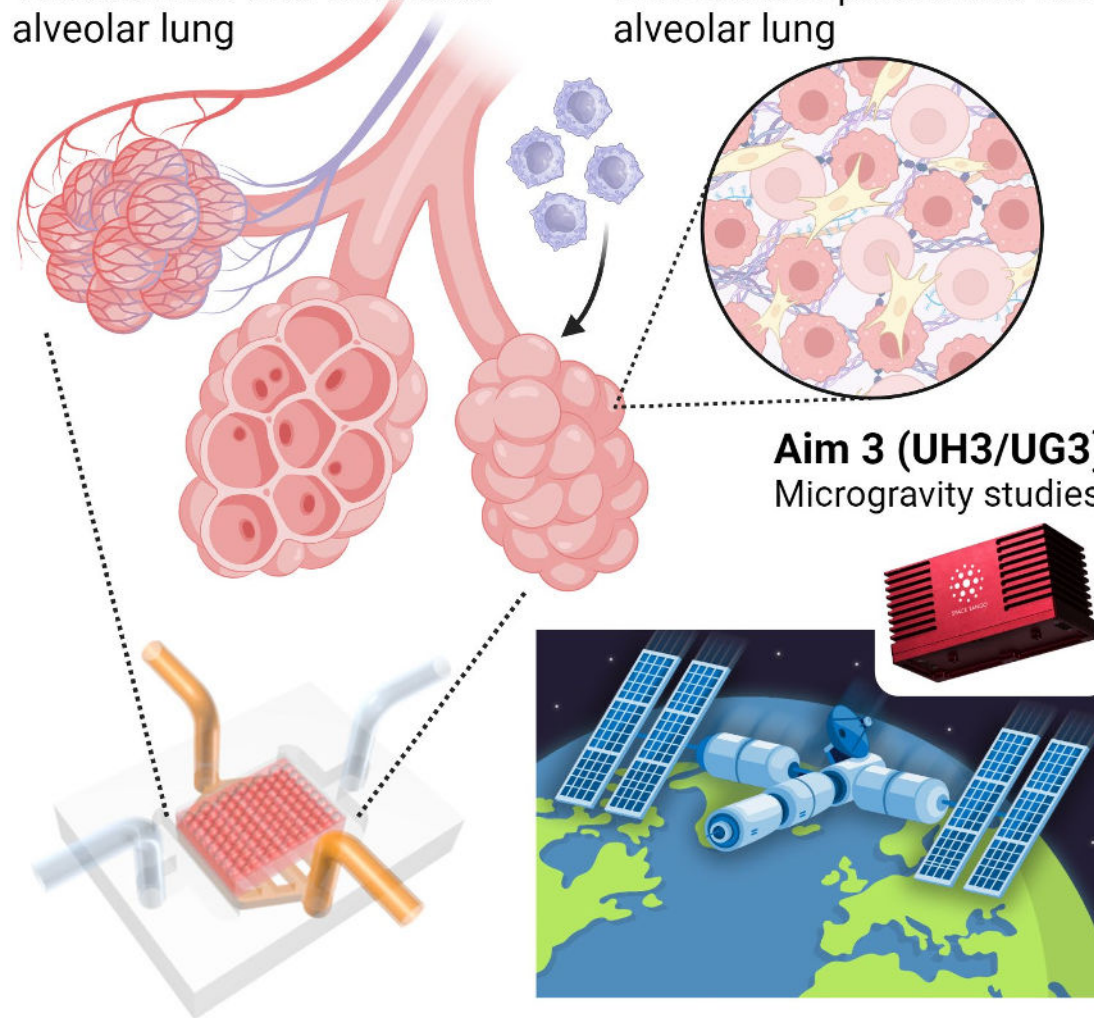
Optimizing a vascularized and ventilated human alveolar lung-on-a-chip model.

Aim 2 (UG3/UH3):

Optimizing the immunocompetent human alveolar lung-on-a-chip models with healthy and fibrotic phenotypes.

Aim 3 (UG3/UH3):

Studying microgravity effects on the immunocompetent, vascularized, ventilated human alveolar lung-on-a-chip models.





Expertise

- Mechanical, Electrical, Software, Systems Engineering
- Science
- Machining, Electrical Fabrication
- Mission Management, Business Operations, Project Management
- Trained in sterile technique and sterile assembly of hardware

Offices

- Lexington, KY - Headquarters
- Central Florida
- Washington, D.C.

Launch Operations

- NASA Kennedy Space Center - Cape Canaveral, FL
- NASA Wallops Flight Facility - Wallops Island, VA

43

MISSIONS

295

PAYLOADS DELIVERED

304

EXPERIMENTS CONDUCTED

29

PEER-REVIEWED JOURNAL

PUBLICATIONS SUPPORTED

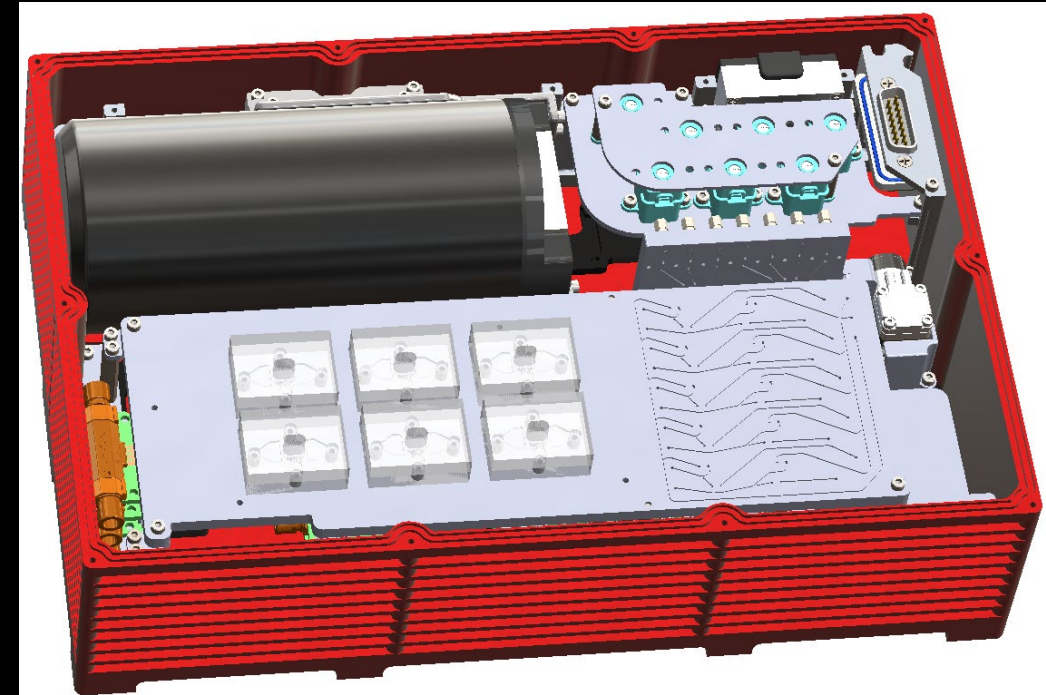
Tissue Chips in Space

- NIH/NCATS Tissue Chips in Space:
 - University of Florida (3 flights)
 - Emulate, Inc. (3 flights)
 - Tissue Chips in Space 2.0 (2 awards)
- MassChallenge:
 - Encapsulate, Inc. (1 flight)
- NSF/CASIS:
 - Mount Sinai School of Medicine (1 flight pending)
- NASA:
 - AVATAR (Artemis II, 2026)
 - A Virtual Astronaut Tissue Analog Response



Support and services for UG3

- Power provided by PAUL facility to allow for culture maintenance of cells and culture media storage at 4 °C
- 9U Tissue Chip CubeLab includes:
 - 6 tissue chips
 - Automate media exchanges
 - Automated vacuum actuation*
 - Automated oxygen** and glucose sensing*
 - Automated fluorescence imaging
 - Automated media sampling
 - Automated fixation with RNALater
- Cold storage return at or below -20 °C
- Asynchronous ground control



Drawing includes Zhang's chip specs

* Requires technical development

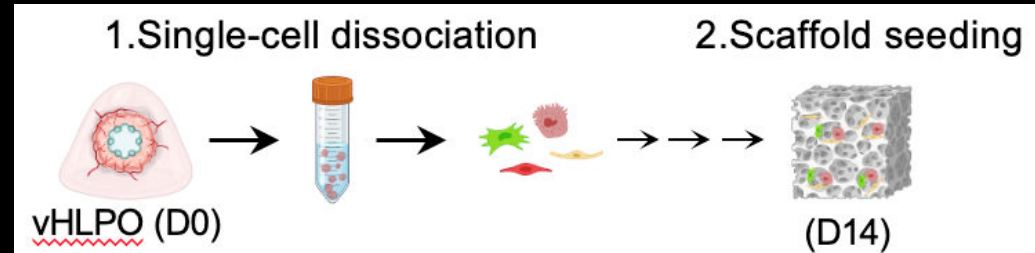
** Currently in 3 project payloads with testing data (EVT, PVT)

Milestone Plan (Space Tango)

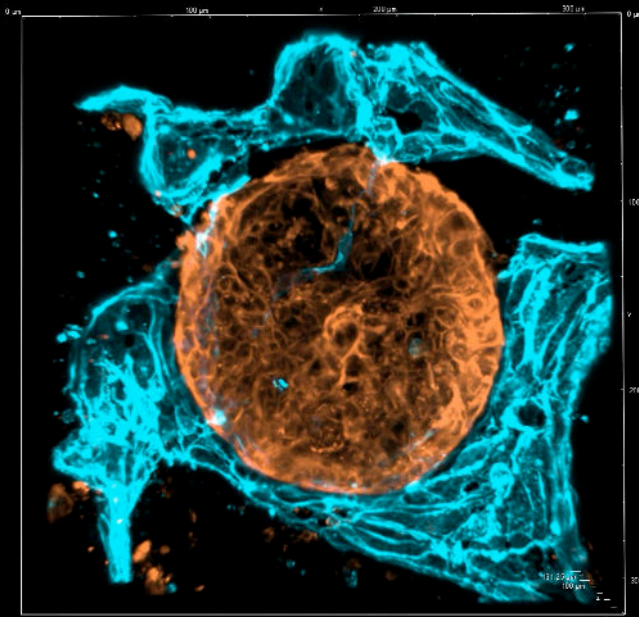
Task Name	Duration	Y2				Y3				Y4				Y5				Y6	
		Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	
Brigham and Womens Hospital	1177 days	[Timeline bar spanning from start of Y2 to end of Y6]																	
UG - 3	649 days	[Timeline bar spanning from start of Y2 to end of Y4]																	
Concept Definition	30 days	[Timeline bar in Qtr 3 of Y2]																	
Concept and Technology Development	55 days	[Timeline bar in Qtr 4 of Y2]																	
Preliminary Design and Development	162 days	[Timeline bar in Qtr 1 of Y3]																	
Detailed Design and Development	115 days	[Timeline bar in Qtr 3 of Y3]																	
Assembly, Integration, Test and Launch	96 days	[Timeline bar in Qtr 2 of Y4]																	
Operations and Sustainment	151 days	[Timeline bar in Qtr 3 of Y4]																	
External Milestones	80 days	[Timeline bar in Qtr 3 of Y4]																	
UH - 3	533 days	[Timeline bar spanning from start of Y4 to end of Y6]																	
Concept Definition	15 days	[Timeline bar in Qtr 1 of Y4]																	
Concept and Technology Development	100 days	[Timeline bar in Qtr 2 of Y4]																	
Preliminary Design and Development	35 days	[Timeline bar in Qtr 3 of Y4]																	
Detailed Design and Development	80 days	[Timeline bar in Qtr 4 of Y4]																	
Assembly, Integration, Test and Launch	95 days	[Timeline bar in Qtr 1 of Y5]																	
Operations and Sustainment	103 days	[Timeline bar in Qtr 4 of Y5]																	

Lung Organoid-Derived Alveolar Epithelial and Endothelial Cells

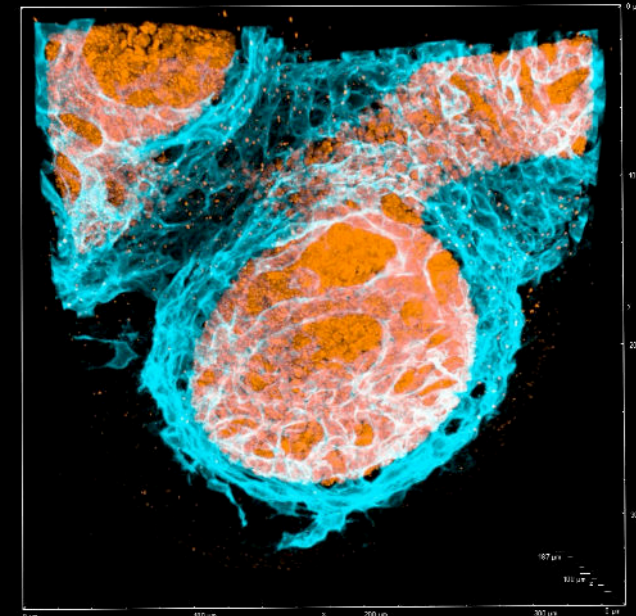
Organoid Cell-Seeded Alveolar Lung Model



Lung Organoid-on-a-Chip



Mouse Lung E12.5



Vessel: CD31 Epithelium: EPCAM

Dynamic Culture for Vascular Network Formation

