ORGANOIDS

Faculty Profiles

JOHNS HOPKINS UNIVERSITY

JOHNS HOPKINS TECHNOLOGY VENTURES

JHU CENTER FOR MICROPHYSIOLOGICAL SYSTEMS

“Preclinical models reflecting normal and diseased human tissue biology are central to advancing medical science and clinical treatments.

Over the past decade, advances in human stem cell biology, tissue engineering, and microtechnology have led to the development of microphysiological systems (MPS) – a platform technology to study human tissues under complex physiological conditions.

The vision of the JHU-MPS Center is to build a hub for development and validation of predictive human stem cell-based, in vitro 3D organotypic models of human diseases and precision medicine applications.”

CENTER’S WEBSITE

DEOK-HO KIM, PHD

Professor of Biomedical Engineering, Director of MPS Center

AREAS OF SPECIALIZATION

Develops multiorgan microphysiological systems to understand tissue crosstalk with applications in inflammatory bowel disease, autoimmune diseases of the liver, and Parkinson's disease.

PUBLICATIONS

- Simulated microgravity attenuates myogenesis and contractile function of 3D engineered skeletal muscle tissues, *Microgravity*, 2024.
- Microphysiological Models of Lung Epithelium-Alveolar Macrophage Co-Cultures to Study Chronic Lung Disease, *Advanced Biology*, 2023.
- Heart-on-a-chip platforms and biosensor integration for disease modeling and phenotypic drug screening, *Biosensors and Bioelectronics*, 2023.

MARTIN TRAPECAR, PHD, MSC

Assistant Professor of Medicine and Biomedical Engineering, Associate Director of MPS Center

AREAS OF SPECIALIZATION

Multi-scale fabrication of bio-inspired materials and systems to model organs and disease (e.g. heart-on-a-chip to study cardiotoxicity) or understand systems mechanobiology (e.g. mechanical properties of malignant tumor cells)

PUBLICATIONS

- Multiorgan microphysiological systems as tools to interrogate interorgan crosstalk and complex diseases, FEBS Letters, 2021.
- Human physiomimetic model integrating microphysiological systems of the gut, liver, and brain for studies of neurodegenerative diseases, Science Advances, 2021.

RAMANA SIDHAYE, MD

Associate Professor of Medicine, Associate Director of Physician-Scientist Pathway of the Osler Residency Program

AREAS OF SPECIALIZATION

Building models of lung epithelium to understand exposure to environmental contributors to lung disease, such as cigarette smoke, air pollution, and aerosolized pollutants.

PUBLICATIONS

- Dysfunctional Epithelial Barrier Is Characterized by Reduced E-Cadherin in Idiopathic Subglottic Stenosis, Laryngoscope, 2024.
- Microphysiological Models of Lung Epithelium-Alveolar Macrophage Co-Cultures to Study Chronic Lung Disease, Advanced Biology, 2023.
- Cigarette smoke-induced injury induces distinct sex-specific transcriptional signatures in mice tracheal epithelial cells, Am J Physiology and Lung Cell Molecular Physiology, 2023.

PETER SEARSON, PHD

JOHNS HOPKINS
TECHNOLOGY VENTURES

Joseph R. and Lynn C. Reynolds Professor of Engineering in Materials Science and Engineering, with joint appointments in Chemical and Biomolecular Engineering, Oncology, Physical Medicine and Rehabilitation, and Physics and Astronomy

AREAS OF SPECIALIZATION

Develops vascular models on a chip to model the blood-brain barrier in neurodegenerative disease, infectious disease, cancer metastasis, and other injuries and pathologies.

PUBLICATIONS

- A tissue-engineered model of the blood-tumor barrier during metastatic breast cancer, Fluids and Barriers of the CNS, 2023.
- Visualization of the Dynamics of Invasion and Intravasation of the Bacterium That Causes Lyme Disease in a Tissue Engineered Dermal Microvessel Model, Advanced Science, 2022.
- Effects of acute and chronic oxidative stress on the blood–brain barrier in 2D and 3D in vitro models, Fluids and Barriers of the CNS, 2022.

YUN CHEN, PHD

Assistant Professor Mechanical Engineering

AREAS OF SPECIALIZATION

Leveraging tissue models to understand how biophysical changes may serve as a causal force in cancer, diseases, and other pathologies, as well as developing biophysical treatments for these ailments.

PUBLICATIONS

- Modeling collective cell behavior in cancer: Perspectives from an interdisciplinary conversation, Cell Systems, 2023.
- Migration and 3D Traction Force Measurements inside Compliant Microchannels, Nano Letters, 2022.
- A novel human endometrial epithelial cell line for modeling gynecological diseases and for drug screening, Laboratory Investigation, 2021.

KEN BOHELER, PHD

Research Professor in Biomedical Engineering

AREAS OF SPECIALIZATION

Utilizing pluripotent stem cell biology to cardiovascular lineages and applications thereof to study drug re-purposing and immune diseases, cardiac disease, and more.

PUBLICATIONS

- Adipose tissue-derived human mesenchymal stromal cells can better suppress complement lysis, engraft and inhibit acute graft-versus-host disease in mice, Stem Cell Research & Therapy, 2023.
- Understanding arrhythmogenic cardiomyopathy: advances through the use of human pluripotent stem cell models, Genes, 2023.
- A high-throughput functional screening platform for determining the effects of galactic cosmic radiation on human cardiac tissue, Tissue Engineering, 2022.

VASILIKI MACHAIRAKI, PHD, MSC

Assistant Professor of Neurology and Genetic Medicine

AREAS OF SPECIALIZATION

Simplifying stem cell biology systems to study neural precursor cells and neuronal differentiation along biocompatible nanofibrous scaffolds for studies of the nervous system.

PUBLICATIONS

- Mass Spectrometry Imaging of Organoids to Improve Pre-Clinical Research, Advanced Healthcare Materials, 2024.
- Generation and Characterization of a Human-Derived and Induced Pluripotent Stem Cell (iPSC) Line from an Alzheimer's Disease Patient with Neuropsychiatric Symptoms, Biomedicines, 2023.
- Excitatory Neurons Derived from Human-Induced Pluripotent Stem Cells Show Transcriptomic Differences in Alzheimer’s Patients from Controls, Cells, 2023.

MARK DONOWITZ, MD

LeBoff Professor of Medicine and Physiology, Director of the Hopkins Center for Epithelial Disorders, Founding Director of NIH/NIDDK Hopkins Conte Digestive Diseases Center for Basic and Translational Research

AREAS OF SPECIALIZATION

Developed and utilize human mini-intestines to advance understanding of human digestive physiology and pathophysiology associated with host-pathogen interactions

PUBLICATIONS

- Co-culturing human intestinal enteroid monolayers with innate immune cells, Methods in Molecular Biology, 2023.
- The role of CFA/I in adherence and toxin delivery by ETEC expressing multiple colonization factors in the human enteroid model, PLoS Neglected Tropical Diseases, 2022.
- Epithelial and Neutrophil Interactions and Coordinated Response to Shigella in a Human Intestinal Enteroid-Neutrophil Coculture Model, mBio, 2022.

ROBERT JOHNSTON, PHD

Associate Professor of Biology

AREAS OF SPECIALIZATION

Generates human retinal organoids that mimic developmental biology to understand how the diversity of neuronal cell types are generated

PUBLICATIONS

- Single-cell transcriptome analysis of xenotransplanted human retinal organoids defines two migratory cell populations of nonretinal origin, Stem Cell Reports, 2023.
- Foveolar cone subtype patterning in human retinal organoids, bioRxiv, 2023.
- CRISPR generated SIX6 and POU4F2 reporters allow identification of brain and optic transcriptional differences in human PSC-derived organoids, Frontiers in Cell and Developmental Biology, 2021.

HEE CHEOL CHO, PHD

Assistant Professor of Surgery, Co-Director of Blalock-Taussig-Thomas Pediatric and Congenital Heart Center

AREAS OF SPECIALIZATION

Researches the biology of pacemaker cells in the heart to develop biological pacemaker alternatives for patients with irregular heart rhythms, particularly among pediatric cardiac patients.

PUBLICATIONS

- Simulated microgravity improves maturation of cardiomyocytes derived from human induced pluripotent stem cells, Scientific Reports, 2024.
- Implementing Biological Pacemakers: Design Criteria for Successful Transition From Concept to Clinic, Circulation: Arrhythmia and Electrophysiology, 2021.
- Regeneration of infarcted mouse hearts by cardiovascular tissue formed via the direct reprogramming of mouse fibroblasts, Nature Biomedical Engineering, 2021.

DAVID GRACIAS, PHD, MSC

Professor of Chemical and Biomolecular Engineering

AREAS OF SPECIALIZATION

Designs, develops, and characterizes miniaturized devices and intelligent materials for drug delivery, sensors, electronics, and other tools. Founding member of the organoid intelligence field, with inventions of microscale EEG-like caps.

PUBLICATIONS

- Microinstrumentation for Brain Organoids, Advanced Healthcare Materials, 2024.
- Untethered shape-changing devices in the gastrointestinal tract, Expert Opinion on Drug Delivery, 2023.
- Toward single cell tattoos: Biotransfer printing of lithographic gold nanopatterns on live cells, Nano Letters, 2023.
- Autonomous untethered microinjectors for gastrointestinal delivery of insulin, ACS Nano, 2022.

GABSANG LEE, PHD

Associate Professor of Neurology and Neuroscience

AREAS OF SPECIALIZATION

Establishing novel methodology to derive and isolate neurons, glia, and skeletal muscle from human pluripotent stem cells to study peripheral nervous system diseases.

PUBLICATIONS

- Precision Medicine in Parkinson's Disease using Induced Pluripotent Stem Cells, Advanced Healthcare Materials, 2024.
- Advanced human iPSC-based preclinical model for Parkinson’s disease with optogenetic alpha-synuclein aggregation, Cell Stem Cell, 2023.
- Engineering Skeletal Muscle Grafts with PAX7:: GFP-Sorted Human Pluripotent Stem Cell-Derived Myogenic Progenitors on Fibrin Microfiber Bundles for Tissue Regeneration, Bioengineering, 2022.

CHRISTOPHER A. ROSS, MD, PHD

Professor of Psychiatry and Behavioral Sciences, Director of the Division of Neurobiology

AREAS OF SPECIALIZATION

Uses biophysical and biochemical techniques and cell models to conduct phenotypic screens to study Huntington's disease, Parkinson's disease, and more complex diseases such as schizophrenia and bipolar disorder

PUBLICATIONS

- Neuroprotective Effects of σ 2 R/TMEM97 Receptor Modulators in the Neuronal Model of Huntington's Disease, ACS Chemical Neuroscience, 2022.
- Immortalized striatal precursor neurons from Huntington's disease patient-derived iPS cells as a platform for target identification and screening for experimental therapeutics, Human Molecular Genetics, 2021.
- Pharmacological rescue in patient iPSC and mouse models with a rare DISC1 mutation, Nature Communications, 2021.

ANDREA TRIMM, PHD

Senior Staff Scientist at Johns Hopkins Applied Physics Laboratory

AREAS OF SPECIALIZATION

Uses microfluidics as an interface to study biological systems, particularly in microbiome systems to study microbial communities and develop synthetic ecosystems.

PUBLICATIONS

- Screening microbiota for effects on host tissues, Biotechnology and Bioengineering, 2023.
- Cell-Free Synthetic Biology Biosensors, Handbook of Cell Biosensors, 2022.
- A Microfluidics and Agent-Based Modeling Framework for Investigating Spatial Organization in Bacterial Colonies: The Case of Pseudomonas Aeruginosa and H1-Type VI Secretion Interactions, Frontiers in Microbiology, 2018.

DAVID HACKAM, MD, PHD

Surgeon-in-Chief, Johns Hopkins Children's Center, Professor of Surgery, Professor of Cell Biology, Professor of Genetic Medicine

RESEARCH INTERESTS

Necrotizing Enterocolitis, Inflammatory Bowel Disease, Short Bowel Syndrome, Artificial Intestine - derived from patient-specific intestine stem cells.

RECENT RESEARCH HIGHLIGHTS

- Generating an Artificial Intestine for the Treatment of Short Bowel Syndrome
- Human Milk Oligosaccharides Protect against Necrotizing Enterocolitis by Inhibiting Intestinal Damage via Increasing the Proliferation of Crypt Cells
- The human milk oligosaccharides 2'-fucosyllactose and 6'-sialyllactose protect against the development of necrotizing enterocolitis by inhibiting toll-like receptor 4 signaling
- Breast milk protects against the development of necrotizing enterocolitis through inhibition of Toll-like receptor 4 in the intestinal epithelium via activation of the epidermal growth factor receptor.

JANET STAAB, PHD

Instructor of Medicine

RESEARCH INTERESTS

Epithelial/microbial interactions, Intestinal organoids/enteroids – human primary, adult stem cell derived, Incorporates epithelial and immune system physiologically relevant to gut, Innate immunity of mammalian mucosa.

RECENT RESEARCH HIGHLIGHTS

- Co-culturing Human Intestinal Enteroid Monolayers with Innate Immune Cells
- In vivo development of immune tissue in human intestinal organoids transplanted into humanized mice
- A primary human macrophage-enteroid co-culture model to investigate mucosal gut physiology and host-pathogen interactions

TATIANNA (TASHA) LARMAN, PHD

Assistant Professor of Pathology

RESEARCH INTERESTS

Physiologic perturbations to the intestinal mucosal microenvironment , Primary human tissue and ex vivo 3D intestinal organoid models, Inflammatory Bowel Disease.

RECENT RESEARCH HIGHLIGHTS

- Colonic epithelial adaptation to EGFR-independent growth induces chromosomal instability and is accelerated by prior injury