JOB ANNOUNCEMENT

POSTDOCTORAL RESEARCHER AT THE CENTER FOR NANOSCALE SCIENCE & TECHNOLOGY AT NIST (GAITHERSBURG, MD, USA)

MAY 24, 2017

Vision

How often do you have an opportunity to help shift a paradigm? Here might be one: our research team wants to create alternatives for animal experiments. We build microphysiological systems that have the potential to mimic the human body more truthfully than do animals.

When patients are treated with a new drug, we count on animal experiments to predict the outcome. Often though, those predictions miss the mark: drugs are less effective or more toxic than hoped for. That's because human metabolic pathways can differ from those in animals. The resulting metabolites can inflict unanticipated injuries.

Microphysiological systems provide a way to test drugs in the presence of human metabolic pathways. The systems contain small compartments for human tissues that are interconnected via microfluidics. The tissues provide all enzymes that convert drugs, and the fluidic channels distribute the generated metabolites. Drug toxicity is easy to spot when cells start to lose their function.

State-of-the-Art

Current microphysiological systems contain 2 - 14 human organ compartments (1,2). The devices have been challenged with painkillers and known toxicants. They are capable of reproducing acute toxicity to the lung (3), kidney (4), and liver (5), and drug-induced weakened heart muscle contractions (7). The systems can also generate physiologic concentrations of orally taken painkillers (6). Advanced microphysiological systems have been operated with primary cells and stem-cell derived tissues, (5,7,8) providing more authentic paths for drug action.

Our Team

Our team is a group of postdocs, graduate students, and undergraduate students who are passionate about developing microphysiological systems. We focus on easy to use platforms, pumpless designs, and integrated biomarker measurements. Our laboratory is located on the NIST campus in Gaithersburg, MD, in the USA. We have access to a full nanofabrication suite (CNST) and precision measurement tools. We collaborate with many other research groups in the US (University of Maryland, University of Illinois at Urbana Champaign, University of Cincinnati) as well as abroad (Gunma University, Japan).

Your Contribution

In order for microphysiological systems to gain traction in industry, we need to solve the following challenges (9):

1. Drug toxicity depends on drug concentrations (or drug metabolite concentrations). To create physiologic drug metabolite concentrations, the systems must reflect human physiology. That means, the systems must replicate organ size ratios, blood flow rates, and drug residence times accurately.
2. The enzymes within the tissues must retain near-physiologic activity levels.
3. The systems must have integrated sensors for continuous tissue health monitoring.

4. The systems must be easy to use.
5. The systems must run for 30 days or longer so that chronic drug exposures can be simulated.
6. At the end of an experiment, it must be possible to recover tissues for further examination.
7. We need to develop a cell culture medium that will adequately supply all tissues with nutrients. This is challenging because many cell types require specific growth factors for proper tissue functioning in vitro.
8. The addition of undefined animal serum to cell culture medium causes high experiment-to-experiment variability. A cell culture medium that does not contain animal serum would aid in making results more reproducible.
9. In the future, iPS cell-derived tissues might also make it possible to create a microphysiological system that represents a particular group of patients. To advance precision medicine, the systems must support human primary cells or stem-cell derived tissues.

We encourage you to propose ideas that solve some of these challenges.

Literature

1. Advanced Drug Delivery Rev. 2014, 69, 158-169
2. Biotechnology and Bioengineering 2016, 113 (10), 2213-2227
3. Biotechnology Progress 2008, 20 (1), 316-323
4. Journal of Applied Toxicology 2016, 36 (2), 330-339
5. Biotechnology and Bioengineering 2014, 111 (10), 2027-2040
6. Biotechnology and Bioengineering 2009, 104 (1), 193-205
7. Scientific Reports, 2016, 6 (1), 20030
8. Lab on a Chip, 2016, 16 (14), 2719-2729
9. Stem Cell Research & Therapy 2013, 4 (Suppl. 1):I1

Other resources

10. Companies work on commercializing such systems: Hμrel Corporation, Hesperos, and Emulate
11. Patents related to body-on-a-chip devices: US patent 5,612,188
12. NIH “tissue chips” program website: https://ncats.nih.gov/tissuechip/projects/2014.

How to apply

Qualifications: Candidates must have a Ph.D., M.D. or equivalent, and if they are not US citizens or permanent residents, candidates must be eligible to obtain work authorization in in the US in the form of OPT, J1 visa, H1B visa, or other work visa.

To apply, please email CV, cover letter, and 3 references to Mandy B. Esch, Ph.D.: mandy.esch@nist.gov