

NIH Tissue Chip Program: Updates

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NCATS

The NIH Tissue Chip Program

GOAL: Develop an *in vitro* platform that uses human tissues to evaluate the efficacy, safety and toxicity of promising therapies.



National Institutes of Health



Phase 1:
Development



Phase 2: Cell incorporation &
organ integration



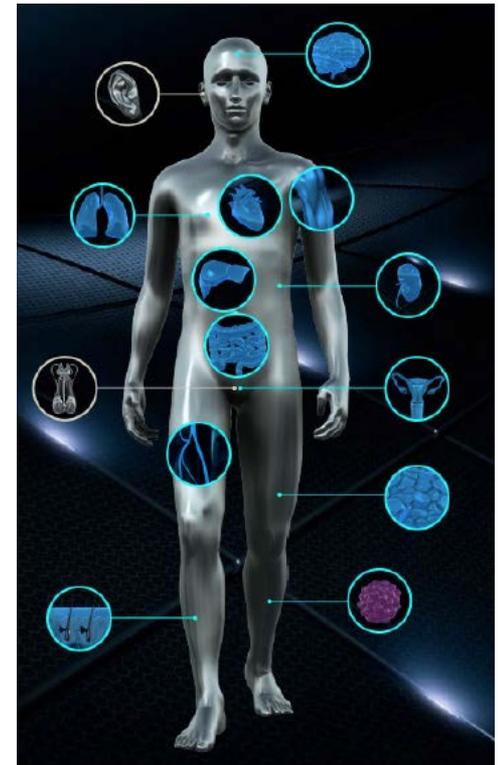
DARPA: Organ integration



**FDA provides insight and expertise throughout the program

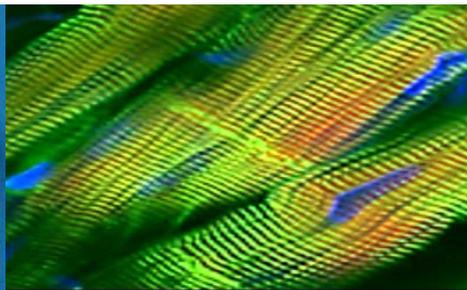
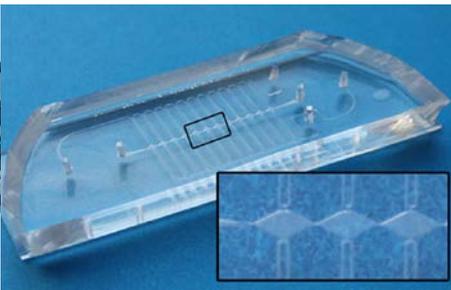
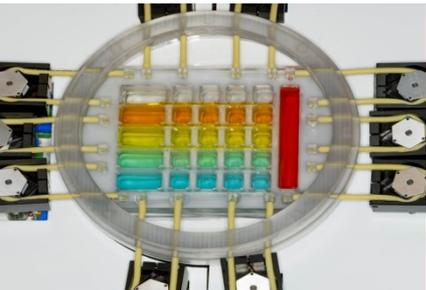
Current Goals:

- Integration
- Compound testing
- **Validation**
- **Partnerships**
- **Adoptions of the tech to the community**



New Tissue Chip Initiatives & Projects

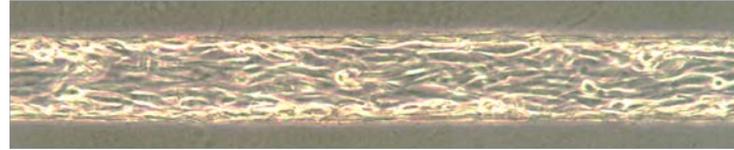
- Tissue Chip Testing Centers (2016-2018)
 - Tech transfer and testing at 2 independent centers (Texas A&M and MIT)
- Tissue Chips for Disease Modeling (2017–2022)
 - Develop tissue chip models of human disease
 - Using human primary or induced pluripotent stem cell sources
 - Use to test effectiveness of candidate therapeutics
 - NCATS joined by NIEHS, NINDS, NIAMS, NIDDK, NICHD, ORWH, NIDCR, NIBIB, NHLBI
- Tissue Chips in Space (2017–2021)
 - Partnership with Center for the Advancement of Science in Space (CASIS)
 - Adapt, refine chips for on-flight experiments at the International Space Station U.S. National Laboratory
 - To understand diseases
 - Improve human health on Earth



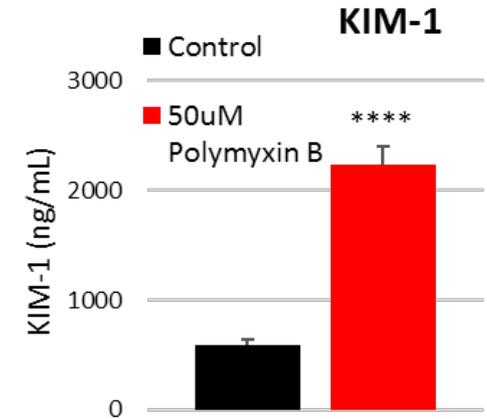
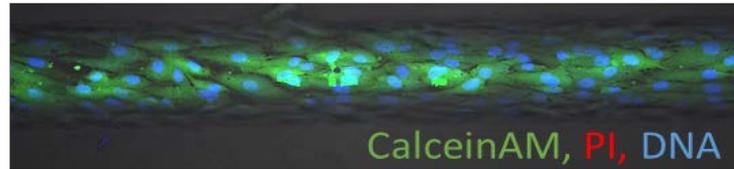
Tissue Chips Testing Centers - Kidney MPS yielding first results at Texas A&M



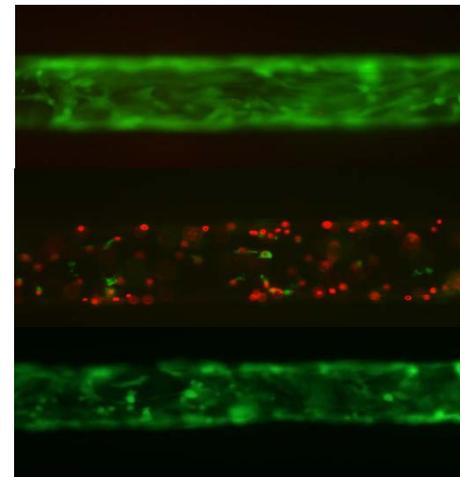
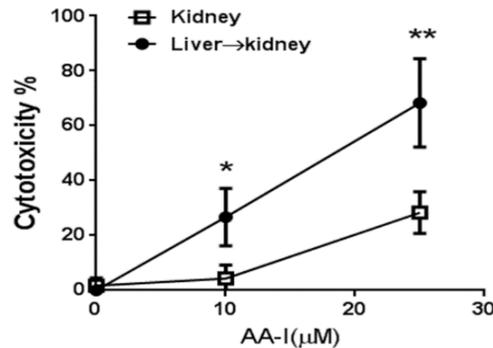
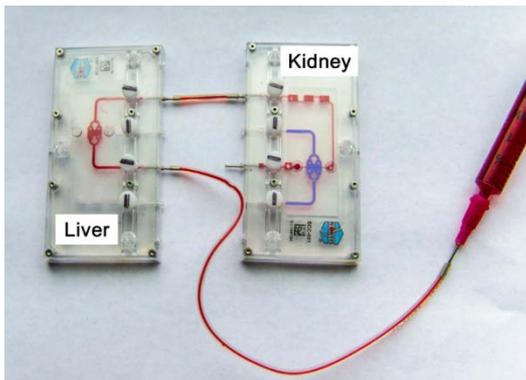
UW Primary Human Renal Proximal Tubule Cells (7 D)



Direction of media flow (0.5 μ l/min) \rightarrow



Human Mechanism of Aristolochic Acid Nephropathy Elucidated by Coupled Liver-Kidney MPS (Himmelfarb, Wash U)

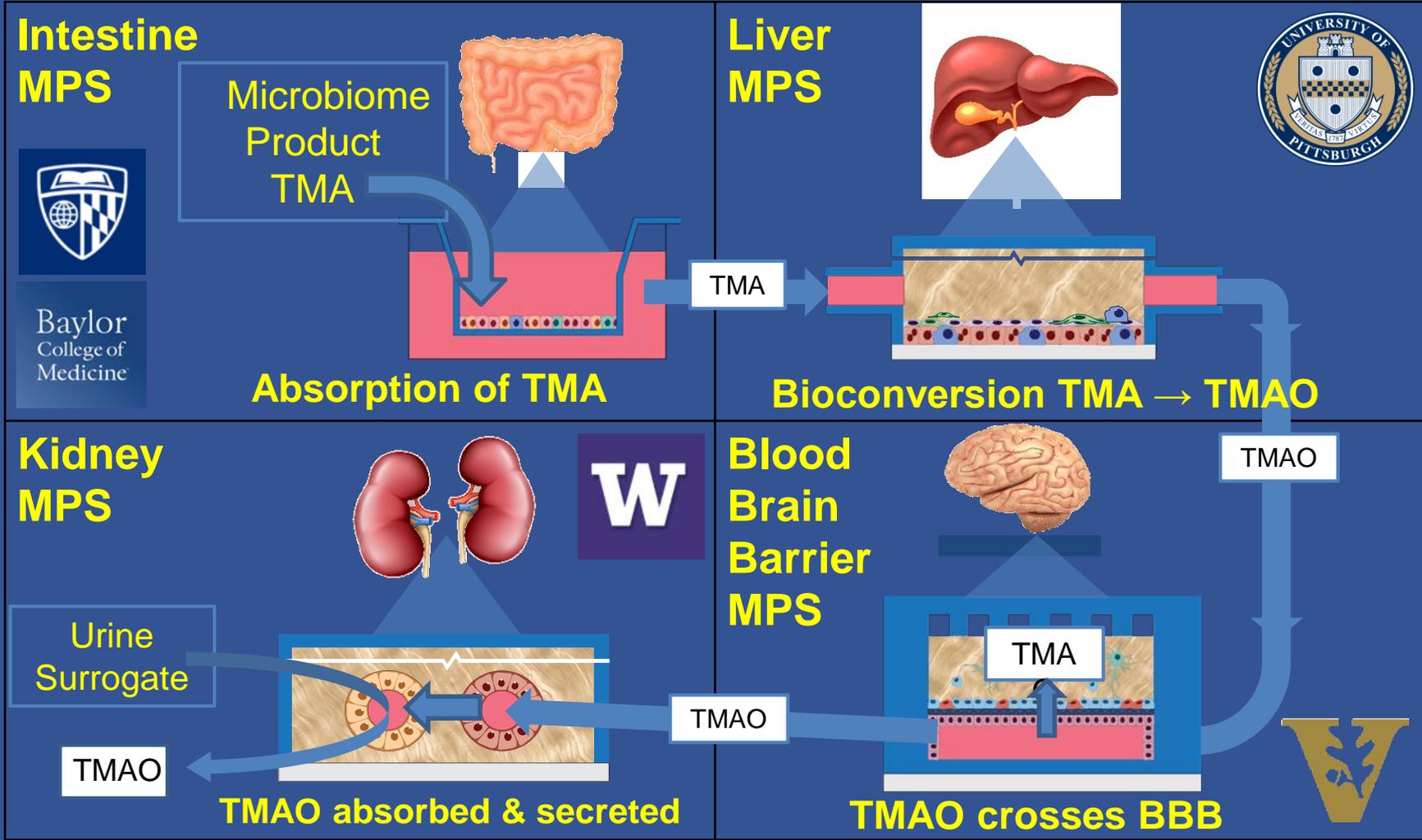


Vehicle control

Nephrotoxic metabolite from liver

Metabolite + Probenicid 2mM

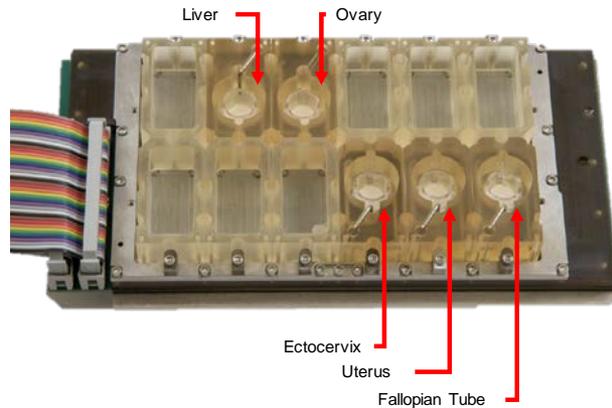
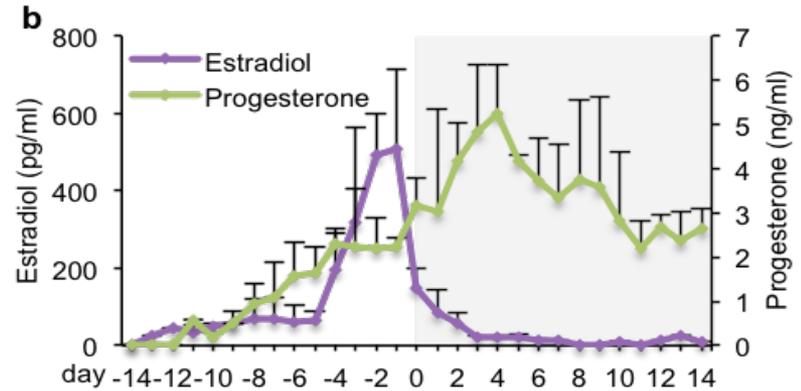
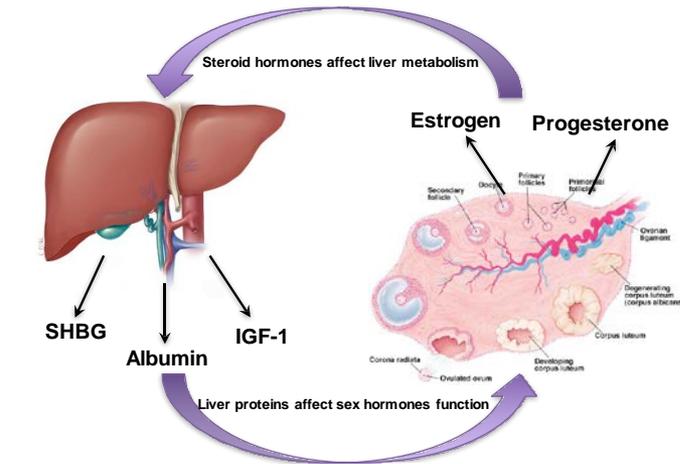
Functional coupling of four chips demonstrates physiological processing of the microbiome product trimethylamine (TMA)



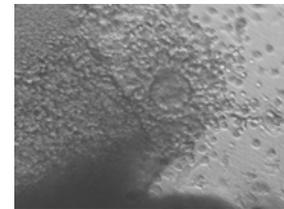
Vernetti L et al (2017) 'Functional Coupling of Human Microphysiology Systems: Intestine, Liver, Kidney Proximal Tubule, Blood-Brain Barrier and Skeletal Muscle'. Sci Rep 7:42296).

EVATAR

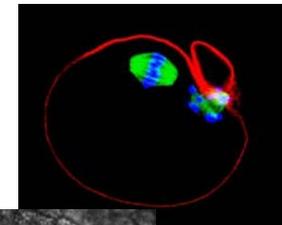
An *ex vivo* female reproductive tract



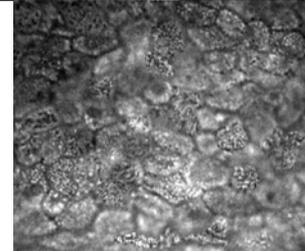
Ovulation



Mature Egg



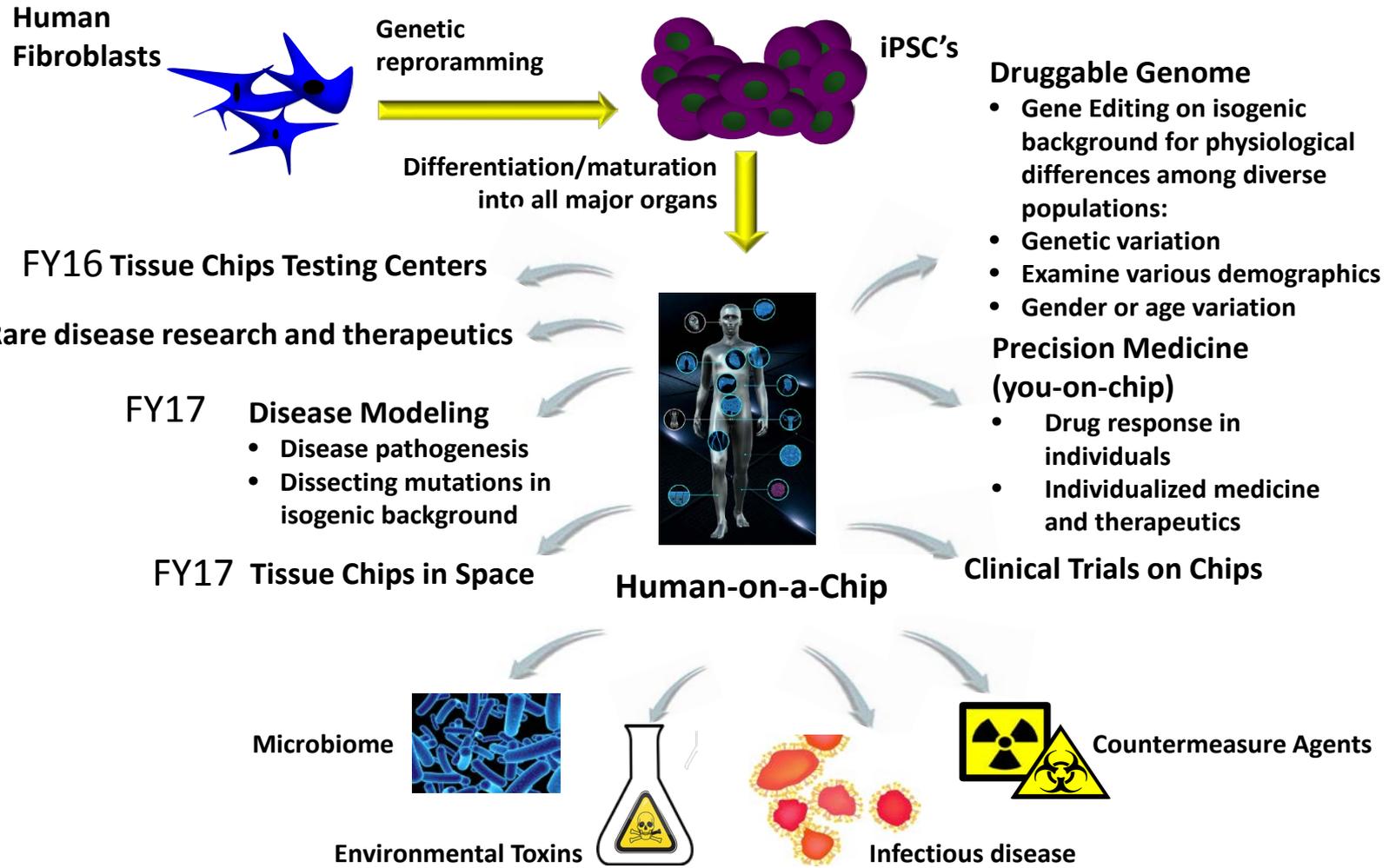
Fallopian Tube



Xiao S et al (2017) 'A microfluidic culture model of the human reproductive tract and 28-day menstrual cycle'. Nat Comm March 28 doi: 10.1038/ncomms14584.



Future Directions in Tissue-on-chips Technology



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