3D-Printed Microfluidic Device for the Analysis of Intestinal Tissue Ex Vivo

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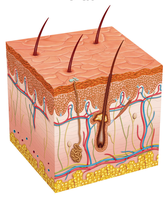
Overall Project Objective

Create a novel approach for studying the intestine and other barrier organs.

Barrier Tissues and Challenges

Air

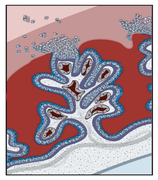
Skin



Fatty tissue

Barrier tissues act as a partition between two distinct environments

Maternal blood

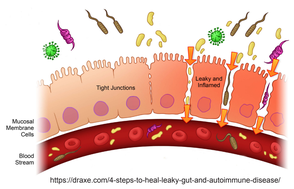


Placenta

Fetal blood

Lumen

Intestine

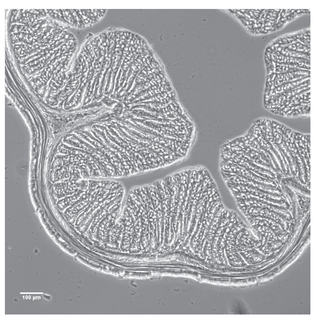


https://draxe.com/4-steps-to-heal-leaky-gut-and-autoimmune-disease/

Serosa

Improving Existing Models

Ex Vivo



Ex vivo mouse colon retains physiological accuracy

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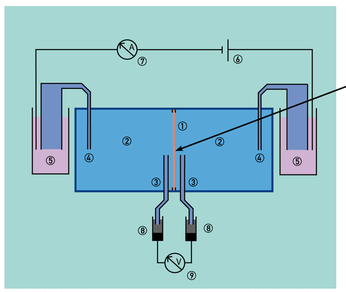
Ussing Chamber



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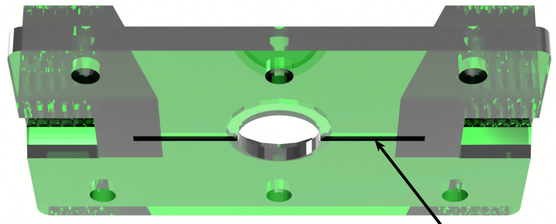
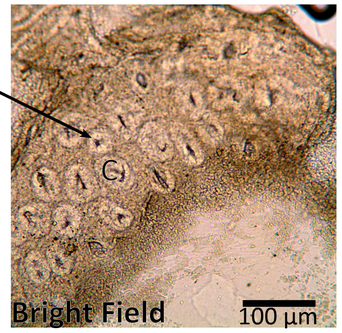
Ussing chambers allow for differential media

Human-Gut-On-a-Chip

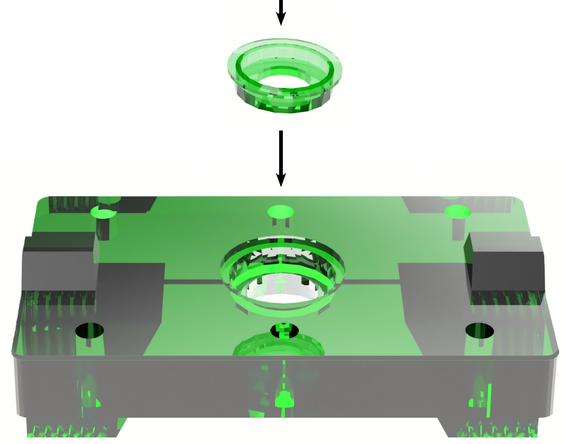


Luminal microfluidic channel

Crypts on the luminal surface of human colon biopsy

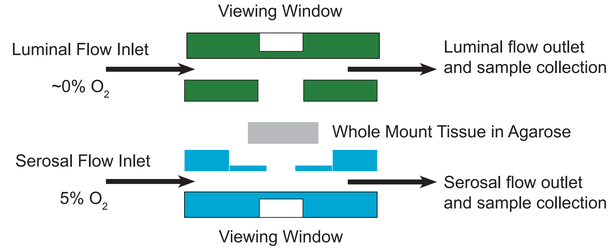


Biopsy sample

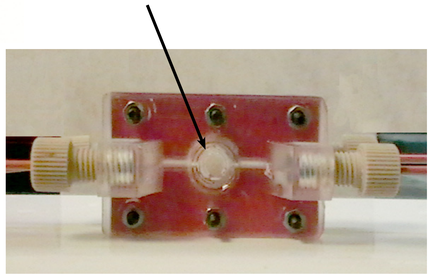


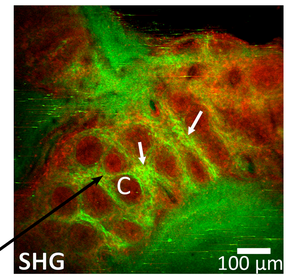
Key Characteristics and Features

- Dual perifusion to mimic the dual microenvironment of the gut.
- Differentially control media composition and drug delivery.



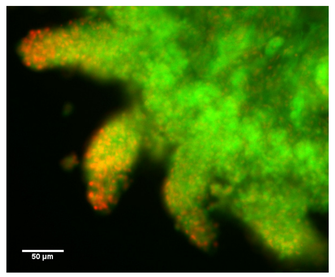
- Measurement and control of oxygen concentration.
- Window will allow second harmonic generation microscopy.





Collagen patterning surrounding crypt cells in intestinal wall

Mouse small intestine fillet was cultured for 24hr. Red label (ethidium homodimer) indicates physiological cell death near the apex of the villi



Translational Value and Application

The microfluidic instrumented tissue device can provide insight into complex physiological and pathogenic mechanisms in the intestines. There are potential applications in drug development and personalized medicine.

Acknowledgements

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