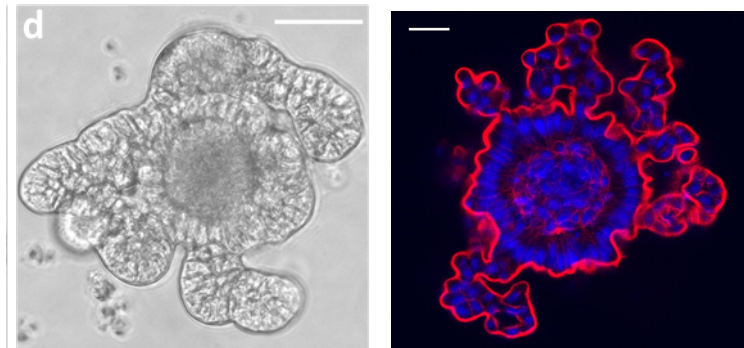


Innovations to support genetic improvement in tropical poultry production systems; enteroids to measure gut health.



Lonneke Vervelde

The Roslin Institute

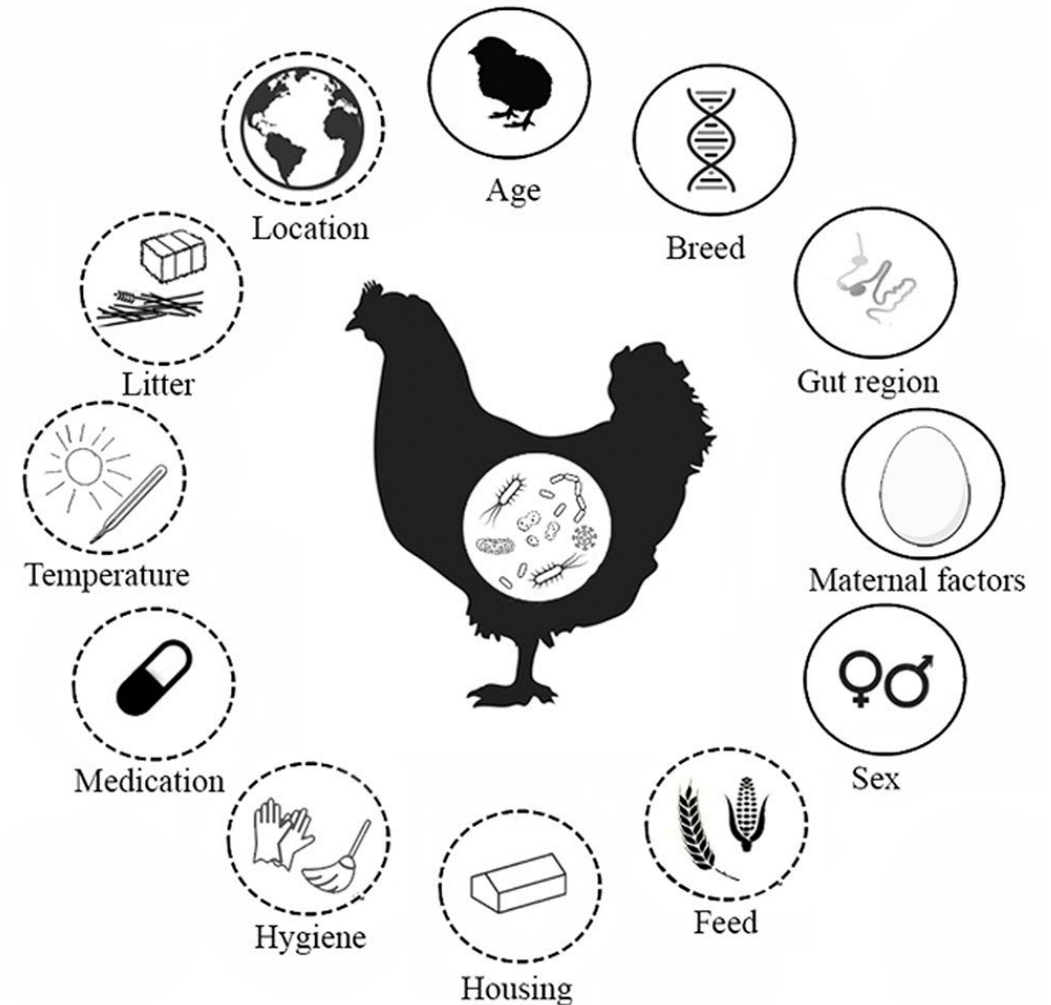
lonneke.vervelde@roslin.ed.ac.uk

 @LVervelde

Poultry gut health is crucial for performance



Factors affecting gut health



Phases of development of the intestine

Development

- Gut tissues
- Gut immunity
- Gut microbiota

Development of gut
for rest of its life

Maintenance

- Mature gut
- Stable microbiota
- Promote barrier integrity

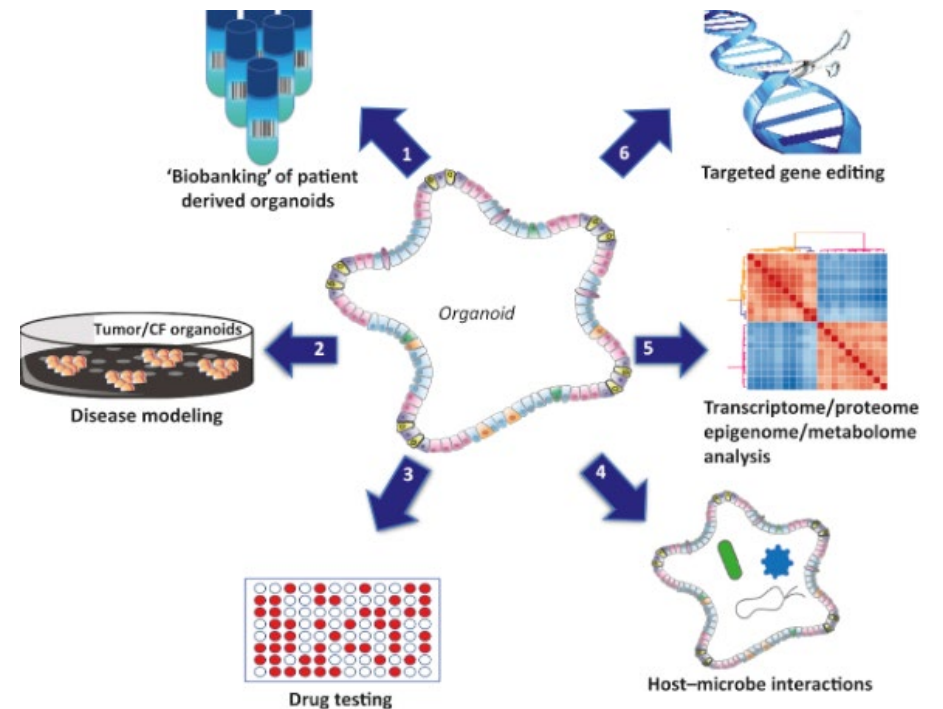
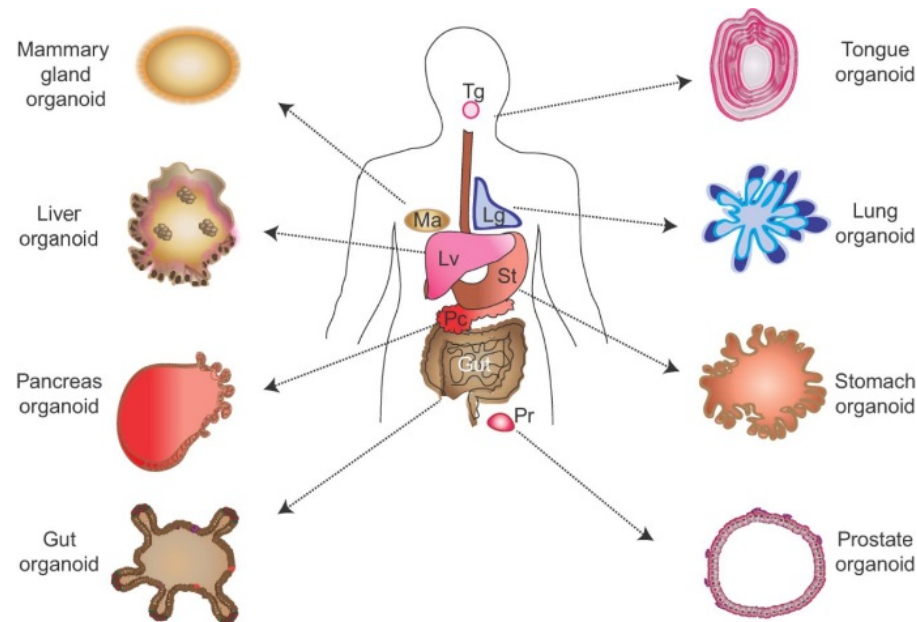
Support gut to conserve
homeostasis

Develop *in vitro* technology to determine parameters for gut health
and improve survival rate → Intestinal organoids or enteroids

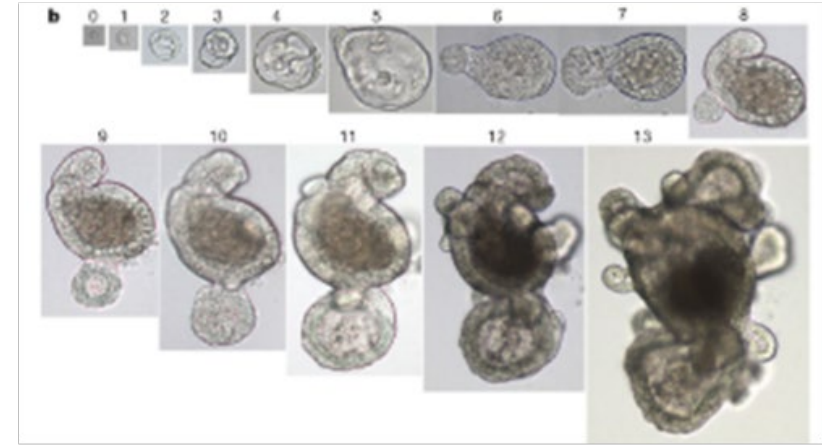
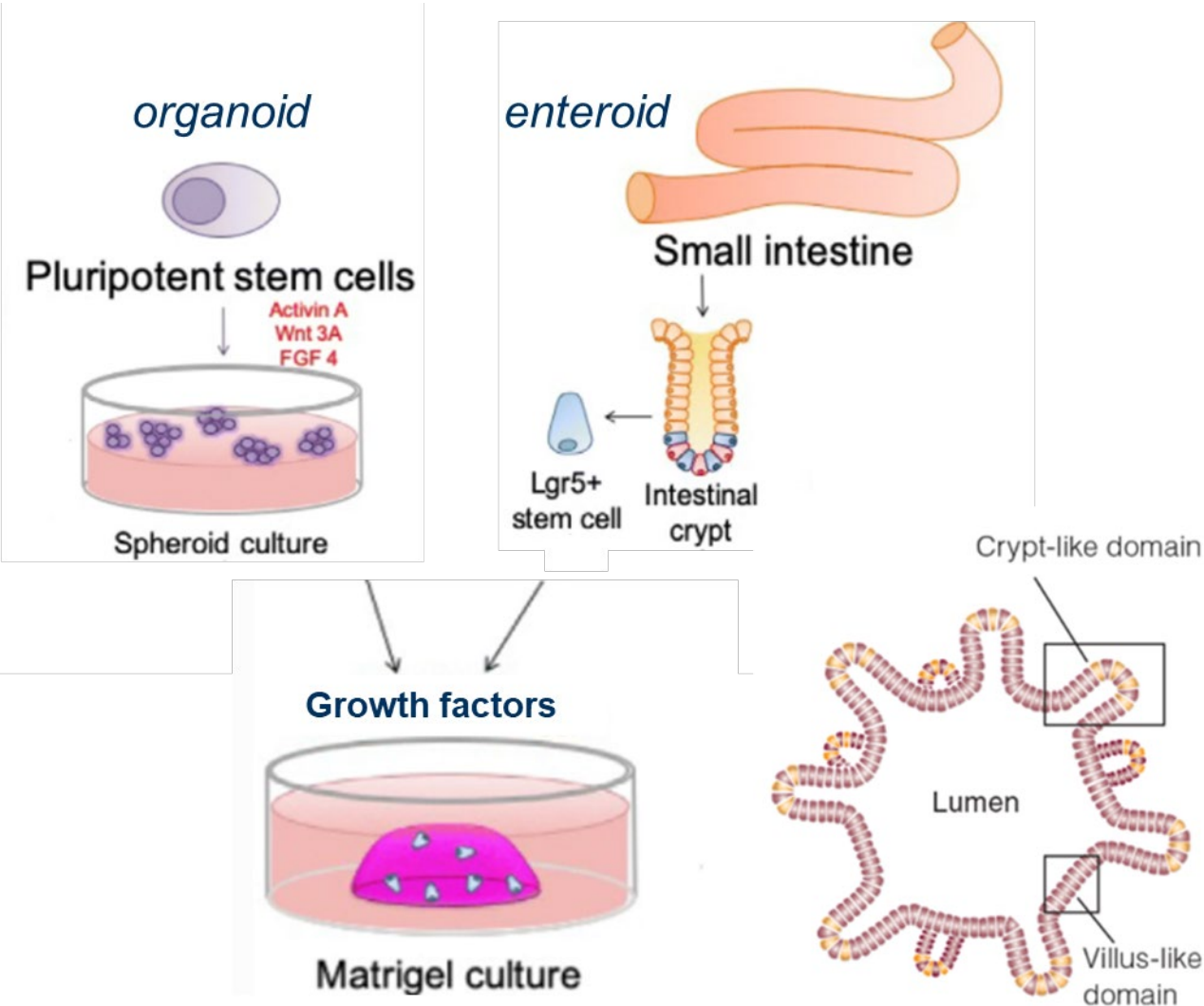
Organoids: miniature in vitro grown organs

Self-organized 3D tissue cultures derived from stem cells

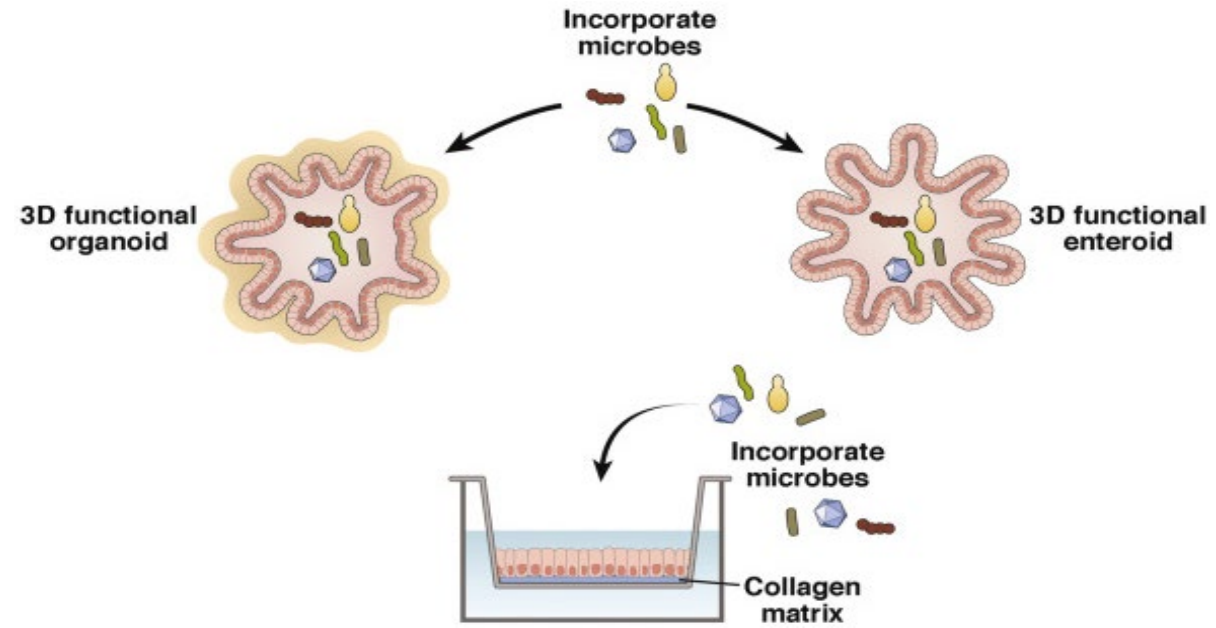
- multiple organ-specific cell types
- cells are grouped together and spatially organized, similar to an organ
- capable of recapitulating some specific function of the organ



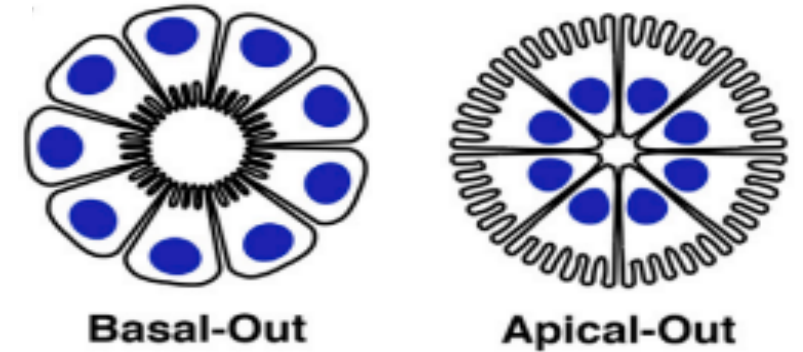
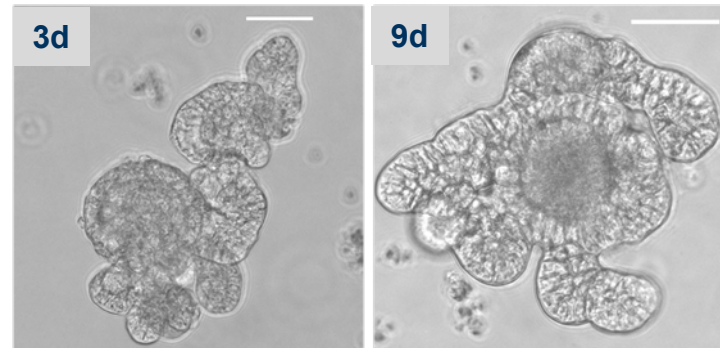
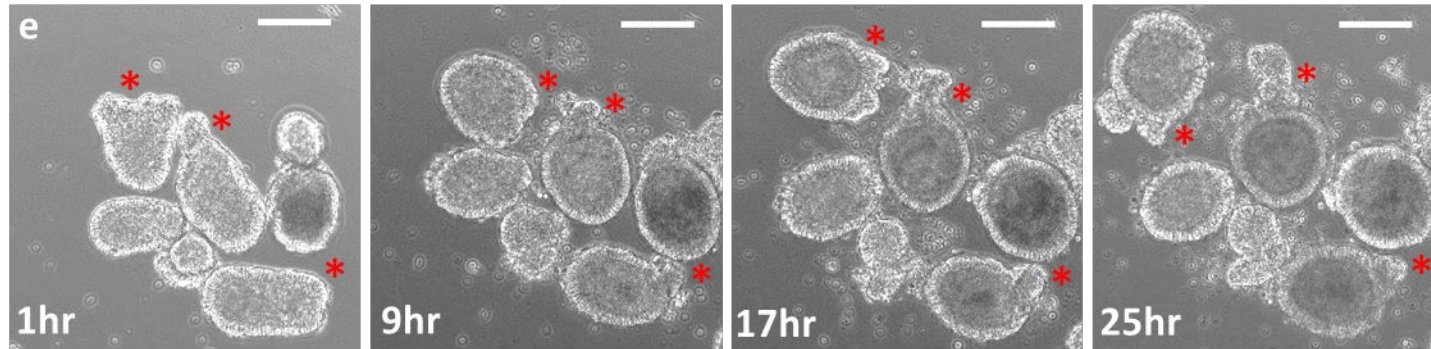
Mammalian intestinal organoids and enteroids



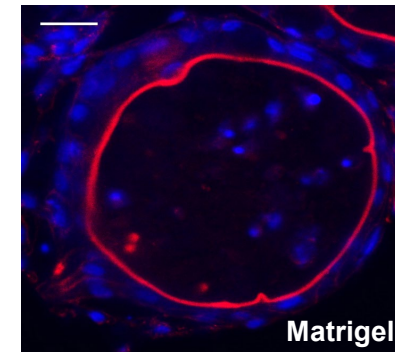
Sato et al., Nature, 2009, 459, 262-265



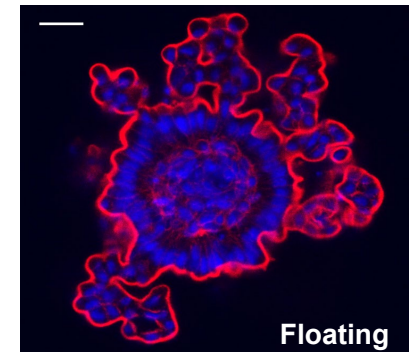
Avian 3D enteroids inside out polarity under floating conditions



ED18

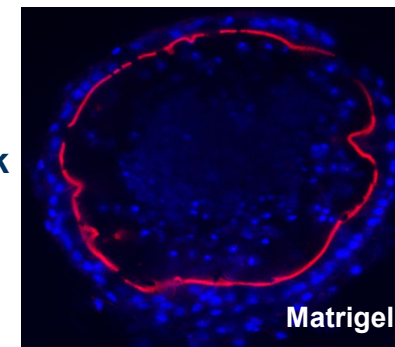


Matrigel

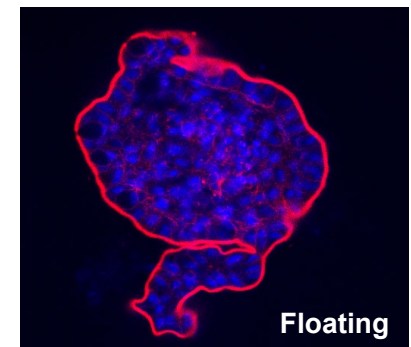


Floating

9 week



Matrigel



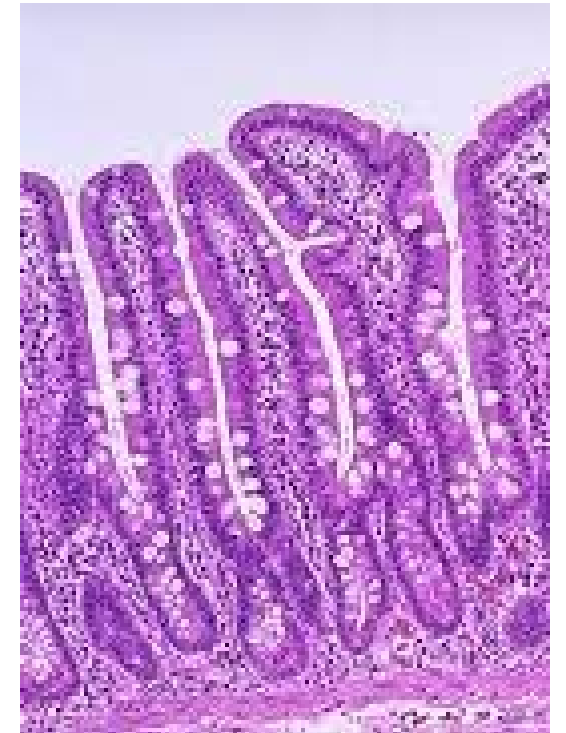
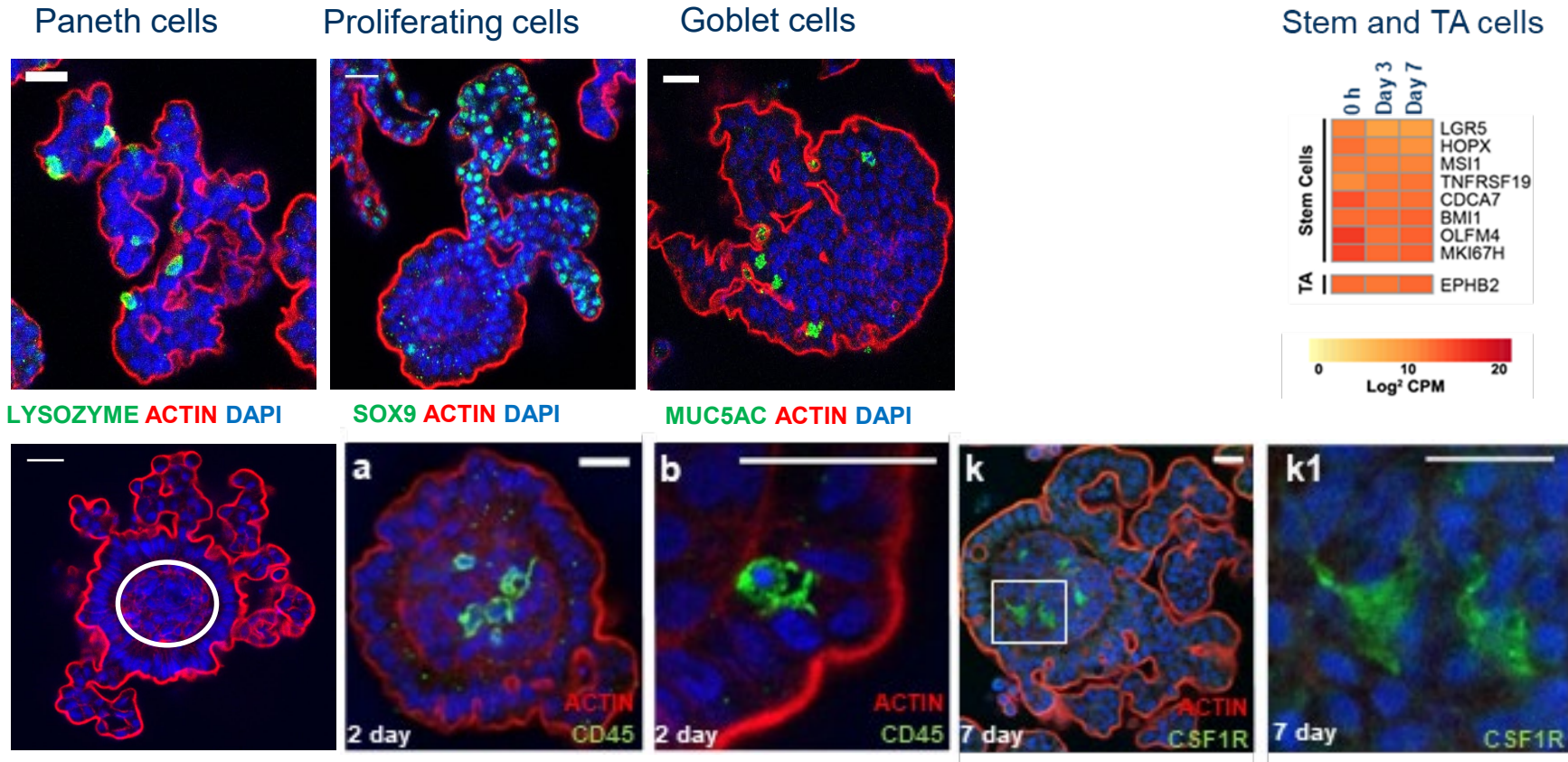
Floating

Nash et al, 2021
Communications Biology

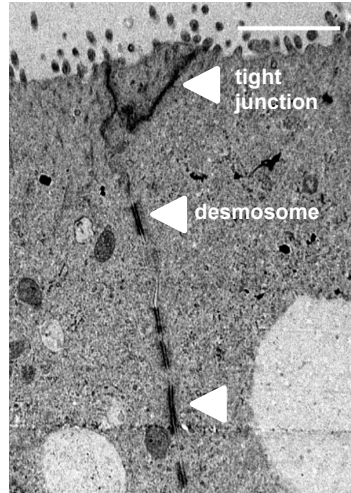
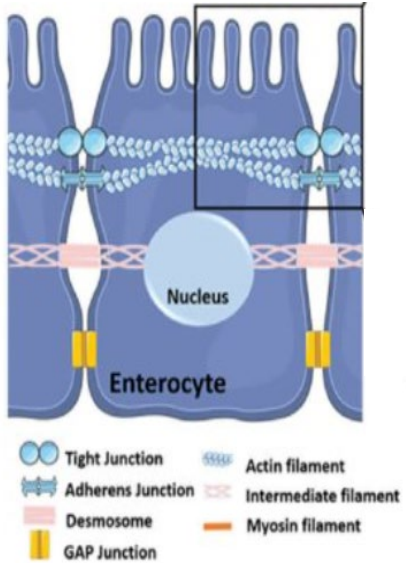
- Extracellular matrix determines orientation of chicken enteroids
- Easy access to apical side of the enterocytes

Chicken 3D enteroids; representation of gut

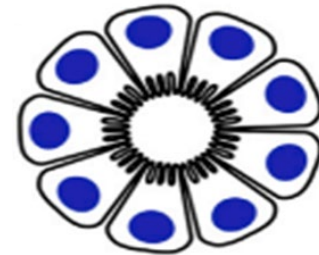
- Are all cells present in the intestine represented?
- Are the enteroids functionally similar to the intestine?



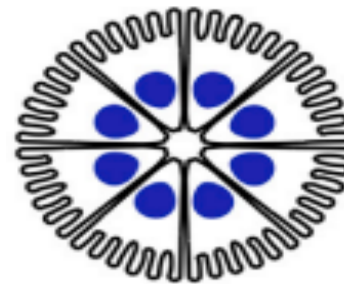
Functional characterisation 3D chicken enteroid epithelial barrier function



Epithelial barrier maintained by intercellular junctional complexes

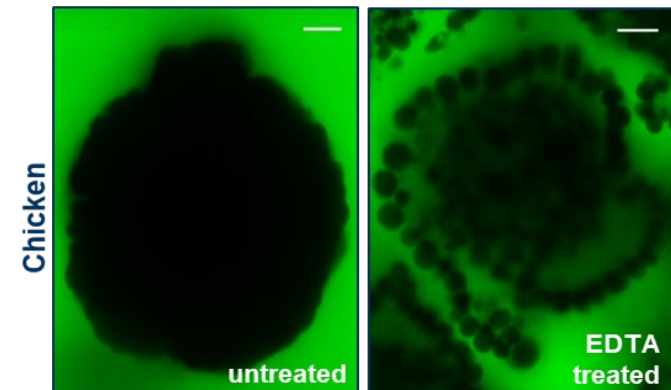
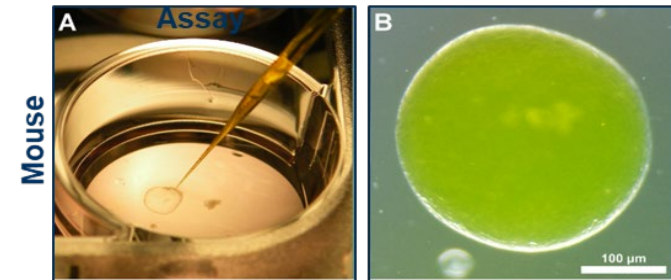


Basal-Out

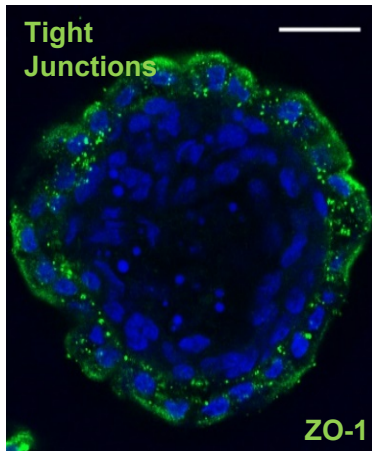
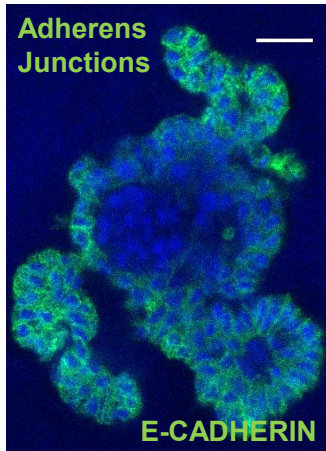


Apical-Out

FITC-Dextran Diffusion Assay

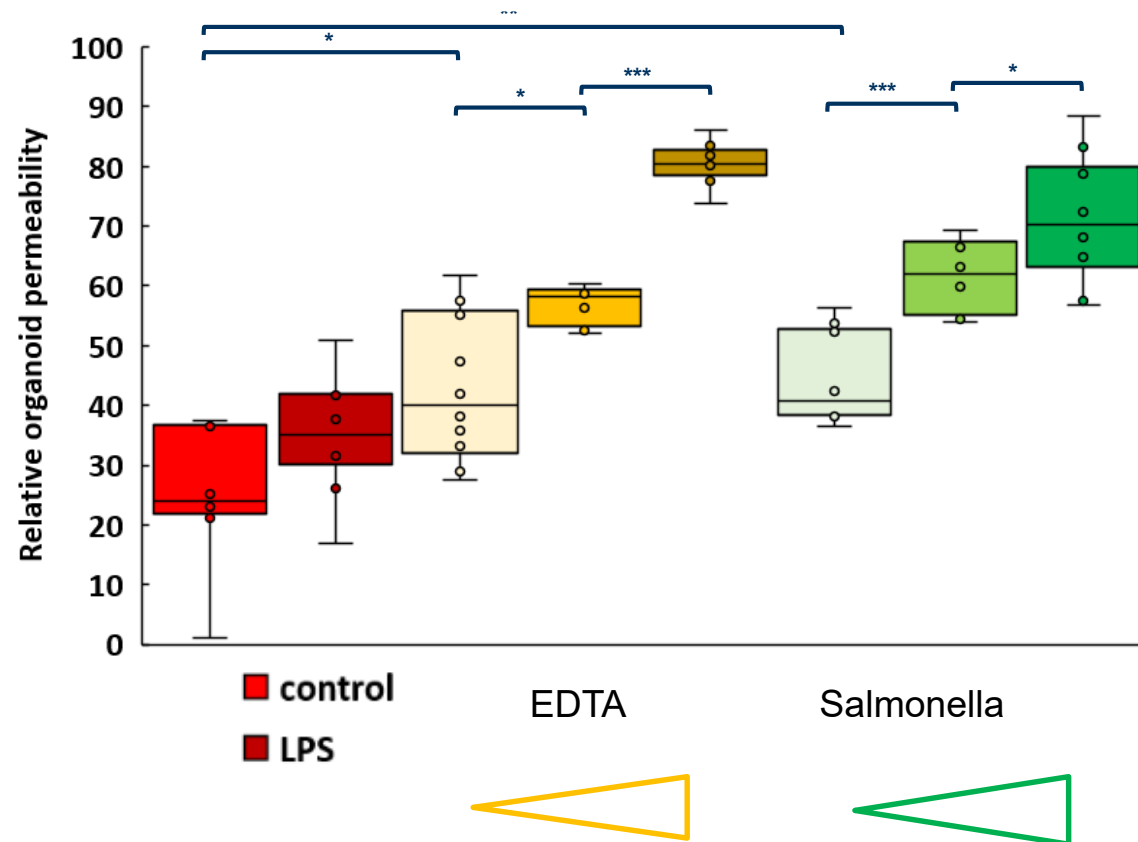
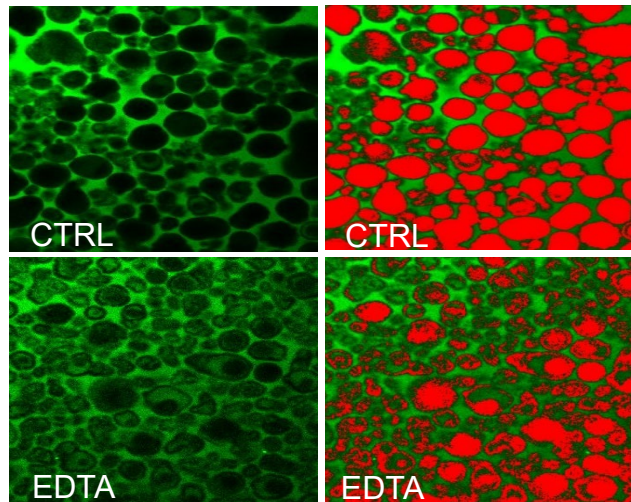


Quantify amount of leakage



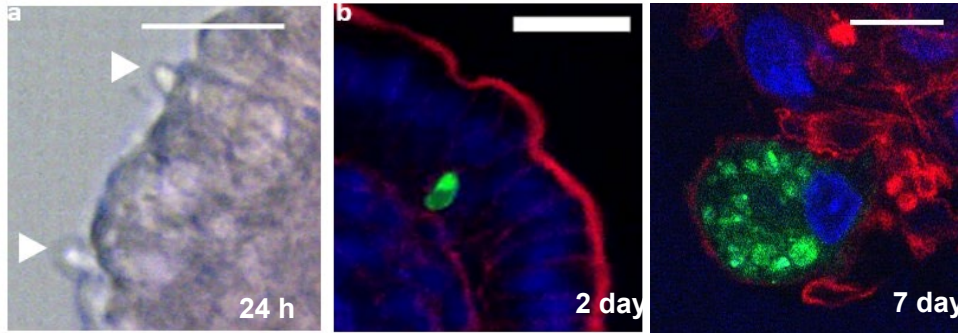
Functional characterisation 3D chicken enteroid epithelial barrier function

Quantification epithelial barrier integrity
Using bio-imaging tools

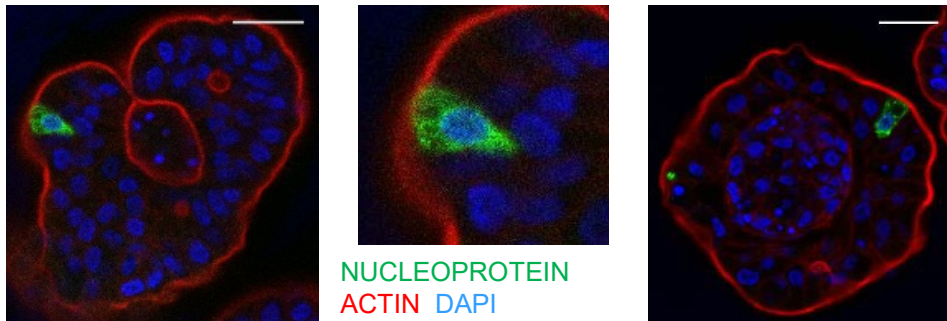


Functional characterisation 3D chicken enteroid

Host pathogen interaction

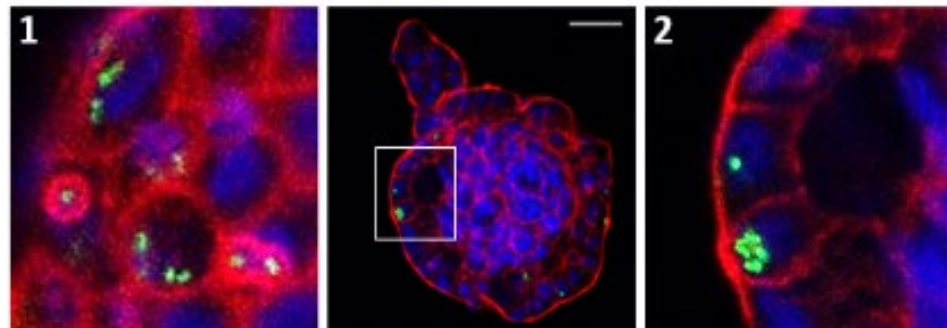


Parasites
Eimeria tenella



Viruses
Influenza virus

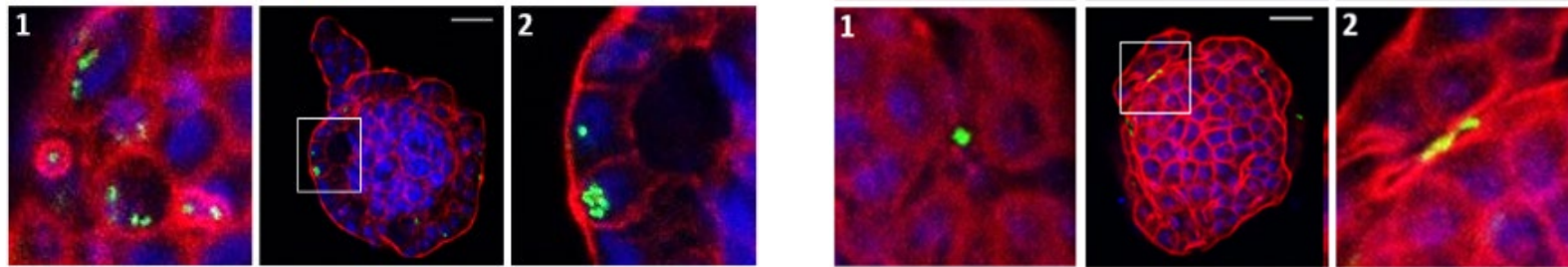
Do the pathogens induce immune responses?



Bacteria
Salmonella enterica serovar Typhimurium

Functional characterisation 3D chicken enteroid Host pathogen interaction and immunity

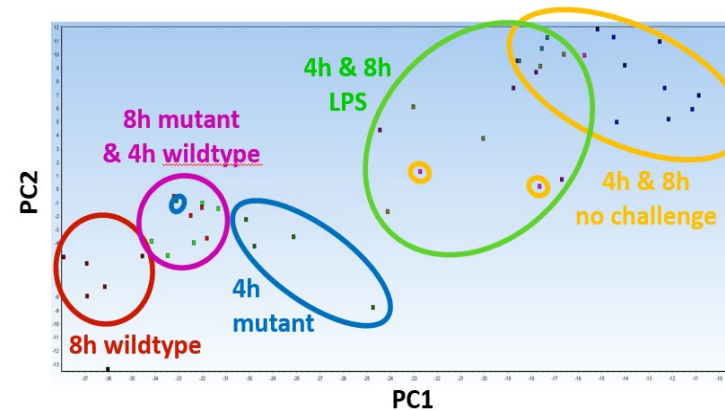
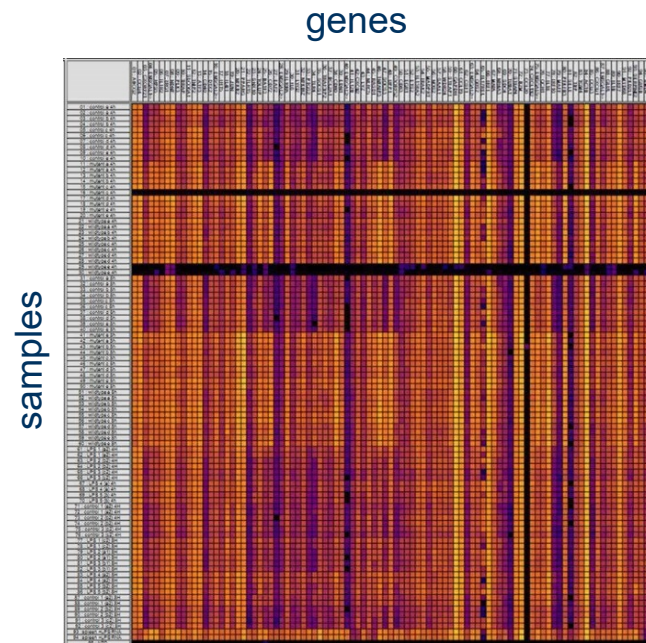
Salmonella enterica serovar Typhimurium – eGFP; wild type and non invasive mutant



Isolate RNA
4 and 8 hpi



Fluidigm RT-qPCR array
96x96 set up
89 immune genes
Borowska et al 2019





Chicken 3D enteroids; novel model for gut health

3D chicken enteroids

- Represent all cell types found in chicken epithelium and lamina propria
- Bacteria, viruses and parasites enter and replicate
- Immune responses induced similar to *in vivo* responses

- Excellent model for wide range for applications



Nash, Morris, Mabbott, Vervelde
2021 Communication Biology

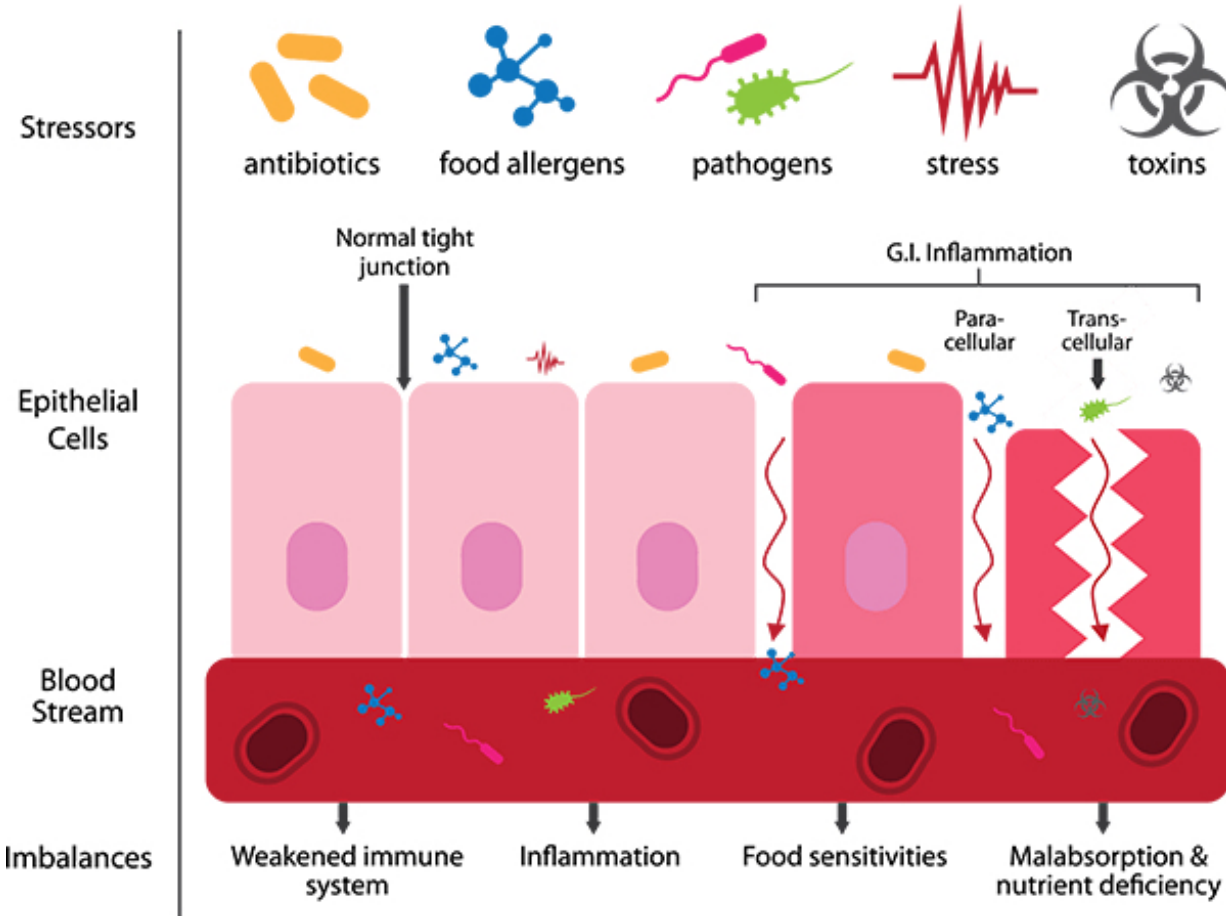
Chicken 3D enteroids; novel model for gut health

Future applications

- Use the 3D enteroids to compare the inherent gut health of commercial hybrid birds & indigenous breeds (ACGG/TPGS lines).

- Test the ability to resist intestinal disease challenge and resist heat stress.

- Test the importance of nutrition on barrier integrity and immunity.





Thank you



Tessa Nash
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Samantha Ellis, Safieh Zeinali, Karen Bryson



CTLGH

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CTLGH Team



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