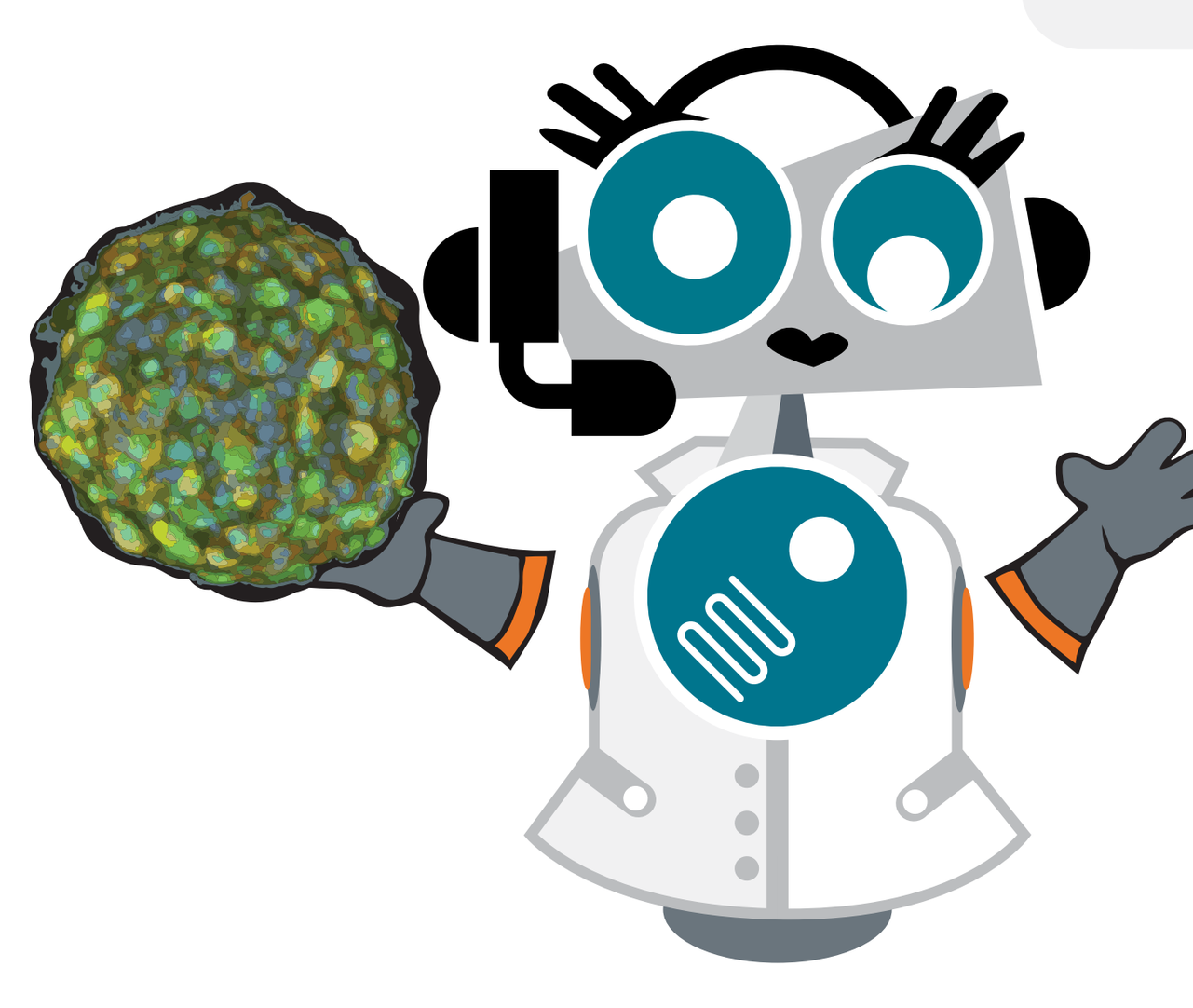
MOLECULAR DEVICES

History of Organoid Research:

From Sponge Cells to Functional Organs

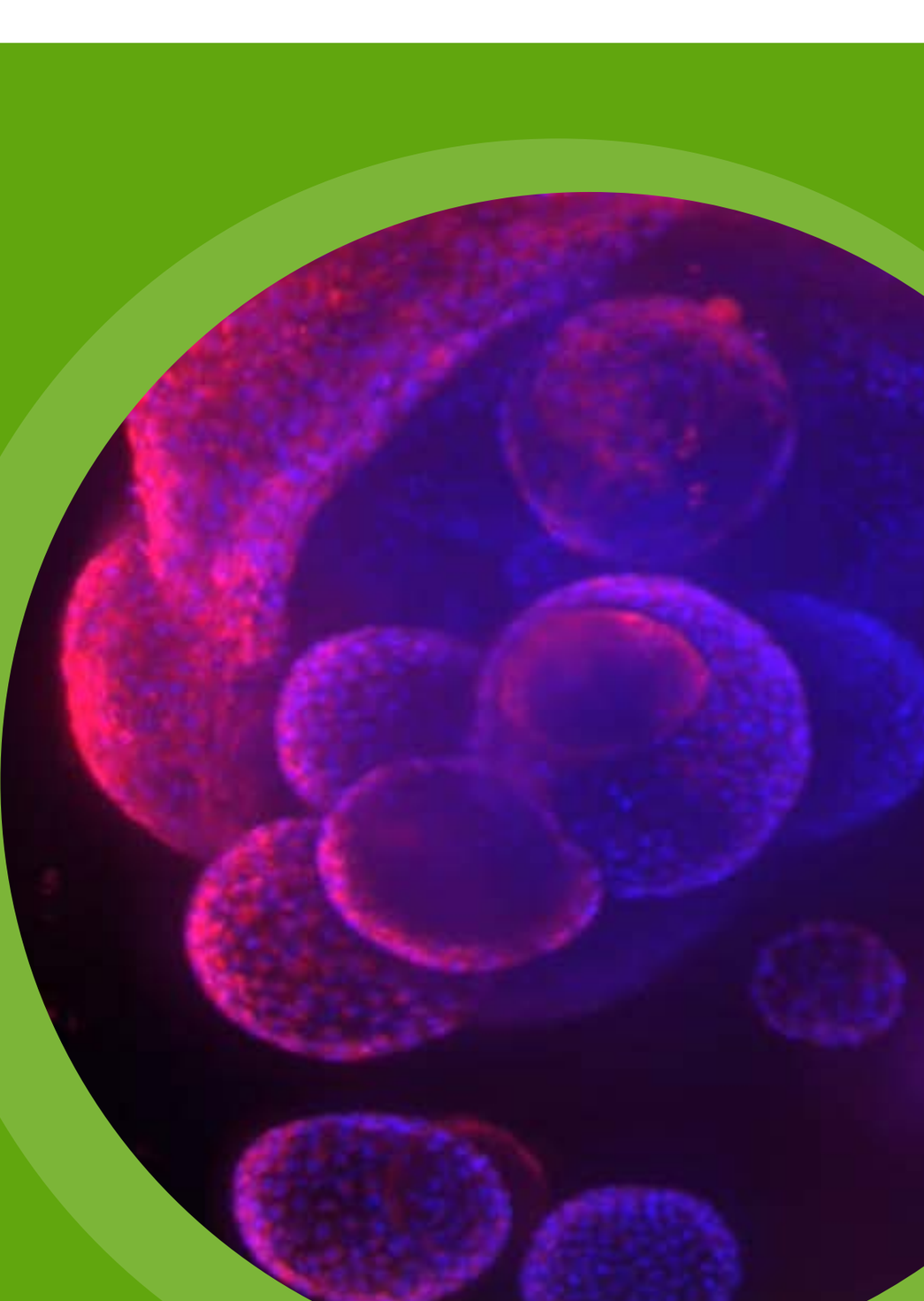


Organoids refers to a 3 dimensional assembly that contains multiple cell types, that are arranged with realistic histology, at least at the micro scale. Organoids may be formed from human or animal cells, which may be differentiated cells, stem cells or a mixture of both

3D organoids are undeniably at the center of disease modeling and drug discovery. Because these cell cultures self-organize into clusters and differentiate into cell types that make up a functional organ, they are much better at mimicking in vivo conditions.

Interestingly, the idea of organoids is not new. Today's organoid technology is the product of decades of research In fact, the foundations of the concept go back to the beginning of the 20th century.

Here is a brief rundown of the **history of organoids** and how Molecular Devices found itself a spot on the timeline with its extensive organoid research solutions.



Pre-organoid Era

Before Stem Cell: Self-organization and Re-aggregation

Henry Van Peters Wilson in 1907, discovered that siliceous sponge cells, which were previously degenerated, could self-organize and differentiate into perfect sponges.

- 1907 SPONGE CELLS
- 1944 AMPHIBIANS
- 1946 CYSTIC TERATOMA
- 1960 EMBRYONIC CHICKS
- 1961 EMROYOID BODIES
- 1981 PLURIPOTENT STEM CELL
- 1985 EXOCRINE PANCREATIC
- 1987 EPITHELIAL CELL
- 1998 EMBRYONIC STEM CELLS
- 2002 HEPATOCYTE

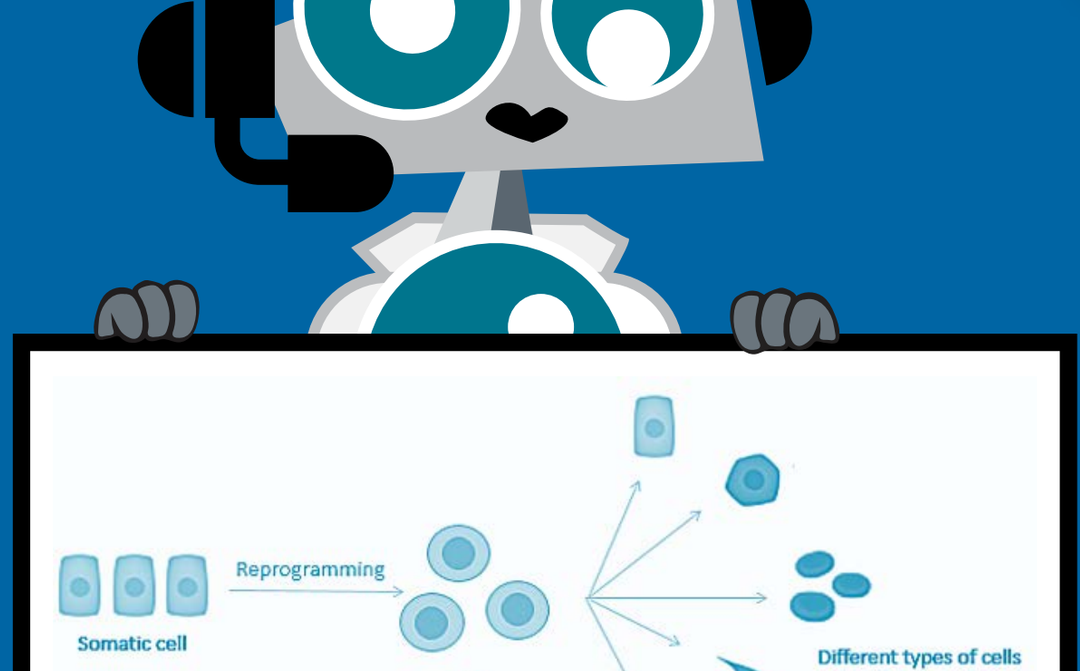
The Importance of Extracellular Matrix (ECM)

The 1980s saw significant milestones in organoids research, as the cell-matrix interactions were investigated in the context of organoid development.

Stem Cells

Researchers could isolate pluripotent stem cells from mouse embryos for the first time in 1981.

Induced pluripotent stem cells (iPSCs)



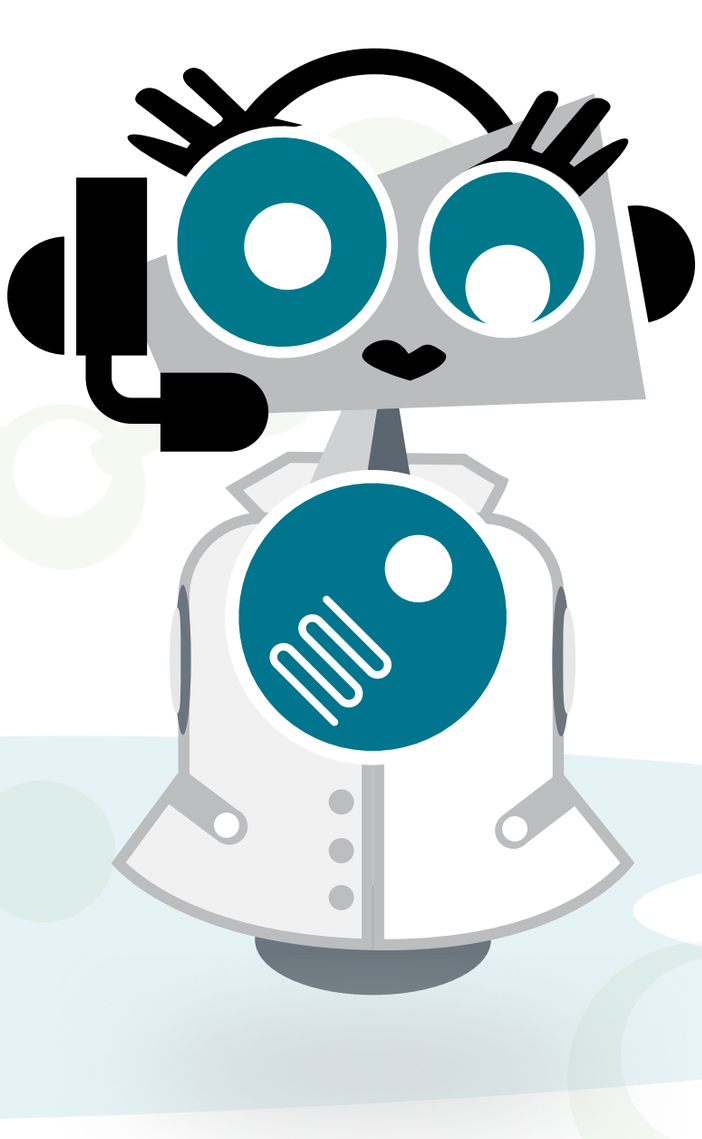
An **induced pluripotent stem cell,** also referred to as iPS cell or iPSC, is a cell taken from an adult tissue – a somatic cell usually derived from skin or blood – and genetically modified back into an embryonic-like, pluripotent state. First developed from mouse skins cells by Shinya Yamanaka's team at Kyoto University, Japan in 2006, iPS cells held promise in the field of regenerative medicine

Modern Organoid

After Stem Cell: Modern Organoid Research

The advent of human induced pluripotent stem cells (iPSCs) presents unprecedented opportunities to model human diseases—from differentiated cells derived from iPSCs in 2D monolayers to recent advancements that mimic in vivo tissues and organs at the 3D level.

- 2006 INDUCED PLURIPOTENT STEM CELL (iPSC)
- 2008 3D CEREBRAL CORTEX – In 2008, Sasai et.al laid the foundations of brain organoids by demonstrating self-organization of human brain iPSCs into neural cells that formed polarized cortical tissue
- 2009 INTESTINAL – Sato et al. demonstrated for the first time that intestinal adult stem cells (ASCs) could self-organize and differentiate to form intestinal crypt-villus structures that contained all the different intestinal cell types
- 2010 GASTRIC
- 2010 RENAL – Renal organoids from murine fetus-derived kidney stem cells
- 2011 RETINAL – Formation of a self-organized optic cup structure from human ESCs in 3D culture



Modern organoid research quickly expanded over the previous decade to include various organs and disease models.

Here are a few highlights...

2013: CEREBRAL, INNEAR EAR, LIVER, LIVER BUD, PANCREAS

2014: GASTRIC, GASTRULOID, LUNG, POLARIZED EMBRYO, PROSTATE, SALIVARY

2015: CHOLANGIOCYTE, FALLOPIAN TUBE, HIPPOCAMPAL, KIDNEY, MAMMARY GLAND

3D CEREBRAL ORGANOID – 2013; The first study to derive 3D cerebral organoids containing different brain tissues

LIVER ORGANOID – Lgr5+ liver stem cells were expanded as liver organoids and were differentiated into functional hepatocytes when transplanted into mice

PANCREAS – 2013: Formation of pancreatic organoids with the cancer disease model from adult pancreas tumors

LUNG ORGANOID – 2014: Lung organoids from the 3D coculturing of endothelial cells and bronchioalveolar stem cells

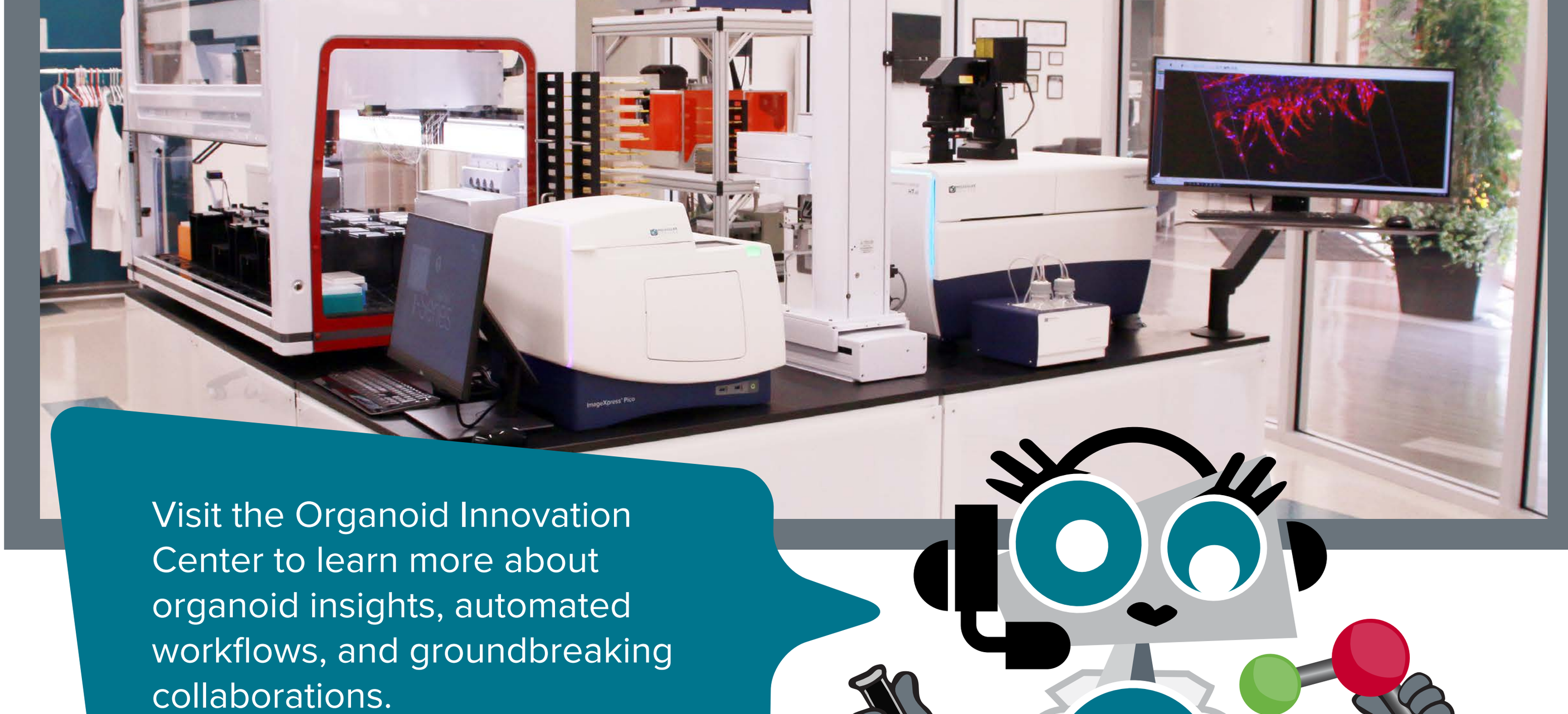
- 2017 ENDOMETRIUM
- 2018 PLACENTA, HEPATOCYTE
- 2019 LUNG, FOETAL HEPATOCYTE
- 2020 SNAKE VENOM GLAND, SKIN

Organoid image gallery

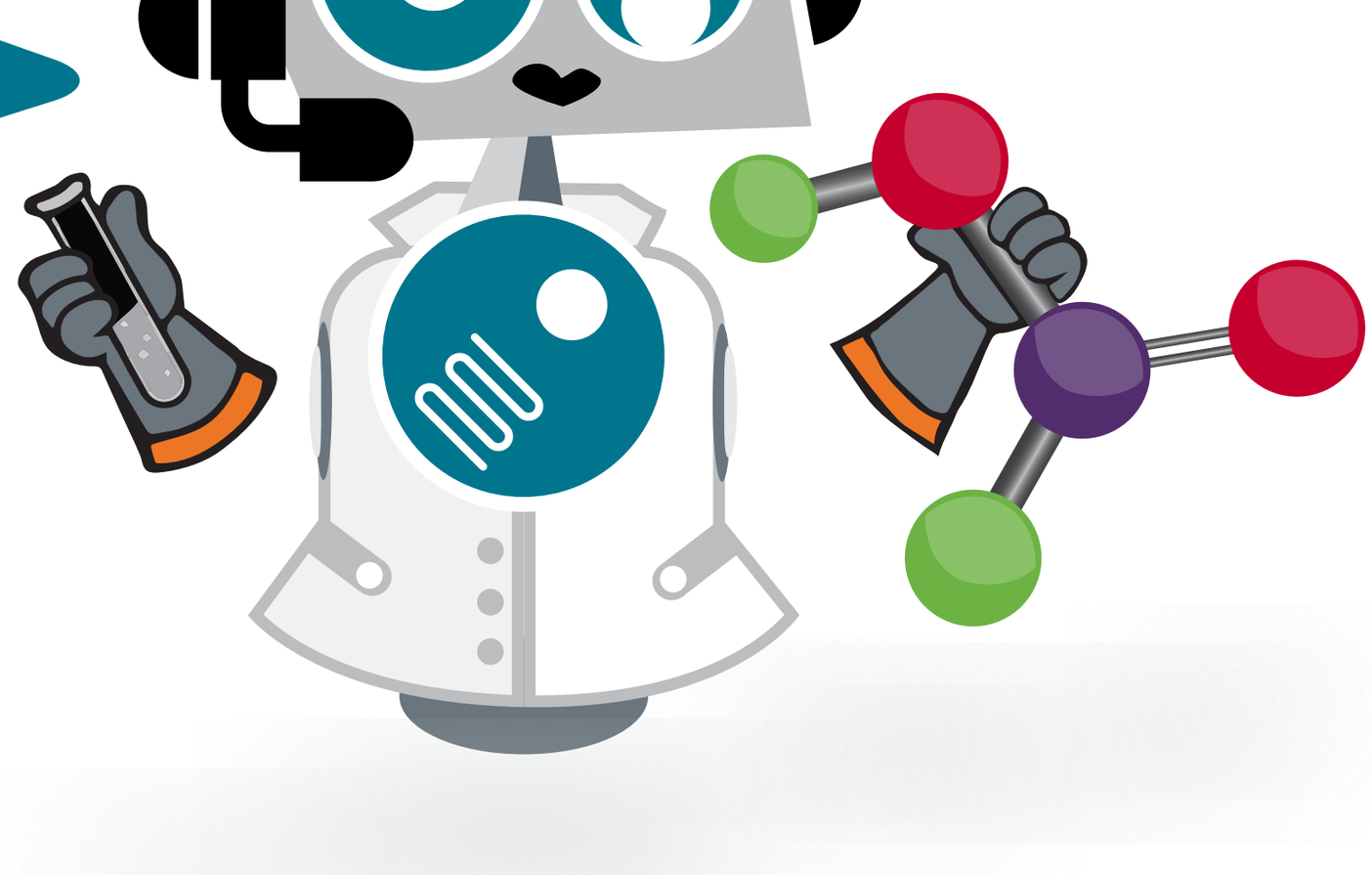
Advances in Organoid Research

Over the recent decade, the advances in organoid development have skyrocketed, generating more complex and life-like organoids than ever. Inevitably, imaging and analysis techniques need to keep up with the continuous developments as sample types shift from 2D to 3D.

The **Organoid Innovation Center** is a collaborative hub where you can test automated workflows for organoid culturing and screening, with guidance from in-house scientists.



Visit the Organoid Innovation Center to learn more about organoid insights, automated workflows, and groundbreaking collaborations.



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