TECHNOLOGY NETWORKS

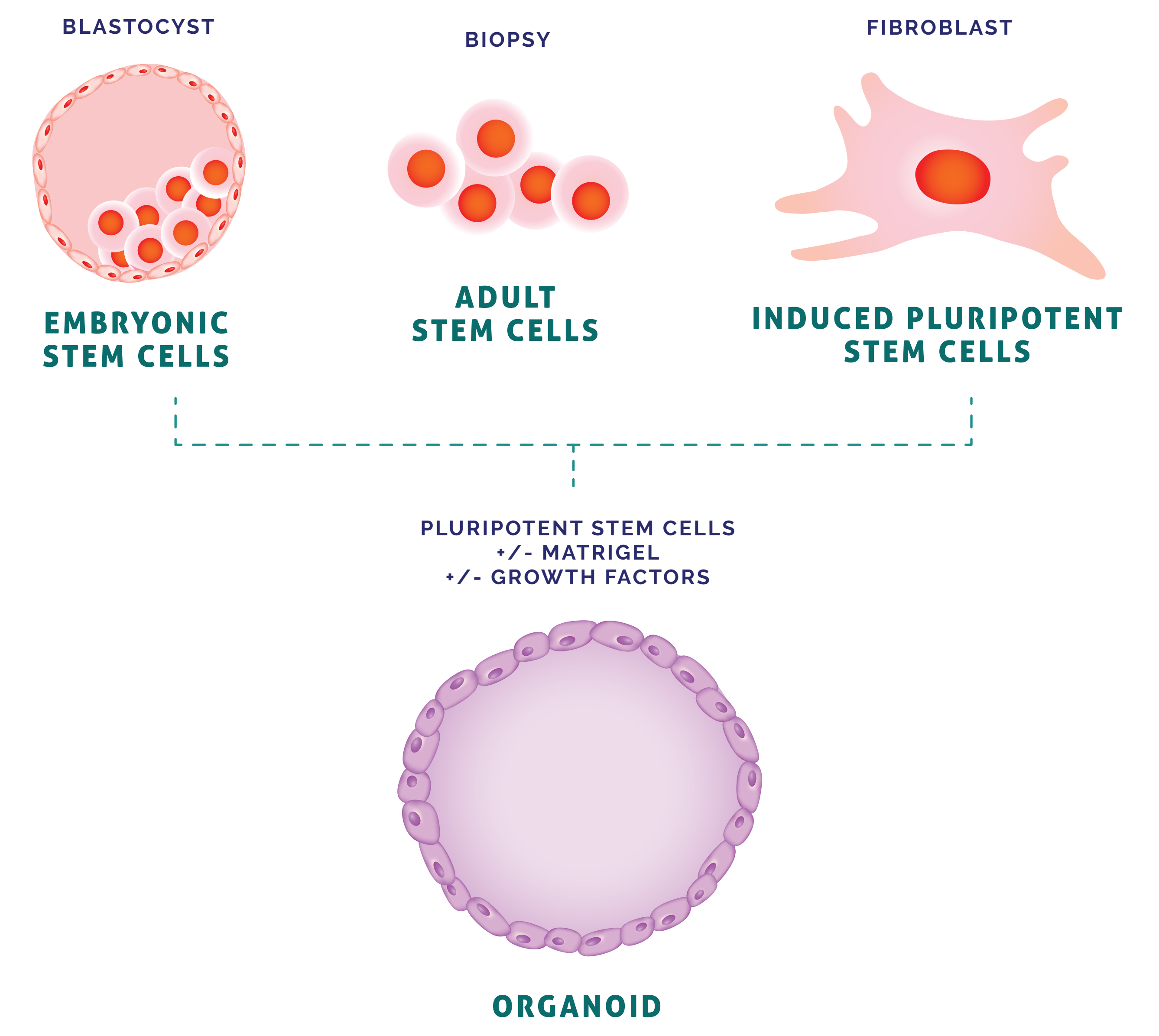
ORGANOIDS

REVOLUTIONIZING THE STUDY OF HUMAN DEVELOPMENT AND DISEASE

WHAT IS AN ORGANOID AND HOW ARE THEY CREATED?

Often referred to as "mini-organs", organoids are tiny self-organizing 3D assemblies of cells which show some physiological features of a specific organ.[1]

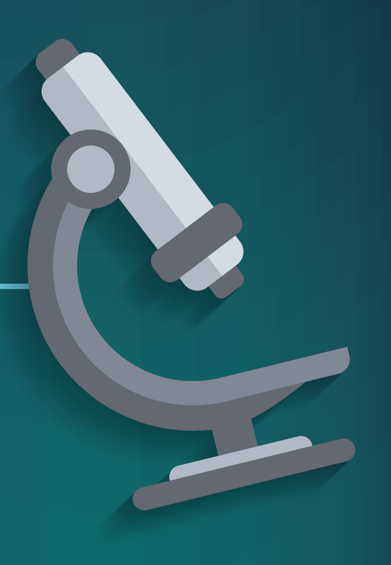
Organoids are generated from embryonic stem cells, adult stem cells, or induced pluripotent stem cells. The stem cells are exposed to a specific combination of signaling molecules, growth factors and chemicals to coax them to generate the tissue of interest.[2]



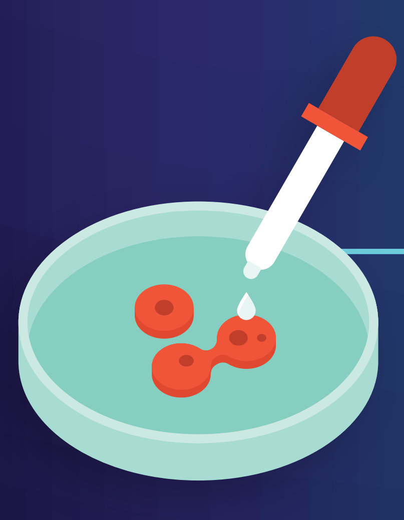
APPLICATIONS OF ORGANOIDS

As an intermediate between traditional 2D *in vitro* cell cultures and animal models, organoids are a useful tool for several applications.[3]

DEVELOPMENTAL BIOLOGY
Study how organs normally form and grow.



DISEASE PATHOLOGY
Identify what goes wrong in diseases ranging from cancer to emphysema.

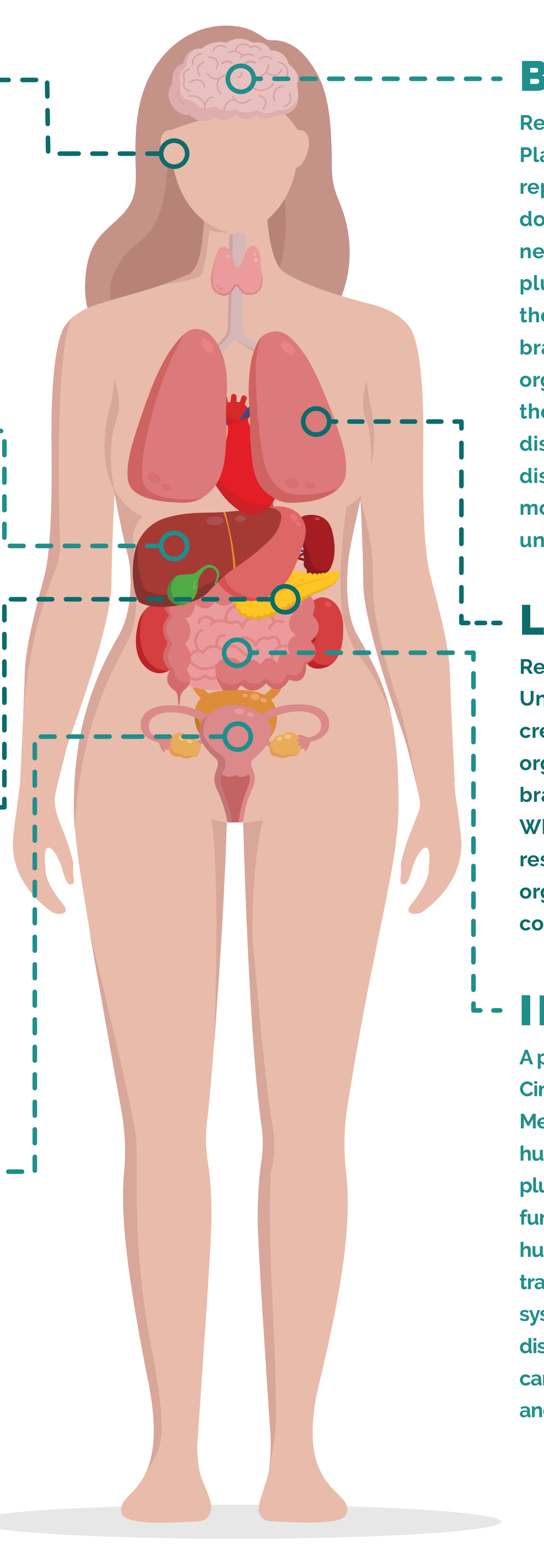


REGENERATIVE MEDICINE
Create cells for autologous or allogenic cell therapy.

PERSONALIZED MEDICINE
See how an individual will respond to a therapy. Organoids can act as an avatar.

DRUG DISCOVERY
Evaluate the efficacy and toxicity of drugs without the need for animal models.

WHICH ORGANOIDS HAVE ALREADY BEEN CREATED?



EAR[4]
An inner-ear organoid containing sensory cells and supporting cells developed by researchers at Indiana University School of Medicine enables the study of inner ear disorders and potential therapies.

BRAIN[5]
Researchers from the Max Planck Institute of Psychiatry reprogrammed skin cells donated from patients with neuronal heterotopia into pluripotent stem cells and then used these to generate brain organoids. Using the organoids as a model to study the neurodevelopmental disorder, the researchers discovered a new set of molecular signatures that are unique in the diseased cells.

LIVER[6]
Liver organoids were created by a team at Wake Forest Institute for Regenerative Medicine which mimic fetal development and the function of the human liver. The mini-livers could increase understanding of how liver diseases such as hereditary biliary atresia develop.

LUNG[7]
Researchers from Columbia University Medical Center created the first lung organoids which included branching airway structures. When infected with respiratory syncytial virus, the organoids responded in a way comparable to a real lung.

PANCREAS[8]
An international team of researchers generated a library of 66 pancreatic tumor derived organoids and found three signatures of gene activity that predicted sensitivity to the five chemotherapies administered to pancreatic cancer patients.

INTESTINE[9]
A project led by researchers at Cincinnati Children's Hospital Medical Center generated human embryonic colons from pluripotent stem cells, which functioned much like natural human tissues when transplanted into mice. The system will enable the study of diseases such as colitis, colon cancer, irritable bowel syndrome, and Hirschsprung's disease.

WOMB[10]
University of Cambridge scientists created functional womb organoids, which could provide a model for the early stages of pregnancy and diseases of the womb such as endometriosis.

THE FUTURE[11]

Organoids possess tremendous potential as tools for research in numerous areas ranging from modelling diseases to drug development. Equipping organoids with more complex vascular systems is thought to be the key to producing larger organoids with truly *in vivo*-like functionality.

REFERENCES:

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