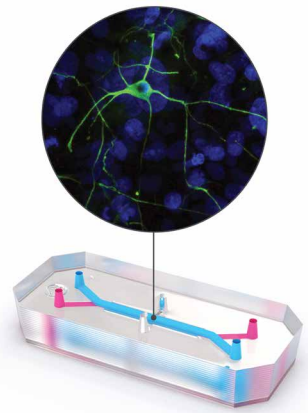
Brain Bio-Kit

Organ-Chips & qualified human cells.
Conveniently kitted for reproducible results.

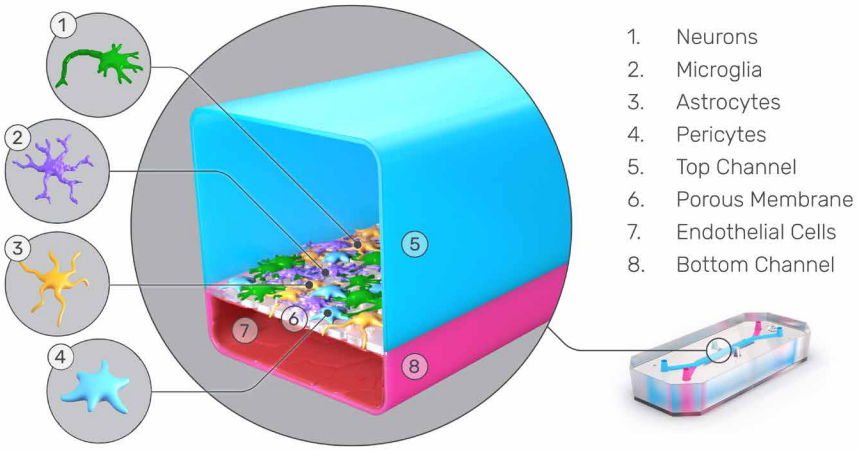


Overview

Despite decades of research, there remains a lack of effective disease-modifying therapies for many neurological diseases, largely due to the limited human relevance of current preclinical models. To accelerate the development of effective therapeutics, more physiologically relevant models of the human brain are needed. The Emulate Brain-Chip is an advanced *in vitro* model of the neurovascular unit, with five human cell types in a dynamic and tunable microenvironment to recreate the highly complex and species-specific biology of the human brain and blood-brain barrier (BBB). The Brain-Chip can be applied for disease research and drug discovery to investigate mechanisms of neuroinflammation and evaluate the efficacy and BBB penetration of drug candidates.

Model Configuration

The Brain-Chip consists of four neural cell types seeded in the top channel and brain microvascular endothelial cells in the bottom channel. The two-channel structure of the model allows for distinct media to be flowed through each channel for improved cell differentiation and enables researchers to perform BBB penetration studies or evaluate the impact of test article route of administration on cell response.



1. Neurons
2. Microglia
3. Astrocytes
4. Pericytes
5. Top Channel
6. Porous Membrane
7. Endothelial Cells
8. Bottom Channel

Model Characterization

This Brain-Chip demonstrates morphological and functional characteristics of cortical brain tissue, incorporating both neuronal cells and the blood-brain barrier (BBB) in a single model for improved human relevance. Characteristic morphology, gene expression, and functionality remain stable up to seven days in culture, with neuronal synaptic activity and barrier function in line with *in vivo* levels.

- **Human-based model:** Avoid translational issue caused by species differences.
- **High barrier integrity:** *In vivo*-like BBB permeability (see **Figure 1**)
- **Multicellular complexity:** Inclusion of five cell types for improved BBB integrity and cell-cell interactions.
- ***In vivo*-like gene expression:** Close overlap with adult human cortex, with 35% closer overlap with adult human cortex than Transwells
- **Enhanced neuronal functionality:** Glutamate activity is significantly higher than Transwell models due to dynamic microenvironment with media flow.

Learn more in the Brain-Chip Characterization Note.

Brain-Chip Permeability

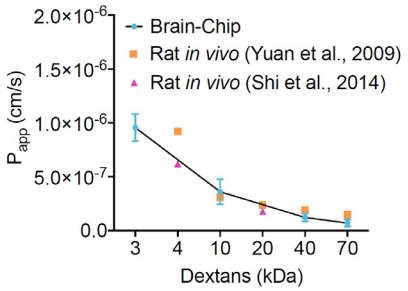


Figure 1: *Apparent permeability (P_{app}) of different sizes of dextran molecules (3-70 kDa) in the Brain-Chip, correlated with previously reported in vivo rodent brain uptake data.*

Cytokine Secretion

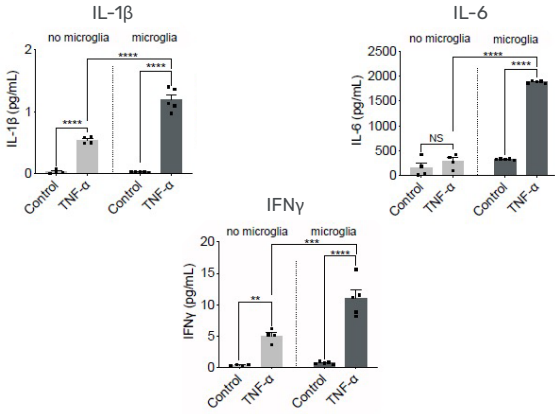


Figure 2: *Secreted levels of proinflammatory cytokines in control or TNF-α-treated Brain-Chips, with or without microglia. **P<0.01, ***P<0.001, ****P<0.0001.*

TNF-α-Induced Permeability Increase

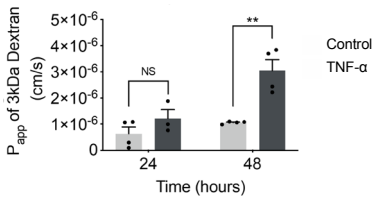


Figure 3: *Permeability Increase. Barrier peameability to 3kDA fluorescent dextran, upon 24 and 48 h of treatment with TNF-α. NS = not significant; **P<0.01.*

SUPPORTED APPLICATION

Neuroinflammation

The Brain-Chip has been validated as a model of neuroinflammation, a mechanism seen in many neurodegenerative diseases such as Alzheimer's and Parkinson's, enabling researchers to identify novel drug targets and validate drug target effect. Unlike many *in vitro* models of the brain and BBB, the Brain-Chip incorporates microglia—the resident brain immune effector cell critical for modeling neuroinflammation. Key features of neuroinflammation can be modeled by administering proinflammatory cytokine TNF-α, including:

- Significant enrichment of gene pathways related to inflammation
- Astrogliosis and microglial activation
- Secretion of proinflammatory cytokines (see **Figure 2**)
- Increased blood-brain barrier permeability (see **Figure 3**)

Part of the Human Emulation System®

The Brain-Chip is designed to be cultured on the Human Emulation System, which is comprised of instruments, consumables, and software, providing the dynamic culture conditions needed to culture up to 12 Organ-Chips.

Brain-Chip Specifications

Specification	Details
Validated applications	TNF-α-mediated Neuroinflammation
Storage conditions	• Cells: store in liquid nitrogen • ER-1® and ER-2® reagents: 2–8 °C • Other kit components: Ambient temperature (15–25 °C)
Shelf life	1 year from date of manufacture
Cell types	iPSC-derived glutamatergic and GABAergic neurons, primary astrocytes, primary microglia, primary pericytes, and iPSC-derived brain microvascular endothelial cells.
Characterization Endpoints	Transcriptomic profiling, immunofluorescent staining of cell markers and tight junctions, and blood-brain barrier permeability.

Ordering Information

The Brain Bio-Kit includes the essential components needed to create the Brain-Chip—including Emulate qualified cells—and is available in multiple sizes to meet various study needs.

To learn more and order, visit emulatebio.com/brain-chip

Product Name	Description	Chips Per Kit	Catalog Number
Brain Bio-Kit	Chip-S1® Stretchable Chips, Pod® Portable Modules, ER-1® / ER-2® Chip Activation Reagents, Seeding Media, Short-Term Maintenance Media, Steriflip® Filter, Emulate-qualified human cells: iPSC-derived neurons, primary microglia, primary astrocytes, primary pericytes, and iPSCs for differentiation into brain microvascular endothelial cells	6	BIO-BR1-COR6
		12	BIO-BR1-COR12