# Developing a Placental Cell Membrane Model to Investigate Drug-Membrane Interactions

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**July 30th, 2025**
This research was made possible by funding from the Valerie Kuehne Undergraduate Research Awards, University of Victoria

## The Project:

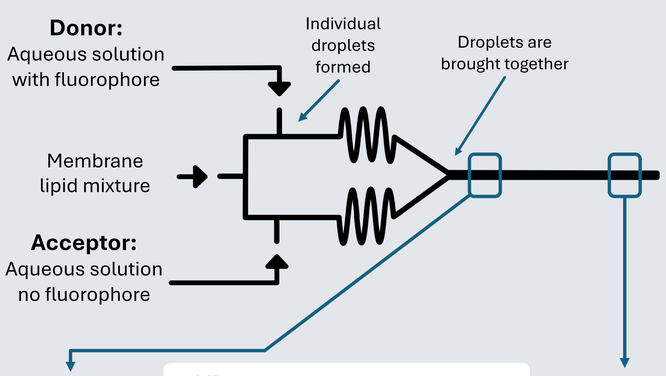
Little is known about the interactions between common drugs and placental cell membranes. Developing an *in-vitro* model can allow for accessible investigation and research of these interactions in a variety of conditions.

## Why Is This Important?

- While up to 90% of pregnant people in developed countries will use over the counter or prescription medications,[1] less than 10% of FDA approved pharmaceuticals have an understood risk to fetal development.[2]
- Traditional pharmaceutical testing methods involve the use of animals which can be both lengthy and resource intensive and testing on pregnant people can endanger the developing fetus or parent.
- Using a microfluidic platform to model placental cell membranes can allow for repeatable and accessible analysis of drug-membrane interactions at different stages of development.

## How Did I Make The Model?

Microfluidic Device Diagram

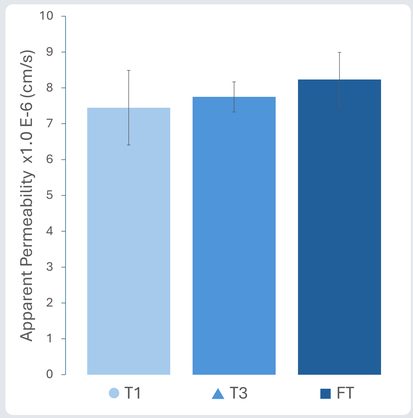



Acceptor droplet intensity over 14 minutes. Each line represents one of the examined 1st trimester (T1), 3rd trimester (T3), and full-term (FT) placental cell membrane lipid mixtures.

- Phospholipids were mixed in the molar ratios of placental cell membrane lipids found at different stages of development.[3]
- A microfluidic device was used to form two aqueous droplets which are coated in a layer of lipids.
- The droplets were brought together to from a droplet interface bilayer (DIB) mimicking a cell membrane.
- Transfer of fluorophore from the donor to acceptor droplet was recorded through intensity, along with the DIB dimensions, to determine membrane permeability.

## What Were The Results?

- The membrane saw an increase in permeability through the stages of development.
- The initial testing did not show statistically distinct results but using refined data collection and analysis methods should reduce variation.
- This is important as it shows this *in-vitro* model can likely be used to characterise the interactions of various medications with the placental barrier.




Apparent permeability of DIB membranes using 1st trimester (T1), 3rd trimester (T3), and full-term (FT) placental cell membrane lipid mixtures, with standard error bars showing uncertainty.

## What's Next?

- Refining the data collection and analysis of the DIBs would help to reduce sample variation, making further compound analysis possible.
- Future experiments could include a widespread characterization of pharmaceutical compounds, both already in circulation and during development of new medications.
- Expanding this model to conditions affecting the placental barrier, such as pre-eclampsia, could help analyse the affected membrane's characteristics and look at the effects of various therapies on the membrane itself.

## References

1. Daw, J. R. et al. (2011). *Pharmacoepidemiology and Drug Safety, 20*(9), 895.
2. Lynch, M. M. et al. (2017). *Maternal and Child Health Journal, 22*(1), 92.
3. Bailey-Hytholt, C. M. et al. (2020). *ACS Applied Materials & Interfaces, 12*(28), 31099.