



Virtual Tissue Modeling Research Area

To understand the effects of chemical exposures, risk assessors must understand how chemicals impact human systems, including tissues and organs. EPA's Chemical Safety for Sustainability Research Program research focuses on developing tools that can bridge the gap between observations in lab-based experiments and more complex biological interactions.

EPA's Chemical Safety for Sustainability Research Program

The goal of EPA's Chemical Safety for Sustainability (CSS) National Research Program is to provide information and methods to make better-informed, more timely decisions about the safety of chemicals, many of which have not been thoroughly evaluated for potential risks to human health and the environment.

About Virtual Tissue Modeling Research

The **Virtual Tissue Modeling** Research Area examines complex chemical-biological interactions using cutting-edge technologies such as organ-on-chip (3-D cell cultures designed to mimic the architecture and physiology of organs), *in vitro* (cell-based), and alternative *in vivo* (animal) models. Ultimately, these data are used to computationally simulate and predict how chemicals impact key biological processes such as human development.

Research in this area will focus on:

- Developing models of increasing levels of biological complexity to capture cell-based impacts of chemical exposures to the developing embryo
- Developing data and methods to link high-throughput toxicity data with outcomes at the organ or individual level

Why Is Virtual Tissue Modeling Research Important?

To bridge the gap from molecular changes to endpoints relevant for hazard assessment, models of biological systems are needed that can be experimentally probed and computationally simulated. Virtual tissue models provide this flexibility while providing data needed for faster chemical risk assessments and minimizing dependence on animal study data.

Interested In Learning More?

EPA's Chemical Safety Research Program: epa.gov/chemical-research

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The Question

How can we use innovative approaches to simulate biological interactions that occur after exposure to a chemical?

New Approach Methods

EPA is developing and incorporating **new approach methods** to assess the safety of chemicals at a lower cost and in less time



High-Throughput Screening: EPA scientists are growing neural cells that mimic important processes of brain development, which can be used to screen and prioritize thousands of chemicals not yet evaluated.



Virtual Tissue Models: EPA scientists are using computational methods to create virtual tissue models to simulate how chemicals may affect human development.



Alternative Animal Models: EPA scientists are investigating the potential of chemicals to affect human development by testing chemicals in developing zebrafish.



Adverse Outcome Pathways: EPA scientists are using AOP frameworks to organize data to predict changes in biological pathways and the potential effects of chemicals on the developing nervous system.

Learn more about EPA's New Approach Methods on our webpage:
<https://www.epa.gov/chemical-research/evaluating-effects-chemicals-nervous-system-development>

Virtual Tissue Modeling Research Area Up Close

Examples of Research and Products



How Virtual Tissue Modeling Fits In

CSS is organized around three research topics that address specific science challenges in assessing the safety of chemicals: Chemical Evaluation, Complex Systems Science, and Knowledge Translation & Delivery.

Included in our *Complex Systems Science* research topic, our **Virtual Tissue Modeling** research is focused on developing tools that can be used to bridge the gap between observations in lab-based experiments and more complex biological interactions. These methods can provide data needed for chemical risk assessments while minimizing dependence on animal study data.

Science To Achieve Results (STAR) Organotypic Culture Model Development

- ⇒ **What is it?:** Through our Science to Achieve Results (STAR) grant program, the EPA has funded four Research Centers to develop *in vitro* systems of cell cultures that replicate human biological interactions within complex tissues or organs, called Organotypic Culture Models (OCMs). When developed and evaluated, these OCMs will provide information needed to help predict toxicity due to chemical exposures.
- ⇒ **Impact:** The OCMs will provide the biological understanding and data to help evaluate, improve and extend computational models currently being developed by EPA scientists.
- ⇒ **Who Can Use It?:** Once completed, researchers and risk assessors looking for new ways to predict chemical toxicity
- ⇒ **Learn More:** epa.gov/sites/production/files/2016-02/documents/ocm_factsheet.pdf

Blood-brain barrier development: systems modeling and predictive toxicology

- ⇒ **What is it?:** A journal article published in *Toxicological Sciences* providing useful research into understanding the relationship between *in vitro* bioactivity dose and external exposure concentration.
- ⇒ **Impact:** This research will inform adverse outcome pathways to reduce uncertainty in translating *in vitro* data and *in silico* (computer-based) models for use in risk assessments that aim to protect neurodevelopmental health.
- ⇒ **Who Can Use It?:** Researchers and risk assessors interested in modeling neurodevelopment
- ⇒ **Learn More:** doi.org/10.1002/bdr2.1180

Learn more

EPA's Chemical Safety Research Program: epa.gov/chemical-research