



Adverse Outcome Pathways Research Area

The real world is inherently more complicated than current experimental models of toxicology can depict. In the same way you might piece together a jigsaw puzzle, EPA's Chemical Safety for Sustainability National Research Program is using adverse outcome pathway (AOP) frameworks to piece together information needed to interpret data from traditional and new testing approaches. AOPs facilitate more effective and efficient use of toxicological data to support chemical decision-making.

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 Adverse Outcome Pathway Research

The **Adverse Outcome Pathways (AOP)** research area organizes existing biological information to help researchers understand and predict the potential effects of chemicals. The adverse outcome pathway conceptual framework links stressor-induced changes at the molecular level, through effects at the cellular and tissue level, to human and ecological health outcomes. AOPs provide a scientifically-supported synthesis, integration, and summarization of existing knowledge and evidence that enables us to use a broader scope of available information to evaluate chemicals with little data.

AOP research focuses on developing AOPs for high-priority pathways and applying well-developed AOPs to case studies, addressing the widely varying needs of decision makers.

Why Is Adverse Outcome Pathway Research Important?

AOPs serve as a tool to enhance the utility of diverse biological information and data for assessing hazards to human health and the environment. They facilitate communication between scientists generating biological data and end-users of the information, such as modelers or decision makers, by distilling complex information in a comprehensible manner to support decision making.

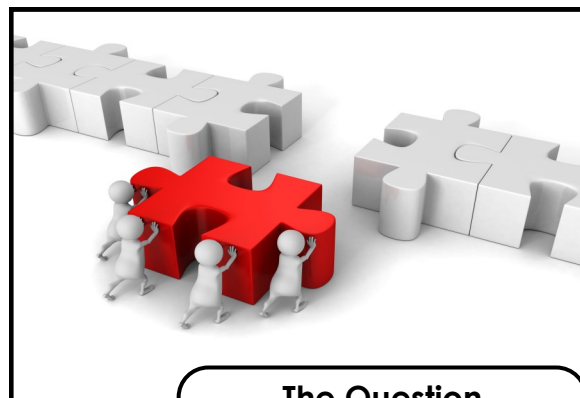
Interested In Learning More?

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

Contact Us:

Jeffrey Frithsen, National Program Director: frithsen.jeff@epa.gov

Joe Tietge, Deputy Program Director: tietge.joe@epa.gov



The Question

Can we better organize biological information to understand the effects of chemicals?

Our Adverse Outcome Pathway Tools



AOP-Wiki: interactive, crowd-sourced tool for AOP development, organizing available knowledge and evidence into written descriptions of individual pathways. The platform allows users to capture, review, browse, and comment on AOPs.



SeqAPASS: tool allowing researchers and regulators to extrapolate toxicity information across species



ToxEval: risk-based prioritization tool that facilitates rapid analysis and visualization of chemical monitoring data in comparison to toxicity benchmarks like biological effects measured in ToxCast high throughput screening assays.

Visit these and our other AOP tools on our webpage: epa.gov/chemical-research/research-understanding-chemicals-interactions-biological-systems

Adverse Outcome Pathways Research Area Up Close

Examples of Research and Products



AOP-Wiki 2.0

- ⇒ **What is it?:** A globally accessible platform for developing and disseminating AOP descriptions in accordance with international guidance and templates.
- ⇒ **Impact:** The AOP-Wiki allows the broader scientific community to engage in AOP development in an open, transparent, and collaborative environment and share that information globally in a human and machine-readable format. The AOP-Wiki helps to bridge the gap between toxicity data and adverse effects relevant to risk assessment, thereby aiding translation and interpretation of chemical safety results.
- ⇒ **Who Can Use It?:** Everyone, including researchers and risk assessors interested in the application of toxicity data to adverse health outcomes
- ⇒ **Learn More:** aopwiki.org

The adverse outcome pathway: A multifaceted framework supporting 21st century toxicology

- ⇒ **What is it?:** A mini-review that describes the conceptual basis of AOPs and their current status relative to use by scientists and decision makers, including four illustrative examples of the framework to diverse assessment scenarios.
- ⇒ **Impact:** This article demonstrates the utility of AOPs as translational frameworks that help weave together various data streams including *in silico*, *in vitro* and *in vivo* data to increase the capacity and efficiency of assessments.
- ⇒ **Who Can Use It?:** Everyone, especially decision makers interested in example applications of AOPs
- ⇒ **Learn More:** doi.org/10.1016/j.cotox.2018.03.004

How Adverse Outcome Pathways Fit 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 *Complex Systems Science* research topic, our **AOP** research provides a framework for organizing, communicating, and understanding science-based links between molecular events caused by a chemical stressor (such as those investigated in High-Throughput Toxicology Research Area) and relevant adverse outcomes at various levels of biological complexity.

Learn more

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