Chemical Safety for Sustainability National Research Program

Chemicals are integral to the American economy and provide key building blocks for the many products that benefit society. Sustainable development can yield unprecedented benefits to society today without compromising the health and welfare of future generations. Smart new strategies are needed to make decisions that protect public health and promote sustainable chemical design and use.

Chemicals fuel innovation—surface coatings that make buildings more resistant to wear, detergents that allow energy-efficient laundering, preservatives that keep cosmetics and foods fresh. However, depending on their use, chemicals may have harmful impacts on human health and the environment. For instance, evidence is mounting that some chemicals found in everyday products may disrupt the endocrine system and affect the development of children and sensitive ecological species. Novel information and methods are needed to make informed, timely decisions about thousands of chemicals in commerce.

The U.S. EPA's Chemical Safety for Sustainability Research Program (CSS) is designed to infuse 21st century science into Agency decisions aimed at reducing risks associated with exposure to chemicals in commerce, the environment, products and food. This science will enable the Agency to: address impacts of existing chemicals, anticipate impacts of new chemicals, and evaluate complex interactions of chemical and biological systems to promote proactive action and sustainable innovation.

The Science Challenges

Chemical Evaluation:
Thousands of chemicals have not been evaluated and new chemicals are continually being developed and introduced into commerce. CSS is advancing cutting-edge methods to provide data for risk-based evaluation of both existing chemicals and emerging materials.

Life Cycle Analytics:
Chemical substitutions and other alternatives designed to solve one environmental health problem may have unintended consequences. CSS is exploring new ways to evaluate risks to human and ecological health across the lifecycle of manufactured chemicals, materials and products. CSS methods will efficiently evaluate alternatives and support

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more sustainable chemical design and use.

Complex System Science:
The real-world is inherently more complicated than current experimental models of toxicology can depict. CSS research adopts a systems-based approach to examine complex chemical-biological interactions and predict potential for adverse outcomes resulting from exposures to chemicals.

Translation & Delivery:
Decision-makers need demonstrated solutions to translate new information into action. CSS promotes web-based tools, data, and applications to support chemical safety evaluations and related decisions. CSS engages Agency partners and stakeholders to ground truth the transparency, access, relevance, and applicability of our research.

How CSS Research is Making a Difference

CSS research is transforming chemical evaluation through groundbreaking research, translation, and tools such as:

CSS is accelerating the pace of data-driven chemical evaluations. EPA's high-throughput toxicity research effort **ToxCast** uses automated chemical screening technologies to measure changes in biological activity that may suggest potential for hazardous effects. Coupled with related high-throughput exposure estimations from **ExpoCast**, this multi-year effort is generating and sharing an unprecedented volume of exposure and toxicology data and knowledge transparently.

What We Do:

Build Knowledge Infrastructure. Make information publicly accessible. Combine different types of data in new ways to characterize impacts of chemicals to human health and the environment.

Develop Tools for Chemical Evaluation. Develop and apply rapid, efficient, and effective chemical safety evaluation methods.

Promote Complex Systems Understanding. Investigate emergent properties in complex chemical-biological systems by probing how disturbances and changes in one part affect the others and the system as a whole.

Translate and Actively Deliver. Demonstrate application of CSS science and tools to anticipate, minimize, and solve environmental health problems.

CSS is enabling sustainable environmental and public health decisions. The Chemical/Product Categories Database (**CPCat**) compiles information on chemicals found in consumer products. This new publicly available database maps over 40,000 chemicals to a set of terms categorizing their use or function for high level exposure evaluation. CSS is also working on developing lifecycle assessment tools that incorporate impacts of human exposures to environmental chemicals.

The Web-based Interspecies Correlation Estimation (**WebICE**) application estimates acute toxicity in aquatic and terrestrial organisms. The Markov Chain Nest Productivity Model (**MCnest**) quantitatively estimates the impact of pesticide-use scenarios on reproductive success of bird populations. Together these two tools are informing ecological risk assessments, in particular for endangered species.

CSS is shifting the paradigm of toxicity characterization from apical endpoints to "tipping points." Using systems science, CSS identifies early indicators of adversity or biological harm associated with chemical exposures, and builds predictive models that are more public health protective. The Adverse Outcome Pathway Wiki (**AOP-Wiki**), created through a joint venture between the European Commission and EPA, is a web-enabled and publicly accessible repository that stimulates and captures new and existing crowd-sourced AOP knowledge from the global scientific community.

CSS tools are being applied to support sustainable innovation of chemicals and emerging materials. The **iCSS Dashboard** provides a publicly accessible interactive tool to explore rapid, automated chemical screening data on 1,800 chemicals found in consumer and industrial products. Users of the iCSS Dashboard can perform basic data and chemical selection, as well as simple data exploration in a seamless environment.

More Information

EPA Chemical Safety Research:
http://epa.gov/research/chemicalscience/

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