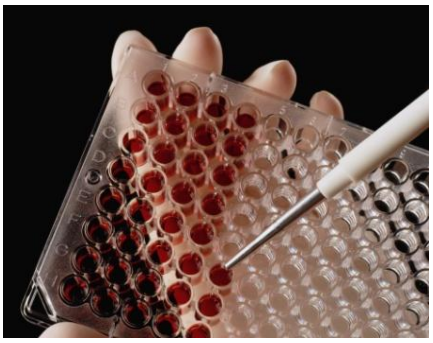
CHEMICAL SAFETY FOR SUSTAINABILITY RESEARCH

Background
Chemical safety is a major priority of the U.S. Environmental Protection Agency. Moving toward a healthier, more sustainable environment requires making safer, "greener" chemicals and producing new and existing chemicals in ways that are safer for humans and wildlife.



The challenges are formidable: Tens of thousands of chemicals are currently in use and hundreds more are introduced into the market every year. Many of these chemicals have not been thoroughly evaluated for effects on human health, wildlife and the environment, particularly when considering the consequences of use over a chemical's life cycle (production, use and disposal).

EPA's Chemical Safety for Sustainability (CSS) research program:

- Improves protection of human health and the environment by evaluating chemicals for potential risks.
- Assesses potential risks of nanomaterials (chemicals with different properties due to their small size) and endocrine disrupting chemicals (chemicals that affect hormone activity).
- Assesses toxicity of chemicals using innovative technology (e.g., computational toxicology).
- Provides tools and guidance for "greener" chemical production to improve environmental sustainability.

Research Focus Areas
Seven questions motivate CSS research:

What chemical properties influence toxicity potential?

Chemicals have unique properties such as molecular shape, size or reactivity that can influence their toxicity. EPA is improving its ability to predict toxicity by studying various chemical properties and their connection to adverse health outcomes. This information will improve EPA's understanding of the relationships between chemical properties and disease.

For example, EPA researchers are assessing the chemical properties of nanomaterials to determine whether their unique characteristics increase toxicity potential.

How do chemicals interact with the biological processes of humans and wildlife?

EPA is investigating how chemicals interact with important biological processes inside the human body and other animals. As part of this effort, scientists are developing virtual models of the liver and embryo that will simulate responses to a chemical.

Using innovative technologies such as automated-rapid chemical screening, researchers are collecting new types of informative data on the biological effects of large numbers of chemicals. These groundbreaking approaches have quickly produced results that are being used to help prioritize chemicals for further testing and to help build the virtual liver and embryo models.

Virtual systems models are being built by integrating and encoding data from many sources including chemical exposure, biological processes, toxicity, disease outcomes and automated chemical screening results. The virtual embryo and liver models are using the available data to mathematically determine the function of molecules, cells, tissues and organs, and how those functions are impacted by environmental chemicals.

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What is the link between chemical exposures and adverse health outcomes such as disease?

Biomarkers are biological indicators in humans and animals of exposure to a chemical or a response (effect) from exposure to a chemical. EPA is conducting research to understand the association between exposure, exposure biomarkers, effects and environmental or health outcomes. Scientists will then use linkages to develop tools to predict health outcomes from chemical exposure.

How can we measure the long-term effects of exposure to multiple chemicals?

In the real world, living things are exposed to many chemicals at the same time. Cumulative risk research identifies, predicts and assesses the potential human health and environmental outcomes that may occur due to multiple and continuous exposures to chemicals, with a focus on those chemicals found in consumer products. For example, researchers are assessing the cumulative risk of perfluoroinated chemicals, commonly found in non-stick cookware, waterproof clothing and stain-resistant carpet. These chemicals do not metabolize quickly, meaning they stay in the body for longer times and are found in water.

Why do we need to study the entire life of a chemical?

To fully understand the environmental impacts of chemicals and to design "green" chemicals, scientists are collecting data on the entire life cycle of chemicals—from creation to disposal. This research will pave the way for safer methods of making, processing, disposing and recycling chemicals by studying a chemical's total lifecycle risk. By studying the building blocks of a chemical, scientists will determine if certain types of chemicals (e.g., petroleum-based or renewable) are "greener". Energy consumption and waste products during the production of a chemical are also being studied to figure out more sustainable processes. These studies will provide data to inform the design of green chemicals.

Examples of sustainable research projects include determining how to safely dispose of pharmaceuticals and rare earth elements used in electronics.

How do we improve risk assessment of chemicals?

Scientists need innovative approaches to improve their ability to assess the health and environmental risks from chemicals. Researchers are advancing the next generation of risk assessment called NexGen to decrease testing costs and time and increase confidence in chemical risk assessment. Scientific tools to evaluate and characterize the reliability and uncertainty of data, methods and models are being developed to improve risk assessment. Policy-makers and risk assessors will help design these easy- to- use, computer-based tools to guarantee that they will address their needs. Training on the tools will be provided.

Where can I find the research results on chemical safety?

Publicly available data is available online in the Aggregated Computational Toxicology Resource warehouse (actor.epa.gov) and includes:

- Data on 500,000 environmental chemicals from 500 public sources.
- Animal study data including 30 years and $2 billion of animal testing.
- Data collected from rapid automated chemical screening.
- Chemical exposure studies.

Collaboration

EPA Program Offices, EPA Regions, and external stakeholders have participated in the CSS research planning process. Collaboration is vital for the success of CSS. EPA will continue to seek input to continuously enhance CSS research.

More information:

www.epa.gov/research/chemicalscience/

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