

Tox21: Chemical Testing in the 21st Century

The Toxicology in the 21st Century program, known as Tox21, is a collaboration of federal agencies that seeks new ways to rapidly test the effects of chemicals on human health.

Who we are

Four agencies contribute to the partnership.

- National Institute of Environmental Health Sciences, National Institutes of Health (NIH)
- National Center for Advancing Translational Sciences, National Institutes of Health
- Center for Computational Toxicology and Exposure, Office of Research and Development, U.S. Environmental Protection Agency (EPA)
- U.S. Food and Drug Administration (FDA), U.S. Department of Health and Human Services

Our purpose

The Tox21 collaboration formed in 2008 to address concerns that traditional toxicology testing methods could not keep pace with a rapidly expanding list of chemicals and substances. The program draws on the expertise, resources, and capabilities of each partner to evaluate thousands of commercial substances including pesticides, food additives/contaminants, medical compounds, and environmental chemicals. Use of advanced rapid assay technology increases the speed and volume of testing. These high-throughput techniques complement traditional toxicology methods, advance efforts to replace, reduce, refine (3Rs) animal testing, and produce more affordable, and efficient results.

Tox21 partners deposit these assay results into public, searchable databases, as well as create software tools and web interfaces to display information in ways that are accessible and useful to researchers and decision-makers.



National Institute of Environmental Health Sciences National Center for Advancing Translational Sciences



Our goals

Testing of substances and collection of data remains a core focus of Tox21, but the partners also pursue a number of related goals to advance this testing and the field of toxicology. These include:

- Determining which substances should receive priority in the evaluation process.
- Identifying mechanisms of action that require further investigation.
- Developing better models to predict biological responses to substances.
- Employing *in vitro* testing methods using human cells.
- Decreasing testing time and costs.
- Continuing efforts to replace, reduce, and refine animal testing in the study of toxicity.





Our accomplishments

Tox21 has tested over 10,000 chemical compounds using more than 100 high-throughput assays. These evaluations have covered more than 60 important targets and pathways in the body and generated in excess of 150 million data points.

The research partners have identified approximately 2,800 human, rat, mouse, and zebrafish genes in cells and tissues that are particularly useful in studying responses to toxic chemicals.

Tox21 researchers have shared new approaches and techniques in hundreds of articles published in peerreviewed scientific journals.

Tox21 data and tools are used worldwide to support scientific inquiry into the bioactivity of compounds in commerce and the environment.

Our resources

Another key objective of Tox21 is to ensure that testing data and research resources are widely disseminated to the wider scientific community. To advance that goal, the program partners have made a variety of databases and tools available to researchers and decision-makers via the Tox21 website.

PubChem: Open chemistry database — including Tox21 high-throughput screening data — with information on compound structures, properties, biological activities, and safety.

Tox21 Data Browser: High-throughput screening data, including concentration-response curves, curve fitting results, and activity metrics for more than 10,000 substances in the Tox21 chemical library.

BioPlanet: Interactive browser with assays, chemical descriptions, and screening data presented in graphs, tables, and charts to support improved toxicity prediction models.

EPA CompTox Chemicals Dashboard: Searchable database and analytical tools for assay results, chemical descriptors, exposure information, and chemical read-across.

Tox21 Toolbox: Software tools for accessing Tox21 screening data and integrating with other publicly available data.



With the assistance of robotics, Tox21 has tested thousands of substances.

Our path forward

High-throughput screening remains an important part of the Tox21 portfolio. As the partnership moves forward, however, it seeks to expand its research and outreach by:

- Developing additional alternative test systems that are predictive of human toxicity.
- Addressing technical limitations of *in vitro* test systems.
- Curating legacy animal (in vivo) toxicity testing data.
- Establishing scientific confidence in *in vitro* test systems.
- Refining alternative methods for characterizing pharmacokinetics and disposition in *in vitro* assays.

For more information



To learn more about Tox21, its achievements, specific projects, and additional resources, please visit our website at https://tox21.gov.