

Toxicology, the study of chemicals and their toxic effects, is hundreds of years old. Now an unprecedented revolution in toxicology is underway. Public concern about chemicals, demands for more testing and the development of less toxic alternatives, and pressure to eliminate the testing of chemicals on animals have prompted major changes. The days of exposing animals to escalating doses of a chemical and waiting to see what effects this has are giving way to new *in vitro* and computer-based *in silico* techniques for determining, at a molecular and cellular level, whether chemicals are harmful and by what mechanism this occurs.

The SEURAT-1 Program <http://www.seurat-1.eu/>, a €50 million collaboration of several research projects involving 69 academic and research institutions, industry, and hundreds of researchers across Europe and around the world, is helping lead the development of this 'new-age toxicology'. Funded by a unique partnership between the European Commission and Cosmetics Europe - the Personal Care Association in anticipation of the Commission's ban on testing cosmetics ingredients on animals (which took effect March 2013), SEURAT-1 (Safety Evaluation Ultimately Replacing Animal Testing) offers an ideal opportunity to report on fascinating scientific developments as the field of chemical safety and testing enters a radically new era.

Story possibilities include:

1. **The revolutionary changes underway in how chemicals are tested.** The old *in vivo* method exposed a group of experimental animals to a substance to see what effects it had on the animals' health. Instead, the new *in vitro* methods exposes cells to a test substance and monitors whether changes in the cells are part of 'toxicity pathways' or 'adverse outcome pathways' (AOPs), changes in cell function or metabolism known to lead to the disease at the organ or whole animal level. This move toward a new mechanistic pathway approach also involves *in silico* toxicology, the use of computers to analyze the potential toxicity of chemicals.
2. **Can the regulatory and political world rely on the new toxicology?** This new approach to chemical testing poses immense challenges to regulators, who are comfortable making their judgments about which products to approve based on the old method of seeing what a test substance does to an entire animal. Can regulators trust the results of this new approach and decide which chemicals are safe, at which doses, based only on what happens at the molecular and cellular level?
3. **A partnership on chemical testing between government and business?** The SEURAT-1 projects are funded by a unique partnership between the European Commission and European cosmetics industry. The consortium was established in 2010 in anticipation of ban on animal testing of cosmetic ingredients in the EU (which took effect in 2013) and a recognition that such a ban would create major gaps in methods for safety testing for the cosmetics industry both in Europe and worldwide. So both parties put up half the money for SEURAT-1. The consortium funds several independent but complementary projects working on different aspects of the challenge of advancing the science and developing a 'new toxicology', and coordinates their work and findings.
4. **Each of the SEURAT-1 research projects are interesting stories in their own right:**
 - **The HeMiBio Project** <http://www.seurat-1.eu/pages/cluster-projects/hemibio.php> is developing what amounts to a simplified functioning liver in a microbioreactor. Combining pumps and sensors, this tiny device exposes some types of liver cells to a chemical being investigated, and by measuring indicators like oxygen uptake or glucose or urea levels in the cells as the chemical flows over them, this 'liver in a dish' can reveal whether the test chemical initiates liver-related adverse outcome pathways (AOPs) at the cellular level, pathways that are believed to be the precursors to health problems. A working prototype of this device is already operational.
 - **The SCR&Tox Project** <http://www.seurat-1.eu/pages/cluster-projects/scrttox.php> is helping develop pluripotent stem cells into the specific types of cells necessary for this new *in vitro*

toxicology, including heart cells, nerve cells, skin cells, muscle cells and liver-like cells that hopefully might be used in the HeMiBio microbio reactor.

- **The NOTOX Project** <http://www.seurat-1.eu/pages/cluster-projects/notox.php> is a sweeping set of investigations by more than 100 researchers at several European universities. Using information about what happens to cells in bioreactors and other *in vitro* environments, and advanced *in silico* computer techniques, NOTOX creates models that predict what test substances would do to an entire organ. Turning the findings about AOPs at the cellular level into reliable predictions of what the test chemical would do to the whole organ is a critical part of establishing this new systems biology approach to risk assessment as a method that regulators and company safety assessors can rely on as they decide which substances to approve as safe for public use.
 - **The DETECTIVE Project** <http://www.seurat-1.eu/pages/cluster-projects/detective.php> is helping identify novel biomarkers of toxicity at the cellular level that indicate activity that could lead to harm to the whole organism. These are the red flags that are key indicators of adverse outcome pathways/AOPs.
 - **The COSMOS Project** <http://www.seurat-1.eu/pages/cluster-projects/cosmos.php> is collecting the toxicological data, making them available through a public database, and using them to update safe limits of exposure to cosmetics ingredients (the so-called area of the Threshold of Toxicological Concern) as well as to develop models to help implement the AOP concept.
 - **The ToxBank Project** <http://www.seurat-1.eu/pages/cluster-projects/toxbank.php> is creating the technological infrastructure to support a 'data warehouse' for the results of all the SEURAT-1 projects. This high-tech project is vital to the entire new field of toxicology since AOP research will be producing vast amounts of data from numerous sources that can only be used if it is brought together and organized.
 - **The JRC** (the European Commission Joint Research Centre) besides being a partner in 4 of the SEURAT-1 projects is providing additional support to the demonstration of the SEURAT-1 proof-of-concepts, supplementing modelling activities of the cluster and providing large reference datasets to support the establishment of AOPs.
5. **Coordination of the work of SEURAT-1 with the ToxCast** <http://www.epa.gov/ncct/toxcast/> **program at the United States Environmental Protection Agency.** Work to develop the new toxicology is happening around the globe. SEURAT-1 is in close collaboration with one of the worlds' other leading programs, ToxCast in the United States. Together, these programs are leading the development of this revolution in toxicology, an approach that will allow more chemicals to be tested, faster, without using animals, and which will ultimately provide regulators with information on which they can base decisions about public health and safety.

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A press corner is available at the SEURAT-1 website : <http://www.seurat-1.eu/pages/press-corner.php>

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