Molecular Design Research Network (MoDRN)

Baylor University, George Washington University, University of Washington, Yale

BiologyComputational ChemistryEngineeringToxicology











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MoDRN Goals

We plan to advance the understanding of safe chemical design through 3 key areas:

- **Research:** We will develop <u>computer models</u> and <u>public databases</u> that will aid in the <u>design of new chemicals</u>. Our models will evaluate the toxicological pathways that lead to toxicity endpoints and empirically validated by toxicological experiments.
- Education: We will develop a series of <u>educational tools</u> for teachers, students and the general public.
- Outreach: We will engage professional scientific societies, business sectors, and policy makers to <u>ensure awareness</u> of the scientific tools available.

Overall, our project strives to improve sustainable molecular design by reducing the costs of screening for adverse effects of new chemicals.

Rationale

Our world is made up of chemicals with numerous beneficial effects, but that can also have unintended adverse consequences.

The term "green" in *green chemical*s implies that the compounds are safe, but this is not necessarily true. Similarly, *natural....* does not mean *better* or *safer*.

The prudent safety assessment of new chemicals necessitates studies in animals and cells that are relevant to human health and the environment, and also examining the characteristics of chemicals which are harmful.



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For example: aflatoxins are natural products, but also potent liver carcinogens





Our Framework





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Communication among toxicologists and chemists can be challenging...





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Oxidative stress is an important mechanism of toxicity for many chemicals, and thus relevant for assessing health effects



developmental deformities, Alzheimers and Parkinsons disease

Bottom line: Once we understand the mechanisms of chemical toxicity such as oxidative stress, we can better design new chemicals that don't cause the injury

Zebrafish facilitate the safety assessment of new chemicals



- Freshwater fish native to India, common in pet trade
- Small fish, rapid development with timelines linked to human development, one of the most *high-throughput* toxicological models
- Powerful genetic tools for studies of *disease susceptibility*
- Optically clear embryos and larvae
- Similar sensory systems as other fish as well as humans