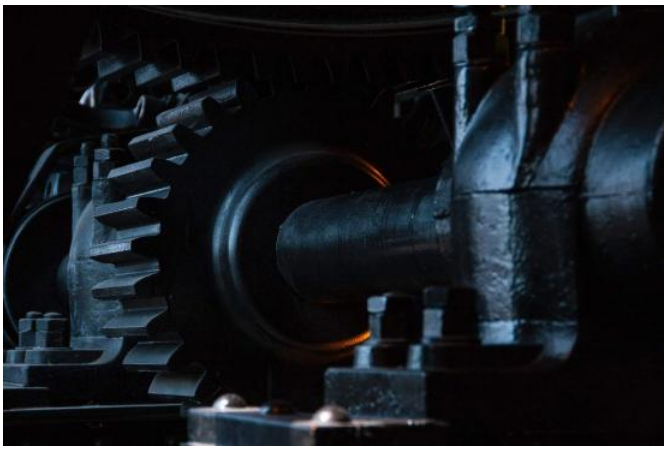
4.1: Systems Toxicology

Learning Objectives

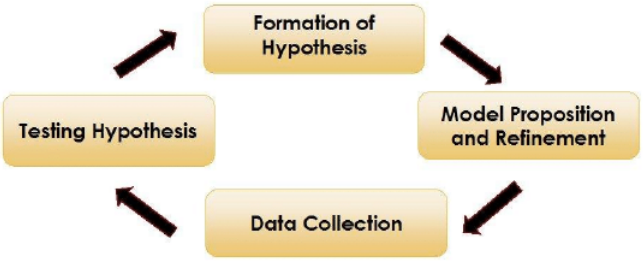
- 1: Understand the concept of systems toxicology.
- 2: Understand the approaches of traditional toxicology approaches vs. the new toxicity testing paradigm.
- 3: Recognize the driving force behind the growth of this field.
- 4: Applications of this field.

The word “systems” originates from the Latin word “systema” which means a complete concept that has several parts. Similarly systems toxicology is a branch of science that utilizes data from different branches of toxicology and integrates them to provide a holistic approach for safety assessment.



Toxicology is the science of understanding the adverse effects of xenobiotics (drugs, chemicals, etc.) on biological systems. Biological systems are extremely complex. Due to the vast number of toxicology research approaches over the years, and a lot of data have been generated in different systems- in vivo, in vitro, in silico (especially due to “omics” approaches). However, there is currently a lack of interpreting/utilizing that data for efficient safety assessment of xenobiotics.

Systems toxicology aims to fill this gap and utilize these data from different systems and integrate them into meaningful assessment for safety. It relies heavily on mathematical and computational models to link the data from various systems. So, in order to have fully validated systems toxicology approaches it is important to have “real” (in life) data from animal models to validate the hypothesis.



The Driving Force

The main driving force behind the development of systems toxicology approaches is the fact that the whole “safety assessment” process is a very lengthy, time consuming and expensive process in case of chemicals as well as the pharmaceutical industry. In order to make this process more efficient, it is important for early pharmaceutical/chemical (especially pharmaceuticals)candidate selection/screening. Screening thousands of compounds is a lengthy process and current high-throughput screening approaches together with large volume data analysis techniques have helped in more efficient selection of target molecules.

Schematic for the drug development process

Topic 1: Key Points

In this section, we explored the following main points:

- 1: The concept of systems toxicology and the different approaches and the driving force behind the development of this field.

Knowledge Check

1. Systems toxicology is usually applicable in the ...

Early discovery phases of drug development

During marketing of the drug

During regulatory safety testing phases

None of the above

Answer

Early discovery phases of drug development

2. Systems toxicology approach involves...

Traditional animal experiments

Alternative in vitro methods

Computational and mathematical models

All of the above

Answer

All of the above

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